

整形外科感染対策における 国際コンセンサス

人工関節周囲感染を含む筋骨格系感染全般

Proceedings of the Second International Consensus Meeting on Musculoskeletal Infection

Chairmen | Javad Parvizi, MD, FRCS
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ICM 翻訳プロジェクトチーム

Second **INTERNATIONAL**
CONSENSUS MEETING (ICM)
on **MUSCULOSKELETAL INFECTION**



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序文

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Thorsten Gehrke, MD

英語の辞書ではコンセンサスを「何かの事柄についての一般的な合意」と定義しています。その位置付けは、物事を決めるに当たり、完全に同意するということと、全く同意しないということの中間ぐらいであると見なされています。コンセンサスを形成する過程は、共通の価値観や同じ目的を持っている参加者の考え方によって決まります。コンセンサスは、ある特定の事柄に関する合意形成につながり、それは将来の全体的な方向性を示すことになります。整形外科領域の感染に関する第2回国際コンセンサス会議（ICM）は、上記の目的を念頭に置いて開催されました。この会議は2013年に開催された最初のICM会議の成功の上に成り立っており、前回会議の参加者のご意見を参考に、よりよい成果を得るという気持ちを持って開催いたしました。第2回ICM会議は、初回会議とは次の3つの部分が変更になっております。

- 1) 今回は整形外科のすべての専門領域の専門家から参加者を募りました。
股関節および膝関節（人工関節）；足と足関節；腫瘍；小児整形；肩；肘；脊椎；スポーツ；外傷
- 2) コンセンサスは再びDelphi法に従って行われました（下記参照）。しかし今回は、以前のようにこの会議の中心メンバーが論文調査を行い、各質問に対する推奨と理論的根拠を書き出すという代わりに、世界中から選ばれた各分野の専門家が一堂に会して話し合いが行われました。各質問について、参加者には前もって入手可能な文献を評価し、現在の診療にかかわるエビデンスを抽出し、さらなる検討が必要と思われる分野を特定していただきました。また各「推奨」に関連するエビデンスレベルの特定もお願いいたしました。私たちの知る限りでは、整形外科領域の感染に関連する論文の見落としはないと考えています。
- 3) 今回の会議には政府機関、スポンサーや機器メーカーからの参加を認めました。これらの参加者には投票権は認めませんでしたが、将来の整形外科領域の感染に対して資金提供や支援をお願いしたり、技術を承認していただいたりするためのロードマップを作成する上で、彼らの存在は重要であると考えたからです。

Delphiという名前は、Oracle of Delphiから派生したもので、冷戦の初めのころに技術的な要因が戦争に与える影響を予測するためにDelphi法は開発されました。Henry H. Arnold 将軍は米国陸軍航空隊のために、将来の戦闘に有用であろうと考えられる技術に関する報告書を作成するように命じました。しかし、この分野ではほとんど「科学的なエビデンス」がないため、利用できる予測方法、技術的アプローチおよび定量的モデルがないことがすぐに分かりました。これらの制限を克服するために、Delphi法がRANDプロジェクトによって1950年代と1960年代に開発されました^[1]。Delphi法は今日でも軍によって使用され続けており、科学および医学の領域に応用されつつあります^[2]。

最初のICM会議で使用されたDelphi法の正確な説明は以前に公開されており^[3]、その文章や要約はさまざまな場所で公開されています^[4-6]。2回目のICM会議も同様の手順で行われ、プロセスの各手順はWilliam Cats-Baril先生の指導のもとで行われました。2016年6月に、世界中から多くの専門家の要請を受けて、第2回コンセンサスミーティングを開催しようとする機運が盛り上がり、開催することになりました。その内容は下記の13のステップからなります。

ステップ1（2016年8月から2016年12月まで）：**参加者の選択**。このステップは、見落とすことなく合意プロセスに役立つ専門知識を持つ方々を世界中から集めることを目的としました。参加者は、その分野での論文実績（過去5年以内に少なくとも5つの論文）を持っている方、専門学会からの推薦者、または整形外科感染症の多くの治療実績を持った専門家という基準で選ばれました。このようにして選ばれた953人の代表者に招待状を送ったところ、招待状に返事をいただけなかった63人と参加見合わせのご連絡をいただいた21人を除く869人にご参加いただくことになりました。

ステップ2 (2016年12月から2017年4月)：問題の特定。その後参加者には、整形外科領域の感染に関する事柄で、調査が必要だと考えられる5～10の質問（問題）を考えていただくように依頼いたしました。その結果、合計3,210の質問が寄せられました。

ステップ3 (2017年4月から2017年8月)：質問のランキング。その後参加者には、集められた質問を専門分野別に再度お送りし、優先順位を付けるように依頼いたしました。このプロセスでは、重複する質問を意図的に削除したり、質問の「書き方」に注文を付けたりすることはしませんでした。私たちは、おそらく「重複」が質問の優先順位の高さを表しているのであろうと考えました。

ステップ4 (2017年8月から2017年11月)：ランク付けされた質問の評価。ランキングの結果が帰ってくると、重複した質問を削除し、各質問の中心となるような部分はDelphi法に従って書き直していただきました。このステップでは、「～の役割はありますか？」や「～の役割は何ですか」などの「示唆するような」言葉遣いを削除する必要がありました。これにより、検討すべき最終的な652の質問が確定いたしました。

ステップ5 (2017年12月)：質問の割り当て。最終的に決められた質問は、少なくとも2人の専門家に回答を依頼いたしました。それらの専門家を決めた基準は、論文実績や回答したいと強く希望する人ということで選びました。各質問に提示されたトピックの検討方法や回答の書き方に関する具体的なお願いを、それぞれの人にお伝えしました。

ステップ6 (2017年12月から2018年3月)：システマティックレビュー。質問を割り当てられた先生には、この期間で質問に対する論文を積極的に調査していただき、各質問に対する回答を準備していただきました。グループ内で討議して回答すると決めた肩グループを除き、それ以外の全ての整形外科領域の質問を割り当てられた二人の先生方には、誰からの影響も受けずに独立して回答していただくようにいたしました。また、この段階では英語で書かれた論文のなかで、見逃されているものはないと思われました。

ステップ7 (2018年2月から2018年4月)：参加者間の検討。一方の回答者から受け取った文書はもう一方の回答者に送られ、二人はお互いの記載内容や検討結果を共有いたしました。本部が調整し、意見の集約を行い、両方の参加者が受け入れ可能な1つの文書ができあがりました。このプロセスだけで6,000を超える電子メールが交換されました。

ステップ8 (2018年4月から2018年5月)：文書の統合／編集。受け取ったすべての文書をレビューし、文章の盗用を除去するためにチェックを行い、参考文献を更新し、英語を編集いたしました。

ステップ9 (2018年6月から2018年7月)：すべての参加者による文書評価。作成された文書はウェブサイト（www.ICMPhilly.com）に何ヶ月間も掲載し、参加者全員（一般を含む）から閲覧できるようにしました。一方で最終文書を参加者にも送付し、ウェブサイトに投稿されてくるあらゆる質問に対して、回答を考えていただくように依頼いたしました。私たちはこの期間に参加者から大量のコメントを受け取り、会議の前に全ての文書に適切な変更を加えました。

ステップ10 (2018年7月)：会議前の最終検討／編集。文書全体を内部の編集チームによってレビューし、さらにいくつかの変更を加えました。2018年6月30日までの最新の論文もチェックし、関連するそれぞれの分野に追加いたしました。

ステップ 11 (2018 年 7 月 25 日～26 日): **投票前の議論**。フィラデルフィアに來られたすべての参加者は、専門とするワーキンググループに分かれ、それぞれの分野における質問について議論しました。質問を次の 4 つのカテゴリーに分けました: 1) 臨床的に非常に重要であるが、推奨を裏付ける証拠がほとんどないもの、2) 意見の統一は得られてないが、臨床的に重要なもの、3) 非常に臨床的に重要で、強力な裏付け証拠があるもの、4) エビデンスの有無にかかわらず、臨床的に重要でないもの。会議中には、カテゴリー 1) と 2) の質問を議論していただきました。

ステップ 12 (2018 年 7 月 27 日): **投票**。すべての質問はスクリーンに映し出され、参加者にはリアルタイムでの投票を依頼いたしました。投票結果は、投票後直ちにスクリーンに表示いたしました。各推奨項目に対しては、「同意する」、「同意しない」、「棄権する」の 3 つの回答のどれかに投票していただきました。投票の段取りは、投票の前に William Cats-Baril 先生により参加者に明確に説明していただきました。

ステップ 13 (2018 年 8 月以降): **合意文書の配布**。会議の後、投票結果を文書に反映いたしました。この文書は医学雑誌の外部編集者、特に Michael A. Mont 先生とその仲間の Nipun Sodhi 先生、Thomas Bauer 先生、Adolph J. Yates 先生によってさらに査読をしていただきました。また、会議参加者には 4 週間以上にわたって最終的な査読を行う機会と追加のフィードバックを提供する機会が与えられました。ご提案いただいた適切と思われる変更は、すべて文章に反映いたしました。最終的な文書は、様々な雑誌に投稿し、単行本として出版するために入稿いたしました。さらに最終文書は、現在さまざまな言語に翻訳されつつあります。

以上の文章から分かりますように、参加者には合意文書を作成するあらゆる過程に深く関わっていただきました。しかし、上記のような複雑なプロセスであるが故に、様々な間違いをもたらす可能性があることも事実です。それらをできるだけ少なくするためにあらゆる努力を払いました。私達はまた世界中からのすべての専門家に來ていただけるように努力いたしました。しかし、この会議に参加すべき専門家を見逃している可能性は大きいと考えております。今回見逃された専門家や文書の誤りを容認しなければならない読者、意図せずに見落とされてしまった論文の執筆者、そして私たちの誤りのために迷惑したと感じる全ての人に、前もってお詫び申し上げます。今回作成された文書が、今後何年にもわたり整形外科診療のなかで役立ち、患者ケアの改善につながることを願っております。

(翻訳: 田中 康仁)

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翻訳書発刊の経緯

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筋骨格系の感染に対する第2回国際コンセンサス会議（The Second International Consensus Meeting (ICM) on Musculoskeletal Infection）が、2018年7月25日～27日の3日間にわたり米国・フィラデルフィアで開催されました。Javad Parvizi 先生と Thorsten Gehrke 先生の熱い情熱を持って開催まで漕ぎ着けられたこの会議には、全世界から800人以上の専門家が集まり、筋骨格系の感染の予防、診断および治療についてのコンセンサスがまとめ上げられました。会議開催の経緯とコンセンサスをまとめるプロセスに関しましては、前ページに翻訳いたしております序文に詳しく記載されておりますので、是非ご一読ください。日本からも多数のメンバーが選考され、会議に参加してまいりました（図1）。参加者はみんな真剣なまなざしで、会場は熱気で包まれておりました（図2）。全体会議で総論の検討の後、サブスペシャリティの領域に分かれて投票が行われました。2013年に開催された第1回の会議では人工関節周囲感染（PJI）が主なテーマでしたが、今回からは股関節・膝関節、足・足関節、腫瘍、小児整形、肩関節、肘関節、脊椎、スポーツ、外傷、バイオフィルムのそれぞれの分野で検討され、整形外科領域のほぼ全領域を網羅した内容となりました。

Parvizi 先生から日本語への翻訳依頼があり、急遽第2回国際コンセンサス会議に参加したメンバーが中心となり、ICM 翻訳プロジェクトチームが立ち上がりました。すでに発刊されております2013年に開催された第1回国際コンセンサス会議の翻訳書は、今回のメンバーでもある関東労災病院の山田浩司先生が中心となり、東京大学の田中栄先生と横浜市立大学の齋藤知行先生に監訳いただき、上梓されておりますので手に取られた方も多いと思います。基本的な形式は踏襲させていただき、質問と推奨のみを翻訳し、文献はまとめて各項目の後ろに掲載いたしました。今回は質問総数が652題となり、前回の204題と比較して3倍以上に増えたためにサイズをA4判として、ページ数も増えることになりました。全文を参照されたい方は、



図1. The 2nd International Consensus Meeting(ICM)への日本からの参加メンバー（フィラデルフィアにて）



図2. 会議風景：フロアから意見を述べられる Parvizi 先生

次ページに記載いたしております ICM Philly のアプリをダウンロードするか、<https://icmphilly.com/document/> から直接お読みいただくことも可能ですので、是非ご活用下さい。

出版方法につきましては種々検討いたしましたが、出版経費やそれと連動する書籍の定価などの要因を考え、出版社を介さない形で、我々独自で翻訳・出版しようということになりました。少しでも早く最新の内容を皆様方に日本語でお届けしたいという思いから、チームが一丸となり、メンバー一人ひとりが一生懸命に翻訳や校正作業に取り組み、翻訳開始からわずか4ヶ月という短期間のうちに、無事出版まで漕ぎ着けることができました。この場をお借りいたしまして、メンバー各位に篤く御礼申し上げます。今回の出版は、このような業務になれない集団により作り上げられたものですので、不備な点も多々あるとは存じますが、何卒温かくご指導いただけましたら幸甚に存じます。

筋骨格系、特に人工関節の感染は我々整形外科医にとりまして、大変難しい問題ですが、本書がその解決の一助になることを心から願っております。

略語一覧

ACL	anterior cruciate ligament	前十字靭帯
BMI	body mass index	ボディーマス指数
CRP	C-relative protein	C 反応性蛋白
CT	computed tomography	コンピューター断層撮影
DAIR	debridement, antibiotics and implant retention	デブリドマンと抗菌化学療法によるインプラント温存
DNA	deoxyribonucleic acid	デオキシリボ核酸
ESR	erythrocyte sedimentation rate	赤血球沈降速度
FDA	Food and Drug Administration	食品医薬品局
ICG	International Consensus Group	国際コンセンサスグループ
ICM	International Consensus Meeting	国際コンセンサスミーティング
MRSA	methicillin-resistant Staphylococcus aureus	メチシリン耐性ブドウ球菌
MRI	magnetic resonance imaging	磁気共鳴画像
MSIS	MusculoSkeletal Infection Society	筋骨格系感染学会
ORIF	open reduction and internal fixation	観血的整復固定術
PCR	polymerase chain reaction	ポリメラーゼ連鎖反応
PJI	prosthetic joint infection	人工関節周囲感染
SSI	surgical site infection	手術部位感染
TAA	total ankle arthroplasty	人工足関節全置換術
TEA	total elbow arthroplasty	人工肘関節全置換術
THA	total hip arthroplasty	人工股関節全置換術
TJA	total joint arthroplasty	人工関節全置換術
TKA	total knee arthroplasty	人工膝関節全置換術
UKA	unicompartmental knee arthroplasty	人工膝単顆置換術
VTE	venous thromboembolism	静脈血栓塞栓症

Second International Consensus Meeting (ICM) on Musculoskeletal Infectionのアプリケーションの紹介

2018年7月末に米国ペンシルバニア州フィラデルフィアにて、第2回の International Consensus Meeting (ICM) on Musculoskeletal Infection が、Rothman Institute at Thomas Jefferson University の Javad Parvizi 先生と Endo Clinic の Thorsten Gehrke 先生が中心となり開催されました。第2回会議では、腫瘍・関節・脊椎・肩・足・手・外傷・スポーツなど整形外科全領域をほぼ万遍なくカバーしたため、設問数も約3倍のボリュームになりました。これらの設問に対し、世界各国の医師が現在の Periprosthetic joint infection (PJI) に関する文献をもとに、膨大な時間をかけてコンセンサスを作成しています。この膨大かつ有益な情報をいつでもどこでも気軽に活用されることを期待し、Parvizi 先生によってアプリの発案と作成がなされました(図1)。

このアプリケーションには ICM の会議時に使用されたスライドや ICM の全設問だけでなく、Musculoskeletal Infection Society (MSIS) によって作成された診断基準、PJI risk calculator、PJI 関連の最新の文献も含まれています。そして、このアプリケーションは会議が終了した現在においても、一人でも多くの医師が現在の PJI に関する最新の情報に触れることを期待して、upload され続けています。特に、臨床現場で PJI の診断基準を手早く確認したい場合や文献などで情報を得たいときには、非常に有用なツールとして働いてくれるであろうと考えられます。また、このアプリケーションは無料で取得可能となっており、内容に関しては ICM Philly の website (<https://icmphilly.com/ortho-applications/>) で確認されたい。

文責：井上大輔、土屋弘行（金沢大学整形外科）

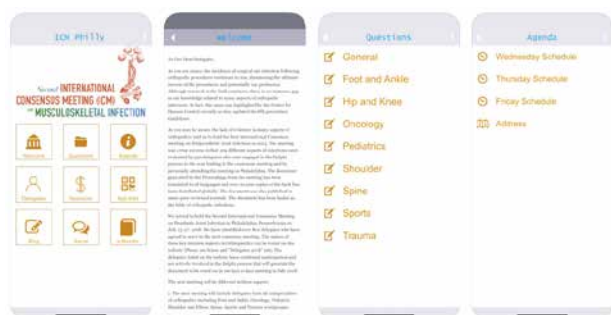


図1. アプリケーション (ICM Philly)



ICM Philly の website

<https://icmphilly.com/ortho-applications/>

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〈監訳者〉

稲葉裕、井上大輔、内山勝文、小林直実、土屋弘行、森井健司、山田浩司

1.1. 予防：宿主関連、局所因子

質問 1：皮膚病変(膿、擦過傷、毛嚢炎など)が手術部位から近い又は遠い部位にあった場合、SSI/PJIは起こりやすいか？ もしそうなら、待機的TJAを受ける前に、これらの皮膚病変を持つ患者は、治療を受ける必要性はあるか？

著者：Hao Shen, Peter Thomas, Qiaojie Wang 翻訳者：井上大輔、土屋弘行

推奨：待機的TJAを受ける患者においては、活動性の皮膚感染症が手術部位から近い又は遠いに関わらず存在するのであれば、SSI/PJIが起きやすいとされている。それゆえ、これらの病変が治療または解決されるまでは、手術は延期すべきである。湿疹または乾癬のような病変部位に手術切開部位を置くこともできるだけ避けるべきである。

エビデンスレベル：Moderate

投票結果：賛成 95%、反対 3%、棄権 2%（満場一致、最も強いコンセンサス）

質問 2：口腔衛生の状態が悪い場合、SSI/PJIは起きやすいか？ もしそうなら、SSI/PJIのリスクを減らすために、口腔衛生の状態が悪い患者の口腔清掃を行う意義はあるか？

著者：Martin Clauss, Oscar Ares, Max Greenky 翻訳者：井上大輔、土屋弘行

推奨：TJAを受ける患者において、口腔内病原体が血行性に散布されるリスクは小さいものの、リスク自体は存在する。口腔衛生が悪い状態のままTJAを受ける患者においては、SSI/PJIのリスクは増加する。それゆえ、口腔病変または口腔衛生状態が悪い患者は、待機的TJAを受ける前に、これらの病変を改善させるべきである。

エビデンスレベル：Limited

投票結果：賛成 92%、反対 5%、棄権 3%（大多数、強いコンセンサス）

質問 3：TJA(股/膝/肩/足)を受ける前に、ルーチンで歯科口腔清掃は施行されるべきか？

著者：William V. Arnold, Juan Ottolenghi, Mauro Belzino 翻訳者：井上大輔、土屋弘行

推奨：歯科病理学の分野からTJAを受ける患者に対しての報告はなされてきたものの、術前に歯科口腔清掃を行う事でPJIの発生率を減少させたとする前向き比較研究はない。

エビデンスレベル：Consensus

投票結果：賛成 76%、反対 17%、棄権 7%（大多数、強いコンセンサス）

質問 4：整形外科手術で尿道カテーテルを使用すると、SSI/PJIのリスクは増加するか？

著者：Filipenko Volodymyr, Max Greenky, Martinez Leibnitz 翻訳者：井上大輔、土屋弘行

推奨：尿道カテーテルとPJIの直接的な関係性については、議論の余地が残っている。しかしながら、尿路感染（UTI）はPJIの発生リスクと関連があるとする研究が存在する。尿路感染のリスクを最小限にするため、術後尿閉（POUR）に対しては間欠的導尿を行い、また尿道カテーテルが挿入されている場合には挿入後 48 時間以内に抜去することを推奨する。

エビデンスレベル：Moderate

投票結果：賛成 89%、反対 6%、棄権 5%（大多数、強いコンセンサス）

質問 5：待機的TJAを受ける前に、ルーチンで尿検査を行う必要性はあるか？ もし必要なら、待機的TJAを受ける前に、無症候性細菌尿に対してはどのように治療すべきか？

著者：Ricardo Sousa, Young-Kyun Lee 翻訳者：井上大輔、土屋弘行

推奨：待機的TJAを受ける前に、無症候性の患者にルーチンで尿検査を行うことは推奨されない。また、無症候性細菌尿を術前に治療することが有益かどうかを示すエビデンスもない。

エビデンスレベル：Moderate

投票結果：賛成 89%、反対 9%、棄権 2%（大多数、強いコンセンサス）

質問 6：術前に症候性の尿路感染(UTI)を持つ患者は、待機的TJAを受ける前に、どのように管理されるべきか？

著者：Young-Kyun Lee, Bülent Atilla, Andrew Battenberg 翻訳者：井上大輔、土屋弘行

推奨：術前の症候性尿路感染は、待機的TJAを受ける前に適切な抗菌薬で治療または根絶されるべきである。

エビデンスレベル：Limited

投票結果：賛成 97%、反対 2%、棄権 1%（満場一致、最も強いコンセンサス）

質問7：術前に症候性または無症候性尿路感染(UTI)を持つ患者では、SSI/PJIのリスクは増加するか？

著者：Kyung-Hoi Koo, Aruna Poojary, Anurag Bari, Satyajeet Bhoite 翻訳者：井上大輔、土屋弘行

推奨：症候性尿路感染は、手術を受ける前に適切な抗菌薬で治療されなければならない。無症候性細菌尿（ASB）においては、SSI/PJIを増加させないので治療は継続するべきではない。**エビデンスレベル：**Strong**投票結果：**賛成 96%、反対 2%、棄権 2%（満場一致、最も強いコンセンサス）**質問8：人工肛門を持つ患者では、SSI/PJIのリスクは増加するか？**

著者：Marcelo Lizarraga Ferrand, Georgios Komnos, Sarango Jorge, Gino Naneti, Elias Luis, Miguel Egoavil 翻訳者：井上大輔、土屋弘行

推奨：人工肛門を持つ患者がTJAを受ける場合、SSI/PJIのリスクが増加するかどうかを示した文献的エビデンスは今のところ存在しない。ただし、汚染防止のために人工肛門からの漏れがない清潔な状態を確認することを推奨する。**エビデンスレベル：**Limited**投票結果：**賛成 94%、反対 4%、棄権 2%（大多数、強いコンセンサス）**1.2. 予防：宿主関連、一般的因子****質問1：どのような修正可能そして修正不可能な宿主因子が、SSI/PJIのリスクを増加させるか？**

著者：Setor Kunutsor, Richard Iorio, James E. Feng, Zlatan Cizmici 翻訳者：井上大輔、土屋弘行

推奨：医学的合併症だけでなく、BMI・喫煙・アルコールのような修正可能な宿主因子もSSI/PJIのリスクを増加させることが示されている。加齢・男性・人種（黒人）のような修正不可能な宿主因子もまた、SSI/PJIのリスクを増加させることが示されている。**エビデンスレベル：**Strong**投票結果：**賛成 98%、反対 1%、棄権 1%（満場一致、最も強いコンセンサス）**質問2：SSI/PJI発生またはSSI/PJIの治療成功に影響を与える遺伝的素因は存在するか？**

著者：Christopher E. Pelt, Li Cao, Lidong Wu, Laura Certain, Michael B. Anderson, Jeremy M. Gililand 翻訳者：井上大輔、土屋弘行

推奨：潜在的な遺伝的素因はあるかもしれないが、TJA後のSSI/PJIの特異的な遺伝的リスク因子を支持する明確なエビデンスは不足している。**エビデンスレベル：**Limited**投票結果：**賛成 93%、反対 2%、棄権 5%（大多数、強いコンセンサス）**質問3：喫煙を継続すると、SSI/PJIの再燃のリスクは増加するか？**

著者：John J. Callaghan, Matthew Austin, Matthew Kheir, Nicholas A. Bedard, David E. DeMik, Max Greenky 翻訳者：井上大輔、土屋弘行

推奨：整形外科手術を施行する患者において、喫煙の継続はSSI/PJIのリスクを増加させるようである。**エビデンスレベル：**Limited**投票結果：**賛成 94%、反対 3%、棄権 3%（大多数、強いコンセンサス）**質問4：低体重患者(BMI<18.5kg/m²)は、整形外科手術後のSSI/PJIのリスクがより高くなるか？もしそうなら、低体重患者のBMIを増加させると、SSI/PJIのリスクが減少するか？**

著者：Jorge Manrique, Andrew Battenberg, João Mauricio Barretto 翻訳者：井上大輔、土屋弘行

推奨：低体重患者（BMI<18.5kg/m²）は、整形外科手術後のSSI/PJIのより高いリスクである。しかしながら、現在のところ、低体重患者のBMIを増加させると、SSI/PJIのリスクを減少させるというエビデンスはない。**エビデンスレベル：**Moderate**投票結果：**賛成 92%、反対 4%、棄権 4%（大多数、強いコンセンサス）**質問5：(A)どのようなBMIの上限閾値が、整形外科手術後のSSI/PJIのリスク増加と関連しているか？(B)どのようなカットオフを導入することで、SSI/PJIの発生は減少するか？**

著者：Stuart Goodman, Ruben Limas, Derek F. Amanatullah, Katherine Hwang 翻訳者：井上大輔、土屋弘行

推奨：A) 肥満はTJA後のSSI/PJIのリスクを増加させる。そのリスクは、あるカットオフ値で急増するというよりは、BMI値を通じて次第に増加していく。BMI>40kg/m²の患者はSSI/PJIのリスクが増加するため、手術はその利益と天秤にかけて、注意深く判断しなければならない。

B) BMIが通常以上の全ての患者において、術前の体重減少はSSI/PJIのリスクを減少させるために有益かもしれない。

エビデンスレベル: A) Strong, B) Consensus

投票結果: 賛成 95%、反対 2%、棄権 3% (満場一致、最も強いコンセンサス)

質問6: 肥満患者において、減量手術はSSI/PJIのリスクを減少させるか?

著者: Mitchell R. Klement, Ngai Nung, Neil Sheth, Suraya Zainul-Abidin, Kae Sian Tay, Ajay Premkumar 翻訳者: 井上大輔、土屋弘行

推奨: 現在のところ、エビデンスははっきりとしていない。したがって、術前に減量手術をルーチンに受けることは推奨されない。

エビデンスレベル: Limited

投票結果: 賛成 85%、反対 7%、棄権 8% (大多数、強いコンセンサス)

質問7: ヒト免疫不全ウイルス(HIV)患者は、SSI/PJIを起こしやすいか? もしそうなら、ヒト免疫不全ウイルス(HIV)患者に対しての手術を行う前の最善の処置は何か?

著者: Mohammad Ali Enayatollahi, Lipalo Mokete, Marisa Sanchez, Jurek R.T. Pietrzak 翻訳者: 井上大輔、土屋弘行

推奨: ヒト免疫不全ウイルス(HIV)感染症は、SSIやPJIのリスク因子として知られている。しかしながら、強力な抗ウイルス療法(HAART)を受けている患者は、そのリスクが小さくなり、HIV陰性の患者と同等となる。このような患者は、栄養失調症、腎・肝疾患、CD4数、ウイルス量を含む患者の全身状態を最適化しておく必要がある。

エビデンスレベル: Moderate

投票結果: 賛成 96%、反対 2%、棄権 2% (満場一致、最も強いコンセンサス)

質問8: 免疫疾患修飾薬(メトトレキセート、抗腫瘍壊死因子(anti-TNF))は、SSI/PJIのリスクを減少させるために術前の投与を中止する必要があるか?

著者: Susan Goodman, Bryan D. Springer, Jasvinder Singh, Adolph J. Yates 翻訳者: 井上大輔、土屋弘行

推奨: 1. 炎症性関節炎(リウマチ性関節炎(RA)、乾癬性関節炎(PsA))をもつ成人患者、若年性特発性関節炎(JIA)、強直性脊椎炎(AS)または全身性エリテマトーデス(SLE)をもつ成人患者、TNF阻害薬やIL-6阻害薬(参照Table1)を含む生物学的抗リウマチ薬を使用している患者は、THAやTKAの施行前に、投与は中断されたほうが好ましく、手術は投与を中断して次の週に行われるほうがよい。これらの治療は、創部が十分に治癒しかつ全ての抜糸が終了し、SSIがないのであれば、術後2週以内に再開する。

2. 炎症性関節炎またはSLE成人患者においては、メトトレキセートを含む疾患修飾性抗リウマチ薬(DMARDs、参照Table1)は、周術期を通じて継続することができる。

3. 重度のSLE成人患者においては、免疫疾患修飾薬(参照Table1)は周術期を通じて継続することができる。

4. 中等度のSLE成人患者において、免疫疾患修飾薬(タクロリムスを除く)は手術前の投与を中断したほうが好ましく、創部が十分に治癒しかつ全ての抜糸が終了し、SSIがないのであれば、最小で術後14日に再開することができる。

5. RA、SLE、AS、PsA、JIAの治療でグルココルチコイド(GCs)の投与を受けているが、成長期のためグルココルチコイドを摂取されておらず、また代替療法を現在受けていない患者においては、生理的用量以上の投与量("stress dose")ではなく常用量のグルココルチコイドが投与されることを推奨する。

TABLE 1. ガイドラインにて含まれる薬物

DMARDs: 周術期を通じて継続	投与間隔	継続 / 休止
メトトレキセート	毎週	継続
スルファサラジン	1日1回または2回	継続
ヒドロキシクロロキン	1日1回または2回	継続
レフルノミド(アラバ)	毎日	継続
ドキシサイクリン	毎日	継続
生物学的製剤: 投与サイクルの最後に、手術や予定手術の前にこれらの薬剤は中止。創治癒遅延、感染や全身性感染症がない場合、最短術後14日で薬剤を再開する。	投与間隔	最終投与から予定手術までの期間
アダリムマブ(ヒュミラ) 40mg	2週	3週
エタネルセプト(エンブレル) 50mg or 25mg	毎週または週2回	2週
ゴリムマブ(シンボニー) 50mg	4週(皮下注) 8週(静注)	5週(皮下注) 9週(静注)
インフリキシマブ(レミケード) 3mg/kg	4、6または8週	5、7または9週
アバタセプト(オレンシア) 500mg(体重調整) 静注 1000mg; 皮下注 125mg	隔月(静注) 毎週(皮下注)	5週 2週
リツキシマブ(リツキサン) 1000mg	4~6ヶ月おき2週間で2回投与	7ヶ月
トシリズマブ(アクテムラ) 静注 4mg/kg; 皮下注 162mg	毎週(皮下注) 4週(静注)	3週 5週
アナキンラ(キネレット) 皮下注 100mg	毎日	2日
セクキヌマブ(コセンティクス) 150mg	4週	5週
ウスチキヌマブ(ステラール) 45mg	12週	13週
ベリムマブ(ペンリスタ) 10mg/kg	4週	5週

DMARDS: 周術期を通じて継続	投与間隔	継続 / 休止
トファシチニブ（ゼルヤンツ）5mg：手術前 7 日に服薬中止	毎日または隔日	7 日
重症 SLE に使用する薬剤：周術期もこれらの薬剤は継続	投与間隔	継続 / 休止
ミコフェノール酸	1 日 2 回	継続
アザチオプリン	毎日または 1 日 2 回	継続
シクロスポリン	1 日 2 回	継続
タクロリムス	1 日 2 回（静注、経口）	継続
軽度・中等度 SLE の場合：周術期にこれらの薬剤は継続しない	投与間隔	継続 / 休止
ミコフェノール酸	1 日 2 回	中止
アザチオプリン	毎日または 1 日 2 回	中止
シクロスポリン	1 日 2 回	中止
タクロリムス	1 日 2 回（静注、経口）	継続
製薬会社がオンラインで提供している添付文書から得た投与間隔 ※2016年 American College of Rheumatology/American Association of Hip and Knee Surgeons における待機的人工股関節または膝関節置換術をうけるリウマチ性疾患を持つ患者の周術期管理 に対するガイドライン		

エビデンスレベル：Limited、based on moderate to low-quality indirect evidence

投票結果：賛成 87%、反対 3%、棄権 10%（大多数、強いコンセンサス）

質問9：肝疾患をもつ患者(C型肝炎、肝硬変など)は、SSI/PJIを生じやすいか？ もしそうなら、肝疾患を持つ患者に対しての術前の最善の治療とは何か？

著者：Chi Xu, Yuhan Chang, Wadih Y. Matar, Daniel Varin, Jui Ping Chen 翻訳者：井上大輔、土屋弘行

推奨：肝炎または肝硬変のような肝疾患を持つ患者は、感染のリスクが高い。これらの患者は、術中や術後出血の増加のリスクがある。よって、そのような合併症が最小限となるように最善の努力がなされるべきである。

エビデンスレベル：Strong

投票結果：賛成 98%、反対 1%、棄権 1%（満場一致、最も強いコンセンサス）

質問10：オピオイドの投与量と SSI/PJI のリスク増加に関連性はあるか？

著者：Efrain Diaz-Borjon, Navin Fernando, Kerri Bell, Ruben Alejandro Morales Maldonado 翻訳者：井上大輔、土屋弘行

推奨：手術前のオピオイドの使用は、SSI/PJI のリスク増加に関連性がある。

エビデンスレベル：Limited

投票結果：賛成 71%、反対 17%、棄権 12%（大多数、強いコンセンサス）

質問11：不安症/鬱病、そして気分障害を持ち合わせていると、SSI/PJI のリスクは増加するか？ もしそうなら、SSI/PJI のリスクを減少させるために、何を行うべきか？

著者：Alexander Rondon, Samuel Wellman, Camila Novaes de Santana 翻訳者：井上大輔、土屋弘行

推奨：鬱病や不安症のような気分障害は、PJI のリスクを増加させることを支持するエビデンスがある。この関係性については、身体的そして心理学的の両面で示されているものの、手術前にこれらの障害を調節または治療を行えば、PJI のリスクが減少するかどうかは明らかではない。

エビデンスレベル：Strong

投票結果：賛成 88%、反対 4%、棄権 8%（大多数、強いコンセンサス）

質問12：整形外科手術をうける患者において、ビタミン D 欠乏症(VDD)は SSI/PJI のリスクを増加させるか？

著者：Andrew Battenberg, Kier Blevins 翻訳者：井上大輔、土屋弘行

推奨：ビタミン D 欠乏症 (VDD) はビタミン D 介在性の自然かつ獲得免疫反応を少なくすることにより、整形外科手術をうける患者において、SSI/PJI のリスクを増加させるかもしれない。

エビデンスレベル：Limited

投票結果：賛成 82%、反対 5%、棄権 13%（大多数、強いコンセンサス）

質問13：術前貧血は、SSI/PJI のリスクを増加させるか？

著者：Riaz Khan, Vasili Karas, Jonathan Coward 翻訳者：井上大輔、土屋弘行

推奨：術前ヘモグロビン値が男性 13.0g/dl・女性 12.0g/dl より低下した場合を術前貧血と定義すると、現状では、術前貧血は TJA における SSI/PJI の独立した危険因子である。

エビデンスレベル：Moderate

投票結果：賛成 89%、反対 8%、棄権 3%（大多数、強いコンセンサス）

質問14：ヘモグロビン濃度を増加させるために、術前の貧血に対してどのような術前治療が最適か？

著者：Riaz Khan, Vasili Karas, Jonathan Coward 翻訳者：井上大輔、土屋弘行

推奨：文献的には、鉄またはエリスロポエチン（EPO）の投与が術前ヘモグロビン濃度を増加させ、術後の同種血輸血の必要性を減少させるとしている。しかしながら、鉄は鉄欠乏性貧血をもつ患者にのみ有効かもしれず、また多くの副作用と関連している。エリスロポエチンは費用が高く、輸血を回避するために術前投与することは、費用対効果が高いとは言えない。術前の同種血輸血のリスクとベネフィットを評価するためには、さらなる研究が必要である。

エビデンスレベル：Limite

投票結果：賛成 92%、反対 3%、棄権 5%（大多数、強いコンセンサス）

質問15：術前ヘモグロビン濃度を増加させると、SSI/PJIの発生率に影響を与えるか？

著者：Riaz Khan, Vasili Karas, Jonathan Coward 翻訳者：井上大輔、土屋弘行

推奨：術前ヘモグロビン濃度を最適化することによって、SSI/PJIを減少させるというエビデンスはないものの、術前に貧血を改善させるためにできる限りの治療を行う事を推奨する。

エビデンスレベル：Consensus

投票結果：賛成 90%、反対 4%、棄権 6%（大多数、強いコンセンサス）

1.3. 予防：宿主リスクの軽減、局所因子

質問1：同じ関節の過去の観血的手術（インプラント残存の有無によらず）は、その後のSSI/PJIのリスクを上昇させるか？

著者：Ran Schwarzkopf, Jonathan Danoff, Arash Aalirezai, David Choon, Peter Gold, Afshin Anoushiravani 翻訳者：楯野良知、土屋弘行

推奨：インプラント使用の有無によらず、観血的手術はTJAを受ける同じ関節のSSI/PJIのリスクを上昇させる。6カ月以内に大きな観血的手術が行われた関節への待機的なTJAは遅らせることを推奨する。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 6%、棄権 4%（大多数、強いコンセンサス）

質問2：化膿性関節炎の既往がある患者では、SSI/PJIのリスクを最小限にするために、どのような戦略をたてるべきか？

著者：James Cashman, Dace Vigante, Eoin Sheehan 翻訳者：楯野良知、土屋弘行

推奨：待機的TJAの前に、適切な診断検査を用いて化膿性関節炎を起こしていた関節の感染を除外しておく必要がある。活動性の感染がある場合は、二期的TJAが推奨される。すべての診断検査が正常で、かつ活動性の軟部組織病変（瘻孔あるいは膿瘍）の存在がない場合は、一期的TJAが考慮されることもある。結核菌（TB）による化膿性関節炎患者では、抗結核薬が既に投与されており、かつ瘻孔あるいは広範囲な軟部組織病変が無ければ、一期的TJAが妥当な治療戦略である。もし先行する感染微生物がわかっている場合、感受性のある抗菌薬（重量比5%以下）を、TJAの際のセメントに配合すべきである。

エビデンスレベル：Consensus

投票結果：賛成 88%、反対 7%、棄権 5%（大多数、強いコンセンサス）

質問3：関節内の弾丸や銃弾の破片の既往は、その後のSSI/PJIの高いリスクとなるか？もしそうなら、SSI/PJIのリスクを下げるためには、何をすべきか？

著者：Ran Schwarzkopf, Matthew Dietz, Afshin Anoushiravani 翻訳者：楯野良知、土屋弘行

推奨：関節内の弾丸や銃弾の破片の既往は、その関節が過去に感染症を発症していなければ、同じ関節におけるその後の待機的TJAのSSI/PJIのリスクを上昇させない。

エビデンスレベル：Consensus

投票結果：賛成 71%、反対 18%、棄権 11%（大多数、強いコンセンサス）

1.4. 予防：宿主リスクの軽減、全身因子

質問1：免疫療法および免疫学的予防法は、バイオフィルム形成と人工物関連の感染を予防できるか？

著者：Edward Schwarz, James W.M. Kigera, Claus Moser 翻訳者：加畑多文、土屋弘行

推奨：整形外科に関連したワクチンや予防接種においてFDAで承認されているものは存在していないが、健常なボランティアにおいてすでに安全性と免疫

原性が確立されている。4 種 - 抗原ワクチン (SA4Ag) は、現在脊椎固定術患者の第 2 相試験で有効性が試験されている。これは、小児の人工内耳の手術において肺炎球菌髄膜炎の発生が減少したとする文献的なエビデンスによっても支持されている。しかしながら、この傾向をサポートしているエビデンスの高い研究はなく、さらなる研究が必要である。

エビデンスレベル: Moderate

投票結果: 賛成 62%、反対 18%、棄権 20% (大多数、弱いコンセンサス)

質問 2: 糖尿病と血糖コントロールを常にスクリーニングすると、SSI/PJI のリスクは低下するか?

著者: Noam Shohat 翻訳者: 加畑多文、土屋弘行

推奨: 糖尿病と血糖コントロールを常にスクリーニングすることは、TJA 後の SSI/PJI の発生を低下させる可能性がある。

エビデンスレベル: Consensus

投票結果: 賛成 96%、反対 3%、棄権 1% (満場一致、最も強いコンセンサス)

質問 3: SSI/PJI を予測するための、最も正確な血糖管理を評価する指標は何か?

著者: Noam Shohat, Kevin Mulhall 翻訳者: 加畑多文、土屋弘行

推奨: HbA1c 値と空腹時血糖値が高いことが、SSI/PJI のリスクを増加させるというエビデンスが示されている一方、両者の関連性は強くはない。最近の知見によると、術前のフルクトサミン値と術直後の血糖値の変動性が、SSI or PJI をより予測するのではないかと示唆されている。

エビデンスレベル: Moderate

投票結果: 賛成 76%、反対 8%、棄権 16% (大多数、強いコンセンサス)

質問 4: 整形外科手術を受ける患者において、術後の SSI/PJI を予測する HbA1c の閾値はどれくらいか?

著者: Hasan Nahouli, William Jiranek, Brian A. Klatt, Majd Tarabichi 翻訳者: 加畑多文、土屋弘行

推奨: 術後の SSI/PJI 発生が予想されうる HbA1c 値の上限閾値は、7.5 ~ 8% 程度である可能性が高い。

エビデンスレベル: Moderate

投票結果: 賛成 88%、反対 3%、棄権 9% (大多数、強いコンセンサス)

質問 5: 整形外科手術を受ける患者において、血小板増加症は術後の SSI/PJI のリスク増加と関連しているか?

著者: Fatih Küçükduymaz, Jay Lieberman 翻訳者: 加畑多文、土屋弘行

推奨: 血小板増加症が術後の SSI/PJIs のリスク増加と関係しているとはいえない。しかしながら、重篤な血小板増加症を持つ患者は、整形外科手術を受ける前に評価を受けるべきである。

エビデンスレベル: Limited

投票結果: 賛成 89%、反対 4%、棄権 7% (大多数、強いコンセンサス)

1.5. 予防: リスクの軽減、局所因子

質問 1: 整形外科手術を受ける患者において、術前に MRSA 除菌を行うことは、SSI/PJIs を低下させることに有効か? もしそうならば、術前の MRSA 除菌は費用対効果がよいか?

著者: Ricardo Sousa, Antonia F. Chen 翻訳者: 加畑多文、土屋弘行

推奨: 術前の黄色ブドウ球菌スクリーニングと除菌プロトコルをルーチンに行うことに関しては、文献的な矛盾が存在しているため、最終的な推奨を提示しえない。さらに、それらをルーチンに行うという治療戦略が最も費用対効果があり、かつ最も容易に実行できそうではあるものの、除菌を選択的に行うもしくはルーチンに行うことに関しても、最終的な推奨を提示することはできない。ムピロシン鼻軟膏による除菌の代わりとしてポビドンヨード鼻軟膏のようなものを使うことにより、継続的な治療プロトコルによって生じる抗菌薬耐性に対する懸念を取り除くかもしれない。

エビデンスレベル: Moderate

投票結果: 賛成 86%、反対 7%、棄権 7% (大多数、強いコンセンサス)

質問 2: MRSA/MSSA を除菌する方法としては、どのようなものが存在するか? それぞれを用いることに関する利益とリスクにはどのようなものがあるか?

著者: Gregory K. Deirmengian, María S. Quevedo 翻訳者: 加畑多文、土屋弘行

推奨: 鼻腔除菌の方法としては、2% ムピロシン軟膏、5% ポビドンヨード溶液、アルコール系製品、クロルヘキシジン系製品などがある。それぞれの方法に、薬剤の効果、耐性菌の出現、患者のコンプライアンスに関することについての利点と欠点がある。しかしながら、どの製品においても可能性はあるものの MRSA の除菌のために好ましい方法としてのコンセンサスには達していない。

エビデンスレベル：Moderate

投票結果：賛成 93%、反対 3%、棄権 4%（大多数、強いコンセンサス）

質問 3：MRSA の除菌を受けた後に、もう一度その患者をスクリーニングする必要はあるか？

著者：Bryan D. Springer, Per Åkesson, Qiaojie Wang, Michael Geary 翻訳者：加畑多文、土屋弘行

推奨：一部の MRSA キャリアは、術前に除菌プロトコルを施行したにもかかわらず、保菌状態のままである。現在の所、再スクリーニングした後に MRSA 除菌を繰り返し行うことで、周術期の予防的抗菌薬のレジメンを変更することができ、更に PJI のリスクを低下させることができるということをサポートするエビデンスは存在しない。

エビデンスレベル：Limited

投票結果：賛成 87%、反対 8%、棄権 5%（大多数、強いコンセンサス）

1.6. 予防：リスクの軽減、全身因子

質問 1：SSI/PJI の既往は、他部位の関節のその後の感染症リスクを上昇させるか？もしそうなら、他部位の関節に活動性あるいは治療後の PJI がある患者では、その関節の待機的 TJA は控えるべきか？

著者：Edmundo Ford Jr, Hany Bedair 翻訳者：楢野良知、土屋弘行

推奨：ある関節の先行する SSI および PJI は、他の関節のその後の感染症のリスクを上昇させる。活動性の感染症がある患者では、他の関節の待機的 TJA は控えるべきである。

エビデンスレベル：Limited

投票結果：賛成 95%、反対 4%、棄権 1%（満場一致、最も強いコンセンサス）

質問 2：SSI/PJI のリスクを下げるために、どのような免疫系賦活作用を用いることができるか？

著者：Edward Schwarz, Ibrahim Azboy, Ismail Turkmen, Abdullah Demirtas 翻訳者：楢野良知、土屋弘行

推奨：患者の免疫力を高めるための最善の医療を行うことに加え、免疫調整薬（アミノ酸）、ビタミン D 補充や黄色ブドウ球菌に対する受動免疫 / 能動免疫が、免疫機能を活性化し SSI/PJI の発生を減少させる可能性を示すいくつかのエビデンスが存在する。

エビデンスレベル：Moderate

投票結果：賛成 74%、反対 11%、棄権 15%（大多数、強いコンセンサス）

質問 3：待機的 TJA が必要で臓器移植を待機している患者では、TJA は臓器移植手術の前か後のどちらに行うべきか？

著者：Mitchell R. Klement, Joris Ploegmakers, Aydin Gahramanov 翻訳者：楢野良知、土屋弘行

推奨：TJA は、実質臓器の移植手術の後に通常の予防抗菌薬を使用しながら実施することを推奨する。一般に公開されたデータベースを利用した近年の研究では、臓器代替医療（血液透析）中に TJA を実施された患者と、臓器移植術（腎移植）の後に実施された患者を比較した結果、臓器移植術後の患者群で感染症が少ないことを報告している。

エビデンスレベル：Moderate

投票結果：賛成 92%、反対 2%、棄権 6%（大多数、強いコンセンサス）

1.7. 予防：抗菌薬（全身投与）

質問 1：ペニシリンやセファロスポリンに対してアレルギーのある患者は、予防抗菌薬投与前にアレルギーテスト、脱感作や試験投与をルーチンに実施するべきか？

著者：Gábor Skaliczki, Michael Kheir, Attila Szatmári 翻訳者：大野久美子、山田浩司

推奨：ペニシリンアレルギー患者の大半はセファロスポリンに対する忍容性が良好であり、通常皮内テストは不要である。ペニシリンやセファロスポリンに対しアナフィラキシーの既往のない患者は、手術室でセファロスポリンの試験投与を行ってもよい。

エビデンスレベル：Moderate

投票結果：賛成 90%、反対 8%、棄権 2%（大多数、強いコンセンサス）

質問 2：ペニシリンやセファロスポリンにアナフィラキシーの既往のある患者はどの予防抗菌薬を投与するべきか？

著者：Gábor Skaliczki, Michael Kheir, Attila Szatmári 翻訳者：大野久美子、山田浩司

推奨：ペニシリンやセファロスポリンにアナフィラキシーの既往のある患者の予防抗菌薬投与は、バンコマイシン、テイコプラニンやクリンダマイシンが選択肢となる。皮内テストを行ってからであれば、ペニシリンにアナフィラキシーの既往のある患者に対しセファロスポリンを投与してもよい。

エビデンスレベル：Moderate

投票結果：賛成 93%、反対 5%、棄権 2%（大多数、強いコンセンサス）

質問 3：整形外科手術を行う MRSA 保菌者に対する適切な周術期の予防抗菌薬は何か？

著者：Chong Bum Chang 翻訳者：大野久美子、山田浩司

推奨：TJA を行う MRSA 保菌者に対する周術期の予防抗菌薬投与は、バンコマイシンやテイコプラニンが推奨される。

エビデンスレベル：Moderate

投票結果：賛成 94%、反対 4%、棄権 2%（大多数、強いコンセンサス）

質問 4：周術期の予防抗菌薬投与法の調整には、どのような患者因子(アレルギー、体重など)を指標とすべきか？

著者：Stanislav Bondarenko, Simon W. Young 翻訳者：大野久美子、山田浩司

推奨：体重調整を行った投与量を投与すべきである。70kg 超の患者で有効な MIC（最小発育阻止濃度：minimum inhibitory concentration）を達成するためには、セファゾリンであれば少なくとも 2g 投与が推奨される。耐性菌保菌者やセファロsporin アレルギーのある患者では、バンコマイシンかテイコプラニンを投与するべきである。ペニシリンアレルギー患者は IgE 関与の有無にかかわらず、交差反応を最小限に抑えるために第 2、3 世代セファロsporin を使用するべきである。

エビデンスレベル：Moderate

投票結果：賛成 95%、反対 3%、棄権 2%（満場一致、最も強いコンセンサス）

質問 5：整形外科手術患者に対する周術期予防抗菌薬の二剤投与の適応は？ 抗菌薬の適切な組み合わせは？

著者：Rolando Suárez, Alex Soriano, Michael Kheir, Laura Morata 翻訳者：大野久美子、山田浩司

推奨：高いレベルのデータが不足しているため、予防抗菌薬の二剤投与は再置換手術や MRSA 感染リスクの高い患者など、感染リスクの高い患者に対してのみ行われるべきである。

エビデンスレベル：Limited

投票結果：賛成 80%、反対 15%、棄権 5%（大多数、強いコンセンサス）

質問 6：術後ドレーンが留置されている患者に、予防抗菌薬投与を延長(24時間以上)すべきか？

著者：Werner Zimmerli, Ed McPherson 翻訳者：大野久美子、山田浩司

推奨：延長すべきでない。術後ドレーン留置の有無にかかわらず、予防抗菌薬投与延長の適応はない。予防抗菌薬投与の延長は、皮膚常在菌の耐性化を助長するなどの潜在的リスクがある。

エビデンスレベル：Strong

投票結果：賛成 91%、反対 8%、棄権 1%（大多数、強いコンセンサス）

質問 7：罹患した関節に以前の手術で挿入したインプラントがある場合、周術期予防抗菌薬の選択に影響はあるか？

著者：José Cordero-Ampuero, Stephen Kates, Mitchell R. Klement 翻訳者：木幡一博、山田浩司

推奨：関節手術で、以前の手術で挿入したインプラントが存在する場合でも、周術期抗菌薬の変更または追加を薦める根拠はない。THA や TKA への入れ替え手術は、初回手術ではなく、むしろ再手術と同様の SSI / PJI リスクを伴うことを示唆する文献が増えており、抗菌薬を変更することでこのリスクを軽減できるかもしれない。しかしながら、エビデンスは十分でないため、この主張を支持または反論するためには更なる研究が必要である。

エビデンスレベル：Consensus

投票結果：賛成 98%、反対 1%、棄権 1%（満場一致、最も強いコンセンサス）

質問 8：メシリン感受性黄色ブドウ球菌(MSSA)による整形外科感染症の治療において、セフトリアキソンをセファゾリンの代わりに利用することができるか？ もしできるのなら、どのような投与方法が推奨されるか？

著者：Jason Webb, Michael Kheir, Randi Silibovsky 翻訳者：木幡一博、山田浩司

推奨：MSSA による整形外科感染症治療のためのセフトリアキソン使用とその適切な投与量を評価している文献は少ない。国際ガイドラインでは、PJI の治療にセフトリアキソンを使用することについて合意は得られていない。

エビデンスレベル：Consensus

投票結果：賛成 90%、反対 4%、棄権 6%（大多数、強いコンセンサス）

1.8. 予防：抗菌薬（局所投与）

質問 1：TKAにおいて静脈内投与または骨内局所投与した場合、バンコマイシンのバイオアベイラビリティ（生物学的利用性）に違いはあるか？

著者：Simon W. Young, Kelly Vince 翻訳者：木幡一博、山田浩司

推奨：違いはある。TKAにおいて予防のためにバンコマイシンおよび他の抗菌薬を骨内局所投与した場合、組織濃度は著しく高くなる。より高濃度にすることでPJIが発生する割合が低下するかどうかは、今のところ不明である。

エビデンスレベル：Strong

投票結果：賛成 91%、反対 2%、棄権 7%（大多数、強いコンセンサス）

質問 2：筋骨格系感染症治療に局所抗菌薬の単独投与は有効か？

著者：Peter Wahl, Jose Baeza, Jorge Manrique, Qun Ren, T. Fintan Moriarty, Albert Ferrando, Manuel Fuertes 翻訳者：木幡一博、山田浩司

推奨：現時点では、投与方法のさらなる改良および薬物動態の改善なしに、局所抗菌薬投与だけで十分に整形外科感染症患者を治療できるとは考えられていない。他の補助療法を、抗菌薬の局所投与と組み合わせる必要がある。

エビデンスレベル：Limited

投票結果：賛成 91%、反対 6%、棄権 3%（大多数、強いコンセンサス）

質問 3：手術中に行う創内へのバンコマイシンパウダーの局所投与は、その後のSSI / PJIリスクを軽減するか？ もし軽減するなら、その使用に関連する危険因子は何か？

著者：Andrew Fleischman, Marco Bernardo Cury, Gabriel Makar 翻訳者：木幡一博、山田浩司

推奨：リスクは軽減しない。PJI予防を目的としたバンコマイシンパウダーに関する質の高い研究はない。脊椎に関する多くの後ろ向き研究は、バンコマイシンパウダーがSSIの発生を減らすとしている。しかし、公表されている唯一のランダム化比較試験（RCT）では、全く予防効果を認めていない。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 6%、棄権 4%（大多数、強いコンセンサス）

質問 4：SSI / PJI治療に抗菌薬を含有させた担体（硫酸カルシウム/リン酸カルシウム（CaS / CaP））の使用は有用か？

著者：Jason Webb, Alex McLaren, Philip Linke, Lars Lidgren 翻訳者：木幡一博、山田浩司

推奨：SSIやPJIなどの筋骨格系感染で、感染部位に抗菌薬を局所投与することを目的としたCaSやCaPからなる抗菌薬含有担体の使用は、SSI / PJI管理で何ら有効性を示していない。

エビデンスレベル：Consensus

投票結果：賛成 80%、反対 13%、棄権 7%（大多数、強いコンセンサス）

質問 5：新鮮凍結同種移植片（FFA）は、人工関節再置換術で抗菌薬局所投与のための担体として使用できるか？

著者：Eivind Witsø, Karan Goswami, Heinz Winkler 翻訳者：木幡一博、山田浩司

推奨：特殊な準備を施した抗菌薬含有同種移植片が、抗菌薬を混入したFFAよりも有効であるとする新たなエビデンスがある。

エビデンスレベル：Limited

投票結果：賛成 63%、反対 14%、棄権 23%（大多数、弱いコンセンサス）

1.9. 予防：術野

質問 1：整形外科手術に先だって自宅で皮膚除菌をすることは、SSI/PJIの発生を低下するのに有用か？

著者：Rafael Tibau Olivan, Brett Levine, Michael A. Mont, Alexis M. Cooper, Maria Tibau Alberdi, Anton Khlopas, Nipun Sodhi

翻訳者：森井健司

推奨：有益である。整形外科手術に先だって自宅で皮膚除菌を行うことは、SSI/PJIの発生を低下するのに有用である。とくにグルコン酸クロルヘキシジン（CHG）はSSI/PJI予防にきわめて有効であることが示されている。

エビデンスレベル：Moderate

投票結果：賛成 92%、反対 5%、棄権 3%（大多数、強いコンセンサス）

質問2：切開予定部位は除毛されるべきか？ またそうであれば、最適な除毛方法と時期は？

著者：James Cashman, Vasileios Nikolaou, Alexis M. Cooper 翻訳者：森井健司

推奨：切開予定部位の体毛は、サージカルクリッパーもしくは除毛クリームによって切開直前に除毛されるべきである。**エビデンスレベル**：Consensus**投票結果**：賛成 84%、反対 13%、棄権 3%（大多数、強いコンセンサス）**質問3：手術用覆布をかけたあとに再度皮膚除菌を行うことは、SSI/PJIの発生率を低下させるのに有用か？**

著者：Majd Tarabichi, Antonia F. Chen, Javad Parvizi 翻訳者：森井健司

推奨：手術用覆布をかけたあとに再度皮膚に除菌処置を行うことは、細菌の定着の軽減や、表層 SSI の発生率低下につながる可能性がある。**エビデンスレベル**：Limited**投票結果**：賛成 74%、反対 15%、棄権 11%（大多数、強いコンセンサス）**質問4：整形外科手術を受ける患者において、SSI/PJIのリスクを低下させる最も有効な術前術野消毒法は？**

著者：Ernesto Guerra, John David Blaha, Hossain Shahcheraghi, Petri Virolainen, Alexis M. Cooper, Jorge Nuñez, Toni Fraguas

翻訳者：森井健司

推奨：イソプロピルアルコールを含有していれば、種々の術野消毒剤（グルコン酸クロルヘキシジン (CHG)、vs ポビドンヨード (PI)）間に差異は認められない。**エビデンスレベル**：Limited**投票結果**：賛成 91%、反対 6%、棄権 3%（大多数、強いコンセンサス）**質問5：患肢の一部ではなく全体を消毒することは、SSI/PJIの発生率を低下させるか？**

著者：Gilberto Lara Cotacio, Joshua Bingham 翻訳者：森井健司

推奨：患肢全体の術前術野消毒は、患肢の部分的術野消毒に関連した汚染リスクを減少させ、SSI/PJI のリスクを低下させる可能性がある。エビデンスは限られているが、患肢の部分的術野消毒には汚染の可能性があり、患肢全体の術前術野消毒にはわずかしき欠点がないことから、患肢全体の術野消毒を推奨する。**エビデンスレベル**：Limited**投票結果**：賛成 84%、反対 12%、棄権 4%（大多数、強いコンセンサス）**質問6：術前術野消毒を手術部位、あるいは患肢の近位もしくは遠位から開始することは、SSI/PJIの発生率に影響するか？**

著者：Gilberto Lara Cotacio, Lucian Bogdan Solomon, Yolandi Starczak, Gerald J. Akins, Ianiv Klaber 翻訳者：森井健司

推奨：エビデンスに欠けるものの、術野消毒を切開予定部位から開始し辺縁部に移動することを推奨する。一般的に、術野消毒は汚染の可能性の低い部位からより高い部位にむかって行われるべきである。瘻孔がある場合、瘻孔の周囲は行程の最後に消毒するべきである。**エビデンスレベル**：Consensus**投票結果**：賛成 95%、反対 3%、棄権 2%（満場一致、最も強いコンセンサス）**質問7：整形外科手術を受ける患者において、使用される手術用覆布の種類(disposable vs. non-disposable)はSSI/PJIが発生するリスクに影響するか？**

著者：Gary Hooper, Arjun Saxena, Richard Kyte, David Kieser, Michael Wyatt , Andrew Beswick 翻訳者：森井健司

推奨：不明である。整形外科以外の手術におけるデータは、disposable な覆布が細菌の透過を阻害し SSI のリスクを低下することを示唆している。覆布が disposable かそうでないかにかかわらず、不浸透性の隔壁素材が使用されるべきである。**エビデンスレベル**：Limited**投票結果**：賛成 90%、反対 3%、棄権 7%（大多数、強いコンセンサス）**質問8：粘着ドレープはSSI/PJIの発生率を低下させるか？ 粘着ドレープの種類によって、有効性は異なるか？**

著者：Timothy L. Tan, Kirill Gromov, Soeren Overgaard 翻訳者：森井健司

推奨：抗菌材料を含有した粘着ドレープが、術野の細菌の定着を減少させるとするエビデンスがある。手術部位への細菌の定着は SSI/PJI を発生させる原因となる可能性があるが、粘着ドレープの使用が実際に PJI の発生率に影響を及ぼしたとする報告はない。多くの外科医が粘着ドレープを切開予定部位に適応するのは、清潔野と消毒されていない領域を物理的に隔離し、術中に覆布が創に入り込まないようにすることを目的としている。

エビデンスレベル：Limited

投票結果：賛成 89%、反対 5%、棄権 6%（大多数、強いコンセンサス）

質問 9：整形外科的手術を受ける患者において、布や不浸透性ストッキネットを足関節や患肢に使用することは、SSI/PJI の発生率に影響するか？

著者：Anil Gambhir, Gustavo Sayago, Arjun Saxena 翻訳者：森井健司

推奨：エビデンスは欠如しているが、術野で発生しうる汚染の予防を目的として、消毒されていない皮膚を常にストッキネットで覆うことを提案する。不浸透性ストッキネットは術中浸透阻止の上乗せ効果をもつ可能性がある。

エビデンスレベル：Consensus

投票結果：賛成 89%、反対 5%、棄権 6%（大多数、強いコンセンサス）

1.10. 予防：手術室、麻酔

質問 1：麻酔の種類（全身麻酔 vs 脊髄幹麻酔）は、SSI/PJI のリスクに影響するか？

著者：Andrew Fleischman, Gabriel Makar, Stavros G. Memtsoudis, Ellen M. Soffin 翻訳者：池田信介、内山勝文、高相晶士

推奨：全身麻酔（GA）と比較して、脊髄麻酔（NA）は、THA および TKA 後の SSI/PJI のリスク低下と関連していると思われる。

エビデンスレベル：Limited

投票結果：賛成 76%、反対 12%、棄権 12%（大多数、強いコンセンサス）

質問 2：区域麻酔を整形外科感染患者に行って良いか？

著者：Andrew Fleischman, Gabriel Makar, Stavros G. Memtsoudis, Ellen M. Soffin 翻訳者：池田信介、内山勝文、高相晶士

推奨：整形外科術後感染患者に区域麻酔を行っても髄膜炎、硬膜外膿瘍、化膿性脊椎炎などの中枢神経系（CNS）感染性合併症は極めて稀であり、脊髄幹麻酔の潜在的な利点は、リスクを上回る可能性がある。

エビデンスレベル：Moderate

投票結果：賛成 91%、反対 3%、棄権 6%（大多数、強いコンセンサス）

質問 3：活動性の高い筋骨格系感染患者に脊髄幹麻酔を行うことは安全か？

著者：Hussein Abdelaziz, Mustafa Citak, Ismet Gavrankapetanović, Yutaka Inaba, 翻訳者：池田信介、内山勝文、高相晶士

推奨：安全である。脊髄麻酔は、敗血症を伴わない（PJI）の患者において安全である。敗血症または他の活動性の高い筋骨格系感染患者に対する脊髄麻酔に関するエビデンスは限られている。

エビデンスレベル：Moderate

投票結果：賛成 93%、反対 3%、棄権 4%（大多数、強いコンセンサス）

1.11. 予防：手術室、スタッフ

質問 1：手術室内の人数は SSI/PJI の発生率に影響するか？ もしそうであれば、手術室の出入りを減らすためにどのような対策が実施されるべきか？

著者：Daniel Del Gaizo, Eustathios Kenanidis, Eleftherios Tsiridis 翻訳者：池田信介、内山勝文、高相晶士

推奨：TJA 中の手術室内の人数とドアが開く回数は、手術室内の浮遊微粒子数と相関する。手術室で浮遊微粒子が増加するとその後、PJI に罹りやすくなる可能性がある。したがって、手術室の出入りは最小限に抑えるべきである。手術室の出入りを減らすため、以下に概説する複数の対策を実施すべきである。

(1) 術中の人数の制限：見学者、研修医、研究者、外部業者は最小限とすべきである；(2) 手術室で頻繁に使用される器具の保管；(3) 手術室内の出入りと感染との潜在的な相関関係に関する手術室スタッフの適切な教育；(4) 必要な物品およびインプラントを手術室に用意するための慎重な術前計画およびテンプレート作成；(5) スタッフへの口頭注意によって出入りを減らす；(6) 患者が手術室に入ったら直ちに外部ドアを閉め、内部ドアのみを開ける；(7) TJA 中のスタッフの交代を最小限とし、理想的にはゼロにする；(8) 外との連絡のためのインターホンの使用；(9) 社交目的の訪問や臨床的検討あるいは次の症例の麻酔薬供給のためにドアを開けない；(10) ドアの開閉を減らすためドアアラームを使用する；(11) 不必要なスタッフの出入りを禁止する；(12) 出入りの多い場所での滅菌機器の露出を減らすため、できるだけ執刀に近い時間に必要な機器を開ける。

エビデンスレベル：Moderate

投票結果：賛成 98%、反対 2%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：TJAを行う術者が上気道感染に罹患している場合、SSI/PJIのリスクは増大するか？

著者：Andrea Baldini, Pier Francesco Indelli 翻訳者：池田信介、内山勝文、高相晶士

推奨：術者または手術チームが上気道感染に罹患していても、患者のSSI/PJIのリスクが増大する可能性は低い。**エビデンスレベル**：Moderate**投票結果**：賛成 85%、反対 8%、棄権 7%（大多数、強いコンセンサス）**質問3：術者や手術室スタッフによる手洗いの技術、時間、薬剤はSSI/PJIのリスクを変化させるか？**

著者：William Griffin, Teija Puhto 翻訳者：池田信介、内山勝文、高相晶士

推奨：リスクを変化させるかは不明であるが、手洗いは、適切な抗菌石鹸と水による伝統的な擦り洗いか、または適切なアルコールベースの手指洗浄剤を使用し行われるべきである。**エビデンスレベル**：Moderate**投票結果**：賛成 93%、反対 5%、棄権 2%（大多数、強いコンセンサス）**質問4：手術室スタッフが着用する帽子の種類は重要か？**

著者：Kier Blevins, Paul Manner, Rajeev Sharma, Naasha Talati 翻訳者：池田信介、内山勝文、高相晶士

推奨：毎日のシャンプーやシャワーのような通常の衛生法では除菌されていないため、使い捨ての帽子が賢明である。ボンネット、ブッフアン、またはヘルメット型など、どの形状が適しているかは不明である。帽子は頭皮、耳、髪の毛全体を覆うことを推奨する。**エビデンスレベル**：Limited**投票結果**：賛成 94%、反対 4%、棄権 2%（大多数、強いコンセンサス）**質問5：術者や手術室スタッフは、手術室でマスクと帽子を着用すべきか？**

著者：Toby Jennison, Rjajendra Shetty, Kevin Tetsworth, Matthew Wilson 翻訳者：池田信介、内山勝文、高相晶士

推奨：手術室スタッフのマスクおよび帽子の使用によって、SSIの頻度は減少すると推測される。この問題に取り組む研究は少なく、データは不足している。臨床的有効性を示す強いエビデンスや現在の診療を変更するための説得力のあるエビデンスは欠如しているが、手術室においては、マスクと帽子という長年に渡り確立された標準法は継続すべきである。手術室の感染性物質からスタッフを守るというマスクの潜在的な役割についてのエビデンスもまた議論の余地がある。手術室でのマスクと帽子着用に対する賛成または反対の説得力のある臨床的エビデンスがないため、現時点では地域または国の安全衛生規制に従うことが推奨される。**エビデンスレベル**：Limited

相反する研究結果が公表されている。今後の調査は、回答への信頼性に重大な影響を与える可能性があり、この推奨を変更する可能性がある。エビデンスは現在、観察研究によってのみ支持されており、RCT または他の高レベルの研究を利用することができていない。

投票結果：賛成 98%、反対 1%、棄権 1%（満場一致、最も強いコンセンサス）**質問6：手術室スタッフまたは術者の露出した顔の毛髪(あごひげと口ひげ)の存在はSSI/PJIの発生率に影響するか？**

著者：Kier Blevins, Karan Goswami, Robin Patel 翻訳者：池田信介、内山勝文、高相晶士

推奨：特定の状況下では、顔の毛髪が細菌汚染のリスクを高める可能性があるが、リスクは理想的には未滅菌フードの有無をマスキングされた状況において評価されるべきであり、限定的で矛盾するデータが存在する。**エビデンスレベル**：Consensus**投票結果**：賛成 89%、反対 5%、棄権 6%（大多数、強いコンセンサス）**質問7：術衣を病院外や制限された手術室エリアの外で着用しないことを厳守することでSSI/PJIのリスクは減少するか？**

著者：Kier Blevins, Parag Sancheti, Annette W-Dahl 翻訳者：池田信介、内山勝文、高相晶士

推奨：制限された手術室環境以外の場所で術衣を着用した手術室スタッフは、待機的TJAや複雑な整形外科手術の際に同じ服を着用しないことを推奨する。**エビデンスレベル**：Consensus**投票結果**：賛成 90%、反対 8%、棄権 2%（大多数、強いコンセンサス）

質問8：手術室スタッフのメチシリン耐性*Staphylococcus aureus/epidermidis* (MRSA/MRSE)の保菌状況は院内のSSI/PJI発生率に影響するか？

著者：Oliver Enke, Rahul Sharma, Rami Sorial, T. David Tarity 翻訳者：池田信介、内山勝文、高相晶士

推奨：手術室スタッフは環境汚染に寄与すると以前から報告されてきたが、手術室スタッフのMRSA/MRSEの保菌と、感染増加の可能性との間に強い相関関係を確立するためには、データが不足している。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 4%、棄権 6%（大多数、強いコンセンサス）

1.12. 予防：手術室、環境

質問1：手術室での層流換気(LAF)の使用によって、SSI/PJIのリスクは減少するか？

著者：Arash Aalirezaie, Everth Merida, MD, J. Manuel Perez-Atanasio, Brian M. Smith, Greg Stocks, Kelly Vince, Kelly Vince

翻訳者：池田信介、内山勝文、高相晶士

推奨：近年の整形外科の文献においても、層流換気システムが整形外科手術におけるSSIやPJIを減少させることは示されていない。現時点において、待機的TJAを含む清潔な手術を層流換気システムのある手術室で行う必要はない。

エビデンスレベル：Moderate

投票結果：賛成 81%、反対 14%、棄権 5%（大多数、強いコンセンサス）

質問2：術中の温風式加温装置の使用は、SSI/PJIのリスクを増加させるか？

著者：Joseph Karam, Mike Reed, Marshall Sangster 翻訳者：池田信介、内山勝文、高相晶士

推奨：温風式加温装置をSSI/PJIのリスク増加と明確に結び付けるエビデンスはない。代替の加温方法が効果的であり使用されるかもしれない。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 2%、棄権 5%（大多数、強いコンセンサス）

質問3：手術室の温度はSSI/PJIの発生率に影響するか？

著者：Sebastian Illiger, Christoph Lohmann, Nilo Paner, Juliane Teuber 翻訳者：池田信介、内山勝文、高相晶士

推奨：手術室の温度は深部体温に影響する可能性があり、それはSSI/PJIの発生率に影響する可能性がある。したがって、最適な手術室温度の維持に努めるべきである。

エビデンスレベル：Consensus

投票結果：賛成 88%、反対 8%、棄権 4%（大多数、強いコンセンサス）

質問4：周術期正常体温はSSI/PJIの発生率に影響するか？

著者：Georgios Komnos, MD, Koji Yamada 翻訳者：池田信介、内山勝文、高相晶士

推奨：一般外科および他の外科分野からのデータに基づき、周術期正常体温は、術後感染のリスクを最小限に抑えるための重要な要因であることがわかっている。整形外科手術においてのエビデンスは乏しいが、整形外科手術を受ける患者においても正常体温は同様に維持されることが推奨される。

エビデンスレベル：Limited

投票結果：賛成 97%、反対 1%、棄権 2%（満場一致、最も強いコンセンサス）

質問5：手術室の浮遊微生物レベルとPJIのリスクとの間には関係があるか？

著者：Rabih O. Darouiche 翻訳者：池田信介、内山勝文、高相晶士

推奨：質の高いエビデンスによって、術中の浮遊微生物レベル（コロニー形成単位：CFU）とPJIの発生率との間に比例関係があることが示されている。

エビデンスレベル：Strong

投票結果：賛成 98%、反対 1%、棄権 1%（満場一致、最も強いコンセンサス）

質問6：手術室の微生物学的清浄度を検証するためにどのような方法があるか？

著者：Kyle H. Cichos, Elie Ghanem, MD 翻訳者：池田信介、内山勝文、高相晶士

推奨：手術室の微生物学的清浄度を検証するために、目視検査、スワブ培養、接触培養プレート、ならびにアデノシン三リン酸（ATP）生物発光など複数の選択肢がある。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 1%、棄権 3%（満場一致、最も強いコンセンサス）

質問 7：手術室での紫外線照射 (ultraviolet (UV) light) 除菌の使用は、SSI/PJI のリスクを軽減するか？

著者：Mustafa Akkaya, C. Lowry Barnes, Murat Bozkurt, Safa Gursoy, Mehmet Emin Simsek, Matthias Wolff

翻訳者：池田信介、内山勝文、高相晶士

推奨：術中の紫外線の使用は浮遊細菌に対して効果的である。しかし、手術室スタッフへの潜在的なリスクがあるため、紫外線は人のいない時間にのみ、手術室の最終的な清掃のために使用することを推奨する。

エビデンスレベル：Moderate

投票結果：賛成 91%、反対 4%、棄権 5%（大多数、強いコンセンサス）

質問 8：ライトハンドルは術中汚染の原因となるか？

著者：Francisco Bengoa, Elie Ghanem, MD, Ianiv Klaber, Daniel Schweitzer, Peteris Studers, Darko Talevski

翻訳者：池田信介、内山勝文、高相晶士

推奨：ライトハンドルは術中の汚染源となる可能性がある。

エビデンスレベル：Moderate

投票結果：賛成 96%、反対 3%、棄権 1%（満場一致、最も強いコンセンサス）

質問 9：手術室ですべての携帯機器／携帯電話を禁止することは有効か？

著者：Piret Mitt, Charles Nelson, Christopher Travers 翻訳者：池田信介、内山勝文、高相晶士

推奨：手術室での携帯機器の使用と、感染率または有害事象との相関を示すエビデンスが乏しいため、現時点では手術室において、これらの機器の使用禁止を推奨することはできない。しかし、携帯電話の定期的な清掃は簡単に効果的な方法であり、日常的に実行すべきである。

エビデンスレベル：Limited

投票結果：賛成 87%、反対 8%、棄権 5%（大多数、強いコンセンサス）

1.13. 予防：手術室、外科手術

質問 1：長時間手術の場合、手術着を替えることで SSI / PJI の危険性は低下するか？ もしそうならば、どのくらいの頻度で手術着を替えるべきか？

著者：Vasili Karas, Wael Samir Osman, Ramy Ahmed Soliman 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：手術着の交換と SSI / PJI の関連性を調べた研究はないため、手術着の交換を推奨することも反対することもできない。しかし、手術中に手術着が汚染した場合や穴が開いてしまった場合は手術着の交換を推奨する。

エビデンスレベル：Consensus

投票結果：賛成 97%、反対 2%、棄権 1%（満場一致、最も強いコンセンサス）

質問 2：手術着は使い捨てのものを使用情况と、再滅菌可能なものを使用する場合とで SSI / PJI の発生率に違いはあるか？

著者：Ibrahim ElGanzoury, Anthony Farrell, Ahmed Nageeb Mahmoud, Eoin Sheehan 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：使い捨ての手術着の方が細菌を拡散させない可能性を示した報告はあるが、手術着の種類が SSI / PJI の発生率に影響するとまでは言えない。

エビデンスレベル：Limited

投票結果：賛成 94%、反対 3%、棄権 3%（大多数、強いコンセンサス）

質問 3：手術着と手術用手袋の境界をテープなどで閉塞させることで SSI / PJI の発生率は下がるか？

著者：David G. Lewallen, Brian M. Smith, Mark J. Spanghel 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：手術着と手術用手袋の境界を閉塞することで SSI / PJI の発生率が下がるというエビデンスはない。しかし、境界部にテープを貼ること手術着と手術用手袋の間から出る粒子の流出が減少し、手術野の汚染を減らし、SSI / PJI の発生率を減少させようという報告はある。

エビデンスレベル：Limited

投票結果：賛成 91%、反対 3%、棄権 6%（大多数、強いコンセンサス）

質問4：手術室で患者にマスクと帽子を付けさせることでSSI / PJIの発生率は下がるか？

著者：Carlos M. Autorino, Andrew Battenberg, Fabio Catani, Andrea Giorgini 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：手術室で患者にマスクと帽子を着けさせることでSSIの発生率を下げたという報告はあるが、患者に必ずマスクと帽子を着けさせることを推奨はできない。しかし、手術室で患者が帽子を被れば空気中の細菌の数を減らすことができ、SSI / PJIの発生率を下げるかも知れない。**エビデンスレベル**：Limited**投票結果**：賛成 93%、反対 4%、棄権 3%（大多数、強いコンセンサス）**質問5：長時間の手術の場合、途中で手袋を交換することでSSI / PJIの発生率は下がるか？ もしそうなら、どのくらいの頻度で交換すべきか？**

著者：Simon W. Young 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：手術中の手袋の交換は汚染を減らし、TJA におけるSSI / PJIの発生率を下げるかもしれない。今までの研究結果から、手袋交換のタイミングはドレーピングが終わった後、インプラントを取り扱う前、そして手袋に目で見えてわかる穴が開いてしまった時には交換する必要がある。そして手袋は手術時間が長くなるほど汚染率、手袋の穿孔率が増すため、少なくとも60～90分に1回は交換する必要がある。**エビデンスレベル**：Limited**投票結果**：賛成 92%、反対 5%、棄権 3%（大多数、強いコンセンサス）**質問6：整形外科医および手術室スタッフの履物の種類(すなわち手術室専用シューズ、外履き、シューカバーで覆った外履き)は、整形外科手術におけるSSI / PJIの発生率に影響するか？**

著者：Ashley Blom, Karan Goswami, Victor Hernandez, Setor Kuntso 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：手術室専用シューズであることや外履きであることがSSI / PJIの発生率に影響を与えることを示した報告はほとんどない。しかし、外履きが目に見えて汚染されている場合は手術室で使用しないもしくはシューカバーの着用を勧める。**エビデンスレベル**：Limited**投票結果**：賛成 94%、反対 4%、棄権 2%（大多数、強いコンセンサス）**1.14. 予防：手術室、手術領域****質問1：汚染のリスクを最小限に抑えるためには手術器具のトレイはいつ開けるのがよいか？**

著者：Timothy Brown, Justinas Stucinskas 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：手術器具のトレイはできるだけ手術の直前に開くべきである。また、開封した後は、使用するまで滅菌タオルあるいはドレープなどで覆っておくべきである。**エビデンスレベル**：Moderate**投票結果**：賛成 97%、反対 2%、棄権 1%（満場一致、最も強いコンセンサス）**質問2：整形外科手術で膿盆を使用することはSSI / PJIの発生率を増加させるか？**

著者：Jon Goosen, Karan Goswami, Myrthe C.L. Hoekstra 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：細菌学的なデータに基づくと、液体で満たされた膿盆をそのままにするのは勧めない。しかし、膿盆の汚染とSSI / PJIの発生率の関連は依然として不明である。**エビデンスレベル**：Moderate**投票結果**：賛成 91%、反対 4%、棄権 5%（大多数、強いコンセンサス）**質問3：電気メスの先端の交換はSSI / PJIの発生率を下げるか？**

著者：Anil Gambhir, Rob Nelissen, Michael J. Petrie 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：電気メスの先端が汚染される可能性はあるが、電気メスの使用時間と汚染との関係は証明されていない。しかし、PJIに対する再置換術（一次的または二次的）を行う場合、デブリドマンの終了時およびインプラントを取り扱う前に電気メスの先端を交換することを勧める。**エビデンスレベル**：Limited**投票結果**：賛成 92%、反対 5%、棄権 3%（大多数、強いコンセンサス）

質問4：手術中に吸引管の先端は定期的に交換した方がよいか？ もしそうなら、どのくらいの頻度で交換すればよいのか？

著者：Federico J. Burgo, Francisco Javier Cabo, Luciano Ravetti, Alfredas Smailys, L. Zeniauskas 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：吸引管の先端は手術中に定期的に交換する必要がある。交換するタイミングは特に決まっていないが、60 分毎に変更するのがよいと考える。吸引管の先端の汚染率は手術時間に比例することが過去の研究により示されている。

エビデンスレベル：Limited

投票結果：賛成 85%、反対 9%、棄権 6%（大多数、強いコンセンサス）

質問5：整形外科の手術中、髄腔内に吸引管を入れておくべきか？

著者：Maha Alsadaan, Hussam AlRumaih, Nicholas Giori, Imran Ilyas, Yakub Saheed 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：整形外科の手術中、吸引管は必要に応じて流体を除去するために髄腔内に挿入してもよいが、髄腔内に入れたままにすると大量の空気および粒子を引き込んでしまい、かえって髄腔を汚染してしまう可能性がある。

エビデンスレベル：Consensus

投票結果：賛成 91%、反対 4%、棄権 5%（大多数、強いコンセンサス）

1.15. 予防：洗浄液

質問1：バイオフィーム形成を防ぐためにどのような殺菌物質が使用され得るか？

著者：Daniel G. Meeker, Silvestre Ortega-Peña, Mark Smeltzer, Jeffrey B. Stambough, Kenneth Urish

翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：複数の研究において、*in vitro* でバイオフィーム形成を防止する特定の殺菌物質が示されているが、*in vivo* においてはバイオフィーム形成を防止する殺菌物質の能力は不明である。既存の感染に対する再置換術の状況で使用され得るが、この問題は十分に研究されていない。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 2%、棄権 2%（大多数、強いコンセンサス）

質問2：整形外科の清潔手術における最適な洗浄法(種類、量、頻度)は？

著者：Ashley Blom, Andrew Fleischman, Setor Kunustor, Gabriel Makar 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：WHO と CDC は外科手術における創部の洗浄に希釈したベタダイン（ポビドンヨード）を使用することを推奨しており、エビデンスもある。しかし、洗浄液の最適な量については判っていない。

エビデンスレベル：Strong

投票結果：賛成 75%、反対 16%、棄権 9%（大多数、強いコンセンサス）

質問3：パルス洗浄機の圧は創部の微生物の量を減らすのに影響するか？

著者：Constantinos Ketonis, Kenneth Urish 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：一連の臨床研究の結果から高压で洗浄した場合と、低压で洗浄した場合に臨床転機、再手術率に差はなかった。Hydrosurgery system は期待される新しい方法だが、まだ十分な研究結果が出ていない。

エビデンスレベル：Moderate

投票結果：賛成 90%、反対 4%、棄権 6%（大多数、強いコンセンサス）

質問4：洗浄液に抗菌薬(ポリミキシンやバシトラシン)を加えることで抗菌作用は増強するか？

著者：JeoungEun Cho, Karan Goswami, Giorgio P. Tonelo Zilotto 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：WHO および National Institute for Health and Care Excellence のガイドラインでは、洗浄液へ抗菌薬を加えないように注意喚起をしている。また、CDC は、SSI の予防のために洗浄液に抗菌薬を加えることで得られるメリットとデメリットにはトレードオフの関係がありそうだとやっている。整形外科領域以外の報告であるが、ポリミキシンやバシトラシンなどの抗菌薬を洗浄液に加えた場合の抗菌効果に関する報告の内容は矛盾しており、耐性化のリスクや費用面での問題、薬剤過敏性などの問題もあり、われわれは洗浄液に抗菌薬を加えることに反対する。

エビデンスレベル：Moderate

投票結果：賛成 92%、反対 4%、棄権 4%（大多数、強いコンセンサス）

質問5：抗菌薬でない自然殺菌物質(例えば、蜂蜜、酢)は、PJIに対するデブリドマン手術の洗浄液としての役割があるか？

著者：Rhidian Morgan-Jones, Javad Parvizi 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：抗菌薬でない自然殺菌物質（蜂蜜、酢など）は、デブリドマン手術の洗浄液としての役割があり得る。

エビデンスレベル：Limited

投票結果：賛成 39%、反対 43%、棄権 18%（合意しない）

1.16. 予防：手術室、外科手技

質問1：皮膚切開に使ったメスは深部を切開する前に交換するべきか？

著者：Tal Frenkel, Francisco Rafael Grieco Silva, Snir Heller, Eric B. Smith 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：皮膚切開に使用したメスは交換する必要がある。表皮の細菌がメスを汚染し、深部感染を発生させる可能性を示した研究がある。

エビデンスレベル：Limited

投票結果：賛成 92%、反対 6%、棄権 2%（大多数、強いコンセンサス）

質問2：手術時間はSSI / PJIの発生率を高めるか？

著者：Robert E. Booth, Qiaojie Wang 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：長期手術時間とSSIには関係がある。手術時間が長くなる原因は手術の複雑性にあると思われる。手術手技に妥協することなく、手術時間を短縮するために最大限の努力をすることによって、感染率が低下する可能性がある。

エビデンスレベル：Moderate

投票結果：賛成 99%、反対 0%、棄権 1%（満場一致、最も強いコンセンサス）

質問3：抗菌薬コーティングされたインプラントはSSI / PJIの発生率を下げるか？

著者：Farhang Alaee, Marc Angerame, Ryan Blackwell, Adam C. Brekke, Sabir Ismaili, Jason Jennings, Philip C. Noble, Sara Stephens
翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：インプラントへの抗菌薬コーティングは、*in vitro* および動物実験の研究においてSSI/PJIを減少させることが示されている。いくつかの臨床研究でも抗菌薬コーティングしたインプラントの有用性が報告されている。しかし、抗菌薬コーティングの有用性を示すにはさらに大規模な研究が必要である。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 6%、棄権 4%（大多数、強いコンセンサス）

質問4：インプラントのサイズはSSI / PJIの発生率に影響するか？

著者：Thomas Bradbury, Paul M. Courtney 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：理論的にはインプラントが小さいほど細菌がコロニーを形成しにくい可能性があるが、インプラントのサイズとPJIの発生率を結び付けた決定的な報告はない。

エビデンスレベル：Limited

投票結果：賛成 85%、反対 10%、棄権 5%（大多数、強いコンセンサス）

質問5：Cアームの使用はSSI / PJIのリスクを高めるか？

著者：Arjun Saxena, Hamish Simpson 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：整形外科手術においてCアームの使用とSSI / PJIの発生率を関連づけた研究はない。しかし、Cアームのカバーが手術中に汚染される頻度が多いことが報告されている。そのため、Cアームの本体だけでなく、カバーも手術野に触れないように最大限努力することを勧める。

エビデンスレベル：Limited

投票結果：賛成 97%、反対 1%、棄権 2%（満場一致、最も強いコンセンサス）

質問6：最近導入された技術(ナビゲーション、ロボットなど)を使用することはSSI / PJIの発生率に影響を与えるか？

著者：Robert Hube, Merrill Lee, Brian M. Smith, Edward Vasarhelyi, Seng Jin Yeo 翻訳者：峯岸洋次郎、内山勝文、高相晶士

推奨：ナビゲーション、患者毎に作成するインプラント設置ガイド、ロボット支援手術がSSI / PJIの発生率を上げることは報告されていない。しかし、これらの技術を使用したため手術時間が延長し、結果的にSSI / PJIの発生率が上昇する可能性がある。

エビデンスレベル：Limited

投票結果：賛成 84%、反対 9%、棄権 7%（大多数、強いコンセンサス）

1.17. 予防：輸血医療

質問 1：同種血輸血は SSI / PJI の危険性を上昇させるか？

著者：Trisha N. Peel, Kalin Mihov, Luis Pulido 翻訳者：池裕之、稲葉裕

推奨：上昇させる。同種血輸血は SSI / PJI のリスク上昇と関連している。

エビデンスレベル：Strong

投票結果：賛成 94%、反対 3%、棄権 3%（大多数、強いコンセンサス）

質問 2：PJI に対する再置換術時の術中あるいは術後回収血は使用可能か？

著者：Rafael Tibau Olivan, William Jiranek, Jorge Manrique, Maria Tibau Alberdi 翻訳者：池裕之、稲葉裕

推奨：不明である。PJI に対する再置換術時の術中あるいは術後回収血は有益である可能性があるが、細菌を播種するリスクがある。この手法に対する利点とリスクを評価するためには、更なる研究が必要である。

エビデンスレベル：Consensus

投票結果：賛成 92%、反対 4%、棄権 4%（大多数、強いコンセンサス）

質問 3：SSI / PJI のリスクを減少させるために、抗血小板薬は術前に休薬すべきか？

著者：David Beverland, Sumon Nandi, Andrew Battenberg, Nicola Gallagher 翻訳者：池裕之、稲葉裕

推奨：アスピリンは術前に休薬するべきではない。アスピリン休薬が SSI / PJI に影響を与えるというエビデンスは無い。理論的には、アスピリン休薬が SSI/PJI に対して有益である可能性があるが、未だ証明されていない。アスピリン休薬に伴って心血管系イベントおよび脳卒中のリスクが上昇する方が重要である。SSI / PJI のリスクを減少させるために、クロピドグレルは手術前に最低 5 日間の休薬をするべきである。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 6%、棄権 4%（大多数、強いコンセンサス）

質問 4：整形外科領域の感染症に対して、エリスロポエチン、造血剤、その他の薬剤投与は有用か？

著者：Seung Beom Han, Martin Sarungi, David Wallace, Woo Young Jang, Jae-Hyuck Choi, Xisheng Weng 翻訳者：池裕之、稲葉裕

推奨：有用である。感染に対する再置換術前にエリスロポエチンを投与することによって、感染沈静化に悪影響を与えることなく、術前のヘモグロビン濃度を上昇させ、同種血輸血の確率を減少させることが可能である。

エビデンスレベル：Moderate

投票結果：賛成 82%、反対 9%、棄権 9%（大多数、強いコンセンサス）

質問 5：TJA において、トラネキサム酸の使用は出血量および同種血輸血の必要性を減少させるか？

著者：Yale Fillingham, Javad Parvizi, Seng Jin Yeo, Henry Wynn-Jones 翻訳者：池裕之、稲葉裕

推奨：減少させる。初回 TJA において、経静脈、局所もしくは経口によるトラネキサム酸投与は出血量および同種血輸血の必要性を減少させるのに有効な手法である。

エビデンスレベル：Strong

投票結果：賛成 98%、反対 1%、棄権 1%（満場一致、最も強いコンセンサス）

質問 6：人工関節再置換術において、トラネキサム酸の使用は出血量および同種血輸血の必要性を減少させるか？

著者：Yale Fillingham, Javad Parvizi 翻訳者：池裕之、稲葉裕

推奨：減少させる。人工関節再置換術において、トラネキサム酸投与は出血量および同種血輸血の必要性を減少させる。

エビデンスレベル：Moderate

投票結果：賛成 97%、反対 0%、棄権 3%（満場一致、最も強いコンセンサス）

質問 7：トラネキサム酸の使用は、整形外科手術後の SSI / PJI 発生率を減少させるか？

著者：Yale Fillingham, Mandus Akonjom, Javad Parvizi, Robert Molloy, Michael A. Mont, Nipun Sodhi 翻訳者：池裕之、稲葉裕

推奨：トラネキサム酸投与は貧血および同種血輸血を減少させることにより、TJA 術後の SSI / PJI 発生率を減少させる。

エビデンスレベル：Limited

投票結果：賛成 89%、反対 5%、棄権 6%（大多数、強いコンセンサス）

1.18. 予防：創傷管理

質問 1：創閉鎖の種類(手法および材料)は SSI / PJI の発生率に影響を与えるか？

著者：Arash Aalirezai, Ran Schwarzkopf, Viktor Krebs, Yale Fillingham, Anton Khlopas, Afshin Anoushiravani, Michael A. Mont, Nipun Sodhi
 翻訳者：池裕之、稲葉裕

推奨：TJA 術後に、創傷閉鎖方法の優位性を示した強いエビデンスは無い。質の高い研究の多くは、創閉鎖の種類による違いは無いという結果であった。

エビデンスレベル：Moderate

投票結果：賛成 90%、反対 8%、棄権 2%（大多数、強いコンセンサス）

質問 2：整形外科患者に対して、陰圧閉鎖療法は有用か？

著者：Mitch Harris, Ruwais Binlaksar, Gregory K. Deirmengian, Abhiram Bhashyam, Andre Shaffer, Reema K. Al-Horaibi
 翻訳者：池裕之、稲葉裕

推奨：合併症のリスクが高い整形外科患者に対して、予防的な陰圧閉鎖療法を使用する事は創治癒を改善し、感染率を低下させるための合理的な選択肢の一つである。合併症リスクが低い患者に対して、ルーチンに予防的な陰圧閉鎖療法を行うことは利点がなく、コストの上昇につながる。近年、陰圧閉鎖療法は術後早期の浸出液の排出に対して有用である可能性が指摘されている。

エビデンスレベル：Moderate

投票結果：賛成 85%、反対 11%、棄権 4%（大多数、強いコンセンサス）

質問 3：抗菌薬コーティング縫合糸は SSI / PJI のリスクを減少させるか？

著者：Feng Chih-Kuo 翻訳者：池裕之、稲葉裕

推奨：抗菌薬コーティング縫合糸を使用することにより、直腸・結腸外科では SSI のリスクを減少させる。しかしながら、整形外科領域において、SSI / PJI を減少させるという明かなエビデンスは無い。

エビデンスレベル：Limited

投票結果：賛成 92%、反対 3%、棄権 5%（大多数、強いコンセンサス）

質問 4：整形外科術後において、創面保護剤(インテグシール、ダーマボンドなど)は SSI / PJI を減少させるか？

著者：Andy O. Miller, Farshad Adib, Brian M. Smith 翻訳者：池裕之、稲葉裕

推奨：創面保護剤は手術創からの浸出液を減少させる可能性があるが、SSI / PJI の発生率に影響を与えるというエビデンスは無い。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 2%、棄権 5%（大多数、強いコンセンサス）

質問 5：手術部位のドレーンの使用は SSI / PJI のリスクを上昇させるか？

著者：Gregory K. Deirmengian, Snir Heller, Kier Blevins, Tal Frenkel 翻訳者：池裕之、稲葉裕

推奨：48 時間未満の手術部位ドレーンの使用が SSI / PJI の発生率を上昇させるという直接的なエビデンスはない。手術部位ドレーンの使用が出血量の増加および同種血輸血の必要性を上昇させ、間接的に SSI / PJI の発生率を上昇させる可能性がある。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 7%、棄権 3%（大多数、強いコンセンサス）

質問 6：整形外科術後において、SSI / PJI のリスクを低下させる創傷被覆材(閉鎖性、銀含浸、ガーゼなど)は何か？

著者：José Gomez, Joseph Karam, Peter F. Sharkey, Mitchell R. Klement 翻訳者：池裕之、稲葉裕

推奨：閉鎖性および／または銀含浸被覆材は通常のガーゼと比較して、創傷合併症、SSI / PJI を減少させることが示されており、ルーチンに使用することを考慮すべきである。現時点では多くの文献が TJA に焦点を当てている。しかしながら、抗菌剤（たとえば銀）の付加、閉鎖性被覆材の性質、またはそれらの組み合わせのどれが SSI / PJI の減少に寄与しているかについては更なる調査が必要である。

エビデンスレベル：Moderate

投票結果：賛成 81%、反対 12%、棄権 7%（大多数、強いコンセンサス）

質問7：整形外科手術後において、滅菌された被覆材はいつ除去され、どのくらいの頻度で交換されるべきか？

著者：Per Gundtoft, Andres Orlando Villanueva, Tommaso Bonanzinga, Hamidreza Yazdi, Carlos Arturo Romero, Mauricio Cordova

翻訳者：池裕之、稲葉裕

推奨：滅菌された手術室環境下で手術創を保護した被覆材は、吸収状態に基づいて交換されるべきである。出血もしくは浸出液が少ない場合には、早期および頻回の被覆材の交換は不要である。被覆材が乾燥している場合でも、最低 48 時間以上の創傷被覆が推奨される。

エビデンスレベル：Limited

投票結果：賛成 97%、反対 3%、棄権 0%（満場一致、最も強いコンセンサス）

質問8：患者はSSI / PJIを避けるために、手術創を濡らす、もしくは水に入ることを控えるべきか？ もしそうならば、術後どの程度の期間までか？

著者：Emmanuel Thienpont, Georgios Komnos, Jessica Amber Jennings, Elvira Montañez, Carlos Jiménez-Garrido, Michael A. Harris

翻訳者：池裕之、稲葉裕

推奨：患者は術後 48 時間は、手術創を濡らさないようにする必要がある。

エビデンスレベル：Limited

投票結果：賛成 86%、反対 11%、棄権 3%（大多数、強いコンセンサス）

質問9：持続する浸出液の定義はなにか？

著者：Paul Lachiewicz 翻訳者：池裕之、稲葉裕

推奨：持続する浸出液の明確な定義は無い。初回手術から 72 時間を超えて持続する、手術創からの液体流出を持続する浸出液と定義する。

エビデンスレベル：Consensus

投票結果：賛成 78%、反対 17%、棄権 5%（大多数、強いコンセンサス）

1.19. 予防：術後因子

質問1：整形外科術後における早期離床は創部からの浸出液またはSSI / PJIのリスクを上昇させるか？

著者：Giles Scuderi, Julio César García Ricaurte 翻訳者：池裕之、稲葉裕

推奨：整形外科術後における早期離床は、創部からの浸出またはSSI / PJI のリスクを上昇させない。

エビデンスレベル：Limited

投票結果：賛成 94%、反対 4%、棄権 2%（大多数、強いコンセンサス）

質問2：TJA 後において、患者は侵襲的な歯科治療を延期する必要があるか？

著者：William V. Arnold, Martin Buttaro 翻訳者：池裕之、稲葉裕

推奨：明確なエビデンスは無いが、可能であればセメントレスインプラントのオッセオインテグレーションが完了するまで、緊急性の無い侵襲的な歯科治療を延期することを推奨する。

エビデンスレベル：Consensus

投票結果：賛成 82%、反対 10%、棄権 8%（大多数、強いコンセンサス）

質問3：人工関節患者において、侵襲を伴う治療(歯科、消化器、泌尿器など)を行う際の予防的な抗菌薬投与は、PJIを予防しうるか？

著者：Inma Neira, Aruna Poojary, María S. Quevedo, Anurag Kumar Bari, Harshad Thakur, Jenrry Pastor Mirez 翻訳者：池裕之、稲葉裕

推奨：歯科治療もしくは泌尿生殖器治療の前のルーチンな予防的抗菌薬投与を行う意味はない。一部の消化器治療はPJIのリスクと関連するという限られたエビデンスがある。

エビデンスレベル：Limited

投票結果：賛成 64%、反対 28%、棄権 8%（大多数、弱いコンセンサス）

質問4：整形外科手術において、VTEの予防法はSSI / PJIのリスクに影響を与えるか？

著者：Ronald Huang, James J. Purtill, I. Remzi Tozun 翻訳者：池裕之、稲葉裕

推奨：影響を与える。TJA を対象としたVTE 予防を評価する多くの研究において、アスピリンはその他の抗凝固薬（ビタミン K 拮抗薬、ヘパリン製剤、Xa 阻害薬、直接的トロンビン阻害薬）と比較して、SSI / PJI のリスクを下げるとされている。

エビデンスレベル：Moderate

投票結果：賛成 80%、反対 10%、棄権 10%（大多数、強いコンセンサス）

1.20. 予防：院内環境

質問 1：予定された TJA 前の長期入院は、その後の SSI / PJI のリスクを上昇させるか？

著者：Jose Luque, Wadih Y. Matar, Alexis M. Cooper, C. Lowry Barnes 翻訳者：池裕之、稲葉裕

推奨：上昇させる。手術前の長期入院は SSI / PJI のリスク上昇と関連している。

エビデンスレベル：Strong

投票結果：賛成 96%、反対 3%、棄権 1%（満場一致、最も強いコンセンサス）

質問 2：感染症患者を個室管理することは、整形外科手術を受ける患者における SSI / PJI のリスクを減少させるか？

著者：Ashok Rajgopal, Shrinand Vaidya, Om Wakde, Inayat Panda, Jitesh Manghwani 翻訳者：池裕之、稲葉裕

推奨：MRSA の保菌者もしくは感染症例を個室で隔離することにより、院内感染は減少する。患者隔離および接触予防策もバンコマイシン耐性腸球菌 (VRE)、*E. coli*、*Klebsiella*、*Acinetobacter*、*Pseudomonas* などの多剤耐性菌のアウトブレイクを防ぐために重要な役割を果たす。整形外科の活動性感染症例を個室管理することが他の患者の PJI 発生率に影響を与えるかどうかは、不明である。

エビデンスレベル：Limited

投票結果：賛成 88%、反対 5%、棄権 7%（大多数、強いコンセンサス）

1.1. PREVENTION: HOST RELATED, LOCAL FACTORS

QUESTION 1: Does the presence of skin lesions (i.e., boils, grazes, folliculitis, etc.), either in the proximity or distant to the surgical site, predispose patients to surgical site infections/periprosthetic joint infections (SSIs/PJIs)? If so, is it necessary for patients with these skin lesions to undergo treatment prior to elective total joint arthroplasty (TJA)?

RECOMMENDATION: The presence of active skin infections, either in the proximity or distant to the surgical site, can potentially increase the risk of SSIs/PJIs in patients undergoing elective TJA. Therefore, surgery should be delayed until these lesions are treated and/or resolved. Placing surgical incisions through eczematous or psoriatic lesions should be avoided as well, whenever possible.

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QUESTION 2: Does poor dental hygiene increase the risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)? If yes, is there a role for obtaining dental clearance in patients with poor dental hygiene to reduce the risk of SSI/PJI?

RECOMMENDATION: There is a small yet real risk of hematogenous spread of oral pathogens to patients undergoing arthroplasty. Patients with poor oral hygiene undergoing arthroplasty are at increased risk of subsequent SSI/PJI. Therefore, patients with oral disease and poor dentition should be identified and optimized prior to elective arthroplasty.

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QUESTION 3: Should routine dental clearance be obtained prior to total joint arthroplasty (hip/knee/shoulder/ankle)?

RECOMMENDATION: No. While dental pathology has been reported in a subset of patients undergoing joint arthroplasty, there are no prospective controlled studies supporting the role of pre-surgical dental clearance in reducing the rates of subsequent periprosthetic joint infections (PJIs).

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QUESTION 4: Does the use of a urinary catheter during orthopaedic surgery increase the risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: The direct association between the use of a urinary catheter and a PJI remains controversial. However, as urinary tract infection (UTI) has been associated as a risk factor for PJIs in some studies, we recommend intermittent catheterization for postoperative urinary retention (POUR), or if an indwelling urinary catheter is utilized, removing it within 48 hours of insertion to minimize the risk of a UTI.

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QUESTION 5: Is routine urinary screening indicated prior to elective total joint arthroplasty (TJA)? If so, how should asymptomatic bacteriuria be treated prior to undergoing elective joint arthroplasty?

RECOMMENDATION: No. Routine urinary screening in asymptomatic patients is not recommended prior to elective TJA. There is also no evidence to demonstrate that preoperative treatment of asymptomatic bacteriuria is of any benefit.

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QUESTION 6: How should a patient with a symptomatic preoperative urinary tract infection (UTI) be managed prior to undergoing elective joint arthroplasty?

RECOMMENDATION: Preoperative symptomatic UTIs should be treated/eradicated with appropriate antibiotics prior to elective total joint arthroplasty (TJA).

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QUESTION 7: Does preoperative urinary tract infection (UTI) (symptomatic and asymptomatic) increase the risk for subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Symptomatic UTI must be treated with appropriate antibiotics before proceeding with the surgery. In asymptomatic bacteriuria (ASB), treatment should be discontinued as it does not increase the risk of a subsequent SSI/PJI.

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QUESTION 8: Does a patient with a colostomy have an increased risk for surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: There is currently no evidence in the literature to determine if a patient with a colostomy is at an increased risk for SSI/PJIs following an arthroplasty procedure. However, it is our recommendation to ensure that the patient has a leak-free and clean colostomy in place to prevent soiling.

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1.2. PREVENTION: HOST RELATED, GENERAL FACTORS

QUESTION 1: What modifiable and non-modifiable host factors contribute to an increased risk of surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Modifiable host factors such as body mass index (BMI), smoking and alcohol, as well as certain medical co-morbidities have been shown to increase the risk of SSIs/PJIs. Non-modifiable factors such as increasing age, male gender and black ethnicity have also been shown to increase the risk of SSIs/PJIs.

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QUESTION 2: Are there any genetic factors that predispose patients to surgical site infection/periprosthetic joint infection (SSI/PJI) or predict the success of the treatment for SSI/PJI?

RECOMMENDATION: The evidence suggests a potential heritable predisposition is possible, but there is a lack of definitive evidence supporting specific genetic risk factors for SSI/PJI after total joint arthroplasty (TJA).

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QUESTION 3: Does current tobacco use increase the risk of surgical site infection/periprosthetic joint infection (SSI/PJI) recurrence?

RECOMMENDATION: Yes. Current tobacco use appears to increase the risk of SSI/PJI in patients undergoing orthopaedic procedures.

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QUESTION 4: Do underweight patients (body mass index (BMI) < 18.5kg/m²) have a higher risk of surgical site infection/periprosthetic joint infection (SSI/PJI) following orthopaedic procedures? If yes, does increasing the BMI in underweight patients reduce the risk of SSI/PJI?

RECOMMENDATION: Yes. Underweight patients (BMI < 18.5kg/m²) have a higher risk of SSI/PJI following orthopaedic procedures. However, there is no current evidence indicating that an increase in the BMI of an underweight individual has an effect on reducing the risk of SSI/PJI.

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QUESTION 5: (A) What upper body mass index (BMI) threshold is associated with an increased risk of surgical site infection/periprosthetic joint infection (SSI/PJI)? (B) Does implementation of these cutoffs reduce the incidence of SSI/PJI?

RECOMMENDATION:

- A) Obesity increases the risk of SSI/PJI after total joint arthroplasty (TJA). The risk increases gradually throughout the full range of BMI rather than surging at a certain cutoff point. A substantially increased risk is noticed in patients with a BMI > 40 kg/m² and the risks of surgery must be carefully weighed against its benefits in these patients.
- B) Weight reduction prior to surgery may have a benefit in mitigating risk for SSI/PJI for all patients with a BMI above normal.

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QUESTION 6: Does bariatric surgery reduce the risk of surgical site infection/periprosthetic joint infection (SSI/PJI) in patients with obesity?

RECOMMENDATION: The evidence is inconclusive at present. Thus, preoperative bariatric surgery cannot be routinely recommended.

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QUESTION 7: Does human immunodeficiency virus (HIV) predispose patients to surgical site infection/periprosthetic joint infection (SSI/PJI)? If so, what optimization should be undertaken prior to operating on patients with HIV?

RECOMMENDATION: Human immunodeficiency virus (HIV) infection is known to be a risk factor for surgical site infection (SSI) and periprosthetic joint infection (PJI). However, in patients who are medically optimized, with highly active antiretroviral therapy (HAART), the magnitude of the risk is small and comparable to HIV-negative patients. Patients must be optimized for underlying conditions including malnutrition, renal and liver disease, cluster of differentiation (CD4) count and viral load.

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QUESTION 8: Do immunomodulatory disease-modifying medications (e.g., methotrexate or antitumor necrosis factor (anti-TNF) agents) need to be withheld preoperatively to reduce the risk for subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION:

- For adults with inflammatory arthritis (rheumatoid arthritis (RA), psoriatic arthritis (PsA), adults with juvenile idiopathic arthritis (JA), ankylosing spondylitis (AS) or systemic lupus erythematosus (SLE)), all biologic anti-rheumatic medications including TNF inhibitors and IL-6 blockers (see Table 1 for complete list) should be withheld for a full dosing cycle prior to total hip (THA) and total knee arthroplasty (TKA), and the surgery should be timed to the week following the withheld dose. These medications can be restarted no less than two weeks after surgery if the wound is healing well, all sutures are out and there are no non-surgical site infections.
- For adults with inflammatory arthritis or SLE, synthetic disease-modifying anti-rheumatic drugs (DMARDs; see Table 1), including methotrexate, can be continued through the perioperative period.
- For adults with severe SLE, immunomodulatory medications (see Table 1) can be continued through the perioperative period.
- For adults with mild SLE, immunomodulating medications (with the exception of tacrolimus) should be withheld prior to surgery and restarted at a minimum of 14 days after surgery if the wound is healing well and all sutures are out and there is no surgical site or non-surgical site infection.
- For adults with RA, SLE, AS, PsA and JIA receiving glucocorticoids (GCs) for treatment of their rheumatic disease, who did not receive GCs during development and are not receiving replacement therapy, we recommend that the usual daily GC dose be given on the day of surgery rather than supra-physiologic ("stress dose") GCs.

TABLE 1. Medications included in this guideline

DMARDs: CONTINUE these medications through surgery.	Dosing Interval	Continue/Withhold
Methotrexate	Weekly	Continue
Sulfasalazine	Once or twice daily	Continue
Hydroxychloroquine	Once or twice daily	Continue
Leflunomide (Arava)	Daily	Continue
Doxycycline	Daily	Continue
BIOLOGICS: STOP these medications prior to surgery and schedule surgery at the end of the dosing cycle. RESUME medications at minimum 14 days after surgery in the absence wound healing problems, surgical site infection or systemic infection.	Dosing Interval	Schedule Surgery (relative to last biologic dose administered)
Adalimumab (Humira) 40 mg	Every 2 weeks	Week 3
Etanercept (Enbrel) 50 mg or 25 mg	Weekly or twice weekly	Week 2
Golimumab (Simponi) 50 mg	Every 4 weeks (SQ) or Every 8 weeks (IV)	Week 5 Week 9
Infliximab (Remicade) 3 mg/kg	Every 4, 6 or 8 weeks	Week 5, 7 or 9
Abatacept (Orencia) weight-based 500 mg; IV 1000 mg; SQ 125mg	Monthly (IV) or weekly (SQ)	Week 5 Week 2
Rituximab (Rituxan) 1000 mg	2 doses 2 weeks apart every 4-6 months	Month 7
Tocilizumab (Actemra) IV 4 mg/kg; SQ 162 mg	Every week (SQ) or Every 4 weeks (IV)	Week 3 Week 5
Anakinra (Kineret) SQ 100 mg	Daily	Day 2
Secukinumab (Cosentyx) 150 mg	Every 4 weeks	Week 5
Ustekinumab (Stelara) 45 mg	Every 12 weeks	Week 13
Belimumab (Benlysta) 10 mg/kg	Every 4 weeks	Week 5
Tofacitinib (Xeljanz) 5 mg: STOP this medication 7 days prior to surgery.	Daily or twice daily	7 days after last dose
SEVERE SLE-SPECIFIC MEDICATIONS: CONTINUE these medications in the perioperative period.	Dosing Interval	Continue/Withhold
Mycophenolate	Twice daily	Continue
Azathioprine	Daily or twice daily	Continue
Cyclosporine	Twice daily	Continue
Tacrolimus	Twice daily (IV and PO)	Continue

NOT-SEVERE SLE: DISCONTINUE these medications in the perioperative period.	Dosing Interval	Continue/Withhold
Mycophenolate	Twice daily	Withhold
Azathioprine	Daily or twice daily	Withhold
Cyclosporine	Twice daily	Withhold
Tacrolimus	Twice daily (IV and PO)	Continue
<i>Dosing intervals obtained from prescribing information provided online by pharmaceutical companies.</i>		
*2016 American College of Rheumatology/American Association of Hip and Knee Surgeons Guideline for the Perioperative Management of Anti-rheumatic Medication in Patients with Rheumatic Diseases Undergoing Elective Total Hip or Total Knee Arthroplasty		

IV, intravenous; SQ, subcutaneous; PO, oral
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QUESTION 9: Does liver disease (hepatitis C, cirrhosis, etc.) predispose patients to surgical site infection/periprosthetic joint infection (SSI/PJI)? If so, what optimization should be undertaken prior to operating on patients with liver disease?

RECOMMENDATION: Yes. Patients with liver disease such as hepatitis or cirrhosis have a higher risk of infection. These patients are at increased risk of intraoperative and postoperative bleeding. All efforts should be made to ensure such complications are minimized.

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QUESTION 10: Is there a link between opioid consumption and an increased risk for surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Yes. The utilization of opioids prior to surgery has been associated with an increased risk of developing SSIs/PJIs.

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QUESTION 11: Does the presence of anxiety/depression and mood disorders increase the risk of surgical site infections/periprosthetic joint infections (SSIs/PJIs)? If so, what are the considerations that should be implemented to reduce the risk of SSIs/PJIs?

RECOMMENDATION: There is emerging evidence to suggest that affective disorders, such as depression and anxiety, increase the risk for PJIs.

Although both physiological and psychological explanations for this association have been offered, it is not clear whether modulating or treating these disorders prior to surgery results in a reduction in the risk of PJIs.

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QUESTION 12: Does vitamin D deficiency (VDD) increase the risk of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs) in patients undergoing orthopaedic procedures?

RECOMMENDATION: Unknown. VDD may increase the risk of subsequent SSIs and/or PJIs in patients undergoing orthopaedic procedures by diminishing vitamin D-mediated innate and adaptive immune responses.

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QUESTION 13: Is preoperative anemia a risk factor for surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Based on available evidence, preoperative anemia, as defined by a hemoglobin of less than 13.0 g/dl in men and 12.0 g/dl in women, is an independent risk factor for postoperative SSI/PJI following total joint arthroplasty (TJA).

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QUESTION 14: What preoperative optimization for anemia can be done to increase the hemoglobin concentration?

RECOMMENDATION: Literature suggests that the administration of iron and/or erythropoietin (EPO) increases preoperative hemoglobin concentration and decreases the need for postoperative allogeneic blood transfusion. However, iron may only be effective for patients with pre-existing iron deficiencies and is associated with many side effects. Given the high costs of EPO, it's preoperative administration to avoid transfusion alone has not been found to be cost effective. Further research is required to assess the risks and benefits of preoperative allogeneic blood transfusion.

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QUESTION 15: Does an effort to increase preoperative hemoglobin concentration influence the rate of postoperative surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: Despite the absence of evidence demonstrating a reduction in SSIs/PJIs with optimization of preoperative hemoglobin, we recommend that all efforts be made to address and optimize anemia preoperatively.

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1.3. PREVENTION: HOST RISK MITIGATION, LOCAL FACTORS

QUESTION 1: Does a prior surgical procedure (with or without retained hardware) in the same joint as the arthroplasty increase the risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Open surgical procedures with or without the use of hardware increases the risk for subsequent SSI/PJI in the same joint receiving arthroplasty. We suggest that elective arthroplasty is delayed on the affected joint that has undergone a recent (within six months) major surgical procedure.

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QUESTION 2: In patients with prior septic arthritis, what strategies should be undertaken to minimize the risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Prior to elective arthroplasty, infection in the joint with prior septic arthritis needs to be ruled out using appropriate diagnostic tests. In the presence of an active infection, two-stage joint arthroplasty is recommended. Single-stage joint arthroplasty may be considered when all diagnostic tests are normal and there is no active soft tissue involvement (such as a sinus tract or abscess). Single-stage arthroplasty is a reasonable treatment strategy in patients with septic arthritis caused by *Mycobacterium tuberculosis* (TB), where anti-tuberculous medications have been commenced and in the absence of a sinus tract or extensive soft tissue involvement. Antibiotics (no more than 5% by weight), targeted towards the prior organism, if known, should be added to cement during arthroplasty.

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QUESTION 3: Does the presence of prior projectile missile/bullet fragments in a joint predispose the patient to a higher risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)? If so, what should be done to reduce the risk of SSI/PJI?

RECOMMENDATION: The presence of a prior projectile missile/bullet fragments in a joint, unless the joint was previously infected, does not increase the risk of subsequent SSI/PJI in patients undergoing elective arthroplasty in the same joint.

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1.4. PREVENTION: HOST RISK MITIGATION, GENERAL FACTORS

QUESTION 1: Can immunotherapy and immunoprophylaxis be used to prevent biofilm formation and implant-associated infections?

RECOMMENDATION: Yes. Although no vaccine or passive immunization has been approved by the Food and Drug Administration (FDA) for an orthopaedic indication, a four-antigen vaccine (SA4Ag) with established safety and immunogenicity in healthy volunteers is currently being tested for efficacy in a phase II

clinical trial of spine fusion patients. This is also supported by evidence from the literature regarding cochlear implants for children showing a decreased incidence of pneumococcal meningitis. However, there are no high-level studies supporting this trend with evidence and further study needed.

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QUESTION 2: Does routine screening for diabetes and glycemic control reduce the risk of surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: The routine screening for diabetes and glycemic control has the potential to reduce the incidence of SSI and/or PJI following total joint arthroplasty (TJA).

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QUESTION 3: What is the most accurate marker for assessing glycemic control that best predicts surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: While there is evidence showing an association between elevated glycated haemoglobin (HbA1c) and fasting blood glucose and increased risk for subsequent SSI/PJI, this association is not strong. Recent findings suggest that fructosamine in the preoperative period and glucose variability in the immediate postoperative period may provide greater prediction of SSI or PJI.

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QUESTION 4: What is the threshold for glycated haemoglobin (HbA1c) that is predictive of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI) in patients undergoing orthopaedic procedures?

RECOMMENDATION: The upper threshold for HbA1c that may be predictive of subsequent SSI/PJI is most likely to be within the range of 7.5 to 8%.

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QUESTION 5: Is thrombocytosis associated with an increased risk of surgical site infections/periprosthetic joint infections (SSIs/PJIs) in patients undergoing orthopaedic procedures?

RECOMMENDATION: It is unlikely that thrombocytosis is associated with an increased risk of postsurgical SSIs/PJIs. However, patients with severe thrombocytosis should undergo evaluation prior to orthopaedic procedures.

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1.5. PREVENTION: RISK MITIGATION, LOCAL FACTORS

QUESTION 1: Is preoperative methicillin-resistant *S. aureus* (MRSA) decolonization effective at reducing surgical site infections/periprosthetic joint infections (SSIs/PJIs) in patients undergoing orthopaedic procedures? If so, is preoperative MRSA decolonization cost-effective?

RECOMMENDATION: No definitive recommendation can be made regarding the routine implementation of preoperative *S. aureus* screening and decolonization protocols due to conflicting literature. Additionally, no definitive recommendation can be made about selective or universal treatment, although the universal treatment strategy seems to be the most cost-effective strategy and easiest to implement. Alternatives to mupirocin such as povidone-iodine nasal ointment may obviate the concern for antibiotic resistance raised by universal treatment protocols.

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QUESTION 2: What methods for methicillin-resistant/methicillin-susceptible *S. aureus* (MRSA/MSSA) decolonization exist? What are the benefits and risks associated with the use of each?

RECOMMENDATION: Methods of nasal decolonization include 2% mupirocin ointment, 5% povidone-iodine solution, alcohol-based products and chlorhexidine-based products. Each method has its own advantages and disadvantages related to proven effectiveness, potential for emergence of bacterial resistance and patient compliance. However, no consensus has been reached on the preferred method for decolonization for MRSA, with all products having a potential role.

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QUESTION 3: After a patient undergoes methicillin-resistant *Staphylococcus aureus* (MRSA) decolonization, is there a need to re-screen the patient?

RECOMMENDATION: We recognize that a subset of MRSA carriers remains colonized despite preoperative decolonization protocols. Currently, there is no evidence to suggest that re-screening and subsequent repeated MRSA decolonization can change the perioperative prophylactic antibiotic regimen and reduce the risk of periprosthetic joint infection (PJI) further.

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1.6. PREVENTION: RISK MITIGATION, GENERAL FACTORS

QUESTION 1: Does prior surgical site infection/periprosthetic joint infection (SSI/PJI) of a joint increase the risk of subsequent infection in another joint? If so, should elective arthroplasty of the joint be withheld in patients with active or treated PJI of another joint?

RECOMMENDATION: Yes. Prior SSI and PJI of a joint increases the risk of subsequent infection in another joint. Elective arthroplasty of the other joint should be withheld in patients with active infection.

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QUESTION 2: What immune system-enhancing strategies can be employed to reduce the risk of surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: Besides medical optimization of patients to enhance their immunity, there is some evidence demonstrating that immunonutrients (amino acids), vitamin D supplementation and passive/active immunization against *Staphylococcus aureus* may enhance immune system function, and potentially reduce the incidence of SSIs/PJIs.

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QUESTION 3: For patients awaiting organ transplant who need elective arthroplasty, should the arthroplasty be done before or after the organ transplant?

RECOMMENDATION: We recommend performing arthroplasty after solid organ transplant, using normal antibiotic prophylaxis. Recent studies utilizing publicly available databases compare patients undergoing total joint arthroplasty (TJA) during organ replacement therapy (i.e., hemodialysis) versus after organ transplantation (i.e., kidney transplant) and consistently report less infections in the post-transplant cohort.

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1.7. PREVENTION: ANTIMICROBIALS (SYSTEMIC)

QUESTION 1: Should patients with penicillin or cephalosporin allergies routinely undergo allergy testing, desensitization or a test dose before administering alternative antibiotic prophylaxis?

RECOMMENDATION: A majority of patients with a penicillin allergy can tolerate cephalosporins and do not need routine skin testing. Patients with a non-anaphylactic reaction to penicillins or cephalosporins can be given a test dose of a cephalosporin in the operating room.

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QUESTION 2: What is the alternative choice of prophylactic antibiotic when the patient has an anaphylactic allergy to penicillin/cephalosporins?

RECOMMENDATION: The choice of prophylactic antibiotic for patients with a known anaphylactic penicillin or cephalosporin allergy includes vancomycin, teicoplanin or clindamycin. Cephalosporins for patients with anaphylactic penicillin allergies may be given following skin testing.

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QUESTION 3: What is the optimal antibiotic for perioperative prophylaxis in methicillin resistant *Staphylococcus aureus* (MRSA) carriers who are undergoing orthopaedic procedures?

RECOMMENDATION: Vancomycin or teicoplanin is recommended as a perioperative prophylactic antibiotic agent for the current MRSA colonizer undergoing total joint arthroplasty (TJA).

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QUESTION 4: What patient factors (allergy status, weight, etc.) should be utilized to alter the choice of perioperative antibiotic prophylaxis?

RECOMMENDATION: A weight-adjusted dose of antibiotics should be administered to patients. A minimum of 2 gm cefazolin is recommended for patients with weight > 70 kg to achieve effective minimum inhibitory concentration (MIC). Vancomycin or teicoplanin should be administered in resistant-strain carriers and those with cephalosporin allergies. Patients with a penicillin allergy, irrespective of immunoglobulin E (IgE) involvement, should be given second or third-generation cephalosporins to minimize cross-reactivity.

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QUESTION 5: What are the indications for dual perioperative antibiotic prophylaxis in patients undergoing orthopaedic procedures? What are the optimal combinations of antibiotics?

RECOMMENDATION: In the absence of high-level data, we recommend that dual antibiotic prophylaxis should be reserved only for patients at high risk of infection, such as those undergoing revision surgery or at high risk for methicillin-resistant *S. aureus* (MRSA) infection.

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QUESTION 6: Should extended (beyond 24 hours) antibiotic prophylaxis be administered to patients with surgical drain(s) in place?

RECOMMENDATION: No. There is no indication for prolonged antibiotic prophylaxis regardless of the presence of surgical drains. Prolonged prophylaxis is potentially dangerous, because it increases the fraction of resistant microorganisms on the skin microbiome.

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QUESTION 7: Does the presence of implants from prior surgery in the affected joint alter the perioperative antibiotic prophylaxis?

RECOMMENDATION: There is currently no evidence to suggest the use of alternate or additional perioperative antibiotics in joint surgery when prior implants exist from previous surgery. There is an increasing body of literature to suggest that conversion hip and knee arthroplasty carries a risk of surgical site infection/periprosthetic joint infection (SSI/PJI) similar to revision surgery rather than primary surgery and altering antibiotics may be one method to mitigate this risk. However, studies will need to be conducted to either confirm or refute this statement given the lack of evidence.

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QUESTION 8: Can ceftriaxone be utilized as an alternative to cefazolin in the treatment of orthopaedic infections caused by methicillin-sensitive *Staphylococcus aureus* (MSSA)? If so, what dosing is recommended?

RECOMMENDATION: There is minimal data in the literature evaluating the use of ceftriaxone and its appropriate dosage to treat orthopaedic infections caused by MSSA. International guidelines state that there is no consensus on the use of ceftriaxone in the treatment of prosthetic joint infection.

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1.8. PREVENTION: ANTIMICROBIALS (LOCAL)

QUESTION 1: Is there a difference in the bioavailability of vancomycin when administered through the intravenous route or intraosseous regional route in total knee arthroplasty (TKA)?

RECOMMENDATION: Yes. Tissue concentrations of vancomycin and other antibiotics are significantly higher when given via intraosseous regional administration for prophylaxis in TKA. Currently, it is unclear whether these higher concentrations will lead to a reduction in prosthetic joint infection (PJI) rates.

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QUESTION 2: Can local antibiotic delivery alone be effective in the treatment of musculoskeletal infections?

RECOMMENDATION: At the present time and without further refinement of delivery mechanisms and improved pharmacokinetics, local antibiotic alone is not believed to be sufficient for the management of patients with orthopaedic infections. Other adjunctive treatment modalities need to be combined with local delivery of antibiotics.

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QUESTION 3: Does the local administration of vancomycin powder to a wound during surgery reduce the risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)? If so, what are the risk factors associated with its use?

RECOMMENDATION: No. There are no high-quality studies on vancomycin powder for the prevention of PJIs. The abundance of retrospective spine literature suggests that vancomycin powder reduces the incidence of surgical site infections. However, the only published randomized control trial (RCT) suggests that it has no impact.

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QUESTION 4: Is there a role for the use of antibiotic-loaded carriers (calcium sulfate/calcium phosphate (CaS/CaP) in the treatment of surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: The use of antibiotic-loaded carriers, specifically CaS and CaP based materials, to locally deliver antimicrobials at sites of musculoskeletal infection, specifically SSI and PJI, have not been shown to have any beneficial effect in the management of SSI/PJI.

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QUESTION 5: Can fresh-frozen allograft (FFA) be used as a carrier to deliver local antibiotics during revision arthroplasty?

RECOMMENDATION: Emerging evidence suggests that specialized preparations of antibiotic-impregnated allograft are more effective than FFA mixed with antibiotics.

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1.9. PREVENTION: SURGICAL SITE PREPARATION

QUESTION 1: Does preoperative skin cleansing at home prior to orthopaedic surgery have a role in the reduction of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Yes. Preoperative skin cleansing at home prior to orthopaedic surgery does have a role in the reduction of subsequent SSIs/PJIs. Specifically, chlorhexidine gluconate (CHG) has been shown to have excellent results in preventing PJIs/SSIs.

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QUESTION 2: Should skin and hair around a planned surgical incision be removed? If so, what is the best method and timing of removal?

RECOMMENDATION: Hair at the surgical incision site should be removed immediately prior to surgery using clippers or depilatory creams.

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QUESTION 3: Does additional skin cleansing after placement of surgical drapes have a role in reducing the rate of surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: Repeat skin cleansing following placement of surgical drapes may reduce bacterial colonization and the incidence of subsequent superficial SSIs.

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QUESTION 4: What pre-surgical skin preparation is most effective in reducing the risk of surgical site infections/periprosthetic joint infections (SSIs/PJIs) in patients undergoing orthopaedic procedures?

RECOMMENDATION: There appear to be no differences between various skin preparation agents (chlorhexidine gluconate (CHG) versus povidone iodine (PI)) as long as isopropyl alcohol is part of the preparation.

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QUESTION 5: Does surgical preparation of the skin on the whole limb instead of a partial limb reduce the rates of surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: Surgical skin preparation of the whole limb may potentially reduce the risk of SSIs and/or PJIs by decreasing the risk of contamination associated with partial limb preparation. Despite the limited evidence, we recommend surgical skin preparation of the whole limb as there is a potential for contamination with partial limb skin preparation, and little downside to whole limb skin preparation.

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QUESTION 6: Does surgical skin preparation starting from the surgical site, proximal portion of the extremity or distal portion of the extremity affect the rate of surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: Despite the absence of supportive evidence, we recommend starting skin preparation from the site of surgical incision and moving towards the periphery. In general, skin preparation should be performed from a less-contaminated towards a more-contaminated area. In the case of a draining sinus, the area around the sinus should be prepped at the end of the preparation process.

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QUESTION 7: Does the type of surgical drape (disposable vs. non-disposable) used affect the risk of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs) in patients undergoing orthopaedic surgery?

RECOMMENDATION: Unknown. The data from non-orthopaedic procedures suggests that disposable drapes resist bacterial passage and reduce the risk of subsequent SSIs. Impermeable barriers should be used regardless of whether disposable or non-disposable drapes are used.

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QUESTION 8: Does the use of incise draping reduce the incidence of surgical site infections/periprosthetic joint infections (SSIs/PJIs)? Is there a difference in efficacy between incise drapes?

RECOMMENDATION: There is evidence to indicate that antimicrobial-impregnated incise drapes result in a reduction in bacterial colonization of the surgical site. While bacterial colonization of the incision may predispose to subsequent SSIs/PJIs, there is no literature to demonstrate that the use of incise drapes results in clinical differences in the rates of subsequent PJIs. Many surgeons prefer to utilize incise draping for physical isolation of sterile from non-sterile regions and to prevent migration of drapes during the procedure.

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QUESTION 9: Does the use of cloth or impervious stockinettes around the ankle and extremity affect the rate of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs) in patients undergoing orthopaedic procedures?

RECOMMENDATION: In the absence of evidence, we propose that a stockinette always be used to cover the unprepared skin in order to prevent potential contamination of the surgical field. Impervious stockinettes may be more resistant to soaking through during the surgery.

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1.10. PREVENTION: OPERATING ROOM, ANESTHESIA

QUESTION 1: Does the type of anesthesia (general vs neuraxial) influence the risk of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: Compared to general anesthesia (GA), neuraxial anesthesia (NA) appears to be associated with reduced risks of SSIs/PJIs after total hip arthroplasties (THAs) and total knee arthroplasties (TKAs).

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QUESTION 2: Can regional anesthesia be administered to patients with orthopedic infections?

RECOMMENDATION: Yes, central nervous system (CNS) infectious complications, such as meningitis, epidural abscesses, or vertebral osteomyelitis, are exceedingly rare when regional anesthesia is administered to patients with infections after an orthopedic procedure. However, the potential benefits of neuraxial anesthesia likely outweigh any possible risks.

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QUESTION 3: Is it safe to perform a neuraxial anesthesia in patients with active musculoskeletal infection?

RECOMMENDATION: Yes. The use of neuraxial anesthesia is safe in patients with periprosthetic joint infections (PJIs) without septicemia. There is limited evidence regarding the use of neuraxial anesthesia in patients with septicemia or other active musculoskeletal infections.

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1.1.1. PREVENTION: OPERATING ROOM, PERSONNEL

QUESTION 1: Does the number of individuals in the operating room affect the rate of SSI/PJI? If so, what strategies should be implemented to reduce traffic in the operating room?

RECOMMENDATION: Yes. The number of individuals in the operating room (OR) and door openings (DO) during total joint arthroplasty (TJA) are correlated to the number of airborne particles in the OR. Elevated airborne particles in the OR can predispose to subsequent periprosthetic joint infections (PJIs). Therefore, operating room traffic should be kept to a minimum. Multiple strategies, outlined below, should be implemented to reduce traffic in the OR during orthopedic procedures.

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QUESTION 2: Does the risk of SSI/PJI increase when the surgeon performing the arthroplasty procedure has an upper respiratory infection?

RECOMMENDATION: It is unlikely that the risks of SSIs/PJIs are increased in patients undergoing orthopedic procedures when the surgeon or surgical team has an upper respiratory infection.

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QUESTION 3: Does the technique, duration, or agent used for surgical hand scrubbing by the surgeon and OR personnel alter the patient's risk of SSIs/PJIs?

RECOMMENDATION: Unknown. Surgical hand preparation should be performed either by traditional scrubbing with a suitable antimicrobial soap and water, or by using a suitable alcohol-based hand cleansing agent.

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QUESTION 4: Does the type of cap worn by the operating room (OR) personnel matter?

RECOMMENDATION: Unknown. The evidence would suggest that, since normal hygiene such as daily shampooing and showering does not result in bacterial decontamination of OR personnel, some form of disposable head covering is prudent. Whether this takes the form of a bonnet, bouffant, or helmet is unknown. We recommend that the cap should cover the entire scalp, ears, and facial hair.

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QUESTION 5: Should surgeons and personnel in the operating room (OR) wear a mask and a cap in the operating room?

RECOMMENDATION: Yes. The use of surgical facemasks and caps by staff in the operating room is presumed to reduce the frequency of surgical site infections. There is a paucity of data, with few studies addressing this topic. The long-standing established standard of surgical facemasks and caps in the operating room should continue despite the lack of strong evidence demonstrating clinical efficacy and a lack of persuasive evidence for altering current clinical practice. Evidence for the potential role for surgical facemasks in protecting staff from infectious material encountered in the operating room is also controversial. In the absence of convincing clinical evidence, either for or against wearing masks and caps in the OR, it is advisable, at this time, to continue to follow local or national health and safety regulations.

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QUESTION 6: Does the presence of exposed facial hair (beard and mustache) on any OR staffer surgeon influence the rate of SSIs/PJIs in patients undergoing orthopedic procedures?

RECOMMENDATION: Although facial hair may increase the risk of bacterial contamination under certain circumstances, risks should ideally be assessed in the context of masking, with and without nonsterile hoods, where limited and contradictory data exists.

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QUESTION 7: Does strict adherence to not wearing operating room (OR) attire outside the hospital or outside the restricted OR area reduce the risk of SSIs/PJIs?

RECOMMENDATION: We recommend that OR personnel wearing attire that has come into contact with areas outside the restricted OR environment, not wear the same attire during elective arthroplasty or complex orthopedic procedures.

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QUESTION 8: Does the Methicillin-resistant *Staphylococcus aureus/epidermidis* (MRSA/MRSE) colonization status of operating room (OR) personnel affect the hospital's rate of SSIs/PJIs?

RECOMMENDATION: Unknown. While operating room personnel have previously been reported to contribute to environmental contamination, the literature provides insufficient data to establish strong correlations between operating room staff colonization with MRSA/MRSE, and potential for increased infections in patients after orthopedic procedures.

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1.12. PREVENTION: OPERATING ROOM, ENVIRONMENT

QUESTION 1: Does the use of laminar airflow (LAF) in the operating room reduce the risk of subsequent SSIs/PJIs in patients undergoing orthopedic procedures?

RECOMMENDATION: Recent orthopedic literature has not demonstrated that the use of laminar flow systems (LAF) reduces surgical site infections (SSIs) or periprosthetic joint infections (PJIs) in orthopedic surgery. At this time, it is not necessary to perform a clean orthopedic surgery procedure, including elective joint arthroplasty, in an operating theater equipped with LAF systems.

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QUESTION 2: Does the use of forced air warming during orthopedic procedures increase the risk of subsequent SSIs/PJIs?

RECOMMENDATION: There is no evidence to definitively link forced air warming to an increased risk of SSIs/PJIs. Alternative methods of warming can be effective and may be used.

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QUESTION 3: Does the operating room temperature affect the rate of subsequent SSIs/PJIs?

RECOMMENDATION: The operating room temperature may affect core body temperature, which could potentially affect the rates of subsequent SSIs/PJIs. Thus, all efforts should be made to maintain an optimal operating room temperature.

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QUESTION 4: Does perioperative normothermia affect the rate of subsequent SSIs/PJIs?

RECOMMENDATION: Based on data from general surgery and other surgical disciplines, normothermia has been found to be an important factor during the perioperative period, to minimize the risks of subsequent infections. Although evidence in orthopedic surgery is sparse, we recommend that normothermia is also maintained in patients undergoing orthopedic procedures.

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QUESTION 5: Is there a relationship between levels of airborne microorganisms in the operating room and the risk of periprosthetic joint infections (PJIs)?

RECOMMENDATION: Yes. High-quality evidence indicates that there is a proportional relationship between intraoperative levels of airborne microorganisms (colony-forming units or CFUs) and the incidence of PJIs.

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QUESTION 6: What method(s) are available to verify the microbiological cleanliness of the operating room?

RECOMMENDATION: Multiple options are available to verify the microbiological cleanliness of the operating room, including visual inspection, swab and culture, contact culture plates, as well as adenosine triphosphate (ATP) bioluminescence.

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QUESTION 7: Does the use of ultraviolet (UV) light decontamination in the operating room reduce the risk of subsequent SSIs/PJIs in patients undergoing orthopedic procedures?

RECOMMENDATION: Yes, the use of UV lights during surgery is effective against airborne bacteria. However, owing to the potential risks to the operating room personnel, it is recommended that UV light only be used at unoccupied times for terminal cleaning of the room.

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QUESTION 8: Are light handles a source of contamination during orthopedic procedures?

RECOMMENDATION: Yes. Light handles are a possible source of contamination during orthopedic procedures.

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QUESTION 9: Is there a role for banning all handheld devices/ mobile phones in the operating room?

RECOMMENDATION: Given a lack of evidence correlating with increased infection rates/adverse outcomes with the use of handheld devices in the operating room, a recommendation to ban these devices in the OR cannot be made at this time. However, regular cleansing of cell phones is an easy and effective practice and should be performed routinely.

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1.13. PREVENTION: OPERATING ROOM, SURGICAL ATTIRE

QUESTION 1: Does changing surgical gowns during prolonged operations reduce the risk of SSIs/PJIs? If so, how frequently should gowns be changed during the procedure?

RECOMMENDATION: We cannot recommend for or against gown changes at specific time intervals as there are no studies evaluating the temporal associations with gown contamination. We do, however, recommend that surgical gowns be changed if saturation or perforation of the gown occurs during surgery.

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QUESTION 2: Does the type of surgical gown (disposable or reusable) used by the operating room (OR) personnel affect the rate of subsequent SSIs/PJIs in patients undergoing orthopedic procedures?

RECOMMENDATION: Unknown. The available low level evidence suggests that disposable gowns may have a higher ability to prevent bacterial dispersion in the OR. Evidence to demonstrate that gown type influences SSI/PJI outcomes are lacking.

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QUESTION 3: Does the use of occlusive strips at the sleeves of the surgical gowns reduce the risk of SSI/PJI?

RECOMMENDATION: There is no direct evidence that occlusive strips at the sleeves of surgical gowns reduce the risk of subsequent SSIs/PJIs. However, there is evidence that occlusive strips prevent the egress of particles from the gown-glove interface of certain gowning systems, and thereby, can reduce contamination of the surgical field and potentially reduce the risks of SSIs/PJIs.

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QUESTION 4: Should patients wear a mask and surgical cap in the operating room to reduce the risk of subsequent SSIs/PJIs?

RECOMMENDATION: Unknown. The use of face masks and surgical caps by inhabitants in the operating room (OR) has not been shown to impact SSI rates, but with the limited evidence available a recommendation for or against patient usage cannot be made. Surgical cap usage by patients in the OR may decrease the risk of SSIs/PJIs by decreasing microbial air contamination.

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QUESTION 5: Does changing gloves during prolonged operations reduce the risk of SSIs/PJIs? If so, how frequently should gloves be changed during the procedure?

RECOMMENDATION: Changing gloves intraoperatively may reduce the risks of SSIs/PJIs in arthroplasty surgery by reducing contamination. Based on prior studies, gloves should be changed after draping, before handling implants, and when macroscopic perforation of the glove occurs. Gloves should also be changed at least once every 60 to 90 minutes, as contamination and glove perforation rates increase with duration of surgery.

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QUESTION 6: Does shoe wear (i.e. operating room (OR) dedicated shoes, uncovered outside shoes, covered outside shoes) of the surgeon and operating room staff affect the rate of SSIs/PJIs in patients undergoing orthopedic procedures?

RECOMMENDATION: There is little or no evidence to suggest that the use of dedicated operating room OR shoes influence the rates of SSIs/PJIs. However, in view of the fact that shoes worn outside may be grossly contaminated, we recommend that outside shoes should not be worn in orthopedic operating rooms, or shoe coverings are worn to prevent the contact of outside shoes with the operating room floors.

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1.14. PREVENTION: OPERATING ROOM, SURGICAL FIELD

QUESTION 1: When should instrument trays be opened during surgery to minimize the risk of contamination?

RECOMMENDATION: Instrument trays should be opened as close to the time of surgery as possible. Once opened, trays and instruments should be covered with a sterile towel or drape when not in use.

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QUESTION 2: Does the use of a splash basin increase contamination of instruments and the rate of subsequent SSIs/PJIs in patients undergoing orthopedic procedures?

RECOMMENDATION: Unknown. We recommend against the use of fluid-filled splash basins that sit open during surgery, based upon microbiological contamination data. However, the independent association between splash basin contaminations and developments of subsequent SSIs/PJIs remains unclear.

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QUESTION 3: Does changing the electrocautery tip during surgery reduce the rate of subsequent SSIs/PJIs?

RECOMMENDATION: While it is clear that electrocautery tips may become contaminated during surgery, no study has been able to prove a relationship between the amount of time that an electrocautery tip is exposed and its contamination. However, in cases where there is known infection, such as a 1-stage or 2-stage exchange arthroplasty for PJI, we do recommend changing the electrocautery tip at the end of the "dirty" portion of the procedure and prior to reimplantation of components.

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QUESTION 4: Should suction tips be regularly changed during surgery? If so, how frequently?

RECOMMENDATION: Yes. The suction tips should be regularly changed during surgery. Although no time threshold has been established for its exchange, we believe it should be changed every 60 minutes. Studies have shown that suction tips get contaminated during surgery and the contamination rate is higher with prolonged operative time.

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QUESTION 5: Should suction tips enter the intramedullary canal during orthopedic surgery?

RECOMMENDATION: Suction tips can be introduced into the intramedullary canal during orthopedic surgery to remove fluid as needed, but should not be left in the canal where they draw in large volumes of ambient air and particles, that could potentially contaminate the intramedullary canal.

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1.15. PREVENTION: ANTISEPTIC IRRIGATION SOLUTION

QUESTION 1: Which antiseptics can be used to prevent biofilm formation?

RECOMMENDATION: Although several studies have demonstrated the ability of certain antiseptic agents to prevent biofilm formation *in vitro*, the ability of antiseptics to provide prevention of biofilm formation *in vivo* is uncertain. They may have use in the context of revision surgery due to existing infection, but this issue has not been adequately studied.

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QUESTION 2: What is the optimal irrigation solution (i.e., type, volume, frequency) to be used during clean elective orthopedic procedures?

RECOMMENDATION: There is ample evidence to support the WHO and CDC recommendations that advocate the use of dilute betadine for the irrigation of wounds during surgical procedures. The optimal volume of irrigation solution is not known.

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QUESTION 3: Does the pressure of the pulsatile delivery mechanism for irrigation fluid influence the efficacy of the irrigation solution to eradicate infecting organisms in the wound?

RECOMMENDATION: A series of clinical studies were unable to observe differences in clinical outcomes or reoperation rates between high-pressure vs low-pressure wound irrigation. Tangential hydrosurgery is an emerging irrigation method that, though promising, still requires further investigation.

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QUESTION 4: Does the addition of topical antibiotics (polymyxin and/or bacitracin) to irrigation solution offer additional antibacterial properties?

RECOMMENDATION: Guidelines from the WHO and National Institute for Health and Care Excellence advise against the addition of topical antibiotics to irrigation solutions. Recent CDC recommendations suggest an uncertain trade-off between the benefits and risks of intraoperative antimicrobial irrigation for the prevention of SSIs. Although data regarding the antimicrobial efficacy of irrigation solutions containing antibiotics, such as polymyxin-bacitracin, are conflicting and largely based on nonorthopedic studies, we advocate against its intraoperative usage in the face of growing antimicrobial resistance concerns, costs, and hypersensitivity implications.

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QUESTION 5: Is there a role for non-antibiotic natural antiseptic agents (e.g., honey, vinegar) as an irrigation solution during surgical debridement for periprosthetic joint infections (PJIs)?

RECOMMENDATION: There may be a role for non-antibiotic antiseptic agents (e.g., honey, vinegar, and so forth) as an irrigation solution during surgical debridement.

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1.16. PREVENTION: OPERATING ROOM, SURGICAL TECHNIQUE

QUESTION 1: Should the knife blade be changed after skin incision for deep dissection?

RECOMMENDATION: Yes, the scalpel should be changed after making the skin incision. There are studies demonstrating that bacteria from the superficial planes of the skin can contaminate the scalpel and potentially transfer this into deeper tissues.

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QUESTION 2: Does operative time affect the risks of surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: Yes. There is an association between prolonged operative times and SSIs. Prolonged operative times may be a result of a considerable and inescapable level of complexity of the surgery. Coordinated efforts to reduce the operative times without technically compromising the procedure can provide additional benefits for infection prevention.

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QUESTION 3: Do antibiotic coatings on implants reduce the rates of surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: The use of antibacterial coatings on implants has been shown to reduce SSIs and/or PJIs based on *in vitro* and preclinical animal model studies. The use of antibiotic-coated implants in small series of patients appears to be encouraging. Larger-scale studies to prove the value of these technologies are needed.

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QUESTION 4: Does the size of an implant (volume) used during orthopedic procedures influence the incidence of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: While a smaller implant may theoretically represent a smaller substrate for colonizing bacteria, there have been no conclusive studies linking implant size and the incidence of subsequent PJIs.

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QUESTION 5: Does the use of C-arm intraoperatively increase the risk of subsequent surgical site infections/periprosthetic joint infections (SSI/PJI) in patients undergoing orthopedic procedures?

RECOMMENDATION: There are no studies that link the use of intraoperative C-arm with a higher rate of subsequent SSI or PJI in orthopedic surgery. However, based on available studies, it appears that the "sterile" cover of C-arm is often contaminated during the surgery. We recommend that all efforts are made to prevent the cover, or any other part, of the C-arm, from coming into contact with the operative field.

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QUESTION 6: Does the use of recently introduced technologies (navigation, robots, etc.) influence the incidence of surgical site infections/periprosthetic joint infections (SSI/PJI) after orthopedic procedures?

RECOMMENDATION: The use of computer navigation, patient-specific instrumentation, and robot-assisted surgery during total joint arthroplasty has not been shown to increase the risk of subsequent SSI/PJI. However, an increase in operative time that may occur as a result of use of these technologies may increase the risk of subsequent SSI/PJI.

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1.17. PREVENTION: BLOOD CONSERVATION

QUESTION 1: Does allogeneic blood transfusion increase the risk of surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Yes. Allogenic blood transfusion is associated with an increased risk of SSI/PJI.

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QUESTION 2: Can intraoperative or postoperative blood salvage be utilized in patients undergoing reimplantation for treatment of periprosthetic joint infection (PJI)?

RECOMMENDATION: Unknown. The limited published data on this subject suggests that the use of intraoperative or postoperative blood salvage in patients undergoing reimplantation for treatment of PJI may be beneficial, but also poses a potential risk of bacterial dissemination. Further studies are needed to evaluate the risks and benefits of this strategy.

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QUESTION 3: Do antiplatelet drugs need to be withheld preoperatively to reduce the risk for subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Aspirin should not be withheld preoperatively. There is no evidence that withholding aspirin affects SSI/PJI rates and the cardiac and stroke risk associated with discontinuing aspirin outweighs any unproven, theoretical benefit with respect to SSI/PJI.

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QUESTION 4: Is there a role for the administration of erythropoietin, hematinics or other agents for patients with orthopaedic infections?

RECOMMENDATION: Yes. Erythropoietin used preoperatively in infected revision arthroplasty results in higher preoperative hemoglobin levels and lower allogeneic transfusion rates without compromising eradication of infection.

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QUESTION 5: Does the use of tranexamic acid (TXA) reduce blood loss and need for allogeneic blood transfusion during primary total joint arthroplasty (TJA)?

RECOMMENDATION: Yes. The administration of intravenous (IV), topical and/or oral TXA is an effective strategy for reducing blood loss and the need for allogeneic transfusion during primary TJA.

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QUESTION 6: Does the use of tranexamic acid (TXA) reduce blood loss and need for allogeneic blood transfusion during revision total joint arthroplasty (TJA)?

RECOMMENDATION: Yes. The administration of TXA during revision TJA reduces blood loss and the need for allogeneic blood transfusion.

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QUESTION 7: Does the use of tranexamic acid (TXA) reduce the incidence of surgical site infection/periprosthetic joint infection (SSI/PJI) following orthopaedic procedures?

RECOMMENDATION: The administration of TXA potentially reduces the incidence of SSI and/or PJI following total joint arthroplasty (TJA) by limiting postoperative anemia and the need for allogeneic blood transfusion.

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1.18. PREVENTION: WOUND MANAGEMENT

QUESTION 1: Does the type of wound closure (technique and material) affect the incidence of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: There is a lack of strong evidence clearly demonstrating the superiority of any wound closure method following total joint arthroplasty (TJA). The majority of the high-quality studies demonstrate no difference between the various types of wound closure.

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QUESTION 2: What is the role for vacuum-assisted incisional dressings (iVAC) in orthopaedic patients?

RECOMMENDATION: Prophylactic iVACs appear to be a reasonable option for improved wound healing and decreasing the infection rate in orthopaedic patients at risk for such complications. Prophylactic iVACs used routinely in uncomplicated cases do not appear to provide benefit and lead to increased costs. Lastly, evidence suggests that iVACs may also play a role in resolving some cases of early, benign postoperative drainage.

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QUESTION 3: Do antibacterial-coated sutures reduce the risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: The use of antibacterial-coated sutures reduces the risk of SSI following colorectal surgery, however, there is no conclusive evidence that its use reduces the risk of subsequent SSI/PJI in orthopaedic patient populations.

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QUESTION 4: Does the use of topical incisional sealants (i.e., integuseal, dermabond, etc.) reduce the incidence of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI) in patients undergoing orthopaedic procedures?

RECOMMENDATION: While we recognize that the use of topical incisional sealants has the potential to reduce wound drainage, there is no evidence that the use of such products has any impact on the incidence of SSI/PJI.

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QUESTION 5: Does the use of surgical suction drains increase the risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: There is no direct evidence to suggest that the use of surgical drains (for < 48 hours) leads to an increase in the rate of subsequent SSI/PJI. The use of surgical drains lead to a higher volume of blood loss and an increased need for allogeneic blood transfusion, which may indirectly increase the rate of SSI/PJI.

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QUESTION 6: What surgical dressing (i.e., occlusive, silver impregnated, dry gauze) is associated with a lower risk of surgical site infection/periprosthetic joint infection (SSI/PJI) in patients undergoing orthopaedic procedures?

RECOMMENDATION: Occlusive and/or silver-impregnated dressings have been proven to reduce the rate of wound complications, SSI and PJI compared to standard gauze dressings and should be considered for routine use. The majority of the literature at present focuses on total joint arthroplasty (TJA). However, further research is required to see if the added antimicrobials (such as silver), the occlusive, active-nature of the dressing or their combination is responsible for the demonstrated reduction in SSI/PJI.

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QUESTION 7: When should sterile surgical dressings be removed and how frequently should subsequent dressings be changed following orthopaedic procedures?

RECOMMENDATION: The dressing placed over the surgical wound under sterile conditions in the operating room should be changed based on saturation of the

dressings. Early removal and frequent changes of the surgical dressing are not needed if there is no significant bleeding or drainage on the original dressing. If the dressing remains dry, wound coverage for a minimum of 48 hours has been recommended.

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QUESTION 8: Do patients need to refrain from getting a surgical incision wet or submerging it in water to prevent surgical site infection/periprosthetic joint infection (SSI/PJI)? If so, for how long postoperatively?

RECOMMENDATION: Patients need to refrain from getting the surgical incision wet for the first 48 hours after surgery.

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QUESTION 9: What is the definition of persistent wound drainage?

RECOMMENDATION: There is no validated definition of “persistent wound drainage.” In the absence of such data, we define persistent wound drainage as any continued fluid extrusion from the operative site occurring beyond 72 hours from index surgery.

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1.19. PREVENTION: POSTOPERATIVE FACTORS

QUESTION 1: Is early mobilization after orthopaedic procedures associated with an increased risk of wound drainage or surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Current literature reports no increased risk of wound drainage or SSI/PJI with early mobilization following orthopaedic procedures.

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QUESTION 2: Is it necessary for a patient to postpone having an invasive dental procedure after total joint arthroplasty (TJA)?

RECOMMENDATION: In the absence of evidence, we recommend that non-urgent invasive dental procedures, if possible, be delayed until osseointegration of uncemented components are complete.

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QUESTION 3: What is the role of prophylactic antibiotics for invasive procedures (dental, gastrointestinal (GI), urologic, etc.) in the presence of an arthroplasty to prevent subsequent periprosthetic joint infection (PJI)?

RECOMMENDATION: There is no role for routine prophylactic antibiotic administration prior to dental or genitourinary (GU) procedures. There is limited evidence that has shown certain GI procedures may be associated with a risk of subsequent PJI.

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QUESTION 4: Does the type of venous thromboembolic (VTE) prophylaxis influence the risk of surgical site infection/periprosthetic joint infection (SSI/PJI) in patients undergoing orthopaedic procedures?

RECOMMENDATION: Yes. In a majority of studies evaluating VTE prophylaxis in patients undergoing total joint arthroplasty (TJA), aspirin appears to result in a lower risk of SSI/PJI than anticoagulants (vitamin K antagonists, heparin-based products, factor Xa inhibitors and direct thrombin inhibitors).

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1.20. PREVENTION: HOSPITAL ENVIRONMENT

QUESTION 1: Does prolonged hospitalization prior to elective total joint arthroplasty (TJA) increase the risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Yes. Prolonged preoperative hospitalization is associated with an increase in the risk of SSI/PJI.

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QUESTION 2: Does placement of patients with an infection in private hospital rooms decrease the risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI) for patients undergoing orthopaedic procedures?

RECOMMENDATION: There is some evidence to suggest that isolation of patients who are carriers of or are infected with methicillin-resistant *Staphylococcus aureus* (MRSA) in private rooms, as well as observing isolation protocols, reduces the rate of hospital-acquired infections. Patient isolation and contact precaution measures also play a key role in controlling outbreaks due to other multi-drug resistant organisms such as vancomycin-resistant enterococci (VRE), *E. coli*, *Klebsiella*, *Acinetobacter*, *Pseudomonas* and others. The issue of whether placing orthopaedic patients with an active infection in private rooms has any effect on the rate of PJI for other patients has not been examined.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

2.1. 診断：定義

質問1：PJIの急性感染と遅発性感染を区別する期間はどのくらいが推奨されるか(4週間、90日間など)?

著者：Marjan Wouthuyzen-Bakker, Alex Soriano, Jeppe Lange 翻訳者：小林直実、稲葉裕

推奨：PJIの急性感染と遅発性感染を区別する期間にエビデンスはない。感染の自然経過は、発症から慢性化までの一連の変化である。感染症患者の術式は、単に感染症状の発症やインプラント挿入からの経過期間に基づいてのみで決定すべきではない。インプラントの安定性、瘻孔の有無、原因菌の病原性、患者の健康状態など、他の要因も考慮すべきである。注意すべきは、初回 TJA および／または感染症の発症から4週間が経過すると、インプラントの温存を含む外科的介入の有効性が損なわれる可能性が高まる点である。

エビデンスレベル：Limited

投票結果：賛成 84%、反対 15%、棄権 1%（大多数、強いコンセンサス）

質問2：インプラントの“colonization”とインプラント感染の定義は何か？

著者：Stephen Kates, Christof Wagner 翻訳者：小林直実、稲葉裕

推奨：“colonization”とは、関節に微生物が定着、かつ増殖している状態を指すが、微生物と宿主の免疫反応との間に相互作用がないため、いかなる臨床症状も呈さない。感染とは、病気の原因となる菌が関節に侵入した結果、宿主の免疫反応と相互作用する状態を指し、臨床症状と病状を引き起こす。

エビデンスレベル：Limited

投票結果：賛成 83%、反対 8%、棄権 9%（大多数、強いコンセンサス）

質問3：瘻孔の定義とは？

著者：Jeffrey Lange, Jesse Otero, Paul Lichstein, Jacob M. Elkins 翻訳者：小林直実、稲葉裕

推奨：瘻孔は次の特徴を有する：（1）人工関節から軟部組織を通り体外まで繋がる非生理的な管腔構造であり、細菌の定着が確定もしくは推定されている。（2）瘻孔は、挿入されたインプラントの露出や、瘻孔造影、超音波、CT、またはMRIなどの画像所見で外部との連続性が認められた場合に確定される。

エビデンスレベル：Consensus

投票結果：賛成 97%、反対 2%、棄権 1%（満場一致、最も強いコンセンサス）

2.2. 診断：臨床検査

質問1：PJIの診断精度が最も高い血液生化学検査項目は何か？ 他の検査と組み合わせることで診断精度は上がるか？

著者：Qiaojie Wang, Sreeram Penna, AliSina Shahi 翻訳者：小林直実、稲葉裕

推奨：これまでに複数の血清マーカーがPJIの診断ツールとして使用されており、CRP および ESR が最も一般的に認められているスクリーニング検査である。CRP と ESR はスクリーニング検査として十分研究されており、単独での使用に高い感度を示す。D-ダイマーはPJIの早期診断に有用である可能性があり、活発に研究されている。血清学的検査を組み合わせることで診断精度が増すことが判明しているが、最適な組み合わせを明らかにするため更なる研究が必要である。また、現時点で、PJIは血液生化学的検査のみに基づいた確定診断は出来ない点に留意すべきである。

エビデンスレベル：Moderate

投票結果：賛成 92%、反対 5%、棄権 3%（大多数、強いコンセンサス）

質問2：急性および慢性のPJIにおいて、血清および関節液マーカーの閾値に影響を及ぼす患者固有の因子(炎症性関節炎、免疫不全状態など)はなににか？

著者：Susan Goodman, Jianhao Lin, Serene Mirza, Shawn Richardson, Cynthia Kahlenberg, Jason L. Blevins, Charles Lautenbach, Jackie Szymonifka, Peter Sculco, Mark Figgie, Michelle Demetres, Lily Martin 翻訳者：小林直実、稲葉裕

推奨：現状、PJIにおける血清および関節液マーカーの閾値に影響を及ぼすとされる炎症性関節炎に固有の因子は知られていない。PJIに関する炎症性関節炎（IA）の文献は少ない。関節液中白血球数（WBC）およびCRPと並び、 α デフェンシンが最も研究されている関節液バイオマーカーであるが、炎症性関節炎患者の関節液を無菌性が感染性が鑑別するにあたって、その有用性は限定的のように見受けられる。

エビデンスレベル：Limited due to small numbers

投票結果：賛成 84%、反対 7%、棄権 9%（大多数、強いコンセンサス）

質問3：検査前の抗菌薬の投与は、PJIの診断検査の精度に影響を与えるか？

著者：Arthur Malkani, AliSina Shahi, Samrath Bhimani 翻訳者：小林直実、稲葉裕

推奨：与える。時期尚早な抗菌薬の投与は、ルーチンで行われる PJI の診断検査精度を低下させる可能性がある。我々は、PJI が疑われる患者に抗菌薬の投与を控えることを強く推奨する。ただし、患者に敗血症による重大な全身症状が見られる場合は例外とし、担当外科医と議論をするべきである。

エビデンスレベル：Strong

投票結果：賛成 97%、反対 2%、棄権 1%（満場一致、最も強いコンセンサス）

質問4：菌種(*fungi*、*C. acnes*、*S. aureus*)は、急性および慢性のPJIにおける血清および関節液マーカーの閾値に影響を与えるか？

著者：Maureen Lynch, James Huddleston 翻訳者：小林直実、稲葉裕

推奨：与える。最近の研究データによれば、急性および慢性の PJI 診断において、ほぼ全ての血清および関節液バイオマーカーの診断閾値が菌の種類から影響を受けると示唆されている。

エビデンスレベル：Moderate

投票結果：賛成 94%、反対 4%、棄権 2%（大多数、強いコンセンサス）

質問5：SSI / PJIの診断における術中グラム染色の診断精度は？

著者：Robert Barrack, Jess H. Lonner, Yale Fillingham 翻訳者：小林直実、稲葉裕

推奨：PJI の診断ツールとして術中グラム染色は感度が低く、高確率で偽陰性をもたらすため信頼性に欠ける。よって SSI/PJI の診断には推奨されない。

エビデンスレベル：Strong

投票結果：賛成 95%、反対 4%、棄権 1%（満場一致、最も強いコンセンサス）

質問6：整形外科患者のSSI/PJIの診断において、プロカルシトニン(PCT)血液検査は有用か？

著者：Muhammad Kazim Rahim Najjad, Kier Blevins 翻訳者：小林直実、稲葉裕

推奨：有用ではない。整形外科患者の感染発症を確定診断するには、血清 PCT よりも有効なバイオマーカーが複数あると文献で証明されている。

エビデンスレベル：Strong

投票結果：賛成 92%、反対 3%、棄権 5%（大多数、強いコンセンサス）

2.3. 診断：菌種同定、培養

質問1：術中培養検査の最適な方法とは？

著者：Ruyin Hu, Ana Lucia Munhoz Lima, Olivier Cornu 翻訳者：小林直実、稲葉裕

推奨：各組織サンプルは、別々の滅菌器具を使用して採取し、培養容器に直接移し、可能な限り迅速に検査室へ運ぶ。採取する術中培養組織（関節周囲組織）のサンプル数は最小3個から最大5個とすべきである。組織培養サンプルは可能な限りインプラント-骨の接触面から採取することが望ましい。スワブを用いた培養検査は診断精度が低いため避けるべきである。関節液も採取し、可能であれば血液培養用の容器に入れる。

エビデンスレベル：Moderate

投票結果：賛成 96%、反対 4%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：SSI / PJIにおいて、細菌培養検査の診断率を上げるために利用可能な方法とは？

著者：Mitchell R. Klement, Karan Goswami, Charles Nelson, Christopher Travers 翻訳者：小林直実、稲葉裕

推奨：診断率を上げるには、最低4個の術中培養組織サンプルを採取すべきである。滑膜、関節液、またはインプラント接触部位組織の培養サンプルが病原体を同定出来る可能性が高いと示唆するエビデンスは限られている。培養サンプルは血液培養ボトルの中で培養するべきであり、増菌培地（チョコレート寒天培地や Schaedler broth など）やビーズ式サンプル破碎装置の使用により同定率を上げることが可能かもしれない。

エビデンスレベル：Moderate

投票結果：賛成 86%、反対 9%、棄権 5%（大多数、強いコンセンサス）

質問3：組織または関節液サンプルの最適な培養期間は？ 採取された培養サンプルは培養陰性の確定までどのくらいの期間維持すべきか？

著者：Kier Blevins, Georgios Komnos 翻訳者：小林直実、稲葉裕

推奨：培養サンプルは5～7日間維持すべきである。低毒性細菌による PJI の疑いがある場合、あるいは術前培養検査は陰性だが臨床 PJI の疑いが高い場

合（培養陰性 PJI）、培養サンプルは 14 ～ 21 日間維持すべきである。

エビデンスレベル：Moderate

投票結果：賛成 87%、反対 12%、棄権 1%（大多数、強いコンセンサス）

質問 4：医療施設間の差異を最小限に抑えるために推奨される標準培養プロトコルは？

著者：Kier Blevins, Arjun Saxena, Lars Frommelt 翻訳者：小林直実、稲葉裕

推奨：アメリカ感染症学会（IDSA）が定める現在のガイドラインによると、培養サンプルは滅菌容器に入れ室温で検査室へ運び、サンプルの汚染、乾燥および栄養欠乏による死滅を制限するため、2 時間以内に速やかに処理すべきとされている。

エビデンスレベル：Limited

投票結果：賛成 92%、反対 3%、棄権 5%（大多数、強いコンセンサス）

質問 5：術前の瘻孔のスワブ検査は、原因菌の同定方法として有効か？

著者：Sam Oussedik, Hernan Prieto, Yusuf Mirza 翻訳者：小林直実、稲葉裕

推奨：PJI において、瘻孔から得た表層組織サンプルの使用は推奨されない。瘻孔の表面から拭き取られた培養サンプルは、深部の組織サンプルとの一致率が低い場合、スワブ培養する意義は限定的である。またそのようなサンプルは、PJI の治療における方針決定プロセスを混乱させる可能性がある。

エビデンスレベル：Moderate

投票結果：賛成 96%、反対 3%、棄権 1%（満場一致、最も強いコンセンサス）

質問 6：関節液サンプルを培養用を送る際、どのように送れば(laboratory vacuum tube、シリンジ、血液培養ボトルなど)培養同定率の増加に繋がるか？

著者：Kier Blevins, Vanya Gant 翻訳者：小林直実、稲葉裕

推奨：アメリカ感染症学会（IDSA）は、培養用の関節液サンプルは室温で滅菌容器に入れて運ぶことを推奨している。また、十分なサンプル量がある場合は、従来の培養の他に追加で血液培養ボトル（十分なサンプル量があれば好気、嫌気性の両方）も使用し、培養同定率を上げる努力をすべきであるとしている。

エビデンスレベル：Moderate

投票結果：賛成 97%、反対 1%、棄権 2%（満場一致、最も強いコンセンサス）

質問 7：感染が疑われる人工関節再置換術の術中穿刺液や組織培養サンプルの採取において、抗菌薬の術前投与は差し控えるべきか？

著者：Natividad Benito, Robert Barrack, Giuseppe Sessa 翻訳者：小林直実、稲葉裕

推奨：人工関節再置換術術前の抗菌薬の投与は、どの程度 PJI が疑われているのか、また術前培養検査の結果に基づいて判断すべきである。PJI の疑いが低い場合、あるいは術前に PJI を引き起こす細菌が既に同定されている場合は、抗菌薬の術前投与をすべきである。術前検査の結果、培養陰性 PJI の疑いが濃厚な場合は、術中の組織培養サンプルの採取量を向上するため、術前抗菌薬の投与は差し控えるべきである。

エビデンスレベル：Moderate

投票結果：賛成 81%、反対 16%、棄権 3%（大多数、強いコンセンサス）

質問 8：術中の組織培養(TC)とインプラントの超音波処理の結果に差異が生じた場合、どのように対処すべきか？

著者：María Eugenia Portillo, Tiziana Ascione, Michael O'Malley 翻訳者：小林直実、稲葉裕

推奨：術中 TC とインプラントの超音波処理の結果に矛盾が生じた際の対処方法について、まだ十分なエビデンスはない。最新の研究では、PJI の原因菌の同定において、超音波処理は術中 TC よりも優れた感度および特異度を有すると示されている。超音波処理を施行した関節液培養検査（SFC）の結果の有意性を定義する閾値として、5 以上のコロニー形成単位（CFU）が最適であるとする統計データがあるが、十分な臨床結果と検証に欠けている。臨床の観点からデータを評価することが推奨される。

エビデンスレベル：Moderate

投票結果：賛成 86%、反対 6%、棄権 8%（大多数、強いコンセンサス）

質問 9：SSI / PJI の疑いのある症例において、抗酸菌 (AFB) および真菌のルーチン検査をする意義はあるか？

著者：Rajesh Malhotra, Syed Shahid Noor, Barry Brause 翻訳者：小林直実、稲葉裕

推奨：ない。SSB / PJI が疑われる場合に、AFB および真菌の検査をルーチンに行うべきではない。これらの検査は、以下のような非定型感染症のリスクが高い患者にのみ限定すべきである：(A) 易感染性患者、(B) 非定型感染症の既往歴、(C) 非定型感染症が風土病として知られている地域に居住している、(D) 培養陰性 PJI。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 6%、棄権 4%（大多数、強いコンセンサス）

2.4. 診断：菌種同定

質問 1：整形外科手術後に感染症を引き起こした sessile microorganisms (固着微生物) を検出する方法はあるか？

著者：Fernando Motta, William Li 翻訳者：小林直実、稲葉裕

推奨：ある。PCR、次世代シーケンシング (NGS)、関節液バイオマーカー (α デフェンシン、白血球エステラーゼなど) などの分子生物学的手法は、培養陰性の PJI を検出する際の強力なツールであることが示されている。ただし PCR については対立する結果も示されている。抜去したインプラントを超音波処理することで、培養と PCR 両方の感度が向上する。

エビデンスレベル：Strong

投票結果：賛成 85%、反対 9%、棄権 6%（大多数、強いコンセンサス）

質問 2：整形外科における感染症の診断において、分子生物学的診断に適したサンプル (組織、体液など) は何か？

著者：Óliver Marín-Peña, Majd Tarabichi, Karan Goswami 翻訳者：小林直実、稲葉裕

推奨：整形外科感染症の診断において、培養に依存しない実行可能な代替法として、いくつかの分子学的手法が開発されてきた。しかしながら、各研究によってその手法と採取するサンプル種にばらつきがあるため、どのサンプルが他のサンプルより採取に適するか推奨することは現状困難である。最適な分子生物学的検査を一つだけ推奨することはまだ不可能だが、当該サンプルを適切に採取し収量を得るため、現在利用されている個々の手法（採取場所、サンプル量、培地、温度、輸送法）を慎重に評価する必要がある。

エビデンスレベル：Limited

投票結果：賛成 87%、反対 2%、棄権 11%（大多数、強いコンセンサス）

質問 3：アクネ菌による SSI / PJI を同定する最適な診断法は何か？

著者：Pablo S. Corona, Daniel Monsalvo, Hamidreza Yazdi, Matias Vicente 翻訳者：小林直実、稲葉裕

推奨：現状、*C. acnes* (アクネ菌) を特定する最適な診断法は、微生物の長期培養（最大 14 日間）とされている。チオグリコレート培地による前培養は、*C. acnes* の同定率を上げると考えられている。

エビデンスレベル：Moderate

投票結果：賛成 92%、反対 3%、棄権 5%（大多数、強いコンセンサス）

質問 4：分子生物学的検査または遺伝子的検査によって同定された細菌 (*Treponema* 属、*Corynebacteria* 属など) は、分離培養された病原体と同じように扱うべきか？

著者：Alexander Shope, Naomi Kobayashi, Adolfo Llinás 翻訳者：小林直実、稲葉裕

推奨：扱うべきではない。特殊な細菌による感染は予後不良であるため、通常の病原性細菌と同等に扱うべきではない。分子生物学的検査または遺伝学的検査による特殊細菌の同定は、外科治療と組み合わせた抗菌薬治療の際、その選択補助になると示されている。特殊細菌や複数菌による感染は予後不良に繋がるため、これらのより新しい技術による検査結果に注目し、治療の選択に有効活用すべきである。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 2%、棄権 5%（大多数、強いコンセンサス）

2.5. 診断：画像診断

質問 1：感染の広がり进行评估し、骨切除部位を判断する際において、どのような画像診断法が利用可能か？

著者：Jiří Gallo, Peter Sculco, Milan Kaminek, Eva Nieslanikova, Libuse Quinn 翻訳者：小林直実、稲葉裕

推奨：画像診断には、PJI 患者における骨軟部組織の病変の広がりを出すのに有効である。CT、MRI または核医学画像診断の使用により、骨軟部組織の病変範囲の抽出や骨切除部位の判断の一助になるかもしれない。

エビデンスレベル：Limited

投票結果：賛成 86%、反対 8%、棄権 6%（大多数、強いコンセンサス）

質問 2：人工関節を有する患者において、感染を示す画像的な徴候とは何か？

著者：Jiří Gallo, Stuart Goodman, Michal Svoboda, Eva Nieslanikova 翻訳者：小林直実、稲葉裕

推奨：股関節と膝関節の X 線画像に見られる PJI の徴候は、早期緩み、インプラントの移動、インプラント周囲の骨透亮像 (radiolucent lines) および / または骨びらん (bone erosions around the prosthetic components) である。特に術後 5 年以内にこれらの兆候が見られた場合、PJI の可能性が高い。ただし、PJI において単純 X 線検査は一般的に正常所見を示すことに注意すべきである。

エビデンスレベル：Strong

投票結果：賛成 98%、反対 1%、棄権 1%（満場一致、最も強いコンセンサス）

質問 3：PJI の診断における核医学画像診断法(3相骨シンチグラフィー、骨髄シンチグラフィー、白血球シンチグラフィー (99^mテクネシウムおよび¹¹¹インジウム)、抗顆粒球モノクローナル抗体シンチグラフィー、もしくはFDG PET/CT)) の役割は？

著者：Claudio Diaz-Ledezma, Andor Glaudemans, Adolfo Llinás 翻訳者：小林直実、稲葉裕

推奨：核医学画像は、特定の患者群における股・膝関節の PJI 診断に使われる可能性がある。PJI が疑われるが関節穿刺液が採取不能（ドライタップ）であるなど、他の検査では診断に至らない患者に対し核医学画像診断が適用される場合がある。

エビデンスレベル：Moderate

投票結果：賛成 85%、反対 10%、棄権 5%（大多数、強いコンセンサス）

質問 4：骨髄炎(インプラント有りまたは無し)の診断における MRI の診断精度は？

著者：Theo L.B. Le Roux, Felipe Gómez-García, René Espinosa-Mendoza 翻訳者：小林直実、稲葉裕

推奨：骨髄炎の診断において、MRI は金属製インプラントがない場合に有用であるが、その他の診断ツールと比較すると感度と特異度が低い。インプラントがない骨髄炎の診断における MRI の感度と特異度は、それぞれ 84% と 60% である。金属製インプラント周囲に生じた骨髄炎に対する MRI の診断精度に関する研究は確認されていない。金属アーチファクトの低減処理が可能な技術がいくつか存在する。

エビデンスレベル：Moderate

投票結果：賛成 96%、反対 1%、棄権 3%（満場一致、最も強いコンセンサス）

2.1. DIAGNOSIS: DEFINITIONS

QUESTION 1: What is the recommended time interval that would divide acute and chronic periprosthetic joint infection (PJI) (4 weeks, 90 days, etc.)?

RECOMMENDATION #1: There is no evidence-based time interval that divides acute from chronic PJI. The natural history of infection is a continuum from initiation to chronicity. Surgical treatment for patients with infection should not solely be based on the duration of symptoms or the time from implantation of the prosthesis. Other factors should also be considered such as implant stability, presence of sinus tract, virulence of the infective organism and the general health of the patient. It is important to note that the efficacy of surgical intervention, involving retention of the prosthesis, is more likely to fail as one moves past four weeks from the index arthroplasty and/or duration of symptoms of infection.

RECOMMENDATION #2: We recommend moving away from the traditional division between acute and chronic infection based solely on time from index arthroplasty or duration of symptoms. Periprosthetic infection is a continuum that leads to establishment of biofilm.

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QUESTION 2: What is the definition of implant “colonization” vs. implant-related infection?

RECOMMENDATION: Colonization is the presence of microbiota in a joint with growth and multiplication of the organism, but without interaction between the organism and the host's immune response thus avoiding any clinical expression. Infection is the invasion of a joint by disease causing organisms that results in an interplay with the host's immune response, causing a clinical expression and disease state.

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QUESTION 3: What is the definition of a sinus tract?

RECOMMENDATION: A sinus tract has the following characteristics: (1) it is an abnormal channel through the soft tissues that allows communication between a joint prosthesis and the outside environment, known or presumed to be colonized by bacteria and (2) its presence may be confirmed with direct visualization of an underlying prosthesis, evidence of communication with fistulogram, ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI).

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2.2. DIAGNOSIS: LABORATORY TEST

QUESTION 1: What serum test(s) have the best diagnostic accuracy for periprosthetic joint infection (PJI)? Does the combination of any number of tests increase the diagnostic accuracy?

RECOMMENDATION: Several serum biomarkers have been used as diagnostic tools for PJI with C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) being the most commonly-accepted screening tests. CRP and ESR are well-researched screening tests and have high sensitivity when used alone. Serum D-dimer for the diagnosis of PJI is being actively evaluated with encouraging early results. Combining serological tests have shown to improve diagnostic accuracy, but further work is needed to identify the optimal combination. It should also be noted that diagnosis of PJI cannot be based solely on serological tests at this time.

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QUESTION 2: Which patient-specific factors (i.e., inflammatory arthritis, immunocompromised state) influence the thresholds for serum and synovial markers in acute and chronic periprosthetic joint infection (PJI)?

RECOMMENDATION: There are currently no inflammatory arthritis-specific factors known to influence the thresholds for serum and synovial markers in PJIs. The literature on PJIs in inflammatory arthritis (IA) is sparse. While α -defensin is the best studied synovial biomarker, as with synovial white blood cell (WBC) count and C-reactive protein (CRP), there appears to be overlap in values limiting their utility in differentiating septic from aseptic effusions in patients with inflammatory arthritis.

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QUESTION 3: Does prior use of antibiotics influence the accuracy of tests used to diagnose periprosthetic joint infection (PJI)?

RECOMMENDATION: Yes. The use of premature antibiotics can compromise the accuracy of the routine diagnostic tests that are used for PJI. We strongly urge the medical community to abstain from administration of antibiotics in patients with suspected PJI, unless the patient has significant systemic instability due to sepsis and following discussion with an orthopaedic surgeon.

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QUESTION 4: Does the type of organism (i.e., fungi, *C. acnes*, *S. aureus*) influence the thresholds for serum and synovial markers in acute and chronic periprosthetic joint infection (PJI)?

RECOMMENDATION: Yes. Emerging data suggests that the type of organism influences the diagnostic thresholds for most serum and synovial biomarkers in the diagnosis of acute and chronic PJI.

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QUESTION 5: What is the diagnostic accuracy of intraoperative Gram stain for the diagnosis of surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Intraoperative Gram stain is an unreliable test to diagnose PJI. It carries a low sensitivity and high rate of false negatives. Therefore, it is not recommended for the diagnosis of SSI/PJI.

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QUESTION 6: Is there a role for procalcitonin (PCT) blood test in the diagnosis of surgical site infection/periprosthetic joint infection (SSI/PJI) in orthopaedic patients?

RECOMMENDATION: No. The literature demonstrates the existence of biomarkers with superior diagnostic value compared to a serum PCT blood test in determining the presence of infection in orthopaedic patients.

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2.3. DIAGNOSIS: PATHOGEN ISOLATION, CULTURE

QUESTION 1: What is the optimal methodology for obtaining intraoperative cultures?

RECOMMENDATION: Each tissue sample should be collected using separate sterile instruments and transferred directly into culture bottles and transferred to the laboratory as soon as possible. A minimum of three and maximum of five intraoperative cultures (periprosthetic tissue) should be obtained. It is preferable that samples are obtained from the implant-bone interface, whenever possible. Swab cultures should be avoided due to their poor diagnostic accuracy. Synovial fluid should also be collected and placed into blood culture bottles, where possible.

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QUESTION 2: What methods can be utilized to increase the diagnostic yield of microbiological culture in surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: At least four intraoperative cultures should be obtained to increase the diagnostic yield. There is limited evidence to suggest that cultures from the synovium, synovial fluid or tissue in contact with prosthesis may be more likely to identify a pathogen. The samples should be inoculated in blood culture bottles and the addition of enriched media (such as a chocolate agar plate and Schaedler broth) or bead mill processing broth may also augment yield.

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QUESTION 3: What is the optimal time for culture processing of tissue or synovial aspirate samples? How long should routine cultures be kept before declared negative?

RECOMMENDATION: Cultures should be maintained for a period of five to seven days. In cases of suspected periprosthetic joint infection (PJI) with low-virulence organisms or if preoperative cultures have proven to be negative and there is a high clinical suspicion for PJI (culture-negative PJI), the cultures should be maintained from 14 to 21 days.

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QUESTION 4: What is the recommended standardized laboratory culture protocol to minimize differences between medical centers?

RECOMMENDATION: Based on current guidelines from the Infectious Disease Society of America (IDSA), specimens for culture should be transported in sterile containers at room temperature and processed promptly within a two-hour window to limit specimen contamination or desiccation and subsequent death from nutrient deprivation.

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QUESTION 5: Does preoperative swabbing of a sinus tract have a role in the isolation of the infecting organism?

RECOMMENDATION: Superficial cultures obtained from a sinus tract should be discouraged in the setting of an infected arthroplasty. Cultures from superficial swabbing of a sinus tract exhibit a low rate of concordance with deep cultures, thus, the value of obtaining such cultures is limited. Furthermore, these cultures can confound the decision-making process in the management of periprosthetic joint infection (PJI).

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QUESTION 6: How should synovial fluid samples be sent (via laboratory vacuum tube, syringe, blood culture tubes, etc.) for culture to increase the culture yield?

RECOMMENDATION: The Infectious Disease Society of America (IDSA) recommends that synovial fluid specimens for culture be transported at room temperature in sterile containers and when ample amounts are available, additional procurement should be made in blood culture bottles (aerobic, and anaerobic if enough specimen volume exists to do so) alongside traditional culture methods in an effort to increase culture yield.

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QUESTION 7: Should perioperative antibiotics be withheld prior to obtaining an intraoperative aspirate and/or tissue samples for culture in suspected infected revision total joint arthroplasty (TJA) cases?

RECOMMENDATION: Administration of perioperative antibiotics during revision arthroplasty should be based on the degree of suspicion for periprosthetic joint infection (PJI) and the results of preoperative culture results. If suspicion for PJI is low or if the infecting organism in a PJI case has been preoperatively identified, then perioperative antibiotics should be administered. In patients with high suspicion for PJI in whom preoperative cultures are negative, perioperative antibiotics should be withheld to improve the yield of intraoperative samples taken for culture.

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QUESTION 8: How should divergent results between intraoperative tissue cultures (TCs) and sonication of the prosthesis be managed?

RECOMMENDATION: Evidence on how to address contradictory results between intraoperative TCs and sonication of the prosthesis is still lacking. Current research shows that sonication yields superior sensitivity and specificity over intraoperative TC for the pathogen identification of prosthetic joint infection. There is statistical support for ≥ 5 colony forming units (CFUs) as optimal threshold defining a positive sonicate fluid culture (SFC), however, clinical outcomes and validation are lacking. We recommend that the data be evaluated in light of clinical picture presented.

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QUESTION 9: Is there a role for routine acid-fast bacilli (AFB) and fungal testing in suspected surgical site infection/periprosthetic joint infection (SSI/PJI) cases?

RECOMMENDATION: No. Testing for AFB and fungi should not be performed routinely in suspected SSI/PJI. Testing of suspected cases of SSI/PJI should be limited to only those patients at higher risk of atypical infections which include the following: (A) immunocompromised host, (B) previous history of atypical infection, (C) patient is living in an area with endemic atypical infections and (D) culture-negative PJI.

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2.4. DIAGNOSIS: PATHOGEN ISOLATION

QUESTION 1: Is there a method to detect sessile microorganisms that have resulted in an infection following orthopaedic procedures?

RECOMMENDATION: Yes. Molecular techniques such as polymerase chain reaction (PCR), next-generation sequencing (NGS) and synovial biomarkers such as alpha-defensin or leukocyte esterase have been shown to be powerful tools in detecting prosthetic joint infections (PJI) with negative cultures, although conflicting

data exists on PCR. Sonication of explanted prosthetics can enhance both the sensitivity of conventional cultures and PCR.

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QUESTION 2: What is the preferred type of sample (tissue, fluid, etc.) for molecular analysis in the diagnosis of orthopaedic infections?

RECOMMENDATION: Several molecular methods have been developed in an effort to provide a viable culture-independent alternative for diagnosis of orthopaedic infections. However, due to the variation between studies with respect to the techniques and variety of samples collected, it remains difficult to recommend collection of one specimen type over another. While we cannot recommend a single molecular diagnostic test, careful assessment of the individual technique (location, volume, medium, temperature and transport) utilized is needed for appropriate collection and yield from the corresponding samples.

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QUESTION 3: What is the best diagnostic method for identifying a *C. acnes* surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Microbiological cultures, incubated for a prolonged period (up to 14 days) is currently regarded as the best diagnostic method for identifying *C. acnes*. Subculture in thioglycolate broth is believed to improve the yield of culture for *C. acnes*.

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QUESTION 4: Should organisms (e.g., *Treponema spp.*, *Corynebacteria spp.*) identified through molecular or genetic testing be treated the same as the pathogens isolated by culture?

RECOMMENDATION: No. Because of their associated poor clinical outcomes, unusual organisms resulting in infection should not be treated equivalently to a usual pathogenic organism. Identification of unusual organisms through molecular and genetic techniques should help aid in antibiotic selection in conjunction with surgery, as indicated. Because of the associated poor clinical outcomes of unusual organisms and polymicrobial infections, the results of these newer techniques should not be ignored, but instead used to help inform therapeutic choices.

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2.5. DIAGNOSIS: IMAGING

QUESTION 1: What imaging modalities are available to help evaluate the extent of an infection and guide bone resection?

RECOMMENDATION: Imaging methods have a potential to demonstrate the extent of soft-tissue/bone involvement in patients with periprosthetic joint infection (PJI). The use of computed tomography, magnetic resonance imaging (MRI) or nuclear medicine techniques may help to delineate the extent of bone and soft tissue involvement and may guide bone resection.

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QUESTION 2: What are the radiological signs indicative of infection in patients with an arthroplasty component in place?

RECOMMENDATION: The radiographic signs associated with periprosthetic joint infection (PJI) at the site of hip and knee are early loosening, component migration, radiolucent lines and/or bone erosions around the prosthetic components, particularly if seen at less than five years postoperatively. However, it is important to note that plain radiographs are generally normal in the setting of PJI.

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QUESTION 3: What is the role of nuclear medicine imaging modalities (three-phase bone scintigraphy, bone marrow scintigraphy, white blood cell (WBC) scintigraphy [with ^{99m}Tc or ¹¹¹In], anti-granulocyte monoclonal antibody scintigraphy and fluorodeoxyglucose-positron emission tomography/computed tomography (FDG-PET/CT) scan in diagnosing periprosthetic joint infection (PJI)?

RECOMMENDATION: Nuclear imaging may be used for the diagnosis of hip and knee PJI in a select group of patients. The test may be ordered in patients in whom PJI is suspected but when other tests are inconclusive, such as patients with dry aspiration of the joint.

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QUESTION 4: What is the diagnostic accuracy of magnetic resonance imaging (MRI) for osteomyelitis in the presence and absence of implants?

RECOMMENDATION: MRI is useful for the diagnosis of osteomyelitis in the absence of metal implants, although there are other diagnostic tools that show greater specificity and sensitivity. The pooled sensitivity and specificity for MRI in diagnosing osteomyelitis without presence of implants are 84% and 60%, respectively. There are no identifiable studies on the diagnostic accuracy of MRI for osteomyelitis around metal implants. Several techniques for reducing metal artifacts exist.

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3.1. 治療：抗菌薬

質問1：複数菌感染したSSI/PJIにおいて、適切な抗菌薬の種類と投与期間は？

著者：Timothy L. Tan, Matthias Wimmer, Camelia Marculescu 翻訳者：森井健司

推奨：複数菌感染 PJI に対する抗菌薬療法における適切な抗菌薬の種類と投与期間は不明である。複数菌感染 PJI に対する抗菌薬療法は、感染の原因となっている細菌をターゲットとすべきである。複数菌感染 PJI は多様性が著しく、抗菌薬療法に関する文献は限られている。個々の細菌の *in vitro* での薬剤感受性、患者のアレルギーや不耐性に基づいて選択した抗菌薬を、4～6 週間、経静脈的に投与すること、もしくは生物学的利用能の高い抗菌薬であれば経口投与することを、我々は推奨する。

エビデンスレベル：Limited

投票結果：賛成 92%、反対 5%、棄権 3%（大多数、強いコンセンサス）

質問2：耐性菌感染のSSI/PJI患者では、どのような抗菌薬を全身投与すべきか？

著者：Juan Pablo Horcajada, John Stammers 翻訳者：森井健司

推奨：耐性菌によるSSI/PJI患者の抗菌薬の選択に関して、既存の文献では十分な回答を得ることはできない。耐性菌によるSSI/PJI患者に使用可能な抗菌薬は多数存在する。抗菌薬の選択では、患者の並存症、投与方法、*Clostridium difficile* のリスク、モニタリングの必要性、アレルギーの既往、不耐性、地域の耐性菌発現パターン、コストと薬剤の入手可能性が考慮されるべきである。理想としては、耐性菌への感受性を持つことに加えて、骨軟部組織への移行性が良好であり、バイオフィルムに活性がある抗菌薬が選択されるべきである。こうした症例においては、感染症専門家および臨床微生物学者へのコンサルトがなされるべきである。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 2%、棄権 2%（満場一致、最も強いコンセンサス）

質問3：C. acnesによるPJIは、他の細菌性PJIと同様の方法で治療されるべきか？

著者：Scott R. Nodzo, Randi Silibovsky, K. Keely Boyle 翻訳者：森井健司

推奨：治療されるべきである。C. acnesによるPJIは、他の原因菌によるPJIと同様の方法で治療されるべきである。

エビデンスレベル：Moderate

投票結果：賛成 94%、反対 4%、棄権 2%（大多数、強いコンセンサス）

質問4：C. acnesによるPJIにおける最も有効な抗菌薬は？

著者：Harriet Hughes 翻訳者：森井健司

推奨：不明である。狭域スペクトラムβラクタム系抗菌薬に対し感受性をもつ可能性が高いため、治療開始時には本薬剤の経静脈投与が良いオプションである。しかし経口投与に変更するさいの最適な薬剤は不明である。リファンピシンの有効性は結論が出ていない。C. acnesによるPJIに対する最適な抗菌薬治療法を決定するため、前向き臨床試験が必要である。

エビデンスレベル：No evidence

投票結果：賛成 93%、反対 2%、棄権 5%（大多数、強いコンセンサス）

質問5：結核性SSI/PJIに使用すべき抗菌薬の種類と投与期間は？

著者：Giovanni Riccio, Luca Cavagnaro, Parham Sendi 翻訳者：森井健司

推奨：結核性SSI/PJIは、投与期間（最低6ヵ月間で2年間まで）と抗菌薬（通常4剤併用）の種類が原因菌の耐性プロファイルにより決定されることをふまえて、感染症専門家の協力のもとに治療されなければならない。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 1%、棄権 3%（満場一致、最も強いコンセンサス）

質問6：真菌性PJIの治療で用いられるセメントスペーサーにおいて、熱に対して安定である抗真菌薬は？ また投与されるべき用量は？

著者：Feng-Chih Kuo, Alex McLaren 翻訳者：森井健司

推奨：アムホテリシンB、とくに使用可能であればそのリボソーム製剤、およびポリコナゾールは、熱に対して安定性をもつ抗真菌薬である。これらは粉末で供給されており、真菌性PJIの患者の治療においてスペーサーとして使用されるポリメタクリル酸メチルに混入が可能である。スペーサーに混入すべき適切な抗真菌薬用量は知られていない。しかしながら、文献によると、アムホテリシンBは40gのセメントに対して150～1500mg、ポリコナゾールは40gのセメントに対して200～1000mgと報告されている。真菌と細菌の混合感染の治療／予防を目的とした抗真菌薬と抗菌薬の併用が考慮されるべきである。

エビデンスレベル：Consensus

投票結果：賛成 92%、反対 2%、棄権 6%（大多数、強いコンセンサス）

3.2. 治療：学際的問題

質問 1：PJI 症例は、治療成績を改善しコストを下げるためには、センター化した施設に紹介すべきか？

著者：Chun Hoy Yan, Viktor Voloshin, Carla Renata Arciola, Sankaranarayanan Arumugam Sarvanan, Oshkukov Sergei, Davide Campoccia, Lucio Montanaro 翻訳者：楫野良知、土屋弘行

推奨：より良い治療成績と治療効率のためには、その通りである。

エビデンスレベル：Consensus

投票結果：賛成 92%、反対 6%、棄権 2%（大多数、強いコンセンサス）

質問 2：整形外科における感染症の手術治療において、どのような術中所見を感染症専門医 (ID) と情報共有しておく必要があるか？

著者：Christopher E. Pelt, Rashid Tikhilov, Claudio Diaz-Ledezma, Laura Certain, Michael B. Anderson 翻訳者：楫野良知、土屋弘行

推奨：PJI の診断に関連する術中所見は、感染症専門医と情報共有しておくべきである。瘻孔の存在（診断大項目）あるいは、細胞数、好中球分画、凍結標本結果といった客観的データ、好中球エラスターゼテスト、 α ディフェンシンラテラルフローテストといった診断検査の結果も共有しておく必要がある。軟部組織や骨病変といった感染症の広がり、インプラントの有無、抗菌薬含有セメントスパーサーに使用した抗菌薬の種類と量もまた有益な情報であり、感染症専門医との情報共有のために手術記録に詳細に記載すべきである。

エビデンスレベル：Consensus

投票結果：賛成 90%、反対 6%、棄権 4%（大多数、強いコンセンサス）

質問 3：PJI の治療後の機能判定のためには、どのような QOL の指標を使用すべきか？

著者：Ari-Pekka Puhto, Samuel Parra Aguilera, Claudio Diaz-Ledezma 翻訳者：楫野良知、土屋弘行

推奨：PJI の治療効果を判定する特異的な QOL の指標は現在のところ存在しない。しかしながら、関連した TJA の治療効果判定には、既知の QOL スコア (Patient-Reported Outcomes Measurement Information System (PROMIS) Global 10, Short Form 36 (SF-36), the Veterans RAND 6-Item Health Survey (VR-12), EuroQol five-dimensional (EQ-5D) 等) と、疾患特異的な患者記入式スコア (Western Ontario McMaster Osteoarthritis Index (WOMAC), Hip Disability and Osteoarthritis Outcome Score (HOOS Jr), Knee Injury and Osteoarthritis Outcome Score (KOOS Jr) 等) の両者を併用することが現在推奨されている。医師記入式スコア、活動性評価スコア、満足度調査のような補助的な情報も有用かもしれない。PJI の治療を行った患者のための理想的な組み合わせはまだ明らかではない。

エビデンスレベル：Consensus

投票結果：賛成 96%、反対 1%、棄権 3%（満場一致、最も強いコンセンサス）

3.1. TREATMENT: ANTIMICROBIALS

QUESTION 1: What is the optimal choice and duration of antibiotic therapy in polymicrobial surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: The optimal choice and duration of antimicrobial therapy in polymicrobial PJIs remain unknown. Antimicrobial therapy for polymicrobial PJI should be targeted at the organisms that are present. There is limited literature on the antibiotic treatment as polymicrobial PJIs are very heterogeneous. We recommend four to six weeks of intravenous or highly-available oral antimicrobial therapy, that is based on the in vitro susceptibilities of the individual microorganisms, patient allergies and intolerances.

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QUESTION 2: What systemic antibiotic therapies should be used in patients with surgical site infection/periprosthetic joint infection (SSI/PJI) caused by resistant organisms?

RECOMMENDATION: The choice of antibiotic therapy in patients with SSI/PJI caused by resistant organisms is not fully answered by literature.

There are a number of antibiotic choices available for patients with SSI/PJI caused by resistant organisms. The antibiotic selection process should consider patient comorbidities, mode of administration, risk of *Clostridium difficile*, need for monitoring, allergy profile of the patient, intolerance, regional resistance patterns, cost and availability. Ideally, apart from having activity against the resistant organisms, antibiotic choice should have good bone and soft tissue penetration and activity against biofilm. Consultation with infectious diseases specialists and clinical microbiologists is warranted in these cases.

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QUESTION 3: Should periprosthetic joint infection (PJI) caused by *C. acnes* be treated the same as other bacterial causes of PJI?

RECOMMENDATION: Yes. PJIs caused by *C. acnes* should be treated in the same fashion as other causes of PJI.

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QUESTION 4: What is the most effective antibiotic in the treatment of *C. acnes* periprosthetic joint infection (PJI)?

RECOMMENDATION: Unknown. High rates of susceptibility to narrow spectrum beta-lactams make these a good initial intravenous (IV) option, though the optimum oral switch is not known. The role of rifampin is controversial. Prospective clinical studies are required to determine the optimal antimicrobial therapy for *C. acnes* PJI.

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QUESTION 5: What antibiotic therapy and duration should be used in surgical site infection/periprosthetic joint infection (SSI/PJI) caused by *Mycobacterium tuberculosis* (TB)?

RECOMMENDATION: TB PJI must be treated in collaboration with an infectious diseases specialist noting that the duration of treatment (minimum six months and up to two years) and the type of antimicrobials (usually a combination of four drugs) is determined based on the resistance profile of the pathogen.

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QUESTION 6: Which antifungal agents are heat-stable and what dose of these agents should be used in cement spacers for fungal periprosthetic joint infection (PJI)?

RECOMMENDATION: Amphotericin B, preferably the liposomal formulation, and voriconazole are heat-stable antifungal agents that are available in powder form and can be added to polymethyl methacrylate (PMMA) cement for spacers during treatment of patients with fungal PJI. The optimal dose of the antifungals that need to be added to a spacer is not known. However, in the literature, the dose of amphotericin B ranges from 150 to 1,500 mg per 40 gm cement and the dose of voriconazole ranges from 200 to 1,000 mg per 40 gm cement. Antibiotics combined with antifungals should be considered for treatment/prevention of coexisting fungal and bacterial infection.

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3.2. TREATMENT: MULTIDISCIPLINARY ISSUES

QUESTION 1: Should periprosthetic joint infection (PJI) cases be referred to a regional center to improve the outcome of treatment and decrease cost?

RECOMMENDATION: Yes, for probable better outcome and greater efficiency.

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QUESTION 2: What intraoperative findings during surgical management of orthopaedic infections need to be communicated with the infectious disease (ID) specialist?

RECOMMENDATION: Intraoperative findings that contribute to the diagnosis of periprosthetic joint infection (PJI) must be communicated to the ID specialist. The

presence of a sinus tract (major diagnostic criteria) or any other valuable objective data such as cell count, neutrophil differential, frozen section, as well as the result of the point of care diagnostic tests, such as leukocyte esterase and lateral flow alpha-defensin need to be communicated to the ID specialist. The extent of infection, in terms of involvement of soft tissues and bone, any hardware retained and the antibiotic type and dose used in the cement spacer are also useful information that should be detailed in the operative report for communication with the ID specialist.

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QUESTION 3: What quality of life (QOL) measures should be used when determining the functional outcomes of periprosthetic joint infection (PJI) treatment?

RECOMMENDATION: Currently, there are no QOL measures specific to determining outcome in PJI. However, when determining the outcomes of any arthroplasty related procedure, the current recommendations are to use both a general well-being/QOL measure (i.e., Patient-Reported Outcomes Measurement Information System (PROMIS) Global 10, Short Form 36 (SF-36), the Veterans RAND 6-Item Health Survey (VR-12), EuroQol five-dimensional (EQ-5D)) and a joint/disease specific (i.e., Western Ontario McMaster Osteoarthritis Index (WOMAC), Hip Disability and Osteoarthritis Outcome Score (HOOS Jr) or Knee Injury and Osteoarthritis Outcome Score (KOOS Jr)) patient-reported outcome measure. Supplemental information such as surgeon-reported outcome measures, an activity-specific score and satisfaction surveys may be helpful. However, the ideal combination has yet to be determined and validated for patients treated for PJI.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

質問 1：関節内に、明らかなマイクロバイーム(微生物叢)は存在するか？

著者：Holger Rohde, Karan Goswami 翻訳者：楫野良知、土屋弘行

推奨：生理的な関節や TJA 後の関節の中に、感染徴候を引き起こさない特異的な微生物が存在する微生物学的な環境 (niche) が存在するかどうかは未だ明らかではない。しかしながら、無菌性ゆるみの臨床標本から回収された Coagulase 陰性ブドウ球菌や *Cutibacterium* 属のような無害な微生物の特徴を考えると、臨床的な感染の徴候や症状が起こる以前にインプラントへの慢性的なコロニーが形成され、長期的に持続した状態となるといった仮説はありえる。臨床的に明らかな感染徴候を示さずに、関節内に微生物が潜んでいるといった臨床的な関与を明らかにするためには、臨床的な相関関係・長期的な経過観察・多施設での検証を行いながら、さらなる検討が必要である。

エビデンスレベル：Limited

投票結果：賛成 80%、反対 7%、棄権 13% (大多数、強いコンセンサス)

質問 2：整形外科手術の後に SSI/PJI を引き起こす微生物の性質は経年的に変化しているか？

著者：Peter Sculco, Karan Goswami, Hannah Groff 翻訳者：楫野良知、土屋弘行

推奨：SSI/PJI を引き起こす微生物の大部分は依然としてブドウ球菌属であるが、耐性菌や非定型的な微生物の流行が継続して発生している。特に、MRSA の頻度は増加している。独立した複数の研究が、細菌培養陰性の PJI の増加について報告している。抗菌薬を選択する上で重要な意味合いがあるため、微生物学的な性質の流動性に関するさらなる検討が必要である。

エビデンスレベル：Moderate

投票結果：賛成 92%、反対 5%、棄権 3% (大多数、強いコンセンサス)

質問 3：FDA やその他の規制団体は、新規性のある抗感染症技術の有効性を評価するために、どのような方法を用いることができるか？

著者：Thomas Grupp, R. Bargon, J. Bruenke, P. Graf, M. Fabritius 翻訳者：楫野良知、土屋弘行

推奨：FDA やその他の規制団体は、病原体に対する抗菌効果の有効性を評価するために、まず *in vitro* での細胞培養法を行い、次に骨伝導能の問題を評価する動物実験、その後 *in vivo* における有用性を検証する骨髓炎/PJI の動物モデルを用いることが可能である。しかしながら、新規性のある抗感染症技術の認可のためには、臨床試験が必要であろう。

エビデンスレベル：Moderate

投票結果：賛成 80%、反対 3%、棄権 17% (大多数、強いコンセンサス)

質問 4：新規の抗菌技術の評価するための非臨床的な方法にはどのようなものがあるか？

著者：K. Scott Phillips 翻訳者：楫野良知、土屋弘行

推奨：現状では、殆どの *in vitro* の評価手法では、新規の抗菌技術の持つ潜在的な性質について、限られた知見しか得ることができない。つい最近では、ヒトの組織と接触したインプラントへの付着とコロニー形成を検査するため、動物またはヒト組織を組み込んだ *in vitro* モデルが登場している。これらのモデルのさらなる発展と検証が必要であり、ヒトの免疫応答の要素を含めた取り組みもまた必要とされる。

エビデンスレベル：Limited

投票結果：賛成 81%、反対 2%、棄権 17% (大多数、強いコンセンサス)

質問 5：PJI のための動物モデルはあるか？

著者：Rahul Goel, Alberto Carli, Camila Novaes de Santana, Thomas Schaer 翻訳者：楫野良知、土屋弘行

推奨：異なる菌種やインプラントデザインを用いて、PJI に類似しているいくつかの動物モデルは存在する。しかしながら、これらのモデルの大多数は、臨床的な PJI の特徴を反映していない。

エビデンスレベル：Limited

投票結果：賛成 88%、反対 4%、棄権 8% (大多数、強いコンセンサス)

質問 6：感染症の研究を行う際、人工関節レジストリーの利用や行政のデータベースの利用に関しての注意点はありますか？

著者：Ola Rolfson, Henrik Malchau, Alexander Rondon, Karin Svensson, Maziar Mohaddes 翻訳者：楫野良知、土屋弘行

推奨：感染症の原因は多因子であり、現状では各国の人工関節レジストリーだけでは、感染症の研究への包括的なアプローチのための十分なデータは提供されていない。

エビデンスレベル：Consensus

投票結果：賛成 91%、反対 6%、棄権 3% (大多数、強いコンセンサス)

QUESTION 1: Is there a distinct microbiome in the joints?

RECOMMENDATION: It remains unclear whether the native joint or a joint after arthroplasty can be considered a microbiological niche in which specific organisms reside without causing any manifestation of infection. However, given the innocuous character of microorganisms (such as coagulase-negative *Staphylococcus*, *Cutibacterium* species) recovered from clinical specimens in the context of aseptic loosening it appears plausible to hypothesize that chronic colonization of devices can occur and be of long-lasting nature before signs and symptoms of clinical infection occur, if they occur at all. Further studies are needed to determine the clinical relevance of microorganisms or microbial dysbiosis detected within joints, without apparent clinical features of infection, ensuring clinical correlation, long-term follow-up and multicenter validation.

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QUESTION 2: Has the profile of organisms causing surgical site infection/periprosthetic joint infection (SSI/PJI) following orthopaedic procedures changed over recent years?

RECOMMENDATION: While the majority of organisms causing SSI/PJI continue to be staphylococcal species, the prevalence of resistant pathogens and atypical organisms continues to rise. In particular, incidence of methicillin-resistant *Staphylococcal aureus* (MRSA) is increasing. Isolated studies have reported an increased prevalence of culture-negative PJI. Further work regarding the flux in organism profile is needed, as it may confer significant antibiotic selection implications.

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QUESTION 3: What methods can the Food and Drug Administration (FDA) and other regulatory bodies use to evaluate the efficacy of novel anti-infective technologies?

RECOMMENDATION: The FDA and other regulatory bodies can use *in vitro* cell culture methods to evaluate the antimicrobial efficacy against pathogens, followed by animal studies to evaluate osseointegration issues and a subsequent osteomyelitis/periprosthetic joint infection (PJI) animal model to evaluate the *in vivo* efficacy. However, clinical trials may be required for clearance or approval of some novel anti-infective technologies.

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QUESTION 4: What are some of the emerging pre-clinical methods for evaluating novel antimicrobial technologies?

RECOMMENDATION: At present, most *in vitro* testing provides limited insight into the potential of novel antimicrobial technologies. More recently, *in vitro* models that incorporate animal or human tissue are emerging to test adherence and colonization to devices in contact with human tissues. Further development and validation of these models is needed, as well as approaches to include the element of human immune response.

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QUESTION 5: Does an animal model for periprosthetic joint infection (PJI) exist?

RECOMMENDATION: Yes, there are several animal models using different species and implant designs that have claimed to pertain to PJI. However, the majority of these models are not representative of clinical PJI.

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QUESTION 6: Are there any concerns regarding the use of joint registries or administrative databases to conduct infection studies?

RECOMMENDATION: Yes. Infections are of a multi-factorial character and currently, national joint registries alone do not provide adequate data for a comprehensive approach to infection research.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

PART II

HIP AND KNEE

SECTION 1: PREVENTION

- 1.1. 宿主関連因子
- 1.2. リスクの軽減
- 1.3. 抗菌薬（全身投与）
- 1.4. 抗菌薬（局所投与）
- 1.5. 手術室環境
- 1.6. 手術手技
- 1.7. 人工関節関連因子
- 1.8. 術後因子

SECTION 2: DIAGNOSIS

- 2.1. 定義
- 2.2. アルゴリズム
- 2.3. 臨床検査
- 2.4. 細菌の分離と培養
- 2.5. インプラント再置換術

SECTION 3: PATHOGEN FACTORS

SECTION 4: FUNGAL PERIPROSTHETIC JOINT INFECTION

- 4.1. 診断と治療

SECTION 5: TREATMENT

- 5.1. アルゴリズム
- 5.2. デブリドマンとインプラント温存
- 5.3. 一次的再置換術
- 5.4. 二期的再置換術、スペーサー関連
- 5.5. 二期的再置換術
- 5.6. 手術手技
- 5.7. 人工物の要素
- 5.8. サルベージ
- 5.9. 抗菌薬
- 5.10. 抗菌薬（二期的）
- 5.11. 抗菌抑制

SECTION 6: OUTCOMES

〈監訳者〉

稲葉裕、井上大輔、内山勝文、小林直実、崔賢民、土屋弘行、宗本充、森井健司

1.1. 予防：宿主関連因子

質問 1：SSI/PJI リスクを考慮した場合、待機的首回 TJA における絶対的および相対的禁忌は？

著者：Richard Iorio, Zlatan Cizmic, James E. Feng, Setor Kunustor 翻訳者：森井健司

推奨：対側肢に感染巣が存在している場合、感染が鎮静するまでは、待機的首回 TJA は禁忌である。糖尿病、低栄養、慢性腎臓疾患、および SSI/PJI のリスクが増大することがわかっている他の疾患が管理されていない患者の TJA は延期されるべきである。

エビデンスレベル：Strong

投票結果：賛成 90%、反対 7%、棄権 3%（大多数、強いコンセンサス）

質問 2：外傷後関節症の場合、関節置換術後の SSI/PJI のリスク上昇と関係するか？

著者：Usama H. Saleh, Neil Sheth, Radwan G. Metwaly, Matthew Sloan 翻訳者：森井健司

推奨：関係する。膝あるいは股関節外傷後関節症の患者の TJA は SSI/PJI 発生の高いリスクを持つ。発生率は手術の既往があり人工物が残存している患者において、きわめて高い。

エビデンスレベル：Moderate

投票結果：賛成 97%、反対 1%、棄権 2%（満場一致、最も強いコンセンサス）

質問 3：SSI/PJI に対して最も感度および特異度の高い栄養状態の指標は？ 栄養状態の改善は SSI/PJI のリスクを低下させるか？

著者：Georgios Komnos, Ronald Huang 翻訳者：森井健司

推奨：複数の大規模な解析において、血清アルブミン値が 3.5 g/dL 未満であることが、TJA 後の SSI/PJI 発生に関する独立した危険因子であると報告されている。現在、術前の栄養状態を表す指標を改善することによって、術後の SSI/PJI のリスクが軽減されることを示す十分なエビデンスは得られていない。これに関するエビデンスは存在していないにもかかわらず、SSI/PJI のリスクを低下させるためには、TJA を行う前に栄養状態を改善することが重要であることを、我々は認識している。

エビデンスレベル：Moderate

投票結果：賛成 98%、反対 1%、棄権 1%（満場一致、最も強いコンセンサス）

1.2. 予防：リスクの軽減

質問 1：適応理由が感染以外であると推測される THA または TKA を受ける患者における適切な術前感染スクリーニング法は？

著者：Matthew Austin, Mark Spangehl, Max Greenky 翻訳者：井上大輔、土屋弘行

推奨：破綻した THA または TKA を予定している全ての患者において、病歴の聴取・画像所見・身体所見を検索することに加えて、ESR や CRP が検査されるべきである。感染の可能性が高い患者においては、術前評価項目の追加が考慮されるべきである。

エビデンスレベル：Moderate

投票結果：賛成 96%、反対 4%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：化膿性関節炎(好気性、嫌気性、真菌性、結核性)の既往がある関節に TJA を施行する場合、PJI のリスクは増加するか？ もしそうなら、感染性関節炎発症後、どれくらいの期間で待機的首回 TJA がなされるべきか？

著者：Saravanan Sankaranarayanan Arumugam, Elie Ghanem, Gwo-Chin Lee, Segei Oshkukov, Viktor Voloshin, Kyle H. Cichos

翻訳者：井上大輔、土屋弘行

推奨：リスクは増加する。化膿性関節炎の既往がある関節に TJA を施行する場合、PJI が起きやすくなる。十分なエビデンスは欠如しているものの、少なくとも抗菌薬による治療が終了し感染の臨床的兆候が消失するまでは、TJA を延期すること、感染から 3 か月以内は施行しないことを推奨する。

エビデンスレベル：Moderate

投票結果：賛成 87%、反対 9%、棄権 4%（大多数、強いコンセンサス）

質問3：初回TJA後に化膿性関節炎を発症した患者において、切除関節形成術、抗菌薬含有セメントスパーサー留置と二期的TJAを適応する際の有用な指標/基準は何か？

著者：Jean-Yves Jenny, Yale Fillingham 翻訳者：井上大輔、土屋弘行

推奨：股関節あるいは膝関節に、活動性のある化膿性関節炎もしくは慢性骨髓炎が発生している患者は、二期的再置換術の適応が最適であろう。鎮静されている化膿性関節炎に一次的再置換術を行う場合、感染再燃のリスクは低いとするエビデンスが存在している。

エビデンスレベル：Limited

投票結果：賛成 85%、反対 11%、棄権 4%（大多数、強いコンセンサス）

質問4：待機的THAを行う患者において、股関節鏡検査の既往はSSI/PJIのリスクを増加させるか？

著者：Arash Aalirezaie, Nirav K. Patel, Zoran Bozinovski, Hamed Vahedi, Perica Lazarovski 翻訳者：井上大輔、土屋弘行

推奨：股関節鏡検査の既往がSSI/PJIのリスクを増加させることを支持するエビデンスはない。

エビデンスレベル：Limited

投票結果：賛成 81%、反対 11%、棄権 8%（大多数、強いコンセンサス）

質問5：待機的TKAを行う患者において、膝関節鏡検査の既往はSSI/PJIのリスクを増加させるか？

著者：Arash Aalirezaie, Nirav K. Patel, Zoran Bozinovski, Hamed Vahedi, Perica Lazarovski 翻訳者：井上大輔、土屋弘行

推奨：待機的TKAを行う患者において、膝関節鏡検査の既往がSSI/PJIのリスクを増加させることを支持するエビデンスはない。

エビデンスレベル：Moderate

投票結果：賛成 81%、反対 12%、棄権 7%（大多数、強いコンセンサス）

質問6：外来でTJAを行う場合、SSI/PJIの発生率は高くなるか？

著者：Francisco Reyes, Jorge Manrique, Mojib Manzary, Wei Huang 翻訳者：井上大輔、土屋弘行

推奨：外来でTJAを行っても、SSI/PJIの発生率は上昇しない。

エビデンスレベル：Moderate

投票結果：賛成 83%、反対 8%、棄権 9%（大多数、強いコンセンサス）

1.3. 予防：抗菌薬（全身投与）

質問1：TJAを行う患者において、SSI/PJIのリスクを減少させるための、最も適切な周術期予防抗菌薬投与法（種類、投与経路、そして回数）は？

著者：Francisco Reyes, Arthur Malkani, Francisco Casas, Daniel Cuellar 翻訳者：井上大輔、土屋弘行

推奨：最も適切な周術期予防抗菌薬は、第一または第二世代セファロスポリン（セファゾリンまたはセフロキシム）であり、執刀開始 30～60 分前に、体重により調整した投与量を経静脈的に単回投与する。

エビデンスレベル：Strong

投票結果：賛成 90%、反対 8%、棄権 2%（大多数、強いコンセンサス）

質問2：体重により調整した予防抗菌薬の推奨投与量は？

著者：Craig A. Aboltins, Timothy L. Tan, Robert Townsend, David Turner 翻訳者：井上大輔、土屋弘行

推奨：成人のTHAまたはTKAにおいて、体重により調整した予防抗菌薬推奨投与量をTable 1に示す。

TABLE 1. 成人におけるTHAまたはTKAにおいて、推奨される体重調整された予防的抗菌薬の投与量

抗菌薬	推奨投与量	再投与間隔
セファゾリン	2 g（患者体重が120 kg ^{*1} 以上なら3 gを考慮）	4 時間
バンコマイシン	15～20 mg/kg ^{*1}	適用不可
クリンダマイシン	600～900 mg ^{*2}	6 時間

※1: 実体重 ※2: 体重調整は推奨されない

エビデンスレベル：Moderate

投票結果：賛成 92%、反対 4%、棄権 4%（大多数、強いコンセンサス）

質問3：TJAを行う患者において、術前抗菌薬は単回投与で十分か？

著者：Timothy L. Tan, Wei Huang, Thorsten Seyler 翻訳者：井上大輔、土屋弘行

推奨：アメリカ疾病予防管理センター（CDC）の現在のガイドラインでは周術期の抗菌薬単回投与を推奨しているものの、これらの研究は検出力不足であり、おもに整形外科以外の専門家によってなされたものである。現在エビデンスは限定されているものの、周術期抗菌薬単回投与は、複数回投与と比較し、SSI/PJIの発生率を増加させないようである。現在、待機的TJAを受ける患者において無作為化前向き試験が進行中であり、この設問に対する明確な結論が提示されるであろう。

エビデンスレベル：Limited**投票結果：**賛成 92%、反対 7%、棄権 3%（大多数、強いコンセンサス）**質問4：外来でTJAを行う場合、術後予防抗菌薬を追加すべきか？**

著者：Adolph J. Yates, Timothy L. Tan 翻訳者：井上大輔、土屋弘行

推奨：CDCの現在のガイドラインでは周術期の抗菌薬単回投与を推奨しているものの、これらの研究は検出力不足であり、おもに整形外科以外の専門家によってなされたものである。現在エビデンスは限定されているものの、周術期抗菌薬単回投与は、複数回投与と比較し、SSI/PJIの発生率を増加させないようである。現在、待機的TJAを受ける患者において無作為化前向き試験が進行中であり、この設問に対する明確な結論が提示されるであろう。

エビデンスレベル：Limited**投票結果：**賛成 94%、反対 4%、棄権 2%（大多数、強いコンセンサス）**質問5：非感染性再置換術を行う患者に対して予防的抗菌薬の投与期間を延長することは、SSI/PJIのリスク減少に寄与するか？**

著者：Feng-Chih Kuo, Marjan Wouthuyzen-Bakker, Edward Hendershot 翻訳者：井上大輔、土屋弘行

推奨：十分なエビデンスは欠如しているものの、感染の存在が術前に確実に否定されている限りにおいて、非感染性再置換術を行う患者に対して通常の予防抗菌薬（最大 24 時間）投与法を推奨する。

エビデンスレベル：Limited**投票結果：**賛成 81%、反対 15%、棄権 4%（大多数、強いコンセンサス）**質問6：PJIの既往を持つ患者において、予防抗菌薬の投与期間や種類を変更すべきか？**

著者：Pablo S. Corona, Matteo Carlo Ferrari, Akos Zahar 翻訳者：井上大輔、土屋弘行

推奨：PJIの既往がある患者に待機的初回TJAまたは再置換術を行う場合、予防的抗菌薬投与法は変更されるべきである。PJIの原因となる最も一般的な細菌だけでなく、初回PJIの起因菌もカバーする単剤または2剤の予防抗菌薬を適応すべきである。

エビデンスレベル：Limited**投票結果：**賛成 93%、反対 6%、棄権 1%（大多数、強いコンセンサス）**質問7：集中治療室(ICU)に入院している患者において、予防抗菌薬の投与期間を延長すべきか？**

著者：Jan Erik Berdal, Ibrahim Tuncay 翻訳者：井上大輔、土屋弘行

推奨：集中治療室に入院している患者において、外科的予防抗菌薬治療は延長すべきでない。

エビデンスレベル：Limited**投票結果：**賛成 82%、反対 13%、棄権 5%（大多数、強いコンセンサス）**質問8：同種骨の使用により、予防抗菌薬において推奨されている投与期間を変更すべきか？**

著者：Heinz Winkler, Oleg Safir, Sergio Rudelli 翻訳者：井上大輔、土屋弘行

推奨：変更すべきでない。同種骨は、人工関節や骨接合材と同様に、コンタミネーションを起こしやすい無血管性の物体であり、細菌のコロニー形成やバイオフィーム形成の足場になりやすい。しかしながら、同種骨の使用と術後感染との因果関係を立証するのは困難であり、したがって予防抗菌薬の使用期間延長を支持するエビデンスは存在しない。

エビデンスレベル：Limited**投票結果：**賛成 91%、反対 6%、棄権 3%（大多数、強いコンセンサス）

1.4. 予防：抗菌薬（局所投与）

質問1：抗菌薬含有セメントの使用により、初回TKAあるいはTHAにおいて、SSI/PJIのリスクが減少することを支持する十分なエビデンスはあるか？

著者：Yale Fillingham, Ali Parsa, Sergei Oshkukov, A. Seth Greenwald 翻訳者：楳野良知、土屋弘行

推奨：初回TKAあるいはTHAにおいて、抗菌薬含有セメントの常用により、SSI/PJIのリスクが減少することを示す十分なエビデンスはない。近年のエビデンスレベルの高い研究やレジストリーデータにおいて、SSI/PJIの減少は示されていない。さらに、コストの増加・耐性菌発生の可能性・宿主における抗菌薬の有害事象発生の可能性が、初回TJAにおいて抗菌薬含有セメントのルーチンな使用を控える十分な理由となっている。

エビデンスレベル：Moderate

投票結果：賛成 38%、反対 58%、棄権 4%（コンセンサス得られず）

質問2：初回TJAにおける抗菌薬含有セメントの有用性は？

著者：Yale Fillingham, Ali Parsa, Sergei Oshkukov, A. Seth Greenwald 翻訳者：楳野良知、土屋弘行

推奨：初回TJAにおいて、抗菌薬含有セメントはSSI/PJIのリスクを減らすために使用されてもよい。コストや潜在的有害事象といった欠点を補う抗菌薬含有セメントの利点が、感染症の高リスク患者において、もっとも正当に評価されてよい。

エビデンスレベル：Moderate

投票結果：賛成 93%、反対 7%、棄権 0%（大多数、強いコンセンサス）

質問3：再置換術の際に使用されるセメントにおいて、セメントの固定強度に影響を与えない適切な抗菌薬の量は？

著者：Andrew Porteous, Matthew W. Squire, Justin Geriner 翻訳者：楳野良知、土屋弘行

推奨：重量比 5% 以下の抗菌薬含有量（40g のセメント 1 袋に対して 2g に相当）であれば、大半のセメントの固定強度は維持される。

エビデンスレベル：Moderate

投票結果：賛成 92%、反対 3%、棄権 5%（大多数、強いコンセンサス）

1.5. 予防：手術室環境

質問1：汚染症例（感染症あるいは開腹手術）の後に同じ手術室で初回TJAを行うと、SSI/PJIのリスクは上昇するか？

著者：Antonia F. Chen, Michael Kheir, Francisco Montilla 翻訳者：楳野良知、土屋弘行

推奨：この話題に関する限られたデータによると、汚染症例の後に待機的なTJAを実施すると、PJIのリスクが上昇する可能性があることが示唆されている。汚染症例の手術の後に手術室のターミナルクリーニングが施行されれば、リスクが減少する可能性がある。この関連性を明らかにするためには、さらなる検討が必要である。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 4%、棄権 3%（大多数、強いコンセンサス）

質問2：清潔な手術用下着の使用は、TJA後の汚染リスクあるいは感染の頻度を減少させるか？

著者：Dominic Meek, Mike Reed, Peter Young, Petros Boscainos 翻訳者：楳野良知、土屋弘行

推奨：清潔な手術用下着の使用は、整形外科手術後のSSI/PJIの発生率と関係ない。

エビデンスレベル：Consensus

投票結果：賛成 85%、反対 6%、棄権 9%（大多数、強いコンセンサス）

質問3：個人用防護服（宇宙服）の使用は、TJAを受ける患者におけるSSI/PJIの発生率に影響するか？

著者：Mark Spangehl, Xianlong Zhang, Simon W. Young 翻訳者：楳野良知、土屋弘行

推奨：強いエビデンスはないものの、個人用防護服の使用はTJAを受ける患者におけるSSI/PJIの発生率を低下させない。

エビデンスレベル：Moderate

投票結果：賛成 87%、反対 11%、棄権 2%（大多数、強いコンセンサス）

質問4：DAIRの過程で、ドレープを交換することは治療の成功率に影響するか？

著者：Plamen Kinov, Akos Zahar, Thorsten Gehrke, Markus Rossmann 翻訳者：楳野良知、土屋弘行

推奨：DAIRの過程でのドレープ交換の影響や有効性について解析されていない。よって外科医の裁量において施行されてもよい。

エビデンスレベル：Consensus

投票結果：賛成 94%、反対 5%、棄権 1%（大多数、強いコンセンサス）

質問 5：両側同時 THA あるいは TKA 患者において、左右個別の手術器械の使用は SSI/PJI の発生率を減少させるか？

著者：Jeffrey Granger, Gustavo A. Garcia, Michel Malo, Moneer M. Abouljoud 翻訳者：楢野良知、土屋弘行

推奨：減少させない。両側同時 TJA において、左右個別の手術器械を使用することによって、SSI/PJI の発生率は減少しない。

エビデンスレベル：Limited

投票結果：賛成 72%、反対 19%、棄権 9%（大多数、強いコンセンサス）

質問 6：デブリドマンの後に再置換術を行う場合、インプラント設置前に新しい手術器械と装備を常に使用することで、SSI/PJI 再燃リスクを減少させるか？感染例の再置換術において、新しいインプラント設置前に術野の環境をすべて新しいものと取り換える必要があるか？

著者：Marie-Jacque Reisener, Adrian van der Rijt, Jorge Manrique 翻訳者：楢野良知、土屋弘行

推奨：感染した関節のデブリドマンの後に術野の環境をすべて新しいものと取り換えることは、術野の汚染微生物数を減少し、手術の治療成績を改善するため、施行を検討すべきである。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 7%、棄権 3%（大多数、強いコンセンサス）

質問 7：術中術野から散乱し無影灯やマスクと接触した後、創部に落下する可能性のあるセメントなどの粒子により、術野の汚染が発生するリスクはあるか？

著者：Greg Stocks, Abtin Alvand, Carlos Meheux, Robert Middleton 翻訳者：楢野良知、土屋弘行

推奨：理論的には、不潔な設備（无影灯、マスク等）に接触した粒子が創部へ落下した場合、術野の汚染が発生する大きなリスクが存在する。しかしながら、この仮説を直接検証した研究は現在、存在していない。術者は粒子を術野に落下させないように注意を払い、予防策を講じなければならないこと、また万が一そのような状況が発生した場合、創部を洗浄する目的で、希釈したポビドンヨードのような消毒薬を大量に使用することを推奨する。

エビデンスレベル：Limited

投票結果：賛成 97%、反対 2%、棄権 1%（満場一致、最も強いコンセンサス）

1.6. 予防：手術手技

質問 1：初回 TKA または再置換術において、ターニケットの使用は SSI/PJI の発生率に影響を与えるか？

著者：Bin Shen, Goran Bićanić, Rahul Goel, Kresimir Crnogaca, Katarina Barbaric 翻訳者：井上大輔、土屋弘行

推奨：TKA 術中のターニケットの使用が、TKA における SSI/PJI のリスクを増加させるかどうかについては、文献的な結論は出ていない。このリスクを減少させるためには、ターニケットの使用時間と圧は最小限にすべきである。

エビデンスレベル：Limited

投票結果：賛成 89%、反対 9%、棄権 2%（大多数、強いコンセンサス）

質問 2：初回 TKA における手術アプローチ（傍膝蓋アプローチ vs 内側広筋下アプローチ）は、SSI/PJI の発生率に影響を与えるか？

著者：Nicholas Giori, Giovanni Balato, Michael Hirschmann 翻訳者：井上大輔、土屋弘行

推奨：初回 TKA の SSI/PJI の発生率は、手術アプローチ（傍膝蓋アプローチ vs 内側広筋下アプローチ）によって影響されない。

エビデンスレベル：Moderate

投票結果：賛成 97%、反対 1%、棄権 2%（満場一致、最も強いコンセンサス）

質問 3：初回 THA における手術アプローチは、SSI/PJI の発生率に影響を与えるか？

著者：Eleftherios Tsiridis, Stefano Bini, Majd Tarabichi, Eustathios Kenanidis, Anastasios-Nektarios Tzavellas 翻訳者：井上大輔、土屋弘行

推奨：初回 THA の手術アプローチは、SSI/PJI の発生率に影響を与えない。

エビデンスレベル：Strong

投票結果：賛成 88%、反対 10%、棄権 2%（大多数、強いコンセンサス）

質問4：人工関節再置換術時の関節周囲注射（PAIs）の使用は、SSI/PJIの再発率に影響を与えるか？

著者：Denis Nam, Hongyi Shao, Maurilio Marcacci 翻訳者：井上大輔、土屋弘行

推奨：影響を与えるかどうかは不明である。初回 TJA における鎮痛コントロールに対して、関節周囲注射（PAIs）は効果的な補助療法であるとされる。しかしながら、再置換術時の SSI/PJI の発生率に与える効果や影響については、今までのところ調査されていない。したがって、再置換術時における関節周囲注射（PAIs）の使用は、外科医の判断によって行われるべきである。

エビデンスレベル：Limited**投票結果：**賛成 91%、反対 5%、棄権 4%（大多数、強いコンセンサス）**質問5：両側同時 THA あるいは TKA は、片側のみ行う場合や、間隔をあけて両側に TJA を行う場合と比較して、SSI/PJI のリスクを増加させるか？**

著者：Carles Amat Mateu, Jiying Chen, Samih Tarabichi 翻訳者：井上大輔、土屋弘行

推奨：両側同時 THA あるいは TKA は、片側のみ行う場合や、間隔をあけて両側に TJA を行う場合と比較して、SSI/PJI のリスクを増加させない。

エビデンスレベル：Moderate**投票結果：**賛成 79%、反対 15%、棄権 6%（大多数、強いコンセンサス）**1.7. 予防：人工関節関連因子****質問1：TJA 後の SSI/PJI のリスクを減少させるインプラントマテリアルは存在するか？**

著者：Paul Ducheyne, Nusret Köse, Sanjib Bhattacharyya 翻訳者：加畑多文、土屋弘行

推奨：TJA を受ける患者において、SSI/PJI を減らす目的で使用されうる様々なインプラントマテリアルが存在する。

エビデンスレベル：Limited**投票結果：**賛成 49%、反対 30%、棄権 21%（コンセンサス得られず）**質問2：人工関節の固定様式は、術後の SSI/PJI の発生に影響をあたえるか？**

著者：Mel Lee, Philip Mitchell, Craig A. Aboltins, Chen-Ta Wu, David Turner 翻訳者：加畑多文、土屋弘行

推奨：THA においても TKA においても、インプラントの固定様式による SSIs/PJI の発生率には差がない。

エビデンスレベル：Moderate**投票結果：**賛成 93%、反対 5%、棄権 2%（大多数、強いコンセンサス）**質問3：セメントレス THA の表面加工様式（グリッドブラスト加工、プラズマスプレー加工、ポーラス加工、ビーズ付加、ハイドロキシアパタイトコーティングなど）は術後の SSI/PJI の発生率に影響を与えるか？**

著者：Valentin Antoci, Constantinos Ketonis 翻訳者：加畑多文、土屋弘行

推奨：多孔部分のサイズ・ジオメトリー・対称性などのようなインプラントの表面粗さが、生体適合性を決定している。いくつかの研究では、インプラントの表面材質が細菌の接着に影響する（細菌の大きさに依存しており、理想的な多孔部分のサイズがある）ことが示されている。多孔部分のサイズが小さすぎると、細菌は付着して増殖すること自体ができない。近年の研究では、抗菌特性を示すといわれるナノチューブなどのいくつかの表面処理加工においては、材質のナノテクスチャーが重要であることがわかってきている。

エビデンスレベル：Limited**投票結果：**賛成 61%、反対 20%、棄権 19%（大多数、弱いコンセンサス）**質問4：摺動面のタイプは、THA 術後の SSI/PJI の発生率に影響を与えるか？**

著者：Richard Trebše, Sumon Nandi 翻訳者：加畑多文、土屋弘行

推奨：金属対金属（MoM）の摺動面をもつ THA においては、PJI の頻度が高い。しかしながら、その他の摺動面においては、PJI の発生率には差がない。

エビデンスレベル：Strong**投票結果：**賛成 84%、反対 10%、棄権 6%（大多数、強いコンセンサス）**質問5：THA におけるモジュラーネックの使用は、術後の SSI/PJI の発生に影響を与えるか？**

著者：Hernan Prieto, Nils P. Hailer, Michael Cross, Mitchell R. Klement 翻訳者：加畑多文、土屋弘行

推奨：モジュラーネックを有するインプラントは、インプラント破損・金属腐食・adverse local tissue reaction（ALTR）を原因とした高い再置換率と関連するとされている。モジュラーネックを使用し失敗に至った THA を有する患者においては、術後 SSI/PJI の発生率がより高くなりことが予想されている。

エビデンスレベル：Limited

投票結果：賛成 72%、反対 21%、棄権 7%（大多数、強いコンセンサス）

質問 6：インプラント関連因子(摺動面など)は、急性および遅発性の PJI における血清および関節液におけるマーカーの閾値に影響を与えるか？

著者：Kevin Perry, AliSina Shahi 翻訳者：加畑多文、土屋弘行

推奨：影響する。金属対金属（MoM）・金属対ポリエチレン・テーパー部の腐食を引き起こしうるモジュラーネックシステムなどは、血清や関節液マーカーに影響しうる。金属デブリは、自動細胞数カウンターに干渉する可能性がある。また、滑液内の金属濃度が上昇しており PJI の評価を必要とする患者の場合には、マニュアルで細胞数をカウントするのが望ましい。したがって、このような状況下における PJI を診断するための血清および関節液マーカーの至適な閾値を確立することが必要である。

エビデンスレベル：Moderate

投票結果：賛成 97%、反対 1%、棄権 2%（満場一致、強いコンセンサス）

質問 7：インプラントを床に落としてしまった場合、または手術室内で非無菌の部分と接触してしまった場合には、どのように対処すべきか？

著者：Julio César Palacio Villegas, Peter Kay, Hamidreza Yazdi 翻訳者：加畑多文、土屋弘行

推奨：ほとんどの病院において、落としてしまった人工物またはインプラントを洗浄再滅菌し再利用することは許可されておらず、行われるべきではない。カスタムメイドインプラントの使用のような極稀な状況においてだけは、落としてしまったインプラントを除染再滅菌した後に、再使用される可能性があるのかもしれない。

エビデンスレベル：Consensus

投票結果：賛成 90%、反対 8%、棄権 2%（大多数、強いコンセンサス）

1.8. 予防：術後因子

質問 1：TJA 後に蜂巣炎を罹患した患者は抗菌薬により治療されるべきであるか？

著者：John O'Byrne, Sean Flynn 翻訳者：森井健司

推奨：されるべきである。PJI が否定されれば、蜂巣炎を呈する患者に経験的抗菌薬投与を行うのが合理的である。

エビデンスレベル：Moderate

投票結果：賛成 94%、反対 4%、棄権 2%（大多数、強いコンセンサス）

質問 2：TJA のあとに大腸内視鏡検査あるいは上部消化管 (GI) 内視鏡検査を行うことは、SSI/PJI 発生リスクの上昇と関係があるか？ もしそうであれば、TJA のあとに大腸内視鏡検査あるいは上部 GI 内視鏡検査を行う際に抗菌薬予防投与を行うことは、このリスクを軽減させるか？

著者：Nicolaas Budhiparama, Tricia Bravo, H. Hidayat, I. Lumban Gaol, N.N. Ifran, D.N. Utomo 翻訳者：森井健司

推奨：大腸内視鏡検査あるいは上部 GI 内視鏡検査は、SSI/PJI のリスクと関連していることを支持するエビデンスは限られているものの、一過性菌血症を発生させる可能性がある。GI 内視鏡検査に先立って抗菌薬を投与することが SSI/PJI のリスクを軽減するというエビデンスは存在していないので、こうした治療行為は避けられるべきである。特定の患者群あるいはハイリスク患者に対してこうした治療が有益であるかを検証するためには、さらなる研究が必要である。

エビデンスレベル：Limited

投票結果：賛成 84%、反対 13%、棄権 3%（大多数、強いコンセンサス）

1.1. PREVENTION: HOST RELATED

QUESTION 1: What are the absolute and relative contraindications to elective primary total joint arthroplasty (TJA), with respect to surgical site infection (SSI) and periprosthetic joint infection (PJI) risk?

RECOMMENDATION: Elective joint arthroplasty is contraindicated in patients with an infectious lesion in the ipsilateral extremity, until the infection is resolved. TJA needs to be deferred in patients with uncontrolled conditions such as diabetes, malnutrition, chronic kidney disease, as well as other diseases that are known to increase the risks of SSIs/PJIs.

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QUESTION 2: Is the diagnosis of post-traumatic arthritis associated with increased risks of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs) after joint arthroplasty?

RECOMMENDATION: Yes. Total joint arthroplasty (TJA) for patients with post-traumatic arthritis of the hip or knee carries higher risks of developing SSIs/PJIs. The incidence is markedly higher in patients with previous surgeries and retained implants.

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QUESTION 3: What nutritional markers are the most sensitive and specific for surgical site infections and periprosthetic infections (SSIs/PJIs)? Does improvement in nutritional status reduce the risk of SSI/PJI?

RECOMMENDATION: Serum albumin < 3.5 g/dL has been demonstrated to be an independent risk factor for SSIs/PJIs following total joint arthroplasty in multiple, large-scale studies. However, other nutritional markers are poorly studied. Currently, there is insufficient evidence to prove that correction of preoperative nutritional markers reduces the risks of subsequent SSIs/PJIs. Despite the absence of such evidence, we recognize the importance of an optimized nutritional status before total joint arthroplasty (TJA) to reduce the risks of SSIs/PJIs.

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1.2. PREVENTION: RISK MITIGATION

QUESTION 1: What preoperative screening for infections should be performed in patients undergoing revision hip or knee arthroplasty because of presumed aseptic failure?

RECOMMENDATION: In addition to taking a thorough history, obtaining radiographic imaging and performing a physical examination, all patients with a failed hip or knee arthroplasty awaiting revision surgery should have their serum erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) measured. Patients with high index of suspicion for infection should be considered for further workup.

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QUESTION 2: Does prior septic arthritis (aerobic, anaerobic, fungal, tuberculosis) of a native joint predispose the patients to an increased risk of subsequent periprosthetic joint infection (PJI) in the same joint receiving arthroplasty? If yes, how soon after a prior septic arthritis can elective arthroplasty be performed in the same joint?

RECOMMENDATION: Yes. A prior septic arthritis in a joint does predispose the same joint to subsequent PJI after arthroplasty. In the absence of concrete evidence, we recommend that arthroplasty be delayed at least until completion of antibiotic treatment and resolution of clinical signs of infection, but no earlier than three months from the inciting event.

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QUESTION 3: What indicators/metrics would compel a surgeon to perform resection arthroplasty and antibiotic spacer insertion, delaying the arthroplasty to a later date, in a patient with prior septic arthritis undergoing primary arthroplasty?

RECOMMENDATION: Patients with active septic arthritis or chronic osteomyelitis of the hip or knee may be best treated with a two-stage arthroplasty. Evidence would suggest a limited risk of infections recurrence following a one-stage arthroplasty in the presence of a quiescent septic arthritis.

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QUESTION 4: Does a prior arthroscopy of the hip joint increase the risks of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs) in patients undergoing elective total hip arthroplasty?

RECOMMENDATION: There is no evidence to suggest that a prior arthroscopy of the hip increases the risk of subsequent SSIs/PJIs.

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QUESTION 5: Does a prior arthroscopy of the knee increase the risk of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs) in patients undergoing elective arthroplasty?

RECOMMENDATION: There is no evidence to suggest that a prior arthroscopy of the knee increases the risk of subsequent SSIs/PJIs in patients undergoing total knee arthroplasty (TKA).

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QUESTION 6: Do patients undergoing outpatient total joint arthroplasty (TJA) have a higher incidence of surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: No. Patients undergoing outpatient total joint arthroplasty do not have a higher incidence of SSIs/PJIs.

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1.3. PREVENTION: ANTIMICROBIALS (SYSTEMIC)

QUESTION 1: What is the most appropriate perioperative prophylactic antibiotic (agent, route and number of doses) for patients undergoing primary total joint arthroplasty (TJA) to reduce the risk of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: The most appropriate perioperative prophylactic antibiotic is a first or second-generation cephalosporin (i.e., cefazolin or cefuroxime) administered intravenously within 30 to 60 minutes prior to incision as a single- and weight-adjusted dose.

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QUESTION 2: What are the appropriate weight-adjusted prophylactic antibiotic dosages?

RECOMMENDATION: The recommended weight-adjusted doses of antimicrobials for prophylaxis of hip and knee arthroplasty in adults are shown in Table 1.

TABLE 1. Recommended weight-adjusted doses of antimicrobials for prophylaxis of hip and knee arthroplasty in adults

Antimicrobial	Recommended Dose	Re-dosing Interval
Cefazolin	2 gm (consider 3 gm if patient weight > 120 kg ^{*1})	4 hours
Vancomycin	15-20 mg/kg ^{*1}	Not applicable
Clindamycin	600-900 mg ^{*2}	6 hours

*1 : Actual body weight.

*2 : No recommended adjustment for weight.

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QUESTION 3: Is one dose of preoperative antibiotic adequate for patients undergoing total joint arthroplasty (TJA)?

RECOMMENDATION: Despite the current guidelines from the Centers for Disease Control and Prevention (CDC) advocating for a single dose of perioperative antibiotics, these studies are underpowered and primarily in specialties outside orthopaedics. From the limited evidence available, it appears that a single perioperative dose of antibiotics, compared to multiple doses, does not increase the rate of subsequent surgical site infections/ periprosthetic joint infections (SSIs/PJIs). A randomized prospective study in patients undergoing elective arthroplasty is underway that should answer this question definitively.

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QUESTION 4: Should patients undergoing outpatient total joint arthroplasty (TJA) receive additional postoperative prophylactic antibiotics?

RECOMMENDATION: Despite the current guidelines from the Centers for Disease Control and Prevention (CDC) advocating for a single dose of perioperative antibiotics, the studies utilized to form these guidelines are underpowered and primarily in specialties outside orthopaedics. The limited evidence suggests that a single perioperative dose of antibiotics, compared to multiple doses, does not increase the rates of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs). A randomized prospective study in patients undergoing elective arthroplasty is underway, which should help answer this question definitively.

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QUESTION 5: Does extended prophylactic antibiotics therapy for patients undergoing aseptic revision help reduce the risk of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: In the absence of concrete evidence, we recommend the use of routine antibiotic prophylaxis (maximum 24 hours) for patients undergoing revision arthroplasty as long as the infection has been properly ruled out prior to surgery.

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QUESTION 6: Should duration and the type of antibiotic prophylaxis be altered in patients with a prior periprosthetic joint infection (PJI)?

RECOMMENDATION: Antibiotic prophylaxis should be tailored in patients with prior PJIs who are undergoing another subsequent elective primary or revision joint arthroplasty. Antibiotic prophylaxis should cover the initial causative organism(s) as well as the most common pathogens that can cause PJI with either single or dual antibiotics.

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QUESTION 7: Should prophylactic antibiotic therapy be administered for an extended duration in patients admitted to the Intensive Care Unit (ICU)?

RECOMMENDATION: Surgical prophylactic antibiotic therapy should not be administered for an extended duration in patients admitted to the ICU.

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QUESTION 8: Does the use of allografts alter the recommended duration of prophylactic antibiotics?

RECOMMENDATION: No. Allografts are avascular materials that are prone to contamination and may serve as a scaffold for bacterial colonization and biofilm production, similar to a prosthesis or osteosynthetic material. However, it is difficult to establish a causal relationship between the use of an allograft and subsequent infection. Thus, there is no evidence to support the use of extended antibiotic prophylaxis.

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1.4. PREVENTION: ANTIMICROBIALS (LOCAL)

QUESTION 1: Is there sufficient evidence to support the use of antibiotic-loaded cement in primary total knee arthroplasty (TKA) or total hip arthroplasty (THA) to reduce the risk of surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: There is no conclusive evidence to demonstrate that routine use of antibiotic-loaded cement in primary TKA or THA reduces the risk of subsequent SSIs/PJIs. Recent high level evidence and registry data has not demonstrated a reduction in SSI/PJIs. Furthermore, the added cost, the potential for the emergence of resistant organisms and the potential adverse effect of antibiotics on the host provide adequate reasons to refrain from routine use of antibiotic loaded cement during primary total joint arthroplasty.

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QUESTION 2にまとめて記載

QUESTION 2: Is there a role for the use of antibiotic-impregnated cement in primary total joint arthroplasty (TJA)?

RECOMMENDATION: Antibiotic-impregnated cement may be used during primary TJA to reduce the risk of surgical site infections/periprosthetic joint infections (SSIs/PJIs). The benefits of antibiotic-impregnated cement versus its cost and other potential adverse effects, may be most justified in patients at high risk of infection.

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QUESTION 3: What is the optimal antibiotic(s) dosage to be used in cement during reimplantation that does not significantly interfere with the mechanical strength of cement used for fixation?

RECOMMENDATION: The mechanical strength of most cement is maintained if ≤5% (w/w) of antibiotics is added (equating to 2 grams in a 40 gram packet).

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1.5. PREVENTION: OPERATING ROOM ENVIRONMENT

QUESTION 1: Does performing a primary total joint arthroplasty (TJA) after a dirty case (infection or open abdomen) in the same operating room increase the risk of surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: The little data on this subject suggests that the risk of PJIs may be higher when an elective arthroplasty follows a contaminated case. The risk may be reduced if terminal cleaning of the operating room can be done after the dirty case. Further studies are necessary to elucidate this connection.

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QUESTION 2: Does the use of sterile surgical vests decrease the risk of contamination or incidence of infection following total joint arthroplasty (TJA)?

RECOMMENDATION: The use of sterile surgical vests has no bearing on the incidence of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs) following orthopaedic procedures.

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QUESTION 3: Does the use of personal protection suits (space suits) influence the rate of surgical site infections/periprosthetic joint infections (SSIs/PJIs) in patients undergoing joint arthroplasty?

RECOMMENDATION: In the absence of strong evidence, we believe the use of personal protection suits does not reduce the rate of subsequent SSIs/PJIs in patients undergoing joint arthroplasty.

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QUESTION 4: Does changing the drapes during debridement, antibiotics and implant retention (DAIR) affect the rate of success?

RECOMMENDATION: The impact and effectiveness of changing the drapes during DAIR has not been investigated and therefore it can be performed at the surgeon’s discretion.

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QUESTION 5: Does the use of separate instruments for each side reduce the rate of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs) in patients undergoing simultaneous bilateral total hip or knee arthroplasties (BTHA or BTKA)?

RECOMMENDATION: No. The use of separate instruments for each side does not appear to reduce the rate of subsequent SSIs/PJIs in patients undergoing simultaneous BTHA or BTKA.

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QUESTION 6: Does routine use of a new set of surgical instruments and equipment following debridement and before reimplantation reduce the risk of surgical site infections/periprosthetic joint infections (SSIs/PJIs) recurrences? Is it necessary to change all surgical fields before the final reimplantation in septic revision surgery?

RECOMMENDATION: The change of the surgical field following debridement of an infected joint leads to a reduction in the bioburden and stands to improve outcome of surgical intervention and should be considered.

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QUESTION 7: Is there a concern for contamination of the surgical field by particles, such as cement, that may escape the wound intraoperatively by coming into contact with the ceiling light or facial masks and fall back into the wound?

RECOMMENDATION: There is logically a high risk that particles which fall into the wound after coming into contact with unsterile equipment (e.g., ceiling lights, facial masks) will contaminate the surgical field. However, no studies investigating this hypothesis directly exist in the current literature. We recommend that surgeons must be conscious of, and take precautions, in order to prevent particles from falling into the surgical field, and should such a scenario arise, to use copious antiseptic solutions, such as dilute betadine, in order to irrigate the wound.

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1.6. PREVENTION: SURGICAL TECHNIQUE

QUESTION 1: Does the use of a tourniquet influence the rates of surgical site infections/periprosthetic joint infections (SSIs/PJIs) in primary or revision total knee arthroplasty (TKA)?

RECOMMENDATION: The literature is inconclusive regarding the use of a tourniquet during TKA and its potential to increase the risks for SSIs/PJIs in TKAs. Tourniquet times and pressures should be minimized to reduce this risk.

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QUESTION 2: Does the surgical approach (parapatellar vs. subvastus) during primary total knee arthroplasty (TKA) affect the incidence of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: The incidence of SSIs/PJIs after primary TKA is not influenced by the surgical approach (parapatellar vs. subvastus).

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QUESTION 3: Does the surgical approach of primary total hip arthroplasty (THA) affect the incidence of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: The surgical approach in primary THA does not affect the incidence of subsequent SSIs/PJIs.

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QUESTION 4: Does the use of periarticular injections (PAIs) affect the rate of surgical site infections/periprosthetic joint infections (SSIs/PJIs) recurrence in reimplantation?

RECOMMENDATION: Unknown. PAIs are an effective adjunct treatment for pain control following primary total joint arthroplasty (TJA), but their effectiveness and impact on the rates of SSIs/PJIs in the revision setting has not been investigated. The use of PAIs at the time of reimplantation can be performed at the surgeon's discretion.

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QUESTION 5: Does simultaneous bilateral hip or knee arthroplasty (SBTHA or SBTKA) increase the risk of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs) compared to unilateral or staged bilateral arthroplasty?

RECOMMENDATION: SBTHA or SBTKA does not increase the risks of SSIs/PJIs compared to unilateral or staged bilateral arthroplasty.

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1.7. PREVENTION: PROSTHESIS FACTORS

QUESTION 1: Are there implant materials that mitigate the risk for surgical site infections/periprosthetic joint infections (SSIs/PJIs) after total joint arthroplasty (TJA)?

RECOMMENDATION: There are various implant materials that can be utilized to reduce the chance for SSIs/PJIs in patients undergoing TJA.

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QUESTION 2: Does the type of fixation of an arthroplasty component influence the incidence of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: There is no difference in the rates of SSIs/PJIs after total hip arthroplasty (THA) or total knee arthroplasty (TKA) based on fixation of the prosthesis.

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QUESTION 3: Does the surface (grit-blasted, plasma-sprayed, porous metal, porous beaded and hydroxyapatite (HA) coated) of uncemented total hip arthroplasty (THA) components influence the rate of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: The surface roughness, including porosity size, geometry and symmetry determines biocompatibility. Several studies have shown that the surface material influences bacterial adherence, with an ideal pore size dependent on bacterial size. Too small a pore size does not allow bacterial lodging. In recent studies, nanotexture of material has been found to be important with some surfaces with nanotubules showing anti-infective properties.

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QUESTION 4: Does the type of bearing surface influence the incidence of surgical site infections/periprosthetic joint infections (SSIs/PJIs) after total hip arthroplasty (THA)?

RECOMMENDATION: There is a higher incidence of PJIs with metal-on-metal (MoM) THA; however, there is no difference in risk of PJIs among other bearing surfaces.

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QUESTION 5: Does the use of a modular femoral neck implants during primary total hip arthroplasty (THA) affect the risks of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: Modular femoral neck implants are associated with increased revision rates due to hardware failure, metal corrosion and adverse local tissue reaction (ALTR). In patients with failed THA as a result of use of a modular femoral neck, a higher incidence of subsequent SSIs/PJIs is expected.

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QUESTION 6: Can implant factors (i.e., type of bearing) influence the thresholds for serum and synovial markers in acute and chronic periprosthetic joint infections (PJIs)?

RECOMMENDATION: Yes. Different bearing surfaces such as metal-on-metal (MoM), metal-on-polyethylene and dual taper modular stems in the setting of taper corrosion can influence the serum and synovial markers. Metal debris may interfere with automated cell counts. Manual cell counts are preferred when evaluating patients for PJIs who have elevated synovial fluid metal levels. Optimal thresholds for serum and synovial markers for diagnosing PJIs in these settings still need to be established.

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QUESTION 7: What can be done with a prosthesis that has been dropped on the floor or allowed to come into contact with a non-sterile portion of the operating room?

RECOMMENDATION: Cleaning, re-sterilization and reuse of dropped prostheses or implants is not permitted in most hospitals and should not be performed. Only in extremely rare circumstances, such as the use of a custom implant, a dropped prosthesis may be decontaminated and sterilized.

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1.8. PREVENTION: POSTOPERATIVE ISSUES

QUESTION 1: Should patients with cellulitis following total joint arthroplasty be treated with antibiotic therapy?

RECOMMENDATION: Yes. When periprosthetic joint infection (PJI) has been ruled out, it is reasonable to treat patients presenting with cellulitis with empiric antibiotics.

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QUESTION 2: Is undergoing a colonoscopy or upper gastrointestinal (GI) endoscopy after total joint arthroplasty (TJA) associated with an increased risk of surgical site infection/periprosthetic joint infection (SSI/PJI)? If yes, does antibiotic prophylaxis prior to a colonoscopy or upper GI endoscopy after TJA reduce the risk?

RECOMMENDATION: Colonoscopy and upper GI endoscopy have the potential to cause transient bacteremia, though the evidence is limited to support an associated risk of SSI/PJI. There is no evidence that administration of antibiotics prior to GI procedures decreases the risk of SSI/PJI and this practice should be avoided. Further research is needed to see if this practice may be beneficial in selected or high-risk patients.

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2.1. 診断：定義

質問1：膝関節および股関節におけるPJIの診断基準は？ いずれの関節に対しても同一の基準を適用できるか？

著者：Noam Shohat, Thomas Bauer, Martin Buttar, Nicolaas Budhiparama, James Cashman, Craig J. Della Valle, Lorenzo Drago, Thorsten Gehrke, Luiz S. Marcelino Gomes, Karan Goswami, Nils P. Hailer, Seung Beom Han, Carlos Higuera, Yutaka Inaba, Jean-Yves Jenny, Per Kjaersgaard-Andersen, Mel Lee, Adolfo Llinás, Alex McLaren, Konstantinos Malizos, Michael A. Mont, Rhidian Morgan Jones, Javad Parvizi, Patricia Peel, Salvador Rivero-Boschert, Carlo Romano, John Segreti, Alex Soriano, Ricardo Sousa, Mark Spanghel, Timothy L. Tan, Rashid Tikilov, Ibrahim Tuncay, Heinz Winkler, Eivind Witso, Marjan Wouthuyzen-Bakker, Simon Young, Xianlong Zhang, Yixin Zhou, Wer Zimmerli 翻訳者：小林直実

推奨：2018年 International Consensus Meeting (ICM) for PJI で提唱された以下の figure を参照とする。

大基準（以下の 2 項目のうち少なくとも 1 つを満たす）			診断	
通常培養で 2 箇所から同一菌株が陽性			感染	
関節、人工関節に交通する瘻孔の形成				

小基準	閾値		スコア	診断
	急性※ 1	慢性		
血清 CRP（mg/L） または D タイマー（μg/L）	100 不明	10 860	2	術前・術後スコアの合計 ≥ 6　：感染 3 ～ 5　：未確定※ 3 < 3　　：感染ではない
ESR 上昇 (mm/hr)	関連なし	30	1	
関節液白血球数上昇（cells/ μ L） または 白血球エステラーゼ または α ディフェンシン陽性（signal/cutoff）	10,000 ++ 1.0	3,000 ++ 1.0	3	
関節液多形核好中球（PMN） 上昇（%）	90	70	2	
培養陽性が 1 つ			2	
病理組織所見陽性			3	
術中の明らかな膿の存在※ 2			3	

※1：本基準は急性感染では検証されていない。 ※2：adverse local tissue reactionが疑われる症例では適応されない。

※3：next-generation sequencingなど分子生物学的診断法を考慮する。

FIGURE 1. Proposed 2018 ICM Criteria for PJI.

エビデンスレベル：Moderate

投票結果：賛成 68%、反対 28%、棄権 4%（大多数、弱いコンセンサス）

質問2：膝関節における化膿性関節炎の定義は？

著者：Douglas Dennis, Ali Parsa, José Ricardo Pécora 翻訳者：小林直実

推奨：化膿性膝関節炎は関連する検査データに基づき臨床的に診断する。化膿性関節炎の徴候としては疼痛を伴う液体貯留、可動域制限と熱感が挙げられる。血液生化学検査、特にCRP、関節液中白血球数 (50,000/mm³)、好中球数分画 (> 90%)、そして関節液の膿様所見などは化膿性関節炎を疑う所見である。

エビデンスレベル：Moderate

投票結果：賛成 92%、反対 7%、棄権 1%（大多数、強いコンセンサス）

質問3：表層SSIsと深部SSIs(PJI)はどのように識別可能か？

著者：Konstantinos Malizos, Georgios Komnos, Antonios Koutalos 翻訳者：小林直実

推奨：表層SSI、深部SSI、PJIを識別する客観的検査や画像診断は未だ確立されていない。臨床評価、感染の精密検査、早期の関節穿刺により識別することが推奨される。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 3%、棄権 1%（満場一致、最も強いコンセンサス）

質問4：化膿性股関節炎と単純性股関節炎はどのように識別可能か？

著者：Alexander J. Shope, Aresh Hashemi-Nejad 翻訳者：小林直実

推奨：現状、化膿性股関節炎と単純性股関節炎を識別するには侵襲的検査が必要である。診断確定用のアルゴリズムも開発されてきたが、一般化に至るエビデンスは足りておらず、更なる研究が必要である。これらの疾患を識別するには、従来どおり医師が患者を治療しながら行う臨床推論・評価・判断を基準とすべきである。

エビデンスレベル：Limited**投票結果**：賛成 88%、反対 3%、棄権 9%（大多数、強いコンセンサス）**質問5：PJIの診断においてどのような臨床所見(例：発熱・紅斑・可動域の減少)の感度と特異度が最も高いか？**

著者：Luiz S. Marcelino Gomes, Noam Shohat, Sergio S. Zullo, Gilberto A. Pereira 翻訳者：小林直実

推奨：人工関節の痛みが最も感度が高いが、PJIの所見としては最も特異度が低い。深部組織に関わる兆候（すなわち 瘻孔、膿、膿瘍、広範囲の壊死）が最も特異度の高い兆候である。関節の種類（股関節あるいは膝関節）、また、PJI発症のタイミング（術後早期なのか、急性血行性か慢性なのかなど）によって臨床所見が大いに変わる点に注意すべきである。

エビデンスレベル：Moderate**投票結果**：賛成 97%、反対 1%、棄権 2%（満場一致、最も強いコンセンサス）**質問6：術中に膿を認めた場合はPJIの明確な兆候と言えるか？**

著者：Javad Mortazavi, Erik Hansen 翻訳者：小林直実

推奨：術野の膿の存在をPJIの明確な兆候とすべきではない。膿の定義は主観的であり、PJIの診断マーカーとしての感度も特異度も高くない。膿をPJIの診断基準とするには、感染による膿の客観的で確証された定義が必要である。

エビデンスレベル：Moderate**投票結果**：賛成 75%、反対 22%、棄権 3%（大多数、強いコンセンサス）**質問7：無菌性ゆるみ(AL)と診断未確定のPJIには関連性があるか？**

著者：Juan C. Martinez Pastor, Derek Amanatullah, Stuart Goodman, Ester Garcia Oltra, Marta Sabater Martos, Jake A. Mooney

翻訳者：小林直実

推奨：ALの何割かは培養陰性感染であるが、培養陰性症例に分子生物学的検査法を実施すると、その最大10%に細菌が検出されことが示されている。しかし診断未確定の感染がALを発症させるかは不明である。細菌培養検査は限界があるためこの問題に対する回答は困難である。次世代シーケンシングなど分子生物学的検査の更なる開発が必要である。

エビデンスレベル：Limited**投票結果**：賛成 90%、反対 8%、棄権 2%（大多数、強いコンセンサス）**質問8：PJIはhighまたはlow-grade infectionと分けられるか？分けられるなら、それぞれのグレードの定義は何か？**

著者：Geert Meermans, Brian Hamlin, Ed McPherson 翻訳者：小林直実

推奨：PJIにおける“infection grade”の採点および分類は可能である。現時点では、McPherson schemaのPJIグレーディングの使用を推奨する。本グレーディング結果は宿主の免疫状態および下肢スコアの低下との相関を明らかにした。国際的なワークグループがステージングシステムの体系化を完成させるまでは、このスキーム（もしくは改良版）を用いることを推奨する。

エビデンスレベル：Moderate**投票結果**：賛成 74%、反対 12%、棄権 14%（大多数、強いコンセンサス）**2.2. 診断：アルゴリズム****質問1：アメリカ整形外科学会(AAOS)が制定するPJI診断アルゴリズムに賛成するか？**

著者：Timothy L. Tan, Javad Parvizi, Craig J. Della Valle, Noam Shohat 翻訳者：小林直実

推奨：是とする。ただし、AAOSのアルゴリズムが紹介されて以降、新たな検査や診断法が続々と生み出されている。AAOSが提案するエビデンスに基づき確証されたアルゴリズムには、AAOSのガイドラインや2013 International Consensus Meeting (ICM) on PJIが含まれている。初段階では血清マーカーを使用し、次段階でさらに特異的で侵襲的な検査をするなど、段階的なアルゴリズムを使用することが引き続き推奨される。

エビデンスレベル：Moderate**投票結果**：賛成 73%、反対 23%、棄権 4%（大多数、強いコンセンサス）

質問2：再置換術前の膝／股関節穿刺において禁忌はあるか？

著者：Mahmoud Abdel Karim, Derek Ward, Jonathan Danoff 翻訳者：小林直実

推奨：患者の感染検査の一つとして実施される膝や股関節の穿刺には、明確に特定される禁忌はない。**エビデンスレベル**：Limited**投票結果**：賛成 90%、反対 8%、棄権 2%（大多数、強いコンセンサス）**質問3：ドライタップの場合、洗浄による液体回収を施すべきか？**

著者：Faiz Shivji, Riccardo Compagnoni, Ernesto Guerra, Jorge Nuñez, Toni Fraguas 翻訳者：手塚太郎、小林直実

推奨：関節液が引けず（ドライタップ）、PJI が疑われる関節への生理食塩水やその他液体注入による回収液の使用は推奨できない。ただし、ある特定の状況下を除くものとする（例：放射線の専門家が無菌状態を維持した状態で穿刺を行うなど）。**エビデンスレベル**：Limited**投票結果**：賛成 83%、反対 14%、棄権 3%（大多数、強いコンセンサス）**質問4：TJAを複数箇所施行されている患者において、一つの関節でPJIを発症した場合、他の関節もPJIの検査をすべきか？**

著者：Georgios Komnos, Akos Zahar, Thorsten Gehrke, Matthias Wolf 翻訳者：手塚太郎、小林直実

推奨：患者がひとつの関節でPJIを発症した場合、TJA が施行されている他の関節も臨床的な検査をすべきである。そしてその結果PJIの疑いが残った場合や患者が免疫不全である場合は関節穿刺を施行すべきである。**エビデンスレベル**：Limited**投票結果**：賛成 92%、反対 6%、棄権 2%（大多数、強いコンセンサス）**質問5：PJIの診断のための point-of-care (POC) rapid tests（簡易迅速診断）は確証された有用なテストか？**

著者：Akos Zahar, Jeroen Neyt, Cesar H. Rocha, Thorsten Gehrke, Christian Lausmann, Julia Vasquez 翻訳者：手塚太郎、小林直実

推奨：有用である。PJI の診断検査として追加できる有用な POC tests はいくつかある。白血球エステラーゼテストや α ディフェンシンラテラルフローテストの有用性と信頼性は数々の研究が証明している。PJI の診断基準を改訂し、これらの検査を含めるよう検討すべきである。**エビデンスレベル**：Moderate**投票結果**：賛成 73%、反対 21%、棄権 6%（大多数、強いコンセンサス）**質問6：培養陰性PJI (CN-PJIs)の罹患率は？ また、そのような症例を確実に診断するためのプロトコルは？**

著者：Karan Goswami, Yong-Chan Ha, Marie-Jacque Reisener, Carsten Perka, Pedro Foguet 翻訳者：手塚太郎、小林直実

推奨：これまで報告されている股関節あるいは膝関節の CN-PJIs 罹患率は、5～42%である。これらのケースをさらに研究するための診断プロトコルには、複数回のサンプル採取、培養期間の延長、インプラントの超音波処理、dithiothreitol (DTT) の使用、PCR、次世代シーケンシング (NGS) などが含まれる。**エビデンスレベル**：Moderate**投票結果**：賛成 91%、反対 8%、棄権 1%（大多数、強いコンセンサス）**質問7：Adverse local tissue reactions (ALTRs)の患者は、PJIを発症する確率が高いか？**

著者：Benjamin A. McArthur, Michael Cross, John Andrawis, Carl Nunziato, Andrea Leyton-Mange 翻訳者：手塚太郎、小林直実

推奨：高い。ALTRs 患者はPJIの発症率が高いと思われる。**エビデンスレベル**：Moderate**投票結果**：賛成 95%、反対 2%、棄権 3%（満場一致、最も強いコンセンサス）**質問8：TJAに痛みをきたした患者を検査する際、血清金属イオン濃度(コバルトおよびクロム)の評価をルーチン化すべきか？**

著者：Paul Lachiewicz, Brett Levine, Daniel Schweitzer, Ianiv Klaber, Francisco Bengoa 翻訳者：手塚太郎、小林直実

推奨：TJA に痛みをきたした全ての患者において、血清金属イオン濃度（コバルトおよびクロム）の評価をルーチン化すべきとするデータはない。痛みをきたしたメタル-オン-メタル (MoM) THA、表面置換型 THA、モジュラーネック型大腿骨インプラント、およびトラニオンの腐食が疑われる一部のメタル-オン-ポリエチレン (MoP) THA の金属イオン濃度を二次的な評価項目にすることには理論的根拠があると考えられる。**エビデンスレベル**：Limited

投票結果：賛成 92%、反対 4%、棄権 4%（大多数、強いコンセンサス）

質問9：Adverse local tissue reaction (ALTR)が存在する場合、PJIはどのように診断すべきか？

著者：Carlos Bracho, Rafael J. Sierra, Rene Mihalić, Craig J. Della Valle, Linda Suleiman 翻訳者：手塚太郎、小林直実

推奨：ALTRが存在するPJIの診断は、通常の診断に使われる多くの検査（手術部位の性状を含む）において偽陽性となることから、困難である。術前から股関節穿刺（関節液中の白血球数の評価や、培養検査など）などの積極的な評価が推奨される。関節液の白血球エステラーゼ検査はALTRsを合併するPJIの診断において容易に実行可能であり安価で信頼性のある検査と考えられる。ALTRsを合併するPJIの診断において、その他の関節液バイオマーカーの有効性を裏付けるエビデンスはない。

エビデンスレベル：

Test	Strength
臨床・画像所見	Consensus：ALTRのPJI診断を裏付けるエビデンスはない。
血清マーカー（ESRおよびCRP）	Strong
関節液中白血球数および好中球分画	Strong
関節液中白血球エステラーゼ	Moderate
CRP in synovial fluid 関節液中CRP	Limited
その他の関節液バイオマーカー（α-ディフェンシン、IL-6, and IL-8など）	Consensus：ALTRのPJI診断を裏付けるエビデンスはない。

投票結果：賛成 84%、反対 7%、棄権 9%（大多数、強いコンセンサス）

2.3. 診断：臨床検査

質問1：PJIの診断ツールにおいて、適切な感度、特異度、陰性適中率(NPV)、および陽性適中率(PPV)はどのくらいか？

著者：Noam Shohat, Susan Odum 翻訳者：手塚太郎、小林直実

推奨：従来、診断ツールの妥当性は、感度、特異度、PPVおよびNPVによって測定される。診断ツールが完璧であれば、PJI患者の100%を感染、無菌患者の100%を非感染と正しい分類が可能となる。だが現状では利用可能な完璧な検査法がないため、感度と特異度の間で一方が増えれば他方が減るというバランス上に成り立っている。偽陽性および陰性の発生率を減らすためには、患者の危険因子、臨床検査、その他評価時に利用可能な検査等から導き出される、感染の検査前確率を考慮に入れることが非常に重要である。

TABLE 1. PJI診断ツールの種類

診断ツール	感度 (95% CI)	特異度 (95% CI)	陽性適中率 (95% CI)	陰性的中率 (95% CI)
血清検査	98.5%* (96.2-99.6)	100% (97.6-100)	100% (100-100)	97.5% (93.7-99.1)
関節液検査	100%* (98.3-100)	100% (85.2-100)	100% (100-100)	100% (100-100)
術中所見	92.9% (80.5-98.5)	95.8% (78.8-99.9)	97.5% (85.1-99.6)	88.5% (72.0-95.8)
総合	96.9% (93.8-98.8)	99.5% (97.2-100)	100% (99.7-100)	96.7% (93.3-98.4)

CI Confidence Interval (信頼区間)
※感染あるいは要追加検査と診断される感度

エビデンスレベル：Moderate

投票結果：賛成 79%、反対 10%、棄権 11%（大多数、強いコンセンサス）

質問2：ESRとCRPが共にPJIと診断される閾値を下回る場合、PJIの診断を除外するか？

著者：Montri D. Wongworawat, Jay Shah, Grigor Grigoryan, Jonathan D. Creech 翻訳者：手塚太郎、小林直実

推奨：ESRとCRPが閾値（MSISとICMで定義された閾値）を下回る場合でも、PJIの診断は除外されない。増殖速度の遅い細菌により発症したPJIの場合、ESRとCRPの値が正常値を示すケースもある。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：PJIの診断においてD-ダイマーの診断制度と閾値は？

著者：Majd Tarabichi, AliSina Shahi 翻訳者：手塚太郎、小林直実

推奨：最近の文献では、PJIの診断のためD-ダイマーを血清マーカーとして使用する事が支持されている。D-ダイマーは850ng/mLが最も有効な閾値であることが示されてきた。だが、この閾値は単施設によるコホート研究にて内部的に定義されたものである。この閾値を検証し、また厳密な閾値を確立するため、更なる研究が必要である。

エビデンスレベル：Limited

投票結果：賛成 74%、反対 16%、棄権 10%（大多数、強いコンセンサス）

質問 4：関節液中白血球数および関節液中好中球分画レベルは、TJA 後にどのような経時的変化を示すか？

著者：Jess H. Lonner, Yale Fillingham, Hany Bedair 翻訳者：手塚太郎、小林直実

推奨：関節液中白血球数と関節液中好中球分画レベルは、術後の時間が経過するにつれ低下する。後者は、急性および慢性 PJI の診断においてこれらのパラメーターでそれぞれ異なる閾値を使用する理論的根拠である。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 4%、棄権 6%（大多数、強いコンセンサス）

質問 5：PJI の診断における α ディフェンシンの役割は何か？

著者：Stergios Lazarinis, Carl Deirmengian, Hannah Eriksson 翻訳者：手塚太郎、小林直実

推奨：関節液中の α ディフェンシンの測定は、既存の PJI 診断検査の補助となる。

エビデンスレベル：Moderate

投票結果：賛成 82%、反対 14%、棄権 4%（大多数、強いコンセンサス）

質問 6：PJI の診断において、組織学的検査による診断の精度と閾値は？

著者：Thomas W. Bauer, Lars Lidgren, Annette W.-Dahl 翻訳者：手塚太郎、小林直実

推奨：術中凍結切片の組織学的検査および好中球浸潤の有無にはばらつきがある。術中凍結切片の作成および病理結果は、病理医によって結果が大きく変わり得る。

エビデンスレベル：Moderate

投票結果：賛成 88%、反対 5%、棄権 7%（大多数、強いコンセンサス）

質問 7：PJI の診断における特定の顆粒球数の計測法および新たな免疫染色法が担う役割とは？

著者：Thomas W. Bauer, Veit Krenn, Noreen Hickok, Vincent Krenn 翻訳者：手塚太郎、小林直実

推奨：特定の顆粒球数の計測法および新たな免疫染色法の役割とは、感染が疑われる症例における補助的病理診断である。高倍率視野数 5（対物レンズ 400 倍）の各視野で、1 視野あたり 5 個以上の多形核白血球（PMN）を認めた場合有意とすることを推奨する。ホルマリン固定切片およびパラフィン包埋切片に対してのみ実施可能と報告されている。よって、術中に得られた凍結切片には適応は不可である。

エビデンスレベル：Moderate

投票結果：賛成 85%、反対 4%、棄権 11%（大多数、強いコンセンサス）

2.4. 診断：細菌の分離と培養

質問 1：術中細菌培養は人工関節再置換術（RTJA）の施術のたび毎回採取すべきか？ そうであれば、その個数は？

著者：Felix Ogedegbe, Elie Ghanem, Gwo-Chin Lee, Bolarinwa Akinola, George Akin, Andrew S. Moon, Kyle H. Cichos

翻訳者：手塚太郎、小林直実

推奨：すべきである。通常培養は RTJA の施術のたびに毎回採取すべきである。少なくとも 3 つの術中培養サンプルを採取すべきである。

エビデンスレベル：Moderate

投票結果：賛成 87%、反対 12%、棄権 1%（大多数、強いコンセンサス）

質問 2：術前穿刺して得られた検体と術中に採取された組織で培養の結果に違いはあるか？ もしあるなら、どちらの結果を採用すべきか？

著者：Tobias Winkler, Carl Deirmengian, Doruk Akgün 翻訳者：手塚太郎、小林直実

推奨：混合感染や弱毒性細菌による感染の場合には特に、術前穿刺検体と術中組織検体の培養の結果に差が生まれる可能性がある。関節から組織を採取する際に培養同定率を最大にするため、術中組織サンプルを複数箇所より収集することが推奨される。

エビデンスレベル：Limited

投票結果：賛成 98%、反対 1%、棄権 1%（満場一致、最も強いコンセンサス）

質問3：骨の培養は、PJIの診断精度を向上させるか？

著者：Richard de Steiger, Brian Hamlin, Sina Babazadeh 翻訳者：手塚太郎、小林直実

推奨：未だコンセンサスは得られていない。PJIの診断精度を上げるために追加で骨の培養をすべきか否か、現段階では判断不可である。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 5%、棄権 5%（大多数、強いコンセンサス）

質問4：二期的再置換術におけるインプラント挿入時において、術前や再置換時に培養組織を採取する意義はあるか？

著者：Stuart Goodman, Derek F. Amanatullah, Katherine Hwang 翻訳者：手塚太郎、小林直実

推奨：術前関節穿刺をするか否かは持続感染の疑いの指標に基づき決定すべきである。ただし、再置換術中は、複数の関節液および組織サンプルを培養検査に提出すべきである。二期的再置換術の臨床成績と再置換術中に採取した組織の培養検査結果との間には正の相関関係がある。

エビデンスレベル：Moderate

投票結果：賛成 95%、反対 4%、棄権 1%（満場一致、最も強いコンセンサス）

質問5：TJAを受ける患者において、当該関節にORIFの手術歴(例：過去の寛骨臼骨折など)がある場合、ルーチンの培養検査を実施すべきか？

著者：Paulo Alencar, Olivier Borens, Rui Manuel Vicente Cabral, Jorge Manrique, João Rodolfo Radtke Gonçalves 翻訳者：手塚太郎、小林直実

推奨：過去にORIFを受けた同じ関節に全置換術を施す場合、術中組織培養を採取すべきである。

エビデンスレベル：Limited

投票結果：賛成 87%、反対 11%、棄権 2%（大多数、強いコンセンサス）

質問6：抜去したインプラントに超音波処理を施す意義はあるか？

著者：Matthew Abdel, Brian A. Klatt, Shaoqi Tian, C.G. Salib 翻訳者：手塚太郎、小林直実

推奨：いくつかの研究では、とりわけ培養陰性感染例において、抜去した整形外科用インプラントの超音波処理により菌の検出が可能であることが実証された。

エビデンスレベル：Moderate

投票結果：賛成 88%、反対 8%、棄権 4%（大多数、強いコンセンサス）

2.5. 診断：インプラント再置換術

質問1：MSISおよびICMが定める基準は人工関節再置換術前の方針決定に有効か？

著者：Carlos A. Higuera, AliSina Shahi 翻訳者：手塚太郎、小林直実

推奨：再置換の時期を決定するためにMSISおよびICM基準が妥当であるかは不明である。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 7%、棄権 3%（大多数、強いコンセンサス）

質問2：感染した股関節や膝の二期的再置換術においてインプラント抜去後の人工関節再置換術の時期を決定するためにどのような指標に基づくべきか？

著者：Arash Aalirezaie, Job Diego Velázquez Moreno, Dirk-Jan Moojen 翻訳者：手塚太郎、小林直実

推奨：人工関節再置換の最適な時期を決定付ける明確な指標はない。よって再置換の時期は、感染の臨床的徴候の軽減、血清マーカーの減少傾向および関節液分析の結果（穿刺が施された場合）に基づいて決定すべきである。

エビデンスレベル：Moderate

投票結果：賛成 96%、反対 3%、棄権 1%（満場一致、最も強いコンセンサス）

質問3：二期的再置換術の一部として行われる人工関節再置換術において、術前血清マーカーの正常化は必要か？

著者：Marco Teloken, Scott Sporer 翻訳者：手塚太郎、小林直実

推奨：必要ではない。CRPやESRは低下傾向であることが望ましいが、これらが異常値を示していても再置換術が行われる症例もある。外科医は炎症マーカーの完全な正常化を待つべきではない。一部の患者では完全には正常化しない可能性や、するとしても長期間かかる可能性があるからである。

エビデンスレベル：Moderate

投票結果：賛成 95%、反対 4%、棄権 1%（満場一致、最も強いコンセンサス）

質問4：再置換術前に抗菌薬を2週間休薬する重要性は何か？

著者：Hangama Fayaz, Carlos A. Higuera, Igor Shubnyakov 翻訳者：手塚太郎、小林直実

推奨：不明である。再置換術前に抗菌薬を休薬する必要性あるいは理想的な休薬期間を裏付ける決定的なエビデンスはない。**エビデンスレベル**：Limited**投票結果**：賛成 92%、反対 7%、棄権 1%（大多数、強いコンセンサス）**質問5：臨床評価、画像診断、血清学的検査、生検と組み合わせたセメントスパーサー留置関節の関節穿刺の診断精度は？ 再置換術前のルーチン検査とすべきか？**

著者：Hangama Fayaz, Carlos A. Higuera, Igor Shubnyakov 翻訳者：手塚太郎、小林直実

推奨：再置換術前の関節穿刺の診断精度は不明である。PJI の診断に使用される各パラメーターやその閾値のいずれも、穿刺の必要性を決定付けるものではない。穿刺を行うかどうかの決定は、持続感染疑いの指標に基づいて行い、個々の状況に応じるべきである。**エビデンスレベル**：Moderate**投票結果**：賛成 95%、反対 4%、棄権 1%（満場一致、最も強いコンセンサス）**質問6：人工関節再置換術の術中検査基準において、方針決定や再発リスクの軽減に役立つ基準は何か？**

著者：Camilo Restrepo, William Griffin 翻訳者：手塚太郎、小林直実

推奨：術中検査では、凍結切片病理検査および好中球エステラーゼ（LE）が再置換術における方針決定基準として使用できる。**エビデンスレベル**：Limited**投票結果**：賛成 66%、反対 25%、棄権 9%（大多数、弱いコンセンサス）**質問7：人工関節再置換術中の凍結切片(FS)の診断精度は？ また、どの閾値を使用すべきか？**

著者：Thomas W. Bauer, Veit Krenn, Vincent Krenn 翻訳者：手塚太郎、小林直実

推奨：適正に査読された文献によると、股関節および膝関節の PJI 症の診断において次のいずれか 2 つの閾値が支持されている：高倍率（400 倍）顕微鏡視野（HPF）1 視野に 5 個の多形好中球（PMN）浸潤が 5 視野以上認められる場合。または、HPF 1 視野あたり 10 個の PMN 浸潤が 5 視野以上認められる場合である。**エビデンスレベル**：Moderate**投票結果**：賛成 83%、反対 10%、棄権 7%（大多数、強いコンセンサス）**質問8：結核菌(TB)に起因するPJI患者は、再置換術前に抗菌薬を2週間休薬すべきか？**

著者：Aree Tanavalee, Miguel Molano 翻訳者：手塚太郎、小林直実

推奨：再置換術前に 2 週間抗菌薬を休薬すべきとするエビデンスはない。結核による PJI 患者は、2 週間の休薬期間を持つ必要はない。**エビデンスレベル**：Consensus**投票結果**：賛成 88%、反対 6%、棄権 6%（大多数、強いコンセンサス）

2.1. DIAGNOSIS: DEFINITIONS

QUESTION 1: What is the definition of a periprosthetic joint infection (PJI) of the knee and the hip? Can the same criteria be used for both joints?

RECOMMENDATION: See Figure 1, Proposed 2018 International Consensus Meeting (ICM) criteria for PJI.

Major Criteria (at least one of the following)	Decision
Two positive growths of the same organism using standard culture methods	Infected
Sinus tract with evidence of communication to the joint or visualization of the prosthesis	

Minor Criteria	Threshold		Score	Decision
	Acute *1	Chronic		
Serum CRP (mg/L) or D-Dimer (ug/L)	100 Unknown	10 860	2	Combined preoperative and postoperative score: ≥ 6 Infected 3 to 5 Inconclusive *3 <3 Not Infected
Elevated Serum ESR (mm/hr)	No role	30	1	
Elevated Synovial WBC (cells/ μ L) or Leukocyte Esterase or Positive Alpha-defensin (signal/cutoff)	10,000 ++ 1.0	3,000 ++ 1.0	3	
Elevated Synovial PMN (%)	90	70	2	
Single Positive Culture			2	
Positive Histology			3	
Positive Intraoperative Purulence *2			3	

*1 : This criteria were never validated on acute infections. *2 : No role in suspected adverse local tissue reaction.
*3 : Consider further molecular diagnostics such as next-generation sequencing

FIGURE 1. Proposed 2018 ICM Criteria for PJI.

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QUESTION 2: What is the definition of septic arthritis in a native knee?

RECOMMENDATION: Native septic arthritis of the knee is a clinical diagnosis supplemented by relevant laboratory data. Signs of septic arthritis include painful effusion, limited range of motion and warmth. Elevated serum inflammatory markers, particularly C-reactive protein (CRP), synovial white blood cell (WBC) counts (50,000 cells/mm³), polymorphonuclear (PMN) cell count percentages (> 90%) and purulent appearance of the synovial fluid indicate a high likelihood of septic arthritis.

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QUESTION 3: How can superficial surgical site infections (SSIs) be differentiated from deep SSIs (i.e., periprosthetic joint infections (PJIs))?

RECOMMENDATION: There is no single objective clinical test or imaging approach established for the differentiation between a superficial SSI, a deep SSI and a PJI. We recommend that clinical evaluation, workup for infection and early joint aspiration should guide the decision.

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QUESTION 4: How can hip septic arthritis be differentiated from toxic synovitis?

RECOMMENDATION: Currently, there is no single diagnostic test or step that can be performed in order to distinguish a patient with a septic hip from one with toxic synovitis non-invasively. Although algorithms have been created to aid in clinical decision making, there is not enough evidence to support their generalization across all populations, therefore, more research still needs to be conducted before they can be fully validated. Clinical reasoning, evaluation and judgment should still be the standard for which physicians make the distinction between these pathologies as they care for their patients.

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QUESTION 5: What clinical findings (e.g., fever, erythema, reduced range of motion) are most sensitive and specific for the diagnosis of periprosthetic joint infections (PJIs)?

RECOMMENDATION: A painful prosthetic joint is the most sensitive, but least specific clinical finding in PJIs. Signs of deep tissue involvement (i.e., sinus tract, purulence, abscess and extensive necrosis) are the most specific signs. It is important to note that clinical findings differ notably based on the type of joint involved (hip or knee), as well as to the timing and presentation of PJIs (i.e., early postoperative, acute hematogenous and chronic).

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QUESTION 6: Should intraoperative purulence be considered as a definitive sign of a periprosthetic joint infection (PJI)?

RECOMMENDATION: Intraoperative purulence should not be considered a definitive sign of a PJI. The definition of purulence is subjective and is neither a sensitive, nor specific, diagnostic marker of a PJI. A validated, objective definition for purulence due to infection is required to set purulence as a diagnostic criterion for PJIs.

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QUESTION 7: Is aseptic loosening (AL) associated with an undiagnosed periprosthetic joint infections (PJIs)?

RECOMMENDATION: Some percentage of AL is due to culture-negative infection, since up to 10% of culture-negative cases contain bacteria when screened by molecular methods. Whether this correlates to an undiagnosed infection causing AL remains unclear. Understanding this issue is limited by the ability of bacterial culture to function as an effective gold standard for detecting infection. The role of molecular techniques such as next generation sequencing in this setting needs to be explored.

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QUESTION 8: Can periprosthetic joint infection (PJI) be assigned a high- or low-grade infection? If so, what is the definition of each grade?

RECOMMENDATION: Yes, PJI can be scored and assigned an "infection grade." At this juncture, we recommend using the McPherson schema as a starting point for grading PJIs, as this system demonstrates outcomes correlating with worsening host and limb scores. We suggest this schema (or a modified version) as a starting point until an international workgroup establishes a codified staging system.

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2.2. DIAGNOSIS: ALGORITHM

QUESTION 1: Do you agree with the American Academy of Orthopaedic Surgeons (AAOS) algorithm for the diagnosis of periprosthetic joint infections (PJIs)?

RECOMMENDATION: Yes. However, since the introduction of the AAOS algorithm for diagnosis of PJIs, numerous new tests and diagnostic modalities have become available. The proposed evidence-based and validated algorithm includes the guidelines from AAOS and the 2013 International Consensus Meeting (ICM) on PJIs. A stepwise algorithm first using serological markers followed by more specific and invasive tests continues to be recommended.

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QUESTION 2: Are there any contraindications to knee or hip aspiration prior to revision surgery?

RECOMMENDATION: There are no clearly identified contraindications to aspiration of the knee or hip joint performed as part of the patient workup for infection.

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QUESTION 3: In the setting of a dry tap, should lavage with a fluid be performed?

RECOMMENDATION: We recommend against injection of normal saline or other fluids into a joint that did not yield any synovial fluid (dry tap) and is being investigated for a periprosthetic joint infection (PJI); except in certain circumstances (e.g., a dedicated radiologist performing aspirate in a sterile fashion).

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QUESTION 4: In patients with multiple arthroplasties in place who have developed a periprosthetic infection (PJI) of one joint, should other joints be investigated for PJIs also?

RECOMMENDATION: We recommend that when a patient develops a PJI in one joint, the other total joint arthroplasties (TJAs) should be examined clinically and if suspicion for PJI remains, or the patient is immunocompromised, then other joints should be aspirated.

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QUESTION 5: Are point-of-care (POC) rapid tests for diagnosing periprosthetic joint infections (PJIs) validated and useful?

RECOMMENDATION: Yes, there are several useful POC tests which can be added to the diagnostic workup of PJIs. A number of studies support the usefulness and reliability of the leukocyte esterase (LE) test strip and the alpha-defensin lateral flow test kit. Diagnostic criteria for PJIs should be updated and consider inclusion of these tests.

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QUESTION 6: What is the prevalence of culture-negative periprosthetic joint infections (CN-PJIs) and what are the diagnostic protocols for further investigating these cases?

RECOMMENDATION: The reported prevalence of CN-PJIs in the hip or knee has ranged from 5-42%. Diagnostic protocols for further investigating these cases include repeat sampling, longer incubation of culture samples, sonication of implants, the use of dithiothreitol (DTT) technology, polymerase chain reaction (PCR) and next generation sequencing (NGS).

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QUESTION 7: Do patients with adverse local tissue reactions (ALTRs) have a higher incidence of periprosthetic joint infections (PJIs)?

RECOMMENDATION: Yes. Patients with ALTRs appear to have a higher incidence of PJIs.

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QUESTION 8: Should we routinely assess for serum/blood metal ion levels (cobalt (Co) and chromium (Cr)) when working up a patient with a painful total joint arthroplasty?

RECOMMENDATION: There is no data to suggest routine assessment of serum/blood metal ion levels (CoCr) in all patients with painful joint arthroplasty. There may be a rationale for second-line assessment of metal levels in painful metal-on-metal (MoM) total hip arthroplasty (THA), hip resurfacing, modular neck femoral components and in certain metal-on-polyethylene (MoP) THA in which trunnion corrosion is suspected.

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QUESTION 9: How is a periprosthetic joint infection (PJI) diagnosed in the presence of adverse local tissue reaction (ALTR)?

RECOMMENDATION: The diagnosis of PJI in the presence of an ALTR is challenging as many of the commonly used tests for diagnosis (including the appearance of the surgical site) can be falsely positive. An aggressive approach to preoperative evaluation including an aspiration of the hip joint (sending the fluid for a manual synovial fluid white blood cell (WBC) count, differential and culture) is recommended. Testing the synovial fluid for leukocyte esterase (LE) appears as a feasible, inexpensive and reliable test for the diagnosis of PJIs in ALTRs. There is no supporting evidence for other synovial fluid biomarkers in the diagnosis of PJIs in the presence of ALTRs.

LEVEL OF EVIDENCE:

Test	Strength
Clinical and radiological findings	Consensus. There is no supporting evidence for PJI diagnosis in ALTR
Serum markers (ESR and CRP)	Strong
Synovial fluid WBC count, manual and PMNs	Strong
Leukocyte esterase in synovial fluid	Moderate
CRP in synovial fluid	Limited
Other fluid biomarkers (i.e., α -defensin, IL-6, and IL-8)	Consensus: There is no supporting evidence for PJI diagnosis in ALTR

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2.3. DIAGNOSIS: LABORATORY TESTS

QUESTION 1: What is an acceptable sensitivity, specificity, negative predictive value (NPV) and positive predictive value (PPV) for a diagnostic tool for periprosthetic joint infections (PJIs)?

RECOMMENDATION: The validity of a diagnostic tool is traditionally measured by sensitivity, specificity, PPV and NPV. A perfect diagnostic tool would be able to correctly classify 100% of patients with PJIs as infected and 100% of aseptic patients as non-infected. Without a perfect test available, we are left to balance between sensitivity and specificity; increasing one would reduce the other. To reduce the rates of false positives and negatives it is extremely important to take into account the pretest probability for infection, derived from patient risk factors, clinical examination and any other examinations available at the point of assessment.

TABLE 1. Variety of diagnostic tools for PJI

Variable	Sensitivity (95% CI)	Specificity (95% CI)	Positive Predictive Value (95% CI)	Negative Predictive Value (95% CI)
Serum testing	98.5%* (96.2-99.6)	100% (97.6-100)	100% (100-100)	97.5% (93.7-99.1)
Synovial fluid testing	100%* (98.3-100)	100% (85.2-100)	100% (100-100)	100% (100-100)
Intraoperative Findings	92.9% (80.5-98.5)	95.8% (78.8-99.9)	97.5% (85.1- 99.6)	88.5% (72.0-95.8)
Overall	96.9% (93.8-98.8)	99.5% (97.2-100)	100% (99.7-100)	96.7% (93.3-98.4)

CI, confidence interval

*Sensitivity for being diagnosed as infected or for moving forward for additional workup.

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QUESTION 2: Does the presence of both an erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) below the periprosthetic joint infection (PJI) thresholds rule out the diagnosis of a PJI?

RECOMMENDATION: Serum ESR and CRP levels below the threshold (as determined by the MusculoSkeletal Infection Society (MSIS) and International Consensus Meeting (ICM)) does not exclude the diagnosis of a PJI. Serum levels of ESR and CRP can be normal in some cases of PJI caused by slow-growing organisms.

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QUESTION 3: What is the diagnostic accuracy and threshold of D-dimer in the diagnosis of periprosthetic joint infections (PJIs)?

RECOMMENDATION: Recent literature supports the use of D-dimer as a serological marker for the diagnosis of PJIs. D-dimer has been shown to best perform at a threshold of 850 ng/mL. However, this threshold was determined internally from a cohort in a single institution study. Further studies are needed in order to validate this threshold or establish a more rigorous threshold.

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QUESTION 4: How does the level of leukocyte count and neutrophil percentage in the synovial fluid change with time following total joint arthroplasty?

RECOMMENDATION: The levels of leukocyte count and neutrophil percentage in the synovial fluid drop as one moves further away from the index arthroplasty. The latter is the rationale behind using different thresholds for these parameters in the diagnosis of acute versus chronic periprosthetic joint infections (PJIs).

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QUESTION 5: What is the role of alpha-defensin in the diagnosis of periprosthetic joint infections (PJIs)?

RECOMMENDATION: Measurement of alpha-defensin in synovial fluid is a complement to existing diagnostic tests for PJIs.

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QUESTION 6: What is the diagnostic accuracy of histologic tests and thresholds used in the diagnosis of periprosthetic joint infections (PJIs)?

RECOMMENDATION: There is a variability of the histologic examination of intraoperative frozen sections as well as the thresholds used for the presence of neutrophils. The preparation and interpretation of frozen sections can be highly operator-dependent.

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QUESTION 7: What is the role of specific granulocyte counting methods and new immunohistologic staining techniques in diagnosing periprosthetic joint infection (PJI)?

RECOMMENDATION: The role of specific granulocyte counting methods and new immunohistologic staining techniques is to support the diagnosis of infection when diagnosis is uncertain. The recommended threshold is 5 or more polymorphonuclear leukocytes (PMNs) per field in each of 5 high power (400x objective) magnification fields. The stains reported-to-date can only be performed on sections of formalin-fixed, paraffin embedded tissue. Therefore, they are not available for use on frozen sections obtained during an operation.

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2.4. DIAGNOSIS: PATHOGEN ISOLATION, CULTURE RELATED

QUESTION 1: Should intraoperative cultures be taken during every revision total joint arthroplasty (RTJA)? If so, how many?

RECOMMENDATION: Yes, routine cultures should be taken during every RTJA. At least three intraoperative culture samples should be obtained.

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QUESTION 2: Are there significant differences in the yield of culture between preoperative aspiration and intraoperative culture samples? If so, which result should be utilized?

RECOMMENDATION: There may be differences in the yield of culture between preoperative aspiration and intraoperative culture samples, particularly in the case of polymicrobial infections or low-virulence organisms. The collection of multiple intraoperative tissue samples is considered by many experts to provide the highest yield in isolating organisms from a joint.

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QUESTION 3: Do bone cultures provide additional diagnostic accuracy in the diagnosis of periprosthetic joint infections (PJIs)?

RECOMMENDATION: Inconclusive. We cannot recommend for or against bone biopsy to provide additional diagnostic accuracy in the diagnosis of PJIs.

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QUESTION 4: Is there a role for obtaining cultures before, and at the time of, insertion of prosthesis during second stage (reimplantation) of a two-stage exchange arthroplasty?

RECOMMENDATION: Preoperative aspiration of a joint should be determined based on the index of suspicion for persistent infection. During reimplantation, however, multiple fluid and tissue samples should be sent for culture. There is a direct correlation between the outcome of two-stage exchange arthroplasty and culture results during reimplantation.

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QUESTION 5: Should routine cultures be taken in patients undergoing total joint arthroplasty (TJA) who had a previous open reduction and internal fixation (ORIF) of the same joint (e.g., prior acetabular fracture)?

RECOMMENDATION: Intraoperative cultures should be taken in patients undergoing TJA who have had a prior ORIF of the same joint.

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QUESTION 6: Is there a role for sonication of implants retrieved during explantation?

RECOMMENDATION: Several studies have demonstrated that sonication of explanted orthopaedic prostheses is a viable method for detecting pathogens, particularly in the setting of culture-negative infections.

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2.5. DIAGNOSIS: REIMPLANTATION

QUESTION 1: Are the MusculoSkeletal Infection Society (MSIS) and International Consensus Meeting (ICM) criteria valid for decision-making before reimplantation?

RECOMMENDATION: The validity of the MSIS and ICM criteria for determination of the timing of reimplantation is unclear.

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QUESTION 2: What metrics should be considered to determine the timing of reimplantation after two-stage exchange arthroplasty of the infected hip or knee?

RECOMMENDATION: There are no definitive metrics to allow determination of optimal timing of reimplantation. Thus, timing of reimplantation should consider resolution of clinical signs of infection, down-trend in the serological markers and results of synovial analysis, if aspiration is performed.

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QUESTION 3: Is normalization of serological markers necessary prior to reimplantation arthroplasty performed as part of a two-stage exchange?

RECOMMENDATION: No. A trend and decline in C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) is expected, but we still recognize that there are certain cases in which reimplantation may be performed despite abnormal levels of ESR and CRP. Surgeons should not wait for complete normalization of the inflammatory markers as this may not occur in some patients and/or take a long period of time.

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QUESTION 4: What is the importance of two-week antibiotic holiday prior to reimplantation?

RECOMMENDATION: Unknown. There is no conclusive evidence to support the need or the ideal length of an antibiotic holiday prior to reimplantation.

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QUESTION 5: What is the diagnostic accuracy of joint aspiration of a cement spacer in conjunction with clinical evaluation, imaging, serologic tests, and biopsies? Should it routinely be performed prior to reimplantation?

RECOMMENDATION: The diagnostic accuracy of joint aspiration prior to reimplantation is not known. None of the parameters being used to diagnose periprosthetic joint infection (PJI), and their respective thresholds, have been determined for aspiration. The decision to perform aspiration should be made based on the index of suspicion for persistent infection and individualized.

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QUESTION 6: What intraoperative metrics can be utilized at the time of intended reimplantation to help decision-making and reduce the risk of subsequent recurrence?

RECOMMENDATION: Intraoperatively, frozen section and leukocyte esterase (LE) strip test can be used as decision-making metrics for reimplantation.

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QUESTION 7: What is the diagnostic accuracy of a frozen section (FS) during reimplantation surgery? What thresholds should be used in this context?

RECOMMENDATION: Adequate peer-reviewed literature exists to support either of two diagnostic thresholds for supporting the diagnosis of periprosthetic infections of the hip and knee: 5 neutrophils (PMNs) in each of at least 5 high power (400X) microscopic fields (HPF), or 10 PMNs in each of at least 5 HPFs.

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QUESTION 8: Should patients with periprosthetic joint infections (PJIs) caused by *Mycobacterium tuberculosis* (TB) undergo the typical two-week antimicrobial holiday prior to reimplantation?

RECOMMENDATION: There is no evidence supporting the two-week antimicrobial holiday before reimplantation. Patients with PJIs caused by TB do not need to have the two-week drug holiday.

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質問 1：原因菌の毒力(弱毒または強毒)は、急性血行性あるいは慢性 PJI の治療に影響するか？

著者：Henk Scheper, Marjan Wouthuyzen-Bakker, Juliana Matos, Arana Stanis Schmaltz, Julia Herkenhoff Carijo 翻訳者：森井健司

推奨：急性血行性あるいは慢性 PJI の治療に、原因菌の毒力が影響することを示すエビデンスは現在存在しない。**エビデンスレベル：**Limited**投票結果：**賛成 69%、反対 27%、棄権 4%（大多数、弱いコンセンサス）**質問 2：単数菌感染と複数菌感染間で PJI の治療成績に差はあるか？**

著者：Timothy A. Tan, Igor Shubnyakov 翻訳者：森井健司

推奨：単数菌感染による PJI と比較すると、複数菌感染による PJI は治療成績が不良である。これは、洗浄デブリドマンで治療された患者と二期的再置換術で治療された患者のいずれにも当てはまる。**エビデンスレベル：**Moderate**投票結果：**賛成 97%、反対 3%、棄権 0%（満場一致、最も強いコンセンサス）**質問 3：TKA と THA の間では、SSI/PJI の原因菌に相違はあるか？**

著者：Karan Goswami, Hannah Groff 翻訳者：森井健司

推奨：TKA と THA の間で SSI/PJI の原因菌プロファイルに差があることを示唆するエビデンスは限られている。膝関節においては *Streptococcus* 属及び培養陰性例が多く、一方で股関節においては *Staphylococcus* 属、*Enterococcus* 属、*Pseudomonas* 属による PJI が多いという報告を認める。部位による原因菌の相違について今後のさらなる検証が必要であり、抗菌薬選択の一助となる可能性がある。**エビデンスレベル：**Limited**投票結果：**賛成 92%、反対 4%、棄権 4%（大多数、強いコンセンサス）**質問 4：PJI の原因菌プロファイルは、国により異なるか？**

著者：Paul M. Courtney, Nemandra A. Sandiford, Daniel Kendoff 翻訳者：森井健司

推奨：異なる。PJI 原因菌プロファイルは国や地域による相違がある。欧州と比較すると、米国およびオーストラリアでは MRSA による PJI の発生頻度が高い傾向がある。**エビデンスレベル：**Moderate**投票結果：**賛成 97%、反対 1%、棄権 2%（満場一致、最も強いコンセンサス）

QUESTION 1: Does the virulence (low or high) of the infecting organism affect the treatment of acute hematogenous or chronic periprosthetic joint infections (PJIs)?

RECOMMENDATION: There is currently no evidence showing that the virulence of an infecting organism affects the treatment of acute hematogenous or chronic PJIs.

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QUESTION 2: Is there a difference in the treatment outcome for periprosthetic joint infections (PJIs) caused by a single organism and a polymicrobial PJI?

RECOMMENDATION: Polymicrobial PJIs demonstrate inferior treatment outcomes when compared to monomicrobial PJIs. This finding is true for both patients treated with irrigation and debridement and two-stage exchange arthroplasty.

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QUESTION 3: Is there a difference in the type of pathogens that can cause surgical site infections/periprosthetic joint infections (SSIs/PJIs) between hip and knee arthroplasty?

RECOMMENDATION: There is limited evidence to support a difference in the organism profile causing SSIs and PJIs between hip and knee arthroplasty. Isolated studies have reported an increased prevalence of *Streptococcal* and culture-negative PJI around the knee, whereas, *Staphylococcal*, *Enterococcal*, *Pseudomonal* PJIs may be more prevalent around the hip. Further work regarding the different flora in these respective body regions is needed, as it may determine antibiotic selection.

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QUESTION 4: Is there a difference in the organism profile that causes periprosthetic joint infections (PJIs) in different countries?

RECOMMENDATION: Yes, there is a difference in the organism profile causing PJIs in different countries and regions of this world. There seems to be a higher incidence of PJI caused by methicillin-resistant *Staphylococcus aureus* (MRSA) in the United States and Australia compared to Europe.

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FUNGAL PERIPROSTHETIC JOINT INFECTION

4.1. 真菌性 PJI：診断と治療

質問 1：真菌性 PJI を診断する適切な方法は？

著者：Feng-Chih Kuo, Majd Tarabichi 翻訳者：森井健司

推奨：真菌性 PJI は関節穿刺液あるいは術中に採取された組織を専用の培地を用いて培養することにより診断される。真菌の菌種の同定は 4 週間を要することもある。培養により診断が困難である場合、真菌を同定することができる分子生物学的手法などを補完的に使用してもよい。

エビデンスレベル：Moderate

投票結果：賛成 95%、反対 3%、棄権 2%（満場一致、最も強いコンセンサス）

質問 2：真菌性 PJI の患者の再置換術に先立って、通常どおり 2 週間の抗菌薬休薬期間を置くべきか？

著者：Feng-Chih Kuo, Giovanni Riccio, Ilaira Repetto 翻訳者：森井健司

推奨：二期的再置換術で治療する真菌性 PJI の症例において、再置換術前に抗菌薬の休薬期間を設けることを支持する決定的なエビデンスはない。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 5%、棄権 5%（大多数、強いコンセンサス）

質問 3：DAIR は、急性真菌性 PJI の治療に適応可能か？

著者：Li Cao, Feng Chih Kuo 翻訳者：森井健司

推奨：真菌性 PJI における DAIR は、特に免疫不全の患者において、比較的高い失敗率を呈する。DAIR の適応は、健康な患者における初回手術例に発生した急性期 PJI（Type A）に限定されるべきである。DAIR が真菌性 PJI に適応される場合、長期間の抗真菌薬投与の適応が考慮されるべきである。

エビデンスレベル：Moderate

投票結果：賛成 91%、反対 5%、棄権 4%（大多数、強いコンセンサス）

質問 4：真菌性 PJI の治療における抗真菌薬の種類、投与方法、投与期間は？

著者：Katherine Belden, Jiying Chen, Feng-Chih Kuo, Rui Li, Jun Fu, Xiangpeng Kong, Haitao Guan, Tao Deng, Chengqi Jia 翻訳者：森井健司

推奨：真菌 PJI の主な原因となる *Candida* に対する感受性を考慮してフルコナゾール の経口または経静脈投与が行われる。リボソーマル アムホテリシン B またはエキノキャンディンの経静脈投与は第 2 選択として考慮されるが、認容性がやや低いようである。抗真菌薬に対する感受性を含む培養結果を、治療法選択の指標に用いるべきである。二期的再置換術が現在の標準的治療法である。最低でも 6 週間のスパーサー挿入期間中は抗真菌薬が投与されるべきである。副作用がなければ、フルコナゾール（一日 400mg）の経口投与を再置換術後 3～6 か月持続するべきである。

エビデンスレベル：Limited

投票結果：賛成 92%、反対 3%、棄権 5%（大多数、強いコンセンサス）

4.1. FUNGAL PERIPROSTHETIC JOINT INFECTION: DIAGNOSIS AND TREATMENT

QUESTION 1: What is the optimal method to diagnose fungal periprosthetic joint infection (PJI)?

RECOMMENDATION: Diagnosis of fungal PJIs is established by incubating joint aspirations or tissue samples collected intraoperatively on specialized culture media. Furthermore, isolation of fungal species may take up to four weeks. However, given the shortcomings associated with the use of culture, alternative techniques capable of detecting fungi, such as molecular techniques, may be used as an adjunct.

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QUESTION 2: Should patients with periprosthetic joint infections (PJIs) caused by a fungus undergo the typical two-week antimicrobial holiday prior to reimplantation?

RECOMMENDATION: There is no conclusive evidence to support the use of an antimicrobial holiday period prior to reimplantation in case of fungal PJI treated with staged revision.

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QUESTION 3: Can debridement, antibiotics and implant retention (DAIR) be used to treat acute fungal periprosthetic joint infections (PJIs)?

RECOMMENDATION: DAIR has a relatively high failure rate in fungal PJIs, especially for immunocompromised patients. DAIR should be reserved for patients with truly acute PJIs after an index arthroplasty and in healthy patients (Type A). If DAIR is performed for fungal PJIs, consideration should be given to anti-fungal suppression therapy.

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QUESTION 4: Which antifungals, route of administration and duration of treatment should be utilized to treat fungal periprosthetic joint infections (PJIs)?

RECOMMENDATION: Fluconazole, by both oral and intravenous routes, is currently the treatment of choice for PJIs due to susceptible fungi, including the *Candida* species which are responsible for the majority of fungal PJI cases. Amphotericin B lipid formulations or echinocandins given intravenously are secondary considerations, but may be less well tolerated. Culture data including antifungal susceptibilities should be used to guide therapy. Two-stage revision is currently the standard of care. Antifungal treatment should be administered during the spacer interval with a minimum treatment duration of six weeks. Following revision, treatment with oral fluconazole (400mg daily) should be continued for three to six months, if tolerated.

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GENERAL ASSEMBLY
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5.1. 治療：アルゴリズム

質問1：早期術後感染と急性血行性感染に対して、異なる治療と対応をすべきか？

著者：Marc Nijhof, Rudolf Poolman, Feng-Chih Kuo, N.J. In den Kleef, Ewout S. Veltman, Dirk Jan F. Moojen 翻訳者：崔賢民、稲葉裕

推奨：症状が出現してから4週以内（できれば7日以内）、インプラントの固定性がよい、瘻孔がない、検出された細菌が抗菌薬に対して感受性がある—これらが当てはまる場合、早期術後感染と急性血行性感染において異なる治療をすべきだという見解を支持するエビデンスはない。

エビデンスレベル：Moderate

投票結果：賛成 94%、反対 5%、棄権 1%（大多数、強いコンセンサス）

質問2：PJIによって全身性敗血症を起こしている患者の外科的治療は通常と異なるべきか？

著者：Antony Rapisarda, Tae-Kyun Kim, Salvador Rivero-Boschert 翻訳者：崔賢民、稲葉裕

推奨：異なるべきである。PJIによる全身性の敗血症を起こしている患者に対しては、抗菌薬治療を併用しながら、外科的な細菌汚染の軽減をインプラントの温存もしくは抜去（適応があり安全であれば）とともに行うべきである。再置換術は敗血症が改善するまで延期すべきである。

エビデンスレベル：Limited

投票結果：賛成 79%、反対 19%、棄権 2%（大多数、強いコンセンサス）

質問3：TJA後、創部からの浸出液が続いている患者にはどのような対応をすべきか？ また外科的治療の適応となるのはどのような場合か？

著者：Ali Oliashirazi, James J. Purtill, Brianna Fram 翻訳者：崔賢民、稲葉裕

推奨：THAもしくはTKA後の創部からの浸出液に対する対応は、非外科的治療と外科的治療の2段階から成る。非外科的治療には、VTE予防薬の中止、栄養学的介入、ドレッシングの工夫（陰圧閉鎖療法）や可動域の制限などが含まれる。非外科的治療を7日間行っても浸出が継続する場合、洗浄・デブリドマン、滑膜切除、一期的再置換術などの外科的治療が適応となる。状況によっては、表層の創部の洗浄も適応となる。

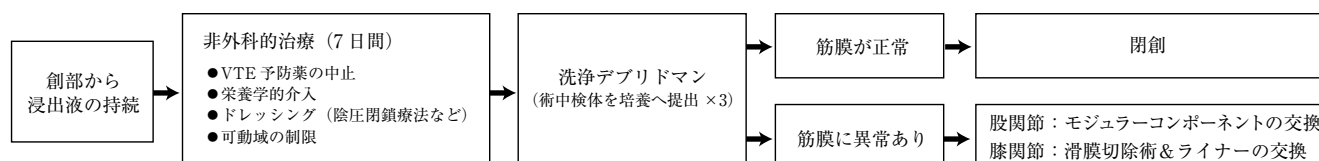


Figure 1：人工関節術後に創部から浸出液の持続

エビデンスレベル：Limited

投票結果：賛成 89%、反対 8%、棄権 3%（大多数、強いコンセンサス）

質問4：両側 THA もしくは TKA の感染はどのように治療するべきか？

著者：Paul M. Courtney, Thanainit Chotanaphuti, Sébastien Lustig 翻訳者：崔賢民、稲葉裕

推奨：両側 THA もしくは TKA 感染に対して、最適な外科的治療方法は明らかではない。コンポーネントの交換は、コンポーネントを温存しながらのデブリドマンと比べて良好な結果となりうるが、一期的再置換術と二期的再置換術のどちらが優れているかを示すデータはない。

エビデンスレベル：Limited

投票結果：賛成 83%、反対 11%、棄権 6%（大多数、強いコンセンサス）

5.2. 治療：デブリドマンとインプラント温存

質問1：PJIの治療において、交換可能なインプラントの交換を伴う DAIR の適応、もしくは禁忌は何か？

著者：Marjan Wouthuyzen-Bakker, Ayman Ebied, Choe Hyonmin, Noam Shohat, Marei, Sameh 翻訳者：渡部慎太郎、崔賢民

推奨：インプラントへの DAIR が最大限に生かされるのは、症状の出現から4週間以内の早期術後感染や急性血行性 PJI でインプラントのゆるみがない症例においてである。KLIC や CRIME80 はリスク評価に有用な指標となりうる。

エビデンスレベル：Moderate

投票結果：賛成 80%、反対 18%、棄権 2%（大多数、強いコンセンサス）

質問2：DAIRは急性PJI患者に対して緊急処置として行うべきか？ もしくはその処置は、DAIRの成功率を上げるための患者状態の最適化を行ってから施行するべきか？

著者：Anna Stefánsdóttir, Georgios Komnos 翻訳者：渡部慎太郎、崔賢民

推奨：DAIRは緊急の処置ではないが、急性PJI患者が医学的かつ外科的に適切な状態である場合は、なるべく緊急で行うべきである。

エビデンスレベル：Limited

投票結果：賛成 97%、反対 3%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：DAIR施行前の原因菌の同定は、整形外科医の治療方針の決定に役立つか？ またその場合、臨床的に状態が安定している患者においては、原因菌の判明を待つべきか？

著者：Jaime Lora-Tamayo, Benjamin Zmistowski, Mikel Mancheno-Losa 翻訳者：渡部慎太郎、崔賢民

推奨：DAIR施行前の原因菌同定は望ましい。しかし、外科的介入の延期によりバイオフィルムの形成が促進され、外科的介入の治療効果を下げる可能性がある場合は、適切な時期の外科的介入を妨げるべきではない。

エビデンスレベル：Limited

投票結果：賛成 94%、反対 4%、棄権 2%（大多数、強いコンセンサス）

質問4：DAIRを行う際に全ての交換可能なインプラントの交換をすることで、SSIやPJIの再発頻度は下がるか？

著者：In Jun Koh, Adrian Taylor, Tae-Kyun Kim, Prashant Meshram 翻訳者：渡部慎太郎、崔賢民

推奨：DAIRを行う際に全ての交換可能なインプラントの交換をすることで、PJIの再発リスクは下がる。

エビデンスレベル：Moderate

投票結果：賛成 94%、反対 4%、棄権 2%（大多数、強いコンセンサス）

質問5：急性PJIのDAIRを行う際、最低限必要な洗浄液の量は？

著者：Wayne G. Paprosky, Evan Schwechter, Linda I. Suleiman, Jeremy Loloi, FosterChen 翻訳者：渡部慎太郎、崔賢民

推奨：急性PJIのDAIRを行う際には、6～9Lの生理食塩水やポビドンヨードの希釈液等で洗浄することを推奨する。

エビデンスレベル：Consensus

投票結果：賛成 90%、反対 7%、棄権 3%（大多数、強いコンセンサス）

質問6：PJIの治療において、洗浄・デブリドマン(I&D)の後に抗菌薬を直接関節内に投与することは有効か？

著者：Leo Whiteside, Briande Beaubien, Kimberly E. Martin, Christopher Ferry 翻訳者：渡部慎太郎、崔賢民

推奨：感染部位における抗菌薬の最小バイオフィルム破壊濃度（MBEC）を達成するという点は注目に値する。良好な結果を報告する後ろ向き研究は存在するが、使用する抗菌薬、対象群、コホートサイズなどにばらつきが多く、ルーチンでの抗菌薬関節内投与はPJIの治療として正当化されない。PJIの治療としてルーチンでの抗菌薬関節内投与の有用性を支持するためには、前向きなランダム比較化試験（RCTs）が必要である。

エビデンスレベル：Consensus

投票結果：賛成 92%、反対 6%、棄権 2%（大多数、強いコンセンサス）

質問7：DAIRはUKAで急性慢性感染を発症した患者にも適応できるか？

著者：Rafael J. Sierra, George Babis, Jean Noël Argenson 翻訳者：渡部慎太郎、崔賢民

推奨：UKA後の急性感染に対しては、早期のDAIRは考慮されるべきである。しかしながら、最初の治療が失敗するか慢性感染が存在する場合、インプラントを抜去し、抗菌薬治療を組み合わせながら一次的もしくは二期的にTKAを行うべきである。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 2%、棄権 2%（満場一致、最も強いコンセンサス）

質問8：DAIRはメガプロステシスのPJIにも適応できるか？

著者：Dwikora Novembri Utomo, Nicolaas Budhiparama, Andrew Battenberg, Ferdiansyah Mahyudin, KuKuh Dwiputra Hernugrahanto, I. Lumban-Gaol 翻訳者：渡部慎太郎、崔賢民

推奨：DAIRはメガプロステシスの急性PJIにも適応可能な選択肢である。ただし、その他の治療オプションと比較したデータに乏しく、どの治療法に優位性があるかを示すエビデンスに欠けるため、DAIRの有効性はまだ明らかでない。治療法の決定は、患者の状態や感染の経過、細菌の特徴、外科的治療歴などを考慮し、ケースバイケースで行うべきである。DAIRは、毒性の高い細菌や耐性菌による広範囲の感染などの複雑な要素を持たない場合、急性PJIに対して、最も適切な治療法である。

エビデンスレベル: Limited

投票結果: 賛成 96%、反対 1%、棄権 3% (満場一致、最も強いコンセンサス)

質問9: 急性PJIにおいて、DAIRによる治療を成功させるための要素は何か?

著者: Marjan Wouthuyzen-Bakker, Alex Soriano 翻訳者: 渡部慎太郎、崔賢民

推奨: 急性PJIにおいて、DAIRによる治療を成功させるための要素として以下のものが挙げられる。

- ・デブリドマンを行う際に交換可能なインプラントの交換を行う。
- ・感染兆候が出現してから最大7日以内で可能な限り迅速にデブリドマンを行う。
- ・感受性のあるブドウ球菌属の感染の場合、抗菌薬治療に（特にニューキノロン系での治療の際は）リファンピシンを追加する。
- ・感受性のあるグラム陰性桿菌感染の場合、ニューキノロン系抗菌薬で治療を行う。

DAIRを用いた急性PJIにおいて、治療を失敗させる要素として以下のものが挙げられる。

- ・患者要素: 関節リウマチ、高齢者、男性、慢性腎不全、肝硬変、慢性閉塞性肺疾患
- ・人工物要素: 人工物の破損、セメント固定された人工物、再置換後の人工物
- ・感染の重症度を示す臨床学的要素: CRP 高値、多量の細菌、菌血症の存在
- ・原因菌: 黄色ブドウ球菌、エンテロコッカス属

エビデンスレベル: Moderate

投票結果: 賛成 92%、反対 5%、棄権 3% (大多数、強いコンセンサス)

質問10: DAIRの施行は、その後の二期的再置換術の結果に影響を与えるか?

著者: Erik Hansen, Jay Shah 翻訳者: 渡部慎太郎、崔賢民

推奨: 不明である。既存のエビデンスからは、DAIRの既往が二期的再置換術の成績に悪影響を及ぼすかどうか不明である。

エビデンスレベル: Limited

投票結果: 賛成 93%、反対 6%、棄権 1% (大多数、強いコンセンサス)

質問11: 初回TJA患者のPJIにおいて、コンポーネントの抜去が必要となる前に許容されるDAIRは何回か?

著者: Fabio Catani, Lazaros Poultsides, Henry Flores, Andrea Giorgini, Georgios K. Triantafyllopoulos, Arjun Saxena

翻訳者: 渡部慎太郎、崔賢民

推奨: DAIRが1度失敗した場合、コンポーネントの除去を考慮すべきである。

エビデンスレベル: Limited

投票結果: 賛成 86%、反対 13%、棄権 1% (大多数、強いコンセンサス)

質問12: 急性PJIに対するDAIR後の適切な抗菌薬治療期間はどのくらいか?

著者: Jamie Lora-Tamayo, David Warren, Mikel Mancheno-Losa, Marius Arndt, Christian Lausmann, Marius Arndt

翻訳者: 渡部慎太郎、崔賢民

推奨: DAIR後の最適な抗菌薬治療期間は、治療の期間、服用量、投与においてかなりの多様性があるため、明らかでない。DAIRによる外科的治療を施行される大多数のPJI症例において、最低6週間の抗菌薬治療が十分であると思われる。

エビデンスレベル: Moderate

投票結果: 賛成 91%、反対 8%、棄権 1% (大多数、強いコンセンサス)

質問13: DAIRを施行したMRSAが原因菌の急性PJIにおいて、最も効果的な抗菌薬の組み合わせは何か?

著者: Camelia Marculescu, Silvano Esposito 翻訳者: 渡部慎太郎、崔賢民

推奨: 非経口抗菌薬と経口リファンピシンを組み合わせた抗菌薬治療を1~6週間行い、その後、MRSAの感受性、患者の耐用性、副作用を考慮したうえで、リファンピシンと感受性の高い経口抗菌薬を3ヵ月併用することを勧める。

エビデンスレベル: Limited

投票結果: 賛成 88%、反対 10%、棄権 2% (大多数、強いコンセンサス)

質問14: DAIRを行ったグラム陰性菌が原因菌の急性PJIに対して、どのような抗菌薬治療(抗菌薬の種類、投与経路、服用量、期間)が推奨されるか?

著者: Jean Yombi, Marjan Wouthuyzen-Bakker 翻訳者: 渡部慎太郎、崔賢民

推奨: DAIRを行ったグラム陰性菌が原因菌の急性PJI患者には、起因菌の種類に応じて6~12週間の抗菌薬治療を行うべきである。ニューキノロン系抗菌薬に感受性がある場合は、ニューキノロン系抗菌薬を使用するとよい。

エビデンスレベル：Moderate

投票結果：賛成 83%、反対 11%、棄権 6%（大多数、強いコンセンサス）

5.3. 治療：一期的再置換術

質問 1：一期的再置換術の潜在的な利点は何か？

著者：Navin Fernando, Pedro Foguet, Michael A. Mont, Nipun Sodhi, Robert Molloy, Ariel Saldaña 翻訳者：崔賢民、稲葉裕

推奨：一期的再置換術の潜在的な利点は、手術による合併症発生率や死亡率の低下、早期機能回復、医療やグローバル経済のコスト減少、ならびに健康に関する質調整生存年数の増加など多岐にわたる。

エビデンスレベル：Moderate

投票結果：賛成 89%、反対 8%、棄権 3%（大多数、強いコンセンサス）

質問 2：慢性 PJI の治療における一期的再置換術の適応、禁忌は何か？

著者：Peter Keogh, Andrew Toms, Akos Zahar, Fares Haddad, Shengjie Guo, S. McHale 翻訳者：崔賢民、稲葉裕

推奨：一期的再置換術は、慢性 PJI 治療において現実的な選択肢である。しかし、敗血症の症候、広範囲の感染、耐性菌による感染、培養陰性 PJI、被覆する軟部組織の欠損を有する患者には一期的再置換術は適切ではない可能性がある。

エビデンスレベル：Moderate

投票結果：賛成 93%、反対 5%、棄権 2%（大多数、強いコンセンサス）

質問 3：一期的再置換術は、セメントレス THA の急性 PJI において有用か？

著者：Rhidian Morgan-Jones, Fares Haddad, Erik Hansen, Malte Ohlmeier 翻訳者：崔賢民、稲葉裕

推奨：有用である。一期的再置換術は、セメントレス THA の急性 PJI 患者に適応がある。

エビデンスレベル：Moderate

投票結果：賛成 89%、反対 7%、棄権 4%（大多数、強いコンセンサス）

質問 4：一期的再置換術と二期的再置換術では、合併症発生率と死亡率に違いはあるか？

著者：Laszlo Bucsi, Andrew Toms, Jerzy Bialecki, Stephen Jones, R. Walker, Kristof Janvari, Pawel Bartosz, Marcin Para, Maciej Kogut

翻訳者：崔賢民、稲葉裕

推奨：PJI 治療の成功への効果を考慮しなければ、二回の手術が必要な二期的再置換術と比較して、一期的再置換術は合併症発生率、死亡率両方においてリスクが低いと考えられる。

エビデンスレベル：Moderate

投票結果：賛成 83%、反対 13%、棄権 4%（大多数、強いコンセンサス）

5.4. 治療：二期的再置換術、スパーサー関連

質問 1：THA、TKA を抜去した場合に使用するスパーサーは、関節型スパーサーあるいは非関節型スパーサーを使用する適応は何か？

著者：Matthew Abdel, D.O. Kendoff, A.K. Limberg, Nemandra A. Sandiford, M.E. Tibbo 翻訳者：内山勝文、高相晶士

推奨：人工関節抜去術を受けた患者において、関節型スパーサーはより良好な可動域、およびより少ない機能的制限をもたらすと考えられることから、可能な限り使用されるべきである。人工関節抜去術を受けた患者において、非関節型スパーサーを使用する適応は、大きな骨欠損、靱帯機能の欠如（膝）、股関節の外転機能の欠如によりスパーサーの脱臼または人工関節周囲骨折の危険性が高い状態にある患者で、創傷治癒を促すために運動を制限したほうが良いような大きな軟部組織欠損を有する患者である。

エビデンスレベル：Strong

投票結果：賛成 91%、反対 7%、棄権 2%（大多数、強いコンセンサス）

質問 2：人工関節再置換術ではなく留置したセメントスパーサーの交換や洗浄デブリドマンの繰り返しに適応となるのは何か？

著者：Karan Goswami, Jorge Manrique, Igor Shubnyakov 翻訳者：内山勝文、高相晶士

推奨：持続的な感染や機械的合併症がある場合、人工関節再置換術ではなく留置したセメントスパーサーの交換や洗浄デブリドマンの繰り返しが施行されることがある。

エビデンスレベル: Limited

投票結果: 賛成 97%、反対 0%、棄権 3% (満場一致、最も強いコンセンサス)

質問3: セメントスペーサーに入れる抗菌薬は原因菌の感受性に合わせて入れるべきか?

著者: Viktor Janz, Andrew Porteous, Vishwas Sharma, Ankit Varshneya, Akos Zahar 翻訳者: 内山勝文、高相晶士

推奨: 人工関節抜去術時のセメントスペーサーに入れる抗菌薬は、原因菌の感受性に合わせて選択されるべきである。培養が陰性の場合、PJIを引き起こす可能性の最も高い原因菌をカバーするために、広域な抗菌薬の追加を考慮する必要がある。

エビデンスレベル: Moderate

投票結果: 賛成 94%、反対 3%、棄権 3% (大多数、強いコンセンサス)

質問4: 多剤耐性菌によって生じたPJIの患者では、どんな抗菌薬をセメントスペーサーに加えるべきか?

著者: Lars Frommelt, Justin Greiner, Valeriy Murylev, Solmaz Saleri, Matthew W. Squire 翻訳者: 内山勝文、高相晶士

推奨: MRSA/MRSE に起因する PJI の場合、バンコマイシンをセメントスペーサーに加える必要がある。VRE などのバンコマイシン耐性株、または多剤耐性グラム陰性 PJI 症例では、既知の感受性に基づいて個々の抗菌薬の選択が必要である。微生物学/感染症の専門家に相談することを強く勧める。

エビデンスレベル: Moderate

投票結果: 賛成 99%、反対 0%、棄権 1% (満場一致、最も強いコンセンサス)

質問5: セメントスペーサーに抗菌薬を使用することの禁忌は何か?

著者: Scott Sporer, Thomas Turgeon 翻訳者: 内山勝文、高相晶士

推奨: 人工関節手術にセメントスペーサーを用いる治療では、熱に安定した抗菌薬に対して患者が重篤な有害反応の病歴を有する場合を除いて、抗菌薬をセメントスペーサーに使用する明確な禁忌はない。

エビデンスレベル: Consensus

投票結果: 賛成 90%、反対 6%、棄権 4% (大多数、強いコンセンサス)

質問6: 吸引ドレーンの使用は抗菌薬含有セメントスペーサーの有効性を減少させるか?

著者: Kier Blevins, John O'Byrne, Michael J. Petrie, Ian Stockley 翻訳者: 内山勝文、高相晶士

推奨: 現在の文献は、吸引ドレーンの使用は抗菌薬含有セメントスペーサーの有効性を減少させないことを示している。

エビデンスレベル: Moderate

投票結果: 賛成 85%、反対 10%、棄権 5% (大多数、強いコンセンサス)

質問7: 人工関節抜去術時のスペーサーとして、感染インプラントを術中オートクレーブ滅菌して再利用することは有用か?

著者: Andrew Battenberg, Lluís Font-Vizcarra, Biagio Moretti, Samuel Wellman 翻訳者: 内山勝文、高相晶士

推奨: 複数の研究で人工膝関節を抜去し、術中にオートクレーブしたインプラントの再利用することは、感染の沈静化を妨げないことを示した。実行可能な選択肢ではあるが、オートクレーブ処理されたコンポーネントの再利用に関連しては法的な影響があり、これらのコンポーネントのオートクレーブ処理のための適切な標準法も知られていない。人工関節抜去術時にオートクレーブ処理されたコンポーネントを再利用することは、特に膝関節においては、適切な動的スペーサーコンポーネントが利用できない場合や、経済的なことを考慮した場合は、適切かもしれない。

エビデンスレベル: Moderate

投票結果: 賛成 82%、反対 12%、棄権 6% (大多数、強いコンセンサス)

質問8: 脱臼した関節型抗菌薬含有スペーサーを入れ換る、または整復する必要があるか?

著者: Pedro Barreira, Daniel Berry 翻訳者: 内山勝文、高相晶士

推奨: スペーサーが皮膚を圧迫して壊死/潰瘍形成、重症の進行性軟部組織欠損や骨欠損、神経血管障害、または著しい疼痛および患者への身体障害を引き起こさない限り、脱臼または折損した抗菌薬含有セメントスペーサーは、最終的な二期的再置換術までその場に置いておいても安全である。

エビデンスレベル: Consensus

投票結果: 賛成 89%、反対 8%、棄権 3% (大多数、強いコンセンサス)

5.5. 治療：二期的再置換術

質問1：股関節と膝関節の二期的再置換術の最適な時期はいつか？

著者：Arash Aalirezaie, Dirk-Jan Moojen, Job Diego Velázquez Moreno 翻訳者：内山勝文、高相晶士

推奨：股関節と膝関節の二期的再置換術の最適な時期は確立されていない。治療を行っている医療チームが、感染は制御されたと感じたときに再手術を行うべきである。

エビデンスレベル：Moderate

投票結果：賛成 93%、反対 4%、棄権 3%（大多数、強いコンセンサス）

質問2：PJIに対して人工関節抜去術を施行した患者において、後で使用するために安定したセメントマントルを温存することは安全か？

著者：Thiago Busato, Douglas Dennis, Michael Kelly, Yair D. Kissin 翻訳者：内山勝文、高相晶士

推奨：セメントを含むすべての異物の徹底的なデブリードマンおよび除去は、PJIの治療における人工関節抜去術の一環として行われるべきである。限られたデータであるが、厳しい条件下で細心の注意を払って行われた外科的手技において、大腿骨のダメージを最小限にするために安定したセメントマントルをその場に残すことが考慮される。

エビデンスレベル：Limited

投票結果：賛成 63%、反対 29%、棄権 8%（大多数、強いコンセンサス）

質問3：外科医は、PJI患者の骨盤内に押し出されたセメントや解剖学的に除去が困難な位置にあるセメントを除去するために努力をするべきか？

著者：Martijn Kuijpers, Dirk-Jan Moojen, Rudolf Poolman, Berend Willem Schreurs, Ewout S. Veltman 翻訳者：内山勝文、高相晶士

推奨：整形外科医は、骨盤内または解剖学的に除去が困難な位置からのセメントの除去の有益性について、感染が持続するリスクを考慮して慎重に検討するべきである。

エビデンスレベル：Consensus

投票結果：賛成 85%、反対 9%、棄権 6%（大多数、強いコンセンサス）

質問4：人工関節再置換術において、骨欠損に対する非抗菌薬含有同種移植骨の使用は、SSI /PJIの再発のリスクを増大させるか？

著者：Mansour Abolghasemian, Mohammad Ghazavi, Jeffrey Lange, Paul Lichstein 翻訳者：内山勝文、高相晶士

推奨：再置換術（PJIの後）の骨欠損に対して非抗菌薬含有同種移植骨を使用することがSSI /PJIの再発のリスクを高めることを実証する証拠はない。

エビデンスレベル：Limited

投票結果：賛成 88%、反対 9%、棄権 3%（大多数、強いコンセンサス）

5.6. 治療：手術手技

質問1：関節鏡手術は、膝または股関節の急性または慢性のPJIの治療に有用か？

著者：Alejo Erice, Anton Khlopas, Percia Lazarovski, Michael A. Mont, John Stammers, Katsufumi Uchiyama 翻訳者：内山勝文、高相晶士

推奨：関節鏡手術は、膝または股関節の急性または慢性のPJIの治療には有用ではない。

エビデンスレベル：Moderate

投票結果：賛成 93%、反対 6%、棄権 1%（大多数、強いコンセンサス）

質問2：すべての金属製インプラントをPJIの根治のために除去する必要があるか？これは他の金属製ハードウェア（フックプレート、ケーブルなど）にも当てはまるか？

著者：Andrew Battenberg, Matthew Dietz 翻訳者：内山勝文、高相晶士

推奨：股関節または膝関節の完全なデブリードマンおよびすべての金属の除去は、PJIの外科治療において理想的である。可能な限りこの原則に従う必要があるが、稀なケースだが、すべてのハードウェアを除去すると感染の罹患率が著しく高くなり、また将来の再建が不可能になる場合がある。後者の状況では、いくつかのハードウェアが温存される可能性がある。

エビデンスレベル：Moderate

投票結果：賛成 97%、反対 3%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：感染したUKAの抜去時に全ての膝関節コンパートメントを切除する必要があるか？

著者：Moneer M. Abouljoud, Tae-Kyun Kim, Timothy L. Tan 翻訳者：内山勝文、高相晶士

推奨：感染したUKAの抜去時に、脂肪帯を含む膝関節の他のコンパートメントも切除する必要がある。**エビデンスレベル：**Consensus**投票結果：**賛成 80%、反対 14%、棄権 6%（大多数、強いコンセンサス）**質問4：部分的な人工関節抜去術(インプラントの一部を温存)は、慢性PJI患者の治療として考慮してもよいか？**

著者：Kyung-Hoi Koo, Adolph Lombardi, Jorge Manrique 翻訳者：内山勝文、高相晶士

推奨：部分的な人工関節抜去術は、インプラントがしっかりと固定されていることが証明されており、抜去することで将来の再建を妨げる場合、慢性PJI患者の治療として考慮される。**エビデンスレベル：**Limited**投票結果：**賛成 68%、反対 29%、棄権 3%（大多数、弱いコンセンサス）**質問5：人工関節の一部のみが(例として、大腿骨側のみで寛骨臼側はなし、脛骨側のみで大腿骨側はなしなど)独立して感染している可能性はあるか？**

著者：Yona Kosashvili, Derek Ward 翻訳者：内山勝文、高相晶士

推奨：人工関節の感染症は、すべての異物の表面にバイオフィームが形成される可能性がある。しかし、感染したしっかりと固定されたインプラントの表面にはバイオフィームを形成することができない稀な状況があるかも知れない。**エビデンスレベル：**Limited**投票結果：**賛成 75%、反対 19%、棄権 6%（大多数、強いコンセンサス）**質問6：異所性骨化(HO)は、感染した人工関節の人工関節抜去術時に除去すべきか？**

著者：Andrew A. Freilberg, Per Kjaergaard-Andersen, Konstantinos Malizos, Marianthe Papanagiotoy, Anna Ziogkou

翻訳者：内山勝文、高相晶士

推奨：将来の再建を不可能にしない程度に、感染した人工関節に近い異所性骨化症(HO)は除去することを強く勧める。**エビデンスレベル：**Consensus**投票結果：**賛成 80%、反対 10%、棄権 10%（大多数、強いコンセンサス）**質問7：軟部組織の被覆に再建皮弁が必要な場合は、インプラント抜去時に行うべきか、それとも再置換術まで延期するべきか？**

著者：David Backstein, Adam Katchy, Jennifer Leighton, Maik Stiehler 翻訳者：内山勝文、高相晶士

推奨：軟部組織の欠損が再建皮弁を必要とする場合、インプラント抜去時、あるいは再置換術時に皮弁での被覆を行うほうが安全である。インプラント抜去時の早期の皮弁被覆は感染根絶のための軟部組織の生物学的活性を改善し、皮弁が生着すると再置換術後の早期の運動が可能になる。**エビデンスレベル：**Limited**投票結果：**賛成 95%、反対 2%、棄権 3%（満場一致、最も強いコンセンサス）**5.7. 治療：人工物の要素****質問1：二期的再置換術時に、セメントあるいはセメントレス人工関節を選択することは、慢性PJIの治療の成功率に影響があるか？ そうであれば、セメントからの抗菌薬の溶出と機械的特性を最大にするための最適な抗菌薬、投与量とは何か？**

著者：Guillem Bori, Mitchell R. Klement, Laurens Manning 翻訳者：内山勝文、高相晶士

推奨：二期的再置換術時にセメントあるいはセメントレスを使用することが感染治療の成功率に影響を与えることを示唆する証拠はない。しかし、固定様式はインプラントの生存率に影響を与える可能性がある。骨量と骨質によって、インプラントの選択と再置換術時の固定方法が決まる。セメントインプラントを使用する場合は、再置換術時に感染性微生物に対する抗菌薬の添加を検討する必要がある。**エビデンスレベル：**Moderate**投票結果：**賛成 93%、反対 4%、棄権 3%（大多数、強いコンセンサス）

質問2：PJIのための一次的再置換術におけるタンタルオーギュメントの使用はその後のSSI /PJIの発生率に影響するか？

著者：Daniel Kendoff, Rafael Llopi, Amir Sandifort, Nemandra A. Sandiford 翻訳者：内山勝文、高相晶士

推奨：後ろ向き研究の知見では、タンタルオーギュメントの使用が、PJIにおける一次的再置換術後の感染率に対する防御効果を有する可能性があることを示唆している。

エビデンスレベル：Moderate

投票結果：賛成 58%、反対 31%、棄権 11%（多数、合意なし）

質問3：高度な多孔性のタンタルの使用は、人工股関節再置換術におけるSSI /PJIの再発リスクの低下と関連しているか？

著者：Michael Kelly, Javad Parvizi, Michael J. Petrie, Ian Stockley 翻訳者：内山勝文、高相晶士

推奨：特にPJIの治療のために、人工関節再置換術を受けている患者において、高度な多孔性のタンタルの使用がSSI /PJIの再発リスクの低下と関連していることを示唆するいくつかのエビデンスがある。

エビデンスレベル：Limited

投票結果：賛成 51%、反対 36%、棄権 13%（多数、合意なし）

5.8. 治療：サルベージ

質問1：TKA後の慢性的なPJIに対する治療法としての膝関節固定術と大腿切断との間に機能的予後と生存率の違いはあるか？

著者：Mohammad Ghazavi, Hamidreza Yazdi 翻訳者：宗本充

推奨：違いはある。TKA後のPJIに対する大腿切断は膝固定術に比べ機能的予後は低く、死亡率は高い。

エビデンスレベル：Moderate

投票結果：賛成 82%、反対 13%、棄権 5%（大多数、強いコンセンサス）

質問2：切断や固定術のサルベージ手術を検討する前に、何回人工関節の入れ替えをするべきか？

著者：Timothy L. Tan, Javad Mortazavi 翻訳者：宗本充

推奨：二期的再置換が不成功になり繰り返し二期的再置換を受けた患者の予後は悪い。二期的再置換が不成功になる原因は患者の全身状態や患部の局所状態によると思われる。したがって、外科医は二期的再置換を繰り返し行うときは患者の合併症や期待できる予後を考慮する必要がある。3回目、4回目の二期的再置換の予後は悲惨である。

エビデンスレベル：Limited

投票結果：賛成 88%、反対 10%、棄権 2%（大多数、強いコンセンサス）

質問3：股関節に感染が持続する患者に対する外科的処置は股関節離断以外にどのようなものがあるか？

著者：Richard Iorio, Zlatan Cizmic, James E. Feng, Setor Kunustor 翻訳者：宗本充

推奨：メガプロステーシスによる関節再建が不可能な場合に、股関節離断の代替になり得る方法としては切除関節形成術が挙げられる。股関節離断は敗血症患者や四肢軟部組織に重度な感染を認める患者に行う最終手段であり、救命処置の一部として行われるものである。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 4%、棄権 3%（大多数、強いコンセンサス）

5.9. 治療：抗菌薬

質問1：PJIに対する一次的再置換術後の推奨される抗菌薬投与期間は？

著者：Sujith Konan, Lars Frommelt, Christian Lausmann, Thorsten Gehrke, Andrea Volpin 翻訳者：宗本充

推奨：一次的再置換術後は10～14日間の静脈内抗菌薬投与を行った後、経口抗菌薬投与をすべきである。一般的に抗菌薬投与の全期間は4～6週間で十分である。

エビデンスレベル：Limited

投票結果：賛成 73%、反対 23%、棄権 4%（大多数、強いコンセンサス）

質問2：PJIに対する抗菌薬投与をいつ中止するかを決定するための適切な指標はあるか？

著者：Angela Hewlett, Isabel Ramirez 翻訳者：宗本充

推奨：適切な指標はない。PJIに対する治療方針を決定し治療に対する反応をモニターする検査はない。ESR や CRP は治療のモニタリングに有用と考えられているが、治療後の持続的な上昇は感染の持続を示唆するものではない。新たなバイオマーカーである D-ダイマーやプレセプシンは有望な指標になりうるという研究結果がある。しかしながら PJI 治療に対する反応のモニタリングとしての有用性を評価するための更なる研究が必要である。

エビデンスレベル：Moderate**投票結果：**賛成 89%、反対 8%、棄権 3%（大多数、強いコンセンサス）**質問3：ICGは整形外科領域の感染症に対する抗菌薬推奨投与期間に関するアメリカ感染症学会(IDSA)のガイドラインに賛同するか？**

著者：Jean Yombi, Camelia Marculescu, Markus Rossmann, Christian Lausmann 翻訳者：宗本充

推奨：ICG と IDSA ではいくつかの病原体に対する抗菌薬推奨投与期間に関して意見の相違がある。意見の相違は静脈内抗菌薬投与後の経口抗菌薬の投与期間に認められる。

エビデンスレベル：Moderate**投票結果：**賛成 82%、反対 3%、棄権 15%（大多数、強いコンセンサス）**質問4：PJIの原因菌の種類によって抗菌薬の種類、投与量、投与経路、投与期間は異なるか？**

著者：Craig A. Aboltins, Jean Yombi, Camelia Marculescu, Dorothy Ling 翻訳者：宗本充

推奨：PJI 患者に投与される抗菌薬の投与期間、投与量、投与経路および種類は検出された原因菌の種類によって決定される。

エビデンスレベル：Limited**投票結果：**賛成 92%、反対 4%、棄権 4%（大多数、強いコンセンサス）**質問5：無菌性ゆるみの診断で再置換術を受けた患者の術中検体が細菌培養陽性であった場合抗菌薬を投与すべきか？**

著者：Carlos A. Higuera, Barry Brause, Charles Vogely 翻訳者：宗本充

推奨：PJI に関する MSIS ならびに ICG の基準に従って、同一細菌が2検体以上から検出された場合は抗菌薬投与が推奨される。1検体からのみ細菌が検出された場合には抗菌薬投与は必要ないかもしれない。しかし他の検査と組み合わせて感染と考えられるときは抗菌薬投与が必要になり得る。

エビデンスレベル：Limited**投票結果：**賛成 90%、反対 8%、棄権 2%（大多数、強いコンセンサス）**質問6：外科的治療を受けているPJI患者の抗菌薬にリファンピシンをいつ追加すべきか？**

著者：Katherine Belden, Werner Zimmerli, Christian Lausmann, Mustafa Citak, Akos Zahar 翻訳者：宗本充

推奨：リファンピシン投与は、DAIR あるいは一期的再置換術のような外科的治療を受けるブドウ球菌による PJI 患者において、抗バイオフィーム効果が必要とされる場合に考慮するべきである。リファンピシンは併用療法でのみ使用されるべきで、最も良い併用はフルオロキノロンとの併用であると報告されている。

エビデンスレベル：Moderate**投票結果：**賛成 96%、反対 2%、棄権 2%（満場一致、最も強いコンセンサス）**質問7：細菌培養陰性のPJIに対する最適な抗菌薬治療法は？**

著者：Harriet Hughes, Gina Ann Suh, Ruben Anemüller, Christian Lausmann 翻訳者：宗本充

推奨：真の培養陰性 PJI 患者にはグラム陽性、陰性の両方に対して有効な広域スペクトル抗菌薬を選択すべきである。さらに、その国の最新の疫学に基づき正しい選択が行われるべきである。

エビデンスレベル：Limited**投票結果：**賛成 87%、反対 6%、棄権 7%（大多数、強いコンセンサス）**質問8：腸球菌によるPJIに対する適切な抗菌薬の種類と投与期間は？**

著者：Randi Silibovsky, Michael Kheir, Kang-il Kim 翻訳者：宗本充

推奨：根拠となるエビデンスは少ないが、腸球菌による PJI に対し少なくとも最初の数週間は抗菌薬併用療法が考慮されるべきである。抗菌薬は細菌の薬剤感受性に応じて調整すべきである。

エビデンスレベル：Limited

投票結果：賛成 85%、反対 9%、棄権 6%（大多数、強いコンセンサス）

質問 9：他の抗菌薬の代わりや併用薬としてのホスホマイシン、チゲサイクリン、ダプトマイシンの適応は？

著者：Jose L. Del Pozo, Alex Soriano, Laura Morata 翻訳者：宗本充

推奨：ダプトマイシンの推奨：ダプトマイシンは MRSA による PJI に対する治療の選択肢である。ホスホマイシンの推奨：PJI に対しホスホマイシンを使用した臨床報告はないが、ダプトマイシン、リファンピシンまたはチゲサイクリンの併用薬として多剤耐性グラム陽性菌（MDR-GP）またはグラム陰性菌（GNB）による感染で感受性がある場合はホスホマイシンの使用を考慮できる。チゲサイクリンの推奨：チゲサイクリンの使用は多剤耐性グラム陽性菌（MDR-GP）またはグラム陰性菌（GNB）による感染で感受性がある場合は考慮できる。

エビデンスレベル：ダプトマイシン：Moderate ホスホマイシン：Limited チゲサイクリン：Limited

投票結果：賛成 86%、反対 4%、棄権 10%（大多数、強いコンセンサス）

5.10. 治療：抗菌薬（二期的）

質問 1：（A）切除関節形成術後の最適な抗菌薬投与期間は？ （B）切除関節形成術後の最適な抗菌薬投与経路は？

著者：Scott R. Nodzo, Oscar Murillo, Anne Lachiewicz, Keely Boyle, Michael O'Callaghan 翻訳者：宗本充

推奨：抗菌薬治療は細菌への感受性、患者の受容性、副作用を基に個別に考慮すべきである。切除関節形成術後の適切な抗菌薬投与期間を決定する明確なエビデンスはないが、2～6 週間の投与を推奨する。静脈内投与、経口投与、併用のどれでも切除関節形成術後の治療に使用可能であるが、経口薬を単独で使用する場合は感染巣の細菌を根絶させるための適切な局所濃度を保てるバイオアベイラビリティが必要である。

エビデンスレベル：Moderate

投票結果：賛成 87%、反対 9%、棄権 4%（大多数、強いコンセンサス）

質問 2：二期的再置換でインプラント再挿入後に経口抗菌薬を予防的に長期投与することは成績不良のリスクを減少させるか？ 減少させるのであれば抗菌薬の適切な投与期間は？

著者：Viktor Janz, Craig J. Della Valle, Linda I. Suleiman 翻訳者：宗本充

推奨：おそらく減少させる。インプラント再挿入後に原因菌に感受性のある経口抗菌薬を 3 ヶ月投与することにより早期成績不良のリスクを減少させるという新しいエビデンスがある。

エビデンスレベル：Moderate

投票結果：賛成 76%、反対 18%、棄権 6%（大多数、強いコンセンサス）

質問 3：二期的再置換の一環としてインプラント抜去を行った後、静脈内抗菌薬投与から経口投与に切り替える最適なタイミングは？

著者：José Cordero-Ampuero, Marc Nijhof, Katherine Belden 翻訳者：宗本充

推奨：PJI に対する二期的再置換の一環で、インプラント抜去を行った後、少なくとも最初の 5-7 日間に静脈内抗菌薬投与を行い、その後感受性のあるバイオアベイラビリティの高い経口抗菌薬を投与することが適切であるというエビデンスが存在する。

エビデンスレベル：Limited

投票結果：賛成 83%、反対 14%、棄権 3%（大多数、強いコンセンサス）

質問 4：慢性的な PJI に対する切除関節形成術後の抗菌薬投与期間は短期間(2週間以内)にし得るか？

著者：Henk Eijer, Brian de Beaubien, Ian Stockley, Adam Kratky, Bernard Kessler, Kimberly E. Martin, Chris Ferry, Michael J. Petrie, Kerri Bell 翻訳者：宗本充

推奨：短期間にすることができる。徹底したデブリドマンおよび抗菌薬含有セメントスパーサー（ALCS）またはセメントビーズの挿入後、全身抗菌薬投与は 2 週間以内の短い期間にすることが考慮され得る。いくつかの研究において長期間の抗菌薬投与と同程度の感染根絶率であったと報告されている。

エビデンスレベル：Limited

投票結果：賛成 64%、反対 32%、棄権 4%（大多数、弱いコンセンサス）

5.11. 治療：抗菌抑制

質問 1：初回 TJA 後に長期間経口抗菌薬を投与することは有効か？

著者：Massimo Franceschini, Rafael Franco-Cendejas, Massimo Coen, Federico Calabrò 翻訳者：宗本充

推奨：有効ではない。初回 TJA 後に予防的に長期間経口抗菌薬を投与することは推奨されない。創閉鎖後 24 時間を超える抗菌薬予防投与が有益であるという根拠はない。それどころか抗菌薬耐性発現を助長し医療費を増加させるかもしれない。

エビデンスレベル：Moderate

投票結果：賛成 95%、反対 4%、棄権 1%（満場一致、最も強いコンセンサス）

質問2：インプラント再挿入後の患者で14日後の細菌培養検査が陰性であった場合、経口抗菌薬を投与する意味はあるか？

著者：Angela Hewlett, John Segreti 翻訳者：宗本充

推奨：培養陰性であった患者において経口抗菌薬を投与することは再感染率を減少させる可能性はあるが、さらなる研究が必要である。

エビデンスレベル：Limited

投票結果：賛成 73%、反対 21%、棄権 6%（大多数、弱いコンセンサス）

質問3：慢性PJI患者において外科的治療の代わりに長期間の経口抗菌薬投与を考慮すべきなのはどのような場合か？

著者：Eric Senneville 翻訳者：宗本充

推奨：外科的手術が患者の機能予後を改善することが期待できない場合や、外科的治療を拒否する患者に対しては、その代わりに長期間の経口抗菌薬投与が考慮される。

エビデンスレベル：Consensus

投票結果：賛成 95%、反対 4%、棄権 1%（満場一致、最も強いコンセンサス）

5.1. TREATMENT: ALGORITHM

QUESTION 1: Should early postoperative infection and acute hematogenous infection be treated and managed differently?

RECOMMENDATION: There is no evidence to support the notion that early postoperative infection and acute hematogenous infection should be treated differently as long as the onset of symptoms is <4 weeks (favorable < 7 days), implants are well-fixed, no sinus tract exists and the isolated infecting organism is sensitive to an antimicrobial agent.

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QUESTION 2: Should operative treatment differ in patients with systemic sepsis in the setting of periprosthetic joint infection (PJI)?

RECOMMENDATION: Yes. Patients with systemic sepsis in the setting of PJI should have surgical bioburden reduction, either with implant retention or resection of components (if indicated and safe), along with concurrent anti-microbial therapy. Reimplantation should be delayed until sepsis is resolved.

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QUESTION 3: What should be done for patients with persistent wound drainage (PWD) after total joint arthroplasty? What are the indications for surgical intervention?

RECOMMENDATION: Management of draining wounds after total hip arthroplasty (THA) or total knee arthroplasty (TKA) consists of two main steps; nonoperative and operative. The nonoperative measures include: modification of venous thromboembolism (VTE) prophylaxis, nutritional supplementation, dressing measures (such as negative pressure wound therapy (NPWT)) and restriction of range of motion. If draining continues for more than seven days after implementing the nonoperative measures, operative interventions may be indicated – including irrigation and debridement, synovectomy and single-stage exchange. In certain situations, superficial wound washout may be indicated (Fig. 1).

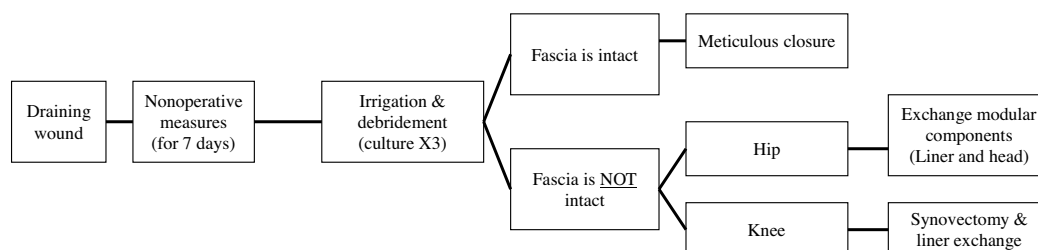


Figure 1. Management of draining wounds after total joint arthroplasty.

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QUESTION 4: How should infected bilateral hip or knee arthroplasties be managed?

RECOMMENDATION: The optimal surgical treatment for infected bilateral hip or knee arthroplasties is unknown. While revising the components likely provides improved outcomes over limited debridement with component retention, data does not preferentially support either a single-stage or two-stage exchange revision arthroplasty.

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5.2. TREATMENT: DEBRIDEMENT AND RETENTION OF IMPLANT

QUESTION 1: What are the indications and contraindications of using debridement, antibiotics and implant retention (DAIR) with exchange of modular components for the management of periprosthetic joint infection (PJI)?

RECOMMENDATION: The best advantage in performing DAIR of the prosthesis is seen in early postoperative PJI and acute hematogenous PJI, defined as symptoms existing for no longer than four weeks, and if the implant is stable. The KLIC and CRIME80 scores may aid in risk stratification.

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QUESTION 2: Is debridement, antibiotics and implant retention (DAIR) an emergency procedure for patients with acute periprosthetic joint infection (PJI) or should patient optimization be implemented prior to surgery to enhance the success of this procedure?

RECOMMENDATION: DAIR is not an emergency procedure but should be performed on an urgent basis when the patient with acute PJI is medically and surgically optimized.

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QUESTION 3: Does identification of the pathogen prior to performing debridement, antibiotics and implant retention (DAIR) help guide the surgeon's decision making? If so, should you wait, in a clinically stable patient, until the pathogen has been identified?

RECOMMENDATION: The identification of the responsible microorganism before DAIR is desirable. However, it should not prevent timely surgical intervention if delay in surgery is believed to promote further establishment of biofilm formation and compromise the outcome of surgical intervention.

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QUESTION 4: Does exchange of all modular components during debridement, antibiotic and implant retention (DAIR) reduce the rate of surgical site infection (SSI)/periprosthetic joint infection (PJI) recurrence?

RECOMMENDATION: Yes. Exchange of all the modular components during DAIR reduces the risk of PJI recurrence.

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QUESTION 5: What is the minimum necessary volume of irrigation solution to use in debridement, antibiotics and implant retention (DAIR) treatment of acute periprosthetic joint infection (PJI)?

RECOMMENDATION: We recommend that 6-9L of irrigation solution, including saline or antiseptic solution such as sterile dilute povidone- iodine, is used during DAIR treatment of acute PJI.

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QUESTION 6: Is there a role for direct intra-articular antibiotic infusion following irrigation and debridement (I&D) for periprosthetic joint infection (PJI)?

RECOMMENDATION: The concept of achieving a minimum biofilm eradication concentration (MBEC) of antibiotics at the site of the infection is compelling. Despite the presence of retrospective studies reporting favorable outcome, because of heterogeneity in terms of adjunctive antibiotics, absence of a control group and small cohort size, the routine administration of intra-articular antibiotics in treatment of PJI is not justified. Prospective, randomized controlled trials (RCTs) are needed to support the routine use of intra-articular antibiotics as a stand-alone or adjunct treatment of PJI.

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QUESTION 7: Can debridement, antibiotics and implant retention (DAIR) be utilized in patients with an acute chronic infection of a unicompartmental knee arthroplasty (UKA)?

RECOMMENDATION: In the event of acute infection following UKA, early DAIR can be considered. However, if initial treatment effort results in failure or chronic infection is present, the implanted prosthesis should be removed and a one-stage or two-stage conversion to total knee arthroplasty (TKA) should be performed in combination with antibiotic therapy.

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QUESTION 8: Can debridement, antibiotics and implant retention (DAIR) be utilized in the treatment of acute periprosthetic joint infection (PJI) with a megaprosthesis?

RECOMMENDATION: DAIR is a viable treatment option in acute PJI of a megaprosthesis. The effectiveness of DAIR is still unclear due to lack of comparative data among the treatment options and limited evidence to suggest superiority of any one treatment. The treatment decision must be made on a case-by-case basis and account for underlying medical conditions, infection history, organism characteristics and surgical history. DAIR is most appropriate for acute PJI without complicating factors, such as extensive and pervasive infection by a high virulence or resistant organism.

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QUESTION 9: What factors are associated with the successful treatment of acute periprosthetic joint infection (PJI) using debridement, antibiotics and implant retention (DAIR)?

RECOMMENDATION: The following factors have been shown to be associated with treatment success in acute PJIs treated with DAIR:

- Exchanging the modular components during debridement
- Performing a debridement within at least seven days, but preferably as soon as possible, after the onset of symptoms
- Adding rifampin to the antibiotic regimen, particularly when combined with a fluoroquinolone, in cases of susceptible staphylococci
- Treatment with fluoroquinolones in cases of susceptible gram-negative bacilli

The following factors have been shown to be associated with treatment failure in acute PJIs treated with DAIR:

- Host related factors: rheumatoid arthritis, old age, male sex, chronic renal failure, liver cirrhosis and chronic obstructive pulmonary disease
- Prosthesis indication: fracture as indication for the prosthesis, cemented prostheses and revised prostheses
- Clinical presentation representing the severity of the infection: a high C-reactive protein (CRP), a high bacterial inoculum and the presence of bacteremia
- Causative microorganisms: *S. aureus* and *Enterococci*

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QUESTION 10: Does performing a debridement, antibiotics and implant retention (DAIR) affect the outcome of a subsequent two-stage exchange arthroplasty?

RECOMMENDATION: Unknown. Based on the available evidence, it is not known if prior DAIR adversely affects the outcome of a subsequent two-stage exchange arthroplasty.

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QUESTION 11: How many debridement, antibiotics and implant retention (DAIR) procedure(s) are acceptable in management of patients with acute periprosthetic joint infection (PJI) of a primary arthroplasty before removal of components needs to be performed?

RECOMMENDATION: After one failed DAIR procedure, strong consideration should be given to removal of components.

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infections due to *Staphylococcus aureus* treated with debridement. Clin Microbiol Infect. 2011;17:439–444. doi:10.1111/j.1469-0691.2010.03244.x.

QUESTION 12: What is the optimal length of antibiotic treatment following debridement, antibiotics and implant retention (DAIR) for acute periprosthetic joint infections (PJIs)?

RECOMMENDATION: The optimal length of antibiotic treatment following DAIR remains relatively unknown as there is considerable heterogeneity regarding the length, dose and administration of treatment. A minimum of six weeks of antibiotic therapy seems to be sufficient in most cases of PJIs managed by DAIR-provided surgical treatment.

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QUESTION 13: What is the most effective combination of antibiotics in the treatment of acute periprosthetic joint infections (PJIs) caused by methicillin-resistant *Staphylococcus aureus* (MRSA) that has undergone surgical management with debridement, antibiotics and implant retention (DAIR)?

RECOMMENDATION: We recommend a combination of a parenteral antibiotic plus oral rifampin for one to six weeks, followed by rifampin and a companion highly bioavailable oral drug for additional three months, depending on the susceptibility profile of MRSA, patient tolerability and side effect profile.

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QUESTION 14: What antibiotic therapy (agent, route, dose and duration) is recommended for gram-negative acute periprosthetic joint infections (PJIs) being treated with debridement, anti-biotics and implant retention (DAIR)?

RECOMMENDATION: Following surgical intervention (DAIR), gram-negative acute PJI patients should also receive antibiotic treatment for 6 to 12 weeks based on the type of organism. In fluoroquinolone-susceptible cases, the recommended antibiotic agent is a fluoroquinolone.

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5.3. TREATMENT: ONE-STAGE EXCHANGE

QUESTION 1: What are the potential advantages of a one-stage exchange arthroplasty?

RECOMMENDATION: The potential advantages of a one-stage exchange arthroplasty are multiple, including a decrease in surgical morbidity and mortality, earlier functional return, decrease in healthcare and global economic costs as well as an increase in health-related quality adjusted life years.

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QUESTION 2: What are the indications and contraindications for a one-stage exchange arthroplasty for the treatment of chronic periprosthetic joint infections (PJIs)?

RECOMMENDATION: One-stage exchange arthroplasty remains a viable option for the management of chronic PJIs. In patients with signs of systemic sepsis, extensive comorbidities, infection with resistant organisms, culture-negative infections and poor soft tissue coverage, one-stage exchange arthroplasty may not be a good option.

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QUESTION 3: Is there a role for single-stage exchange arthroplasty in acute periprosthetic joint infections (PJIs) of cementless total hip arthroplasties (THAs)?

RECOMMENDATION: Yes. Single-stage exchange arthroplasty can be employed to treat patients with acute PJIs of cementless THAs.

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QUESTION 4: Does the morbidity and mortality differ between single-stage and two-stage exchange arthroplasty?

RECOMMENDATION: Putting aside the effect on successful treatment of periprosthetic joint infections (PJIs), it is logical that a single surgical procedure puts patients at lower risk for both mortality and morbidity compared to a two-stage exchange arthroplasty that involves two separate operations.

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5.4. TREATMENT: TWO-STAGE EXCHANGE, SPACER RELATED

QUESTION 1: What are the indications for the use of nonarticulating vs articulating spacers during resection arthroplasty of the hip or knee?

RECOMMENDATION: Articulating spacers appear to provide better range of motion and less functional limitations to the patients undergoing resection arthroplasty and should be used whenever possible. The indications for the use of nonarticulating spacers during resection arthroplasty include patients with major bone loss, lack of ligamentous integrity (knee), or abductor mechanism (hip) that places these patients at elevated risk for dislocation or periprosthetic fracture and patients who have major soft tissue defects in whom motion is protected to allow better wound healing.

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QUESTION 2: What are the indications for interim cement spacer exchange or repeat irrigation and debridement instead of reimplantation?

RECOMMENDATION: Interim cement spacer exchange and/or repeat irrigation and debridement may be performed, instead of reimplantation, in the presence of persistent infection and/or mechanical complications.

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QUESTION 3: Should the antibiotics placed in a cement spacer be tailored to the sensitivity of the infective organism?

RECOMMENDATION: Antibiotics added to cement spacer during resection arthroplasty should be tailored toward the causative organism and its susceptibility. In case of culture-negative periprosthetic joint infections (PJIs), consideration should be given to the addition of a broad-spectrum antibiotic to the cement spacer to cover the most potential pathogens causing PJI.

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QUESTION 4: Which antibiotic(s) should be added to a cement spacer in patients with periprosthetic joint infections (PJIs) caused by multiresistant organisms?

RECOMMENDATION: In the case of PJIs caused by MRSA/MRSE, vancomycin should be added to the bone cement spacer. In vancomycin-resistant strains, such

as VRE, or in multiresistant gram-negative PJI cases, individual decision-making is mandatory based on the known susceptibilities. Consultation with a microbiologist/infectious disease specialist is strongly recommended.

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QUESTION 5: What are the contraindications to use antibiotics in a cement spacer?

RECOMMENDATION: With the exception of a scenario in which a patient has a history of severe adverse reaction to each of the thermally stable antibiotics intended for use in cement spacers in the treatment of prosthetic joint arthroplasty, there are no definite contraindications to use antibiotics in a cement spacer.

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QUESTION 6: Does the use of surgical drains reduce the effectiveness of antibiotic-impregnated cement spacers?

RECOMMENDATION: The current literature indicates that the use of surgical drains does not reduce the overall effectiveness of antibiotic-impregnated cement spacers.

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QUESTION 7: Is there a role for intraoperative autoclaving and reuse of an infected prosthesis as a spacer during resection arthroplasty?

RECOMMENDATION: Multiple studies have demonstrated that the reuse of autoclaved prosthetic components, during knee resection arthroplasty, did not compromise the eradication of an established infection. Though a viable option, there are potential legal implications associated with the reuse of autoclaved components, and a proper standard for autoclaving of these components is also not known. Reuse of autoclaved components in resection arthroplasty, particularly for the knee, may be suitable in scenarios when proper dynamic spacer components are not available or for economic considerations.

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QUESTION 8: Is it necessary to revise or reduce dislocated articulating antibiotic spacers?

RECOMMENDATION: Unless the spacer is pressing against the skin with imminent necrosis/ulceration, resulting in severe, progressive loss of essential soft tissue or bone, neurovascular compromise, or notable pain and disability for the patient, a dislocated or fractured antibiotic-impregnated cement spacer is safe to leave in place until definitive second-stage surgery.

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5.5. TREATMENT: TWO-STAGE EXCHANGE

QUESTION 1: What is the optimal timing for reimplantation of a 2-stage exchange arthroplasty of the hip and knee?

RECOMMENDATION: The optimal timing for reimplantation of a 2-stage exchange arthroplasty of the hip or knee has not been established. Reimplantation may be performed when the treating medical team feels that the infection is under control.

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QUESTION 2: Is it safe to retain a stable cement mantle, for later use, in patients undergoing resection arthroplasty for periprosthetic joint infections (PJIs)?

RECOMMENDATION: Meticulous debridement and removal of all foreign material, including cement, should be part of resection arthroplasty in the management of periprosthetic joint infections (PJIs). Limited data suggest that under strict conditions and following a meticulous surgical technique, a stable cement mantle in the femur may be left in place for later use in order to minimize damage to the femoral bone stock.

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QUESTION 3: Should surgeons make an effort to remove cement that has extruded into the pelvis or at difficult anatomical positions in patients with periprosthetic joint infections (PJIs)?

RECOMMENDATION: The orthopedic surgeon should carefully consider whether the potential benefits of cement extraction from the pelvis or difficult anatomical positions outweigh the potential risks of persistence of infection.

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QUESTION 4: Does the use of non-antibiotic-impregnated allograft for bone defects during reimplantation increase the risk of recurrence of surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: There is no evidence to demonstrate that using nonantibiotic impregnated allograft for management of bone defects during reimplantation (following PJIs) increases the risk of recurrence of SSIs/PJIs.

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5.6. TREATMENT: SURGICAL TECHNIQUE

QUESTION 1: Does arthroscopic surgery have any role in the treatment of acute or chronic periprosthetic joint infection (PJI) of the knee or the hip?

RECOMMENDATION: Arthroscopic surgery has no role in the treatment of acute or chronic PJI of the knee or hip.

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QUESTION 2: Do all metallic implants need to be removed to eradicate periprosthetic joint infections (PJIs)? Does this apply to other metal hardware present (e.g. hook plates, cables) as well?

RECOMMENDATION: Complete debridement of the hip or knee joint and removal of all hardware is ideal during surgical treatment of periprosthetic joint infections (PJIs). This principle should be followed whenever possible. However, there may be rare cases of PJIs when removal of all hardware may lead to marked morbidity and preclude future reconstruction. In the latter situation, some hardware may be retained.

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QUESTION 3: Should all knee compartments be resected during resection of an infected unicompartmental knee arthroplasty (UKA)?

RECOMMENDATION: Yes, during resection of an infected unicompartmental knee arthroplasty (UKA), other compartments of the knee, including the fat pad, should also be resected.

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QUESTION 4: Can sub-radical resection arthroplasty (leaving parts of implants in place) be considered during management of patients with chronic periprosthetic joint infections (PJIs)?

RECOMMENDATION: Sub-radical resection arthroplasty (leaving parts of implants in place) may be considered during management of patients with chronic PJIs when a component is proven to be well-fixed, and its removal precludes opportunity for future reconstruction.

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QUESTION 5: Is it possible to have an isolated infection of only a portion of the joint (for example the femur and not the acetabulum or tibia and not the femur)?

RECOMMENDATION: Unknown. Infection of a prosthetic joint is likely to involve biofilm formation on surfaces of all foreign material. However, there may be rare circumstances when infective organisms may not be able to reach the surface of a well-fixed implant and form a biofilm.

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QUESTION 6: Should heterotopic ossification (HO) be removed during resection arthroplasty of an infected prosthetic joint?

RECOMMENDATION: We recommend that surgeons give strong consideration to removal of accessible heterotopic ossification (HO) in an infected prosthetic joint that will not compromise future reconstruction.

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QUESTION 7: When soft tissue coverage requires a reconstructive flap, can it be performed at the time of explant or should it be deferred until reimplantation?

RECOMMENDATION: When a soft tissue defect requires a reconstructive flap, it is safe to perform flap coverage at the time of explant or at the time of reimplantation. Early flap coverage at the time of explantation improves soft tissue biology for eradication of infection and allows for earlier mobilization following reimplantation given greater flap maturity.

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5.7. TREATMENT: PROSTHESIS FACTORS

QUESTION 1: Does the use of cemented or cementless components at the time of reimplantation affect the success of treating chronic PJI's? If yes, what are the optimal antibiotic(s), dosage, and cement to maximize antibiotic delivery and mechanical properties of the cement?

RECOMMENDATION: There is no evidence to suggest that the use of cemented or cementless components at the time of reimplantation affects the success rate of infection treatment. However, the mode of fixation may affect implant survivorship. The bone mass and the quality should dictate the choice of implant and the mode of fixation during reimplantation. If cemented prostheses are used, consideration should be given to the addition of antibiotics, directed toward the infective organisms, at the time of reimplantation.

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QUESTION 2: Does the use of tantalum (Ta) augments during a single-stage revision for periprosthetic joint infection (PJI) influence the rate of surgical site infections (SSIs) or PJIs?

RECOMMENDATION: Findings of retrospective studies suggest that tantalum augments might have a protective effect against subsequent infection after single-stage revision joint in the context of PJI.

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QUESTION 3: Is the use of highly porous tantalum (Ta) associated with reduced risks of surgical site infections/periprosthetic joint infections (SSIs/PJIs) recurrences in revision total joint arthroplasties?

RECOMMENDATION: There is some evidence to suggest that the use of highly porous tantalum is associated with reduced risks of SSIs/PJIs recurrences in patients undergoing revision total joint arthroplasties, particularly for treatment of PJIs.

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5.8. TREATMENT: SALVAGE

QUESTION 1: Are there differences in outcomes and survivorship between knee arthrodesis (KA) and above-knee amputations (AKA) for chronic knee periprosthetic joint infections (PJIs)?

RECOMMENDATION: Yes, an AKA for the treatment of chronic PJI in total knee arthroplasty (TKA) has a lower functional outcome, and higher mortality rate than KA.

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QUESTION 2: How many exchange arthroplasties are reasonable before a salvage operation (such as amputation or arthrodesis) should be considered?

RECOMMENDATION: Patients with a failed two-stage exchange arthroplasty that undergo a repeat two-stage exchange arthroplasty demonstrate poor outcomes. Failure of the repeat two-stage exchange arthroplasty appears to be dependent on the host grade and status of the extremity. Surgeons thus should consider the patient's comorbidities and expectations when deciding whether to subject the patient to repeat two-stage exchange arthroplasties. The outcomes of a third or fourth two-stage exchange arthroplasty are dismal.

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QUESTION 3: What are surgical alternatives to hip disarticulation in patients with persistent joint infections?

RECOMMENDATION: Surgical alternatives to hip disarticulation include resection arthroplasty when reconstruction of the joint with the use of a megaprosthesis is not possible. Hip disarticulation should be reserved for patients with systemic sepsis and/or extreme soft tissue infections of the extremity, in whom the surgery is performed as part of a life-saving procedure.

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5.9. TREATMENT: ANTIMICROBIALS

QUESTION 1: What is the recommended duration of antibiotics after a single-stage exchange for periprosthetic joint infections (PJIs)?

RECOMMENDATION: In the setting of single-stage exchange arthroplasty, intravenous antibiotics should be administered for 10-14 days followed by oral antibiotics. Generally, the overall duration of antibiotics of 4-6 weeks is sufficient.

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QUESTION 2: Are there any tests that can guide antimicrobial treatment in patients with periprosthetic joint infections (PJIs) so as to determine when treatment may be discontinued?

RECOMMENDATION: No. There are no tests that can be used to guide therapies and monitor responses to treatments in patients with PJIs. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are considered useful for monitoring responses to treatments; however, sustained elevations after treatment does not predict persistent infections. Emerging biomarkers, such as D-dimer and presepsin, have shown promising results. Nevertheless, more studies are required to assess their role in monitoring response to treatment in patients with PJIs.

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QUESTION 3: Does the International Consensus Group (ICG) agree with the Infectious Diseases Society of America (IDSA) guidelines regarding the recommended duration of antibiotic therapy in orthopaedic infection?

RECOMMENDATION: There is some disagreement between what the ICG and the IDSA recommends regarding the duration of antibiotic treatments for different infective organisms. The differences between the two organizations resides on the duration of oral antibiotic therapy following a pathogen-specific intravenous (IV) antimicrobial therapy.

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QUESTION 4: Is the type, dose, route of administration and duration of antimicrobial treatment influenced by the type of infective organism causing periprosthetic joint infection (PJI)?

RECOMMENDATION: The duration, dose, route of administration and the type of antibiotic administered to patients with PJI is determined by the type of infective organism(s) isolated.

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QUESTION 5: When a patient undergoes aseptic revision and intraoperative culture(s) grow an organism, should patients be treated with antibiotic therapy?

RECOMMENDATION: Antibiotic therapies are recommended if two or more cultures isolate the same organism, as per the MusculoSkeletal Infection Society (MSIS) and the International Consensus Group (ICG) criteria for prosthetic joint infections (PJIs). Antibiotic therapies may not be required when a single intraoperative culture isolates an organism. However, there may be circumstances when a single positive culture, combined with other tests, may indicate the presence of an infection and treatment would be indicated.

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QUESTION 6: When should rifampin be added to the regimen of antibiotics for management of patients with periprosthetic joint infections (PJIs) undergoing surgical treatment?

RECOMMENDATION: Rifampin should be considered in the treatment of staphylococcal PJIs in patients managed surgically with debridement, antibiotics and implant retention (DAIR) or single-stage exchange where activity against biofilm is required. Rifampin should only be used in combination therapies, with the best reported combination appearing to be with a fluoroquinolone.

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QUESTION 7: What is the optimal antibiotic therapy in cases of culture-negative (CN) periprosthetic joint infections (PJIs)?

RECOMMENDATION: In patients with true CN PJIs, the antibiotics should be selected to have broad spectrum activity against both gram-positive and gram-negative organisms. In addition, the exact choice should relate to the known modern epidemiology in that country.

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QUESTION 8: What antibiotic therapy and duration of treatment should be used in Enterococcal periprosthetic joint infections (PJIs)?

RECOMMENDATION: Based on the limited available evidence, combination antimicrobial therapy should be considered for the treatment of Enterococcal PJIs, at least during the first weeks of treatment. Antibiotics should be tailored according to the susceptibility of the infective microorganism.

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QUESTION 9: What are the indications for utilizing fosfomycin, tigecycline and daptomycin, either instead of other antibiotics or in conjunction with other antibiotics, for the management of periprosthetic joint infections (PJIs)?

RECOMMENDATION FOR DAPTOMYCIN: Daptomycin is an alternative treatment for patients with PJIs caused by methicillin-resistant *Staphylococcus aureus* (MRSA).

RECOMMENDATION FOR FOSFOMYCIN: Although there is no clinical experience using fosfomycin in PJIs, it could be considered in infections due to multi-drug resistant gram-positive (MDR-GP) or gram-negative bacteria (GNB) as a part of a combination regimen with daptomycin, rifampin or tigecycline when the microorganism is susceptible.

RECOMMENDATION FOR TIGECYCLINE: Tigecycline could be considered for the treatment of MDR-GP or -GNB as a part of a combination regimen when the microorganism is susceptible.

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5.10. TREATMENT: ANTIMICROBIALS (TWO-STAGE)

QUESTION 1: (A) What is the optimal length of administration for antibiotic treatment following resection arthroplasty? (B) What is the optimal mode of administration for antibiotic treatment following resection arthroplasty?

RECOMMENDATION: Antimicrobial therapy should be individualized and based on the sensitivity profile of the microorganism, patient tolerance and drug side-effect profile. There is no conclusive evidence supporting the exact length of antibiotic therapy after resection arthroplasty. We recommend treatment for two to six weeks. Either intravenous, oral antibiotics, or a combination are acceptable for treatment following resection arthroplasty as long as the oral agent has adequate bioavailability and can achieve a concentration at the site of infection to eradicate the infecting organism, if used alone.

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QUESTION 2: Does extended oral antibiotic prophylaxis following reimplantation reduce the risk of future failure? If so, what type of antibiotic should be administered and for how long?

RECOMMENDATION: Possibly. There is emerging evidence that administration of three months of oral antibiotics directed towards the original infecting organism following reimplantation reduces the risk of early failure secondary to periprosthetic joint infections (PJIs).

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QUESTION 3: When is the optimal time to change intravenous (IV) antibiotic(s) to an oral agent(s) after a resection arthroplasty as part of two-stage exchange?

RECOMMENDATION: There is evidence to support pathogen-specific, highly bioavailable oral antibiotic therapy as an appropriate choice after resection arthroplasty in a two-stage treatment of periprosthetic joint infections (PJIs) after an initial IV antibiotic period of at least 5-7 days.

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QUESTION 4: Can short term (two weeks or less) antibiotic treatment be considered following resection arthroplasty for chronic periprosthetic joint infections (PJIs)?

RECOMMENDATION: Yes. Following an aggressive debridement and insertion of an antibiotic-loaded cement spacer (ALCS) or beads, a short-term course of less than two weeks of systemic antibiotic therapy can be considered. Several studies show promising results with infection eradication rates comparable to when a much longer course of antibiotic treatment is used.

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5.11. TREATMENT: ANTIMICROBIAL SUPPRESSION

QUESTION 1: Is there a role for administration of prolonged oral antibiotics following primary total joint arthroplasty (TJA)?

RECOMMENDATION: No. The administration of prolonged oral antibiotics in the context of perioperative prophylaxis after primary TJA is not recommended. Continuing antibiotic prophylaxis longer than 24 hours after wound closure has not proven to be beneficial; indeed, it may contribute to the development of antimicrobial resistance, carries risks and adds to healthcare costs.

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QUESTION 2: What is the role of oral suppression antibiotics after reimplantation in patients with negative cultures after 14 days of incubation?

RECOMMENDATION: There may be a role for the administration of oral antibiotics to decrease reinfection rates following reimplantation in patients with negative cultures, but further study is necessary.

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QUESTION 3: Which patients should be considered for administration of long-term suppressive oral antibiotic instead of surgical treatment in patients with chronic periprosthetic joint infections (PJIs)?

RECOMMENDATION: Long-term suppressive oral antibiotics instead of surgical treatment may be considered for patients who are not *candidates* for surgery, when surgery is not expected to improve the functional outcome for a patient, and for patients who refuse surgery.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

質問1：PJIの患者において、外科的治療の成功はどのように定義づけられるか？ 臨床的、外科的、細菌学および機能的指標としてどのようなものを検討すべきか？

著者：Yale J. Fillingham, Craig J. Della Valle, Linda I. Suleiman, Bryan D. Springer, Thorsten Gehrke, Stefano Bini, John Segreti, Antonia F. Chen, Karen Goswami, Timothy L. Tan, Noam Shohat, Claudio Diaz-Ledezma, Adam J. Schwartz, Javad Parvizi 翻訳者：森井健司

推奨：元来、PJIの治療は、成功か失敗かといった明確なアウトカムで提示されない。通常、治療結果は、成功あるいは失敗の度合いで表現される。よって、アウトカムを評価しうる指標を4つのティア（階層）に編成した。それぞれのティアには、多様な基準によって、成功あるいは失敗と判断される（複数の）状態が含まれている。PJIの治療（結果）を提示しているアウトカムは以下のとおりである（それぞれのティアにおける用語の定義は rationale section に記載されている）。

- ティア 1. 抗菌薬の持続投与を行わない感染の制御
 ティア 2. 抗菌薬持続投与による感染の制御
 ティア 3. 再手術、および／または再置換術、および／またはスぺーサー留置が必要である状態（再手術の種類に基づいて、A、B、C、D、E、およびFのサブグループに分類する）
- A PJIの治療を開始してから1年以上経過した時点での無菌的再置換術
 - B PJIの治療を開始してから1年以上経過した時点での、原因菌存在下での（DAIRを含む）再置換術（ただし切断術および切除関節形成術と関節固定術を除く）
 - C PJIの治療を開始してから1年以内の時点での無菌的再置換術
 - D PJIの治療を開始してから1年以内の時点での、原因菌存在下での（DAIRを含む）再置換術（ただし切断術および切除関節形成術と関節固定術を除く）
 - E 切断術および切除関節形成術と関節固定術
 - F スぺーサーの留置
- ティア 4. 死亡（A、Bのサブグループに分類する）
- A PJIの治療を開始してから1年以内の死亡
 - B PJIの治療を開始してから1年以降の死亡

エビデンスレベル：Consensus

投票結果：賛成 82%、反対 14%、棄権 4%（大多数、強いコンセンサス）

質問2：PJI管理の専門家と認証できうる年間最低PJI治療症例数は存在するか？

著者：George Grammatopoulos, Paul M. Courtney, Guillem Bori 翻訳者：森井健司

推奨：治療成績を改善させるために外科医が治療すべき適切な年間 PJI 症例数は報告されていないが、PJI 患者を治療した経験が多い外科医のほうが、TJA の経験症例数がより少ない外科医よりも良好な治療成績を示すであろうことを示唆するデータがある。合併症の減少や治療成績の向上に至るために、外科医が経験すべきである PJI の最少症例数を決定するには、さらなる解析が必要である。

エビデンスレベル：Limited

投票結果：賛成 97%、反対 1%、棄権 2%（満場一致、最も強いコンセンサス）

質問3：DAIRの成功を予測する際に、適応しうる指標（たとえば、腎機能、肝機能、初回手術、人工関節のセメント固定とCRP(KLIC)スコアなど）は？ これらの指標の信頼性は？

著者：Ayman Ebied, Gregory Poljowski, Sameh Marei, William P. Abblitt, Adam C. Brekke, Lee K. Swiderek 翻訳者：森井健司

推奨：2種類の前後予測スコアリングシステムが報告されている。結果が検証されているものは1つにとどまる。これら2つのスコアリングシステムに用いられている変数の意義を検証したいいくつかの研究があるが、論文の内容にはばらつきや不一致があり、これらの信頼性と実用性に関する普遍の見解を得るにたっていない。

エビデンスレベル：Moderate

投票結果：賛成 91%、反対 7%、棄権 2%（大多数、強いコンセンサス）

質問4：(A)PJIの治療を行った患者の適切な経過観察計画(すなわちスケジュール、検査手技、臨床検査、画像検査)は？ (B)二期的再置換術の過程での人工関節抜去後、炎症マーカーを測定する適切な回数は？

著者：Tiziana Ascione, Ali Oliashirazi, Yi Rong Zeng 翻訳者：森井健司

推奨：(A) 現在、PJIの治療を行った患者に対する適切な経過観察スケジュールに関してコンセンサスは得られておらず、この問題に特化して考察を加えている研究はない。エビデンスは存在していないが、術後6週、3か月、6か月、12か月、その後は1年おきに経過観察し、適宜おのおのの症例の状況に応じて適切に変えることを推奨する。人工関節抜去後の炎症マーカーは毎週検査されるべきである。

(B) 現在、PJIの二期的再置換術の過程で、バイオマーカーがどのくらいの頻度で検査されるべきかを検証した研究はなされていない。現在公開されている大部分の研究においては、関節液中白血球（WBC）数、多核白血球（PMN）、白血球エステラーゼ（LE）、そしてESR、CRPを含む施行可能な一連の臨床検査が、第二段階（再置換術）にいたるまでのあいだに最低1回、行われている。しかしながら、これらの検査の時期の推奨を提示している定まったプロトコールは存在しない。この分野において、今後、整形外科医の判断材料となりコンセンサスを形成する手助けとなる研究が必要である。

エビデンスレベル：(A) Consensus, (B) Consensus

投票結果：賛成 85%、反対 7%、棄権 8%（大多数、強いコンセンサス）

質問 5：PJI の患者を管理する際に、集学的チームを動員することは有益か？

著者：Kordo Saeed, Chun Hoi Yan 翻訳者：森井健司

推奨：PJI の治療には、整形外科医、麻酔科医、感染症専門家、医学微生物学者、形成外科医および補助的部門の協力からなる集学的なアプローチが必要である。PJI の治療に経験をもつ施設、あるいは標準的なプロトコールに順応している施設は、合併症がより少なく良好な治療成績を示していることが報告されている。これらをくつがえす更なる研究が出てくるまでは、PJI 患者は、集学的なアプローチを実践し、PJI の管理の経験を積んだ施設で治療を行うべきである。

エビデンスレベル：Limited

投票結果：賛成 98%、反対 1%、棄権 1%（満場一致、最も強いコンセンサス）

QUESTION 1: What is the definition of success of surgical treatment of a patient with a periprosthetic joint infection (PJI)? What clinical, operative, microbiological and functional metrics should be considered?

RECOMMENDATION: The treatment of PJIs typically does not have a dichotomous outcome. More commonly, the result is a gradient of success or failure. As such, the outcome-reporting tool has been organized into four tiers with each tier encompassing different levels of perceived success or failure. The outcomes reporting for the treatment of PJIs are the following (definitions regarding items within each tier are explained in the rationale section):

- Tier 1. Infection control with no continued antibiotic therapy
- Tier 2. Infection control with patient on suppressive antibiotic therapy
- Tier 3. Need for reoperation and/or revision and/or spacer retention (assigned to subgroups of A, B, C, D, E, and F based on the type of reoperation)
 - A. Aseptic revision > 1 year from initiation of PJI treatment
 - B. Septic revision (including debridement, antibiotic and implant retention (DAIR)) > 1 year from initiation of PJI treatment (excluding amputation, resection arthroplasty and fusion)
 - C. Aseptic revision ≤ 1 year from initiation of PJI treatment
 - D. Septic revision (including DAIR) ≤ 1 year from initiation of PJI treatment (excluding amputation, resection arthroplasty, and fusion)
 - E. Amputation, resection arthroplasty, or fusion
 - F. Retained spacer
- Tier 4. Death (assigned to subgroups A or B)
 - A. Death ≤ 1 year from initiation of PJI treatment
 - B. Death > 1 year from initiation of PJI treatment

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QUESTION 2: Is there a minimum number of periprosthetic joint infection (PJI) procedures that surgeons should perform annually that qualifies them as experts in the management of PJIs?

RECOMMENDATION: While the optimal number of PJI cases a surgeon needs to perform annually to improve outcomes has not been established in the literature, some data suggests that surgeons that care for more PJI patients will have better results than lower volume arthroplasty surgeons. Further studies are needed to identify the minimum number of PJI cases a surgeon should perform to reduce complications and improve outcomes.

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QUESTION 3: What tools (i.e., kidney, liver, index surgery, cemented prosthesis and C-reactive protein (KLIC) score) are available to help predict successful treatment with debridement, antibiotics and implant retention (DAIR)? What is the accuracy of these tools?

RECOMMENDATION: Two prognostic scoring systems have been published and only one has been validated. While several studies exist confirming the significance of the variables utilized by the two scoring systems, the body of literature is heterogeneous and conflicted, such that general statements of their accuracy and applicability cannot be supported.

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QUESTION 4: (A) What is the optimal follow-up plan (i.e., schedule, exam maneuvers, labs, imaging) for patients being treated for periprosthetic joint infections (PJIs)? (B) How frequently should the inflammatory biomarkers be measured after the resection arthroplasty performed as part of two-stage exchange?

RECOMMENDATION:

(A) At present, there is no consensus regarding the optimal follow-up schedule for patients being treated for PJIs and no specific research discussing this topic. In the absence of evidence, we recommend that the patients should be followed at 6 weeks postoperatively, 3 months, 6 months, 12 months, and annually thereafter, with adjustments being made based on individual circumstances. Inflammatory markers should be measured on a weekly basis after resection arthroplasty.

(B) As of now there is no study to assess the frequency with which the biomarkers need to be checked during the course of a two-stage exchange for PJIs. Most of the available studies have checked the available diagnostic battery of the tests, including serum erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) as well as synovial fluid white blood cell (WBC) count, polymorphonuclear (PMN) and leucocyte esterase (LE) at least once prior to the second stage (reimplantation). However, there is no unified protocol that provides recommendations on the timing of these tests. Future studies in this field are required to guide the orthopaedic community and help form a consensus.

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QUESTION 5: Is there a benefit for the engagement of a multidisciplinary team for the management of patients with periprosthetic joint infections (PJIs)?

RECOMMENDATION: The treatment of PJIs takes a multidisciplinary approach, with interactions between the orthopaedic surgeon, anesthesiologist, infectious disease specialist, medical microbiologist, plastic surgeon and ancillary service teams. It is demonstrated that centers with experience in the treatment of PJIs, or those adopting standardized protocols, have improved outcomes with lower complications. Until further research demonstrates otherwise, patients with PJIs should be cared for in centers that use a multidisciplinary approach and have experience in the management of PJIs.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
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BIOFILM

PART III

SHOULDER

SECTION 1: PREVENTION

- 1.1. 抗菌薬
- 1.2. 術中
- 1.3. 患者背景
- 1.4. 皮膚処置

SECTION 2: DIAGNOSIS

- 2.1. 培養の意義
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SECTION 3: TREATMENT

- 3.1. 予期せぬ培養陽性に対する抗菌薬
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- 3.3. 骨移植
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〈監訳者〉

井上和也、中瀬順介

1.1. 予防：抗菌薬

質問1：初回人工肩関節置換術の周術期に最適な抗菌薬は何か？

著者：Paul Pottinger, Aaron J. Tande, Sandra Bliss Nelson 翻訳者：中瀬順介、土屋弘行

推奨：初回人工肩関節置換術を受ける患者は、手術部位に存在する特異的なグラム陽性およびグラム陰性菌をカバーした抗菌薬を投与すべきである。過去の文献によれば、体重を考慮してセファゾリンを投与することが推奨されている（表1）。MRSAの保菌者の場合には、体重を考慮したグリコペプチド系抗菌薬を、できるだけセファゾリンと組み合わせて投与すべきである（表1）。βラクタム系抗菌薬に対する耐性がないと考えられる患者に対しては、セファゾリン投与が可能であるかどうかをさらに評価すべきである。セファゾリンの使用に対する過敏反応や副作用を有する患者には、バンコマイシンまたはクリンダマイシンを投与すべきである。

TABLE 1. 初回人工肩関節置換術を受ける患者に対して推奨される予防抗菌薬

抗菌薬	推奨投与量
βラクタム系抗菌薬に対するアレルギーなし	皮膚切開開始30分から60分以内にセファゾリンを経静脈投与（体重が120 kg以上では3 mg）。術後投与時間はQ4；術後投与は必要なく、24時間を超えてはいけない。
MRSA 感染または保菌の既往	皮膚切開開始2時間以内にバンコマイシン 15 mg/kg を経静脈投与（最大2 mg）。術後投与時間はQ4；術後投与は必要なく、24時間を超えてはいけない。バンコマイシンにセファゾリンを追加することを推奨する。
重度のβラクタム系抗菌薬に対するアレルギー	皮膚切開開始2時間以内にバンコマイシン 15 mg/kg を経静脈投与（最大2 mg）。術後投与は必要なく、24時間を超えてはいけない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：人工肩関節再置換術を受ける患者における周術期に最適な抗菌薬は何か？

著者：Paul Pottinger, Aaron J. Tande, Luis F. Calixto 翻訳者：中瀬順介、土屋弘行

推奨：人工肩関節再置換術を受ける患者は、質問1で議論されたような予防的抗菌薬を投与すべきである。質問5でも述べられているように、術中に感染が疑われる場合には、起因菌が同定されるまで、経口のアモキシシリンまたは第1世代セファロスポリン（またはβ-ラクタムアレルギーの場合には経口ドキシサイクリン）の投与を考慮すべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：術前に特異的な危険因子（性別や合併症など）を持つ患者において、肩関節PJIに対して用いるべき周術期抗菌薬は何か？

著者：Paul Pottinger, Aaron J. Tande, Sandra Bliss Nelson 翻訳者：中瀬順介、土屋弘行

推奨：感染リスクは身体的特徴・合併症・MRSAの保菌・アレルギーにより影響される可能性があるが、予防的投与に用いる薬剤を変更することを支持する特異的な因子は存在しない。MRSA保菌者の場合は、標準的予防に加えてグリコペプチド系抗菌薬を投与すべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：初回人工肩関節置換術または再置換術後の周術期抗菌薬の最適な投与期間はどれくらいか？

著者：Joseph J. King, Brent Morris, Anne Lachiewicz 翻訳者：中瀬順介、土屋弘行

推奨：初回人工肩関節置換術の場合には、感染リスクを低下させるために、皮膚切開開始1時間以内に予防的抗菌薬を経静脈投与（IV）すべきである。抗菌薬の経静脈投与は術後24時間継続してもよい。人工肩関節再置換術の場合も同様に、抗菌薬の経静脈投与は皮膚切開開始1時間以内に投与すべきである。議論の余地はあるものの、現在のところ、培養用の組織が得られるまで、予防的抗菌薬を常用的に使用することは推奨しない（Section 2.5. Diagnosis: サンプルング、質問7参照）。PJIが疑われる場合でなければ、術後24時間のみ抗菌薬の経静脈投与が継続されるべきである。再置換術の場合においては、感染の疑いがありかつ最終の培養結果を待機している状態であるなら、最終培養結果が得られるまでは抗菌薬を継続しても良い。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問5：感染の疑いがない場合に、人工肩関節再置換術後に抗菌薬（培養結果保留中）を投与する事は有用か？

著者：Trisha Peel, Edward Yian, Surena Namdari 翻訳者：中瀬順介、土屋弘行

推奨：臨床的に感染の疑いがない人工肩関節再置換術の術後においては、抗菌薬を長期間継続する必要はない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

1.2. 予防：術中

質問 1：人工肩関節置換術中(初回および再置換)に抗菌薬含有セメントを使用すべきか？

著者：Mark Falworth, Jeremy Somerson 翻訳者：中瀬順介、土屋弘行

推奨：初回人工肩関節置換術または再置換術時に抗菌薬含有セメントを使用すべきかどうかを決定しうる根拠は不十分である。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：初回人工肩関節置換術または再置換術時において、ヨード希釈液・酢酸・抗菌薬含有洗浄液・バンコマイシンのような抗菌薬粉末の手術部位への局所投与は有用か？

著者：Edward Yian, Surena Namdari 翻訳者：中瀬順介、土屋弘行

推奨：肩以外の整形外科分野によれば、初回人工肩関節置換術または再置換術後に PJI を起こすリスクが高いと考えられる患者においては、希釈したポビドンヨードおよびバンコマイシン粉末は、有用かもしれない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：初回人工肩関節置換術または再置換術を受ける患者において、外科的ドレーンは感染リスクに影響を及ぼすか？

著者：Jim Kelly, Vani Sabesan, Diego Lima, Michael Rozell 翻訳者：中瀬順介、土屋弘行

推奨：人工肩関節置換術を受ける患者において、閉鎖的吸引ドレーンを使用することで PJI が予防するという事を支持する根拠はない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 4：初回人工肩関節置換術または再置換術中における PJI のリスク軽減を目的としたトラネキサム酸(TXA)の投与は有用か？

著者：Edward McFarland, José M. Mora, Jorge Rojas 翻訳者：中瀬順介、土屋弘行

推奨：人工肩関節置換術を受ける患者において、PJI の予防のためにトラネキサム酸を常に使用すべき事を支持する根拠はない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

1.3. 予防：患者背景

質問 1：手術時に存在する既往歴は、初回人工肩関節置換術または再置換術後の PJI の潜在的リスク因子となるか？

著者：Brent Morris, Joseph J. King 翻訳者：中瀬順介、土屋弘行

推奨：特定の既往歴や身体的要因は、肩関節 PJI の潜在的なリスク因子であるので、適切な術前評価および術後管理がなされるべきである。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：肩関節の手術歴(関節鏡視下または直視下の非人工関節手術)は、PJI のリスクを増加させるか？

著者：Mark Frankle, Jason Hsu 翻訳者：中瀬順介、土屋弘行

推奨：過去に非人工関節手術を同側に受けている場合は、肩関節 PJI のリスクが増加する可能性がある。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：コルチコステロイド注射の既往は、初回人工肩関節置換術または再置換術後の PJI のリスクを増加させるか？

著者：Mark Frankle, Jason Hsu 翻訳者：中瀬順介、土屋弘行

推奨：コルチコステロイド注射回数の増加、またコルチコステロイド注射と人工肩関節置換術の期間が短くなればなるほど、SSI または PJI のリスクは増加

する可能性がある。

エビデンスレベル: Limited

投票結果: 賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

1.4. 予防：皮膚処置

質問 1：初回人工肩関節置換術または再置換術の施行前の皮膚洗浄(洗浄やブラッシング)は有用か？

著者：Ben Clark, Vani Sabesan, Arjun Meiyappan 翻訳者：中瀬順介、土屋弘行

推奨: クロルヘキシジングルコン酸 (CHG) による洗浄やブラッシング、少なくともこの二つの方法は、肩関節手術前の細菌検出陽性率を減少させる。今後新たな研究がなされるまでは、この方法が効果的であるのかもしれない。

エビデンスレベル: Limited

投票結果: 賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

質問 2：初回人工肩関節置換術または再置換術における周術期の最適な皮膚処置は何か？

著者：Jason Klein, Mark Morrey 翻訳者：大島健史、土屋弘行

推奨: 現時点で人工肩関節置換術における皮膚処置において最も根拠があるものは、2% グルコン酸クロルヘキシジンおよび 70% イソプロピルアルコールによる処置である。

エビデンスレベル: Moderate

投票結果: 賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

質問 3：初回人工肩関節置換術または再置換術の前に、局所の皮膚治療を行う事は有用か？

著者：Ben Clark, Vani Sabesan, Ahmed Al Mansoori 翻訳者：大島健史、土屋弘行

推奨: 現時点では、肩関節 PJI のリスクを低下させるために局所の皮膚治療を行う事を支持する根拠はない。

エビデンスレベル: Limited

投票結果: 賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

質問 4：人工肩関節置換術中に皮下組織と皮膚組織を消毒する必要性はあるか？

著者：Mark Falworth, Jeremy Somerson 翻訳者：大島健史、土屋弘行

推奨: 人工肩関節置換術中に皮下組織および皮膚組織の消毒の有効性があるかどうかの根拠は不十分である。

エビデンスレベル: Consensus

投票結果: 賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

1.1. PREVENTION: ANTIBIOTICS

QUESTION 1: What are the optimal perioperative antibiotics for primary shoulder arthroplasty?

RECOMMENDATION: Patients undergoing primary shoulder arthroplasty should receive antibiotics that cover gram-positive and gram-negative organisms specific to the regionally encountered organisms. Peer-reviewed literature supports cefazolin dosing based on body weight (Table 1). Patients with methicillin-resistant *Staphylococcus aureus* (S. aureus), or MRSA, colonization should receive weight-adjusted glycopeptide, preferably in combination with cefazolin (Table 1). Patients who are believed to have an intolerance to beta-lactam antibiotics should be further evaluated to determine if they can receive cefazolin. Patients with a true hypersensitivity reaction or adverse reaction that precludes the use of cefazolin should receive vancomycin or clindamycin.

TABLE 1. Recommended antimicrobial prophylaxis for patients undergoing primary shoulder arthroplasty

Clinical Situation	Antimicrobial Recommended
No beta-lactam allerg	Cefazolin 2 gm IV (3 gm if patient weighs > 120 kg) starting within 30-60 minutes prior to incision; re-dose Q 4 hours; postoperative doses not required and should not be given beyond 24 hours.
Personal history of MRSA infection or colonization	Vancomycin 15 mg/kg (max dose 2 gm) starting within 2 hours prior to incision; postoperative doses not required and should not be given beyond 24 hours. We favor the addition of cefazolin to vancomycin.
Proven, serious beta-lactam allerg	Vancomycin 15 mg/kg (max dose 2 gm) starting within 2 hours prior to incision; postoperative doses not required and should not be given beyond 24 hours.

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QUESTION 2: What are the optimal perioperative antibiotics for patients undergoing revision shoulder arthroplasty?

RECOMMENDATION: Patients undergoing revision shoulder arthroplasty should receive prophylactic antibiotics as discussed in Question 1. As addressed in Question 5, if there is suspicion for preexisting infection during surgery, consider oral amoxicillin or first-generation cephalosporin (or oral doxycycline if beta-lactam allergic) until cultures are finalized.

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QUESTION 3: Are there perioperative antibiotics that should be used for patients who have specific preoperative risk factors (e.g., patient sex and comorbidities) for shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: While risk of infection may be affected by demographics and comorbidities, outside of known methicillin-resistant *Staphylococcus aureus* (MRSA) colonization or true allergy, there are not patient-specific factors that justify a change in prophylaxis recommendations. Patients with MRSA colonization should receive a glycopeptide in addition to standard prophylaxis.

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QUESTION 4: What is the optimal duration of perioperative antibiotics following primary or revision shoulder arthroplasty?

RECOMMENDATION: For primary shoulder arthroplasty, prophylactic intravenous (IV) antibiotics should be given within one hour prior to incision to decrease the risk of infection. Intravenous antibiotics may be continued for 24 hours postoperatively. For revision shoulder arthroplasty, intravenous antibiotics should be given within one hour prior to incision. While controversial, the current evidence suggests that prophylactic antibiotics should not be routinely held until tissue for culture is obtained (see Section 2.5. Diagnosis: Sampling, Question 7). Intravenous antibiotics should only be continued for 24 hours postoperatively, unless there is a concern for periprosthetic infection. Antibiotics can be continued up until final culture results are obtained in revision cases if there is some suspicion of infection while awaiting the final culture results.

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QUESTION 5: Is there a role for postoperative (pending culture results) antibiotics after revision shoulder arthroplasty without suspicion for infection?

RECOMMENDATION: In revision shoulder arthroplasty without clinical suspicion for infection, prolonged antibiotics are not routinely required.

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1.2. PREVENTION: INTRAOPERATIVE

QUESTION 1: Should antibiotic-impregnated cement be used during shoulder arthroplasty (primary and revision)?

RECOMMENDATION: There is insufficient evidence to determine whether antibiotic-impregnated cement should be used during primary or revision shoulder arthroplasty.

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QUESTION 2: What is the role of topical intrawound antiseptics (dilute betadine lavage, acetic acid or antibiotics added to the irrigation solution) and antibiotic powder (such as vancomycin) during primary or revision shoulder arthroplasty?

RECOMMENDATION: Dilute povidone-iodine and/or vancomycin powder may have a role in patients considered at high-risk for periprosthetic joint infection (PJI) after primary or revision shoulder arthroplasty based on data extrapolated from other orthopaedic specialties.

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QUESTION 3: Do surgical drains influence the risk of infection in patients undergoing primary or revision shoulder arthroplasty?

RECOMMENDATION: There is no evidence to support routine use of closed-suction drains in patients undergoing shoulder arthroplasty for the prevention of periprosthetic joint infection (PJI).

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QUESTION 4: What is the role of tranexamic acid (TXA) during primary or revision shoulder arthroplasty (SA) in decreasing the risk of periprosthetic joint infection (PJI)?

RECOMMENDATION: There is no evidence to support routine use of TXA in patients undergoing shoulder arthroplasty for the prophylaxis of PJI.

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1.3. PREVENTION: PATIENT CHARACTERISTICS

QUESTION 1: What is the role of medical comorbidities as potential risk factors for periprosthetic joint infection (PJI) following primary or revision total shoulder arthroplasty (TSA)?

RECOMMENDATION: Specific patient medical comorbidities and demographic factors are potential risk factors for shoulder PJI and appropriate preoperative evaluation and perioperative management should be standard practice.

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QUESTION 2: Does previous shoulder surgery (arthroscopic or open non-arthroplasty) increase the risk of periprosthetic joint infection (PJI)?

RECOMMENDATION: Previous ipsilateral non-arthroplasty shoulder surgery likely increases the risk of shoulder PJI.

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QUESTION 3: Does prior corticosteroid injection increase the risk of periprosthetic joint infection (PJI) after primary or revision shoulder arthroplasty?

RECOMMENDATION: An increased number of corticosteroid injections and a shorter interval between corticosteroid injection and shoulder arthroplasty may increase the risk for surgical site infection or shoulder PJI.

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1.4. PREVENTION: SKIN PREPARATION

QUESTION 1: Is there a role for preoperative skin scrub (home scrubs and washes) prior to primary or revision shoulder arthroplasty?

RECOMMENDATION: Chlorhexidine gluconate (CHG) showers or cleansing wipes with at least two applications decreases the incidence of positive skin cultures prior to shoulder surgery. Pending further research, this protocol may provide a benefit.

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QUESTION 2: What is the optimal perioperative surgical skin prep for primary or revision shoulder arthroplasty?

RECOMMENDATION: The best available evidence supports 2% chlorhexidine gluconate and 70% isopropyl alcohol for surgical skin prep for shoulder arthroplasty.

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QUESTION 3: Is there a role for topical skin treatments prior to primary or revision shoulder arthroplasty?

RECOMMENDATION: At this time, there is no evidence for or against the use of topical skin treatments to reduce the rate of shoulder periprosthetic joint infection (PJI).

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QUESTION 4: Should the subcutaneous and dermal tissues be disinfected during shoulder arthroplasty?

RECOMMENDATION: There is insufficient evidence for or against disinfection of the subcutaneous and dermal tissues during shoulder arthroplasty.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

2.1. 診断：培養の意義

質問 1：肩関節 PJI の評価における培養陽性の意義は何か？ 臨床的に意義のある培養陽性とコンタミネーションを判別するものは何か？

著者：Frederick Matsen, Andrew Green 翻訳者：大島健史、土屋弘行

推奨：痛みを伴うまたは破綻をきたした人工肩関節を有する患者において培養陽性を示す場合は、臨床症状および診断基準に基づいて適切に治療されるべきである。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：臨床的または画像的には感染徴候が認められない場合に人工肩関節再置換術を受ける患者において、予期せぬ培養陽性 (UPC) の意義は何か？

著者：Grant E. Garrigues, Carlos Torrens, Jaap Willems, Kevin C. Wall, Leila Ledbetter 翻訳者：大島健史、土屋弘行

推奨：予期せぬ培養陽性の意義は不明である。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：臨床的または画像的に感染徴候が認められない場合に人工肩関節再置換術を受ける患者において、予期せぬ培養陽性 (UPC) が認められた場合に行う治療は何か？

著者：Grant E. Garrigues, Carlos Torrens, Jaap Willems, Kevin C. Wall, Leila Ledbetter 翻訳者：大島健史、土屋弘行

推奨：わからない。予期せぬ培養陽性が認められた場合における治療法を示した報告はほとんどない。これらの報告では、抗菌薬の投与・再手術・治療延期が最も一般的な選択肢であることが示されている。しかし、これらの治療法を比較したデータはなく、最適な治療法を決定することは困難である。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 4：肩からの培養陽性菌の定量的評価（細菌の密度、*Cutibacterium acnes* (*Propionibacterium acnes*) 数など）は有用か？

著者：Maria Eugenia Portillo, Andrew Green, Frederick Matsen 翻訳者：大島健史、土屋弘行

推奨：細菌培養結果の半定量的および定量的評価は、PJI の診断に有用である可能性があり、培養陽性の解釈に用いることができるかもしれない。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 0%、棄権 4%（満場一致、最も強いコンセンサス）

2.2. 診断：培養方法

質問 1：肩関節 PJI の患者を評価する際の最適な培養方法（培地、培養期間など）は何か？

著者：Frederick Matsen, Matthew Scarborough, Andrew Green 翻訳者：大石隆幸

推奨：最近の研究結果によれば、肩関節 PJI の診断における組織培養は、好気および嫌気条件の両方が施行されることが最善とされる。固形培地においては、増菌培地を用いることで診断精度が高まる可能性がある。最も一般的な培養期間は 14 日間である。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：肩の組織から分離された *Cutibacterium acnes* (旧名 *Propionibacterium acnes*) は、サブタイプに分類すべきか？

著者：Svetlana Bozhkova, Joseph J. King, Brent Morris, Luciana Gomes, Pedro Brandao, Carla Ormundo Ximenes 翻訳者：大石隆幸

推奨：肩から分離された *Cutibacterium acnes* は、ルーチンにサブタイプに分類すべきではない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：肩関節PJIの診断において、PCR/次世代シーケンシング(PCR/NGS)は有用か？

著者：Antonia Chen, Surena Namdari, Michael Khazzam 翻訳者：大石隆幸

推奨：肩関節PJIの診断において、PCR または NGS の使用を支持する十分なデータは存在しない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

2.3. 診断：診断基準

質問1：肩関節PJIにはどのような臨床徴候(肉眼的な創部の変化(腫脹、紅斑または排膿))があるか？

著者：Jay Keener, Ofer Levy, Adrien Jacquot 翻訳者：大島健史、土屋弘行

推奨：瘻孔の存在は、肩関節PJIに極めて特異的な臨床徴候である。他の肩関節PJIの臨床徴候には、予期せぬ創部からの排膿がある。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：肩関節PJIにはどのような画像所見があるか？

著者：Ofer Levy, Jay Keener, Adrien Jacquot 翻訳者：大島健史、土屋弘行

推奨：肩関節PJIの画像所見として、コンポーネントの緩みまたは沈み込み・骨透亮像・骨溶解像・骨内膜の浸食像および新生骨形成がある。特に、上腕骨での緩みは、肩関節PJIを強く疑う所見である。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：肩関節PJIの術中所見にはどのようなものがあるか？

著者：Jay Keener, Ofer Levy, Adrien Jacquot 翻訳者：大島健史、土屋弘行

推奨：上腕骨でのステムの緩みおよび混濁した滑液は、肩関節PJIを疑うべき所見である。機械的原因またはリウマチ疾患の背景がない場合、明らかな関節内膿瘍またはインプラントと交通する瘻孔は、肩関節PJIの病理学的特徴である。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：肩関節PJIの評価において、インプラント周囲の凍結切片および永久標本は有用か？

著者：Benjamin Zmistowski, Joseph Zuckerman, Mandeep Virk 翻訳者：大島健史、土屋弘行

推奨：経験豊富な病理学者による凍結切片または組織の評価は、人工肩関節再置換術においてPJIの評価に有用である可能性がある。肩関節PJIの起因菌の大部分である弱毒性菌による感染の検出には、有効性が低いかもしれない。

エビデンスレベル：Limited

投票結果：賛成 95%、反対 5%、棄権 0%（満場一致、最も強いコンセンサス）

質問5：肩関節PJIの診断基準は何か？

著者：Grant E. Garrigues, Andrew Green, Benjamin Zmistowski, Jason Hsu, Eric Ricchetti, Surena Namdari, Mark Frankle, Christian Gerber, Robert Tashjian, Frederick Matsen 翻訳者：大島健史、土屋弘行

推奨：肩関節PJIのICM定義を参照されたい。

エビデンスレベル：Consensus

投票結果：賛成 88%、反対 12%、棄権 0%（大多数、強いコンセンサス）

2.4. 診断：炎症マーカー

質問1：肩関節PJIの評価において、ESR・CRP・白血球数は有用か？

著者：Akin Cil, Richard Page, Gokhan Karademir, James Beazley, Nicola Luppino 翻訳者：大石隆幸

推奨：血清ESR・CRP・WBC数は肩関節PJIの診断において感度が低い。これらは感染の標準的な検査として施行されるべきではあるが、正常値であっても感染は除外されない。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 4%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：肩関節 PJI の診断に (a) 滑液中 IL-6 (b) 血清 IL-6 は有用か？

著者：Joseph Iannotti, Victor Naula, Eric Ricchetti 翻訳者：大石隆幸

推奨：(a) 独立したマーカーとして使用する、また他の滑液マーカーとの組み合わせで解釈するいずれの場合においても、肩関節 PJI の診断に有用である可能性がある。

(b) 血清 IL-6 の特異度は高いものの、より容易に測定可能である血清マーカー（ESR、CRP、白血球数）よりも多くの情報をもたらすことはないようである。

エビデンスレベル：Moderate

投票結果：賛成 92%、反対 0%、棄権 8%（大多数、強いコンセンサス）

質問 3：肩関節 PJI の診断において、滑液中の白血球数とその分画は有用か？

著者：Luis E. Cortes Jiménez 翻訳者：大石隆幸

推奨：有用かもしれないが、肩関節領域の文献によれば、現在のところは滑液内細胞数とその分画の診断閾値は不明である。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 4：肩関節 PJI の診断において、滑液内サイトカインは有用か？

著者：Luis E. Cortes Jiménez, Vani Sabesan, Gerald Williams 翻訳者：大石隆幸

推奨：今のところ報告は多くないが、滑液内サイトカインレベルの評価は肩関節 PJI の診断に有用である可能性がある。サイトカインの評価については、質問 2 と 5（Section 1.2. Prevention: 術中）を参照されたい。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 5：肩関節 PJI の診断において、滑液中 TNF- α と IL-2 は有用か？

著者：Joseph Iannotti, Victor Naula, Eric Ricchetti 翻訳者：大石隆幸

推奨：他の滑液マーカーと組み合わせで解釈する場合には、肩関節 PJI の診断において TNF- α と IL-2 は有用であるかもしれない。TNF- α と IL-2、各々単独ではおそらく有用ではないと考えられる。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 0%、棄権 4%（満場一致、最も強いコンセンサス）

質問 6：肩関節 PJI の診断において、滑液における白血球エステラーゼストリップテストは有用か？

著者：Joseph Iannotti, Victor Naula, Eric Ricchetti 翻訳者：大石隆幸

推奨：現在のエビデンスによれば、肩関節 PJI の診断において、関節液の白血球エステラーゼ（LE）ストリップテストは有用ではない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 7：肩関節 PJI の診断において、滑液中の α -ディフェンシンは有用か？

著者：Luis E. Cortes Jiménez 翻訳者：大石隆幸

推奨：滑液中の α -ディフェンシン検査は、肩関節 PJI 診断の一助となるかもしれない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 8：人工肩関節置換術後の PJI の評価において、血清 D-ダイマーは有用か？

著者：Anders Ekelund 翻訳者：大石隆幸

推奨：有用であるかどうかは不明である。現在の所、股関節と膝関節 PJI の評価においては限定的なエビデンスがあるが、肩関節 PJI の診断に際して D-ダイマーの有用性を評価した研究はない。

エビデンスレベル：No Evidence

投票結果：賛成 96%、反対 4%、棄権 0%（満場一致、最も強いコンセンサス）

質問9：人工肩関節置換術後のPJIの評価において、術前の関節穿刺は有用か？

著者：Jonathon Levy; Samer S. Hasan 翻訳者：大石隆幸

推奨：肩甲上腕関節穿刺は、肩関節 PJI の検索に有用である。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

2.5. 診断：サンプリング

質問1：全ての人工肩関節再置換術において、培養のために組織検体を採取すべきか？

著者：Mark Falworth, Edward McFarland, Jorge Rojas 翻訳者：江川琢也、井上和也

推奨：感染が疑われる場合には、全ての人工肩関節再置換術において、培養のために組織検体を採取すべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：人工肩関節置換術後（初回または再置換）の血腫に対して洗浄デブリドマン（I&D）を行う場合、組織検体を採取することは有用か？

著者：Joseph Abboud, Thomas Duquin, Michael Henry 翻訳者：江川琢也、井上和也

推奨：人工肩関節置換術後（初回または再置換）の血腫に対して洗浄デブリドマン（I&D）を行う場合、毎回深部組織の検体を採取し培養に提出すべきである。

エビデンスレベル：Limited

投票結果：賛成 64%、反対 28%、棄権 8%（大多数、弱いコンセンサス）

質問3：手術歴（関節鏡視下手術、直視下手術、ORIF、他の人工関節以外の手術）がある患者に対して施行される初回人工肩関節置換術においては、組織培養はすべきか？

著者：David Choon, Edward McFarland, Christian Gerber, Jorge Rojas 翻訳者：江川琢也、井上和也

推奨：人工関節置換術以外の手術歴がある患者に対しては、培養のために組織検体を採取するかは症例により適応となりうる。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：初回人工肩関節再置換術前の評価において、術前の直視下または関節鏡視下での組織生検は有用か？

著者：Gregory Cvetanovich, Anthony Romeo 翻訳者：江川琢也、井上和也

推奨：人工肩関節再置換術前に鏡視下または直視下で生検を行うことは、肩関節 PJI の診断に役立ちうる。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問5：肩関節PJIの評価で得られた組織のサンプリングの手法（検体数、解剖学的位置）は、凍結切片や永久標本組織の結果に影響を与えるか？

著者：Benjamin Zmistowski, Joseph Zuckerman, Mandeep Virk 翻訳者：江川琢也、井上和也

推奨：肩関節 PJI の凍結切片や永久標本組織の場合、複数の部位から検体を採取すること（最も重要なのは人工物の表面にある膜から検体を採取すること）で診断精度が上がるかもしれない。

エビデンスレベル：Limited

投票結果：賛成 91%、反対 0%、棄権 9%（大多数、強いコンセンサス）

質問6：肩関節PJIを診断する際、取り出された肩関節インプラントに対する超音波処理は有用か？

著者：Gregory Cvetanovich, Anthony Romeo 翻訳者：江川琢也、井上和也

推奨：現在のところ、肩関節 PJI を診断する際、取り出された肩関節インプラントに対して常に超音波処理を行うことが有用であるというエビデンスはない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 7：人工肩関節再置換術では、培養検体が採取されるまで術前抗菌薬の投与は待機すべきか？

著者：Akin Cil, Robert Tashjian, Gokhan Karademir 翻訳者：江川琢也、井上和也

推奨：最近の研究では、術前抗菌薬の予防投与は術中の培養結果に悪影響を及ぼさないことが示されている。我々は、人工肩関節再置換術の際に術前の抗菌薬投与を待機することは推奨しない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 8：肩関節 PJI の評価の際、サンプリングの手法(検体数、組織 vs 液体 vs インプラント、解剖学的位置など)は、標本の培養結果に影響を与えるか？

著者：Benjamin Zmistowski, Joseph Zuckerman, Mandeep Virk 翻訳者：江川琢也、井上和也

推奨：5つの深部組織の検体を、さまざまな手術部位（関節包、上腕骨髄腔、上腕骨近位や関節窩におけるインプラント表面の膜など）から採取することが推奨される。スワブの使用は推奨されない。検体を採取し滅菌容器に直接入れるためには、清潔な器具が使用されるべきある。液状の検体は有用かもしれないが、組織と比べて結果が出にくいとされている。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

2.1. DIAGNOSIS: CULTURE SIGNIFICANCE

QUESTION 1: What is the relevance of positive cultures in the evaluation for shoulder periprosthetic joint infection (PJI)? What defines a clinically relevant positive culture result(s) versus a culture contaminant?

RECOMMENDATION: Positive cultures in a patient with painful or failed shoulder prosthesis should be considered and treated appropriately based upon the clinical context and diagnostic criteria.

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QUESTION 2: What is the relevance of unexpected positive cultures (UPC) in revision shoulder arthroplasty without clinical or radiographic signs of infection?

RECOMMENDATION: The relevance of unexpected positive cultures is unknown.

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QUESTION 3: What is the treatment (if any) for unexpected positive cultures (UPC) in revision shoulder arthroplasty without clinical or radiographic signs of infection?

RECOMMENDATION: Unknown. Few publications offer protocols for addressing unexpected positive cultures. Of these, the most common options include antibiotics, re-operation and withholding any treatment. The lack of comparative data on outcomes of these therapy regimens makes it difficult to conclusively determine optimal management.

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QUESTION 4: What is the role of quantitative evaluation (e.g., density of bacteria, cuti (propi) score) of positive cultures from the shoulder?

RECOMMENDATION: Semi-quantitative and quantitative reporting of bacterial culture results may have clinical utility for the diagnosis of shoulder periprosthetic joint infection (PJI) and may be used to interpret the relevance of positive cultures.

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2.2. DIAGNOSIS: CULTURE TECHNIQUE

QUESTION 1: What is the optimal culture technique (e.g., culture medium, days of incubation) in evaluating patients for shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Current evidence suggests that culture of tissue samples for the diagnosis of shoulder PJI is best performed using both aerobic and anaerobic conditions. For solid culture media, diagnostic accuracy may be improved by using enrichment media. Fourteen days is the most common culture duration cited.

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QUESTION 2: Should *Cutibacterium acnes* (formerly known as *Propionibacterium acnes*) isolated in samples from the shoulder be sub-typed?

RECOMMENDATION: *Cutibacterium acnes* isolated in samples from the shoulder should not be routinely sub-typed.

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QUESTION 3: Is there a role for Polymerase chain reaction/next generation sequencing (PCR/NGS) technique in the diagnosis of shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: There is not sufficient data to support the use of PCR or NGS in diagnosis of shoulder PJI.

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2.3. DIAGNOSIS: DIAGNOSTIC CRITERIA

QUESTION 1: What clinical signs (e.g., gross wound changes (swelling, erythema or drainage)) are concerning for shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: The presence of a sinus tract is the only clinical sign that can be considered highly specific for shoulder PJI. Other clinical signs of shoulder PJI include unexpected wound drainage.

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QUESTION 2: What radiographic findings are concerning for shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Radiographic findings concerning for shoulder PJI include component loosening or migration, radiolucent lines, osteolysis, endosteal scallop-

ing and new bone formation. Specifically, humeral loosening should significantly raise the suspicion for shoulder PJI.

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QUESTION 3: What intraoperative findings are concerning for shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: The presence of humeral stem loosening and cloudy synovial fluid should raise suspicion for shoulder PJI. Gross intra-articular pus (without a mechanical or rheumatologic explanation) or the presence of a sinus tract, communicating with the implant, are pathognomonic for periprosthetic shoulder infection.

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QUESTION 4: What is the role for periprosthetic frozen section and permanent histology in evaluation of a shoulder arthroplasty for periprosthetic joint infection (PJI)?

RECOMMENDATION: Frozen sections or histology, reviewed by an experienced pathologist, may be useful in revision shoulder arthroplasty to evaluate for periprosthetic joint infection. The detection of infection with less virulent organisms, which make up a significant percentage of shoulder PJI, may be less reliable.

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QUESTION 5: What are the diagnostic criteria of shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: See International Consensus Meeting (ICM) definition of shoulder PJI below.

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2.4. DIAGNOSIS: INFLAMMATORY MARKERS

QUESTION 1: What is the role for serum erythrocyte sediment rate (ESR), C-reactive protein (CRP), or white blood cell (WBC) count in the evaluation of a shoulder arthroplasty for periprosthetic joint infection (PJI)?

RECOMMENDATION: Serum ESR, CRP or WBC count have poor sensitivity for the diagnosis of shoulder PJI. Although they should be obtained as part of a standard workup for infection, normal values do not rule out infection.

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QUESTION 2: Is there a role for (a) synovial or (b) serum IL-6 in the diagnosis of shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: (a) There is a potential role for synovial fluid IL-6 in the diagnosis of shoulder PJI, both as an individual marker and when interpreted in combination with other synovial fluid markers. (b) Although its specificity is high, serum IL-6 does not appear to provide additional information beyond the more readily available serum markers (erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), white blood cell (WBC) count).

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QUESTION 3: Is there a role for synovial fluid white blood cell (WBC) count and differential in the diagnosis of shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: There may be a role, but synovial fluid cell count and differential currently lacks diagnostic thresholds from shoulderspecific literature.

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QUESTION 4: Is there a role for synovial cytokines in the diagnosis of shoulder periprosthetic (PJI)?

RECOMMENDATION: While not yet widely available, evaluation of cytokine levels in synovial fluid shows promise in clarifying the probability of shoulder PJI. See Questions 2 and 5 (Section 1.2. Prevention: Intraoperative) for discussion of specific cytokine evaluations.

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QUESTION 5: Is there a role for synovial fluid tumor necrosis factor-alpha (TNF- α) and interleukin (IL)-2 in the diagnosis of shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: There is a potential role for synovial fluid TNF- α and IL-2 in the diagnosis of shoulder PJI when interpreted in combination with other synovial fluid markers. TNF- α and IL-2 may not be as useful individually.

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QUESTION 6: Is there a role for synovial fluid leukocyte esterase strip testing in the diagnosis of shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Given the current evidence, there is no role for synovial fluid leukocyte esterase (LE) strip testing in the diagnosis of shoulder PJI.

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QUESTION 7: Is there a role for synovial fluid alpha-defensin in the diagnosis of shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Synovial alpha-defensin may aid in the diagnosis of shoulder PJI.

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QUESTION 8: Is there a role for serum D-dimer in the evaluation of periprosthetic joint infection (PJI) following shoulder arthroplasty?

RECOMMENDATION: Unknown. There is currently only limited evidence related to the evaluation of hip and knee PJI and no study to date evaluating its use in shoulder PJI.

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QUESTION 9: Is there a role for preoperative joint aspiration in the evaluation of a shoulder arthroplasty for periprosthetic joint infection (PJI)?

RECOMMENDATION: Glenohumeral joint aspiration has a role as part of the investigation for shoulder PJI.

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2.5. DIAGNOSIS: SAMPLING

QUESTION 1: Should tissue samples be obtained for culture in all revision shoulder arthroplasties?

RECOMMENDATION: Tissue samples should be obtained for culture in all revision shoulder arthroplasties when there is suspicion for infection.

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QUESTION 2: Is there a role for obtaining tissue cultures when performing an irrigation and debridement (I&D) for hematoma after shoulder (primary or revision) arthroplasty?

RECOMMENDATION: Deep tissue samples should be routinely obtained and sent for culture when performing an I&D for hematoma after shoulder (primary or revision) arthroplasty.

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QUESTION 3: Should tissue cultures be obtained in primary shoulder arthroplasty (SA) cases with history of prior surgery (arthroscopic, open, open reduction and internal fixation (ORIF), or another non-arthroplasty surgery)?

RECOMMENDATION: Obtaining tissue samples for culture in patients with history of prior non-arthroplasty surgery may be indicated in select cases.

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QUESTION 4: Is there a role for preoperative open or arthroscopic tissue biopsy in the evaluation prior to initial revision shoulder arthroplasty?

RECOMMENDATION: Arthroscopic or open biopsy prior to initial revision shoulder arthroplasty can aid in the diagnosis of suspected shoulder periprosthetic joint infection (PJI).

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QUESTION 5: Does the sampling technique (number of samples, anatomic locations) of the tissue obtained in the evaluation for shoulder periprosthetic joint infection (PJI) affect the result of frozen section and permanent histology?

RECOMMENDATION: Obtaining samples from multiple locations—most importantly from the prosthetic interface membranes—may optimize accuracy if performing frozen section or permanent histology as part of a workup for periprosthetic shoulder infection.

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QUESTION 6: Is there a role for sonication of retrieved shoulder implants in the diagnosis of shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: There is currently no evidence to support routine sonication of the retrieved shoulder implant in the diagnosis of shoulder PJI.

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QUESTION 7: Should preoperative antibiotics be held until after cultures are obtained in revision shoulder arthroplasty (RSA)?

RECOMMENDATION: Recent studies have shown that preoperative antibiotic prophylaxis does not adversely affect intraoperative culture results. We do not recommend routinely holding preoperative antibiotics in RSA.

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QUESTION 8: Does the sampling technique (e.g., number of samples, tissue versus fluid versus implant, anatomic locations) affect the results for culture of specimens obtained in the evaluation of shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: We recommend five deep tissue specimens for culture be obtained from various surgical sites (e.g., capsule, humeral canal and periprosthetic membranes in the proximal humerus and glenoid). Use of swabs is discouraged. Fresh instruments should be used to obtain and place samples directly into sterile containers. Fluid sampling may be beneficial but has lower yield compared to tissue.

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3.1. 治療：予期せぬ培養陽性に対する抗菌薬

質問 1：初回人工肩関節置換術もしくは再置換術に合併する血腫に対する洗浄デブリドマン(I&D)施行後、培養結果の待機期間中に術後抗菌薬を投与する事は有用か？

著者：Joseph Abboud, Thomas Duquin, Michael Henry 翻訳者：大石隆幸

推奨：人工肩関節置換術後（初回または再置換）の血腫に対する I&D 施行後、培養結果の待機期間中にも抗菌薬を投与すべきである。

エビデンスレベル：Consensus

投票結果：賛成 91%、反対 9%、棄権 0%（大多数、強いコンセンサス）

質問 2：人工肩関節再置換術の際、病原性の強い細菌(MRSA, メチシリン感受性ブドウ球菌(MSSA), *E. coli* など)が予期せず術後に培養陽性であると判明した場合、術後の抗菌薬治療は有用か？

著者：Edward Yian, Robert Tashjian, Henk Scheper 翻訳者：大石隆幸

推奨：今までのところ、病原性の強い細菌が術後に培養陽性であったと判明した人工肩関節再置換術症例に対して、長期の術後抗菌薬投与がより有効であったことを明らかに示した報告はない。しかしながら、弱毒菌 (*C. acnes*, Coagulase-negative *Staphylococcus* (CNS)) が予期せず術後に培養陽性と判明した例は多く見受けられるが、この特殊な臨床状況は限定的である。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 4%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：人工肩関節再置換術において、予期せぬ弱毒菌(*C. acnes*、コアグラゼ陰性ブドウ球菌(CNS))が術後に培養陽性であると判明した場合、術後の抗菌薬治療は有用か？

著者：Edward Yian 翻訳者：大石隆幸

推奨：弱毒菌が術後に予期せず培養陽性となった人工肩関節再置換術症例に対して、術後 24 時間以上の抗菌薬治療を行っても、後の感染症のリスクは軽減しないようである。

エビデンスレベル：Limited

投票結果：賛成 84%、反対 4%、棄権 12%（大多数、強いコンセンサス）

3.2. 治療：PJI に対する抗菌薬

質問 1：病原性の強い細菌(MRSA, メチシリン感受性ブドウ球菌(MSSA), *E. coli* など)による急性の肩関節 PJI に対する洗浄デブリドマンを施行した後に抗菌薬治療は必要か？

著者：William Levine, Paul Pottinger, Sandra Bliss Nelson, Iván Encalada, John Itamura 翻訳者：大石隆幸

推奨：信頼性の高いデータは欠如しているものの、MRSA, MSSA, *E. coli* のような病原性の強い細菌による急性の肩関節 PJI には、術後抗菌薬投与が推奨される。最適な抗菌薬・投与方法・投与期間は不明であるため、感染症専門医に相談の上で症例毎に治療すべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：弱毒菌(*C. acnes*、コアグラゼ陰性ブドウ球菌(CNS) など)による急性の肩関節 PJI の管理において、洗浄デブリドマン(I&D)施行後に抗菌薬治療を行う事は有用か？

著者：John Itamura, William Levine, Sandra Bliss Nelson, Iván Encalada, John Itamura 翻訳者：大石隆幸

推奨：弱毒菌による急性の肩関節 PJI に対する I&D 施行後の抗菌薬治療に関する研究は不足している。限られた渉猟可能なデータによれば、抗菌薬治療が推奨されるが、最適な抗菌薬・投与方法・投与期間は不明である。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：亜急性もしくは慢性の肩関節 PJI の管理において、非観血的な抑制療法は有用か？

著者：Anders Ekelund 翻訳者：大石隆幸

推奨：肩関節 PJI の中での限られた症例においては、抗菌薬による抑制療法は有用であるが、報告された症例は極めて少ない。大多数の報告はまず洗浄デブリドマンが施行されており、抗菌薬のみで治療された少数の症例を明確に区別した報告はなされていない。肩関節 PJI に対して抗菌薬単独で治療し、抗

菌薬投与を中止した後にも感染が沈静化しえた症例の報告はなく、治療効果・長期投与による毒性・耐性菌の出現がこの治療方針にとって重要な課題である。抗菌薬による抑制療法の適応・抗菌薬の種類・投与期間に関して、推奨できるデータはない。

エビデンスレベル: Limited

投票結果: 賛成 96%、反対 0%、棄権 4% (満場一致、最も強いコンセンサス)

質問4: 亜急性もしくは慢性のPJIに対して、抗菌薬の点滴治療後に人工関節温存を試みた場合、経口抗菌薬による抑制療法は有用か？

著者: Javier Cobo Reinoso, Jim Kelly, Samer S. Hasan 翻訳者: 大石隆幸

推奨: さらなる外科的治療の施行が困難である慢性もしくは亜急性のPJIの患者の管理においては、経口抗菌薬による抑制療法が有用である可能性がある。

エビデンスレベル: Limited

投票結果: 賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

質問5: 抗菌薬の点滴治療(IV)後に人工関節温存を試みた急性のPJIにおいて、経口抗菌薬による抑制療法は有用か？ 下肢人工関節と同等の投与期間が必要か？ 病原菌(メチシリン感受性ブドウ球菌(MSSA) vs MRSA)により投与期間を変更すべきか？

著者: Joseph Abboud, Thomas Duquin, Michael Henry 翻訳者: 大石隆幸

推奨: 急性の肩関節PJIに対するDAIRの有用性は十分に研究されていないが、感染した人工肩関節をDAIRにより温存した場合には、経口抗菌薬による抑制療法は有用であるかもしれない。最適な投与期間や病原菌によって治療を変更すべきかを示すエビデンスはない。

エビデンスレベル: Limited

投票結果: 賛成 96%、反対 0%、棄権 4% (満場一致、最も強いコンセンサス)

質問6: 亜急性もしくは慢性の肩関節PJIの治療において、病原菌(メチシリン感受性ブドウ球菌(MSSA) vs MRSA)によって経口抗菌薬による抑制療法の期間を変更すべきか？

著者: Henk Scheper, Jeremy Somerson, William Levine, Jose L. Del Pozo, Brian Grogan 翻訳者: 大石隆幸

推奨: 亜急性もしくは慢性の肩関節PJIの治療において、病原菌によって経口抗菌薬による抑制療法の期間を変更すべきかどうかについてを決定するエビデンスは不足している。

エビデンスレベル: Limited

投票結果: 賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

質問7: 弱毒菌(*C. acnes*, コアグラゼ陰性ブドウ球菌(CNS)など)による亜急性もしくは慢性の肩関節PJIに対して一期的再置換術を施行する場合、術後抗菌薬治療の投与方法(点滴(IV)もしくは経口(PO))・投与期間に関する推奨は何か？

著者: Vahid Entezari 翻訳者: 大石隆幸

推奨: 術中培養により病原菌が同定される前に、可能性のある細菌をカバーした経口抗菌薬投与が開始されるかもしれない。もし培養陽性でPJIと診断された場合、抗菌薬の継続投与(6週まで)がなされるべきである。推奨される抗菌薬治療の投与方法(IVもしくはPO)・種類・投与期間を支持するエビデンスはない。

エビデンスレベル: Consensus

投票結果: 賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

質問8: 病原性の強い菌(MRSA, メチシリン感受性ブドウ球菌(MSSA), *E. coli*など)による亜急性もしくは慢性の肩関節PJIに対して一期的再置換術を施行する場合、術後抗菌薬治療の投与方法(点滴(IV)もしくは経口(PO))・投与期間に関する推奨は何か？

著者: Mandeep Virk, Mark Morrey 翻訳者: 大石隆幸

推奨: 病原性の強い菌による亜急性もしくは慢性の肩関節PJIに対する一期的再置換術に対しては、抗菌薬の点滴治療または点滴治療後の経口投与のいずれも妥当な選択肢である。投与方法と投与期間に関するコンセンサスはないため、これらの治療選択については、感染症専門医と相談の上で決定すべきである。

エビデンスレベル: Limited

投票結果: 賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

質問9：臨床所見・画像所見・術中所見からは急性の肩関節PJIであるが、培養陰性である症例に対する最適な抗菌薬治療は何か？

著者：Ben Clark, Jim Kelly, John Itamura, Natividad Benito 翻訳者：大石隆幸

推奨：データは少ないが、局所での病原体を考慮に入れながら、感染症専門医が勧める経験的な抗菌薬治療方法が施行されるべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問10：臨床所見・画像所見・術中所見からは亜急性または慢性の肩関節PJIであるが、培養陰性である症例に対する最適な抗菌薬治療は何か？

著者：Rui Claro, Paul Pottinger, Sandra Bliss Nelson 翻訳者：大石隆幸

推奨：データは少ないが、局所での病原体を考慮に入れながら、感染症専門医が勧める経験的な抗菌薬治療方法が施行されるべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

3.3. 治療：骨移植

質問1：急性の肩関節PJIの治療の際、移植骨や骨セメントは除去すべきか？

著者：Michael Khazzam 翻訳者：井上和也、江川琢也

推奨：わからない。肩関節PJIにおいて移植骨や骨セメントをどのように取り扱うべきかを決定しうる報告はない。

エビデンスレベル：No Evidence

投票結果：賛成 90%、反対 5%、棄権 5%（大多数、強いコンセンサス）

質問2：亜急性または慢性の肩関節PJIの治療の際、移植骨や骨セメントは除去すべきか？

著者：Michael Khazzam 翻訳者：井上和也、江川琢也

推奨：わからない。肩関節PJIにおいて移植骨や骨セメントをどのように取り扱うべきかを決定しうる報告はない。緩みや壊死を認めている異物は除去すべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

3.4. 治療：コンポーネント温存

質問1：急性の肩関節PJIを治療する際、インプラントを温存しつつ洗浄デブリドマン(I&D)を行う事は有用か？

著者：Michael Khazzam 翻訳者：井上和也、江川琢也

推奨：急性の肩関節PJIを治療する際、インプラントを温存しつつ洗浄デブリドマンを行うことを支持するまたは否定しうる質の高いエビデンスは不十分である。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 4%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：亜急性または慢性の肩関節PJIにおいて、コンポーネントを温存しつつ洗浄デブリドマン(I&D)を行う際の適応は何か？

著者：Jeremy Somerson, William Levine 翻訳者：井上和也、江川琢也

推奨：亜急性または慢性の肩関節PJIに対して、コンポーネントを温存しつつ洗浄デブリドマンを行った場合、コンポーネント抜去した場合よりも成功率は低い。適応を絞れば有用な可能性がある。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 0%、棄権 4%（満場一致、最も強いコンセンサス）

質問3：急性の肩関節PJIに対し、洗浄デブリドマン(I&D)を行う際に、モジュラー型コンポーネントは交換すべきか？

著者：Richard Page, James Beazley, Nicola Luppino 翻訳者：井上和也、江川琢也

推奨：摺動面のようなモジュラー型のコンポーネントを交換することで、関節腔全体の徹底的な洗浄デブリドマンが可能になり、できる限りの多くのバイオフィルムが除去可能となるという考え方があるが、それを示す文献は十分でない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：亜急性または慢性の肩関節PJIに対し、洗浄デブリドマン(I&D)を行う際に、モジュラー型コンポーネントは交換すべきか？

著者：Richard Page, Scott E. Paxton, Ben Clark, Surena Namdari 翻訳者：井上和也、江川琢也

推奨：質問5の回答に従う：亜急性または慢性の肩関節PJIに対し外科的治療を行う際、良好に固定された関節窩コンポーネントは抜去すべきか？推奨は限定的ではあるものの、亜急性または慢性の肩関節PJIに対する外科的介入の際には、良好に固定されたコンポーネントも抜去すべきである。それゆえ、良好に固定されたコンポーネントよりもかなり低い合併症発生率で抜去可能であるモジュラー型コンポーネントはバイオフィルムを除去するために交換する、もしくは抜去し抗菌薬含有スパーサーに置換されるべきであると推察される。

エビデンスレベル：No Evidence

投票結果：賛成 95%、反対 5%、棄権 0%（満場一致、最も強いコンセンサス）

質問5：亜急性または慢性の肩関節PJIに対し、外科的治療を施行する際に、良好に固定された関節窩コンポーネントは交換すべきか？

著者：Surena Namdari 翻訳者：井上和也、江川琢也

推奨：コンポーネントを温存した場合は再感染率が高いことから、亜急性または慢性の肩関節PJIが疑われる症例に対して一期的再置換術を施行する場合には、関節窩コンポーネントが良好に固定されていたとしても抜去することが推奨される。もちろん、ハイリスクな患者に対しては、良好に固定されているコンポーネントを抜去することによって起こりえる外科的合併症を防ぐために、再感染率が高いことを許容した上で、コンポーネント温存を選択することもあるかもしれない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問6：臨床的または画像的に感染兆候を認めない肩人工関節再置換術の際に、良好に固定されたインプラントを全て交換することは有用か？

著者：Richard Page, Akin Cil, Gokhan Karademir 翻訳者：井上和也、江川琢也

推奨：わからない。予期せず培養が陽性となる可能性がある場合でさえ、人工肩関節再置換術時に良好に固定されたインプラントを常に交換するといった文献はほとんどない。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 0%、棄権 4%（満場一致、最も強いコンセンサス）

3.5. 治療：インプラント

質問1：急性の肩関節PJIに対する治療において最適なインプラントは何か？：リバース型人工肩関節置換術、解剖学的人工肩関節置換術、人工骨頭置換術

著者：Mark Frankle, Jason Hsu 翻訳者：井上和也、江川琢也

推奨：急性の肩関節PJIに対する治療における最適なインプラントは、腱板・上腕骨頭と関節窩の骨の状態・患者因子によって決まる。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 0%、棄権 4%（満場一致、最も強いコンセンサス）

3.6. 治療：切除

質問1：急性の肩関節PJIに対する切除関節形成術の適応は何か？

著者：José M. Mora, Simon Lambert 翻訳者：井上和也、江川琢也

推奨：急性のPJIに対する切除関節形成術に関する文献はない。現時点では、切除関節形成術の適応に関する決まったエビデンスはない。

エビデンスレベル：No Evidence

投票結果：賛成 88%、反対 8%、棄権 4%（大多数、強いコンセンサス）

質問 2：亜急性または慢性の肩関節 PJI に対して、切除関節形成術は有用か？

著者：José M. Mora, Simon Lambert 翻訳者：井上和也、江川琢也

推奨：亜急性または慢性の肩関節 PJI に対する切除関節形成術の適応を決定できる質の高い情報を持ち合わせた文献はない。インプラントによる再手術が患者の合併症や技術的問題により困難な場合においては、切除関節形成術は亜急性または慢性の肩関節 PJI を根絶するための妥当な救済的治療といえる。

エビデンスレベル：Limited

投票結果：賛成 95%、反対 0%、棄権 5%（満場一致、最も強いコンセンサス）

3.7. 治療：再手術

質問 1：肩関節 PJI に対する治療において、抗菌薬含有スペーサーは有用か？

著者：Mandeep Virk, Iván Encalada, Gerald Williams 翻訳者：井上和也、江川琢也

推奨：抗菌薬含有セメントスペーサーは、局所に高濃度の抗菌薬を提供するという目的で、二期的人工関節再置換術を行う症例の一部で使用されるかもしれない。抗菌薬含有セメントスペーサーは、限られた症例においては最終または恒久的な治療として使用されるかもしれない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：急性の肩関節 PJI の治療において、一次的または二期的人工関節再置換術の適応は何か？

著者：Grant E. Garrigues, Carlos Torrens, Jaap Willems, Elshaday S. Belay, Leila Ledbetter 翻訳者：井上和也、江川琢也

推奨：わからない。肩関節 PJI に対して行われた一期的人工関節再置換術は、統計的には二期の再置換術に比べて再感染率や合併症率は少ない。しかしながら、急性の肩関節 PJI の治療において、一次的と二期の再置換術を直接比較した研究は存在しない。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 4%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：亜急性または慢性の肩関節 PJI に対する一次的または二期的人工関節再置換術の適応は何か？

著者：Grant E. Garrigues, Carlos Torrens, Jaap Willems, Elshaday S. Belay, Leila Ledbetter 翻訳者：井上和也、江川琢也

推奨：現時点では、一次的または二期の再置換術の適応は不明確である。文献的には一次的再置換が二期のより良好であるが、これは選択バイアスや他因子の結果なのかもしれない。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 0%、棄権 4%（満場一致、最も強いコンセンサス）

質問 4：肩関節 PJI に対する二期の再置換術でインプラントを再設置する前に、関節穿刺を施行することは有用か？

著者：Joseph J. King, Samer S. Hasan 翻訳者：井上和也、江川琢也

推奨：肩関節 PJI に対して二期の再置換術を施行する前に、関節穿刺を施行すると有用であるとする情報は不足している。さらに、いくつかの報告によって、関節穿刺は“ドライタップ”や偽陰性の発生率が高いと指摘されている。それゆえ、二期の再置換術前の関節穿刺を支持するエビデンスは乏しい。

エビデンスレベル：Limited

投票結果：賛成 88%、反対 4%、棄権 8%（大多数、強いコンセンサス）

質問 5：肩関節 PJI に対する二期の再置換術でインプラントを再設置する前に、直視下または鏡視下での組織生検を施行することは有用か？

著者：Gregory Cvetanovich, Anthony Romeo 翻訳者：井上和也、江川琢也

推奨：わからない。肩関節 PJI に対して二期の再置換術を施行する前に直視下生検を行うことで、二期の再置換の前に追加の洗浄デブリドマン (I&D) を行う必要がある持続感染のある患者を特定できる可能性があるという、level 4 の文献がある。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

3.1. TREATMENT: ANTIBIOTICS FOR UNEXPECTED POSITIVE CULTURES

QUESTION 1: Is there a role for postoperative antibiotics after performing an irrigation and debridement (I&D) for hematoma complicating a primary or revision shoulder arthroplasty while awaiting culture results?

RECOMMENDATION: Antibiotics should be given after performing an I&D for hematoma after shoulder (primary or revision) arthroplasty while awaiting cultures.

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QUESTION 2: Is there a role for postoperative antibiotic treatment for revision arthroplasty with subsequent unexpected positive cultures for a virulent organism (e.g., methicillin-resistant *S. aureus* (MRSA), methicillin-sensitive *Staphylococcus aureus* (MSSA) or *E. coli*)?

RECOMMENDATION: In aggregate, published studies do not clearly show superiority for prolonged antibiotic use over no prolonged antibiotic treatment in the setting of revision shoulder arthroplasty with subsequent cultures positive for virulent organisms. However, the data on this specific clinical scenario is limited as the vast majority of unexpected positive cultures are with less virulent organisms (e.g., *C. acnes*, Coagulase-negative *Staphylococcus* (CNS)).

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QUESTION 3: Is there a role for postoperative antibiotic treatment when a revision arthroplasty is performed with subsequent unexpected positive cultures of the shoulder caused by an indolent organism (e.g., *C. acnes* or coagulase-negative *Staphylococcus* (CNS))?

RECOMMENDATION: Postoperative antibiotic treatment beyond 24 hours after revision arthroplasty with unexpected positive cultures for an indolent organism does not appear to reduce the risk of subsequent infection.

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3.2. TREATMENT: ANTIBIOTIC FOR PERIPROSTHETIC JOINT INFECTION

QUESTION 1: Is there a need for antibiotic therapy following irrigation and debridement of patients with acute shoulder periprosthetic joint infection (PJI) caused by a virulent organism (e.g., methicillin-resistant *Staphylococcus aureus* (MRSA), methicillin-sensitive *Staphylococcus aureus* (MSSA) or *E. coli*)?

RECOMMENDATION: In the absence of high level data, we propose that patients with acute PJI of shoulder caused by virulent organisms, such as MRSA, MSSA or *E. coli*, receive postoperative antibiotics. The optimal antibiotic, route of administration and duration of treatment are unknown and should be individualized after consultation with infectious disease specialists.

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QUESTION 2: Is there a role for antibiotic therapy in the management of acute shoulder periprosthetic joint infection (PJI) with an indolent organism (e.g., *C. acnes* or Coagulase Negative *Staphylococcus*) after irrigation and debridement (I&D)?

RECOMMENDATION: Antibiotic therapy following I&D for management of acute shoulder PJI with an indolent organism has not been wellstudied in the literature. The limited data available suggests treatment should consist of antibiotic therapy; however, the optimal antibiotic, route of administration and duration of treatment are unknown.

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QUESTION 3: Is there a role for nonoperative suppressive treatment in the management of subacute or chronic shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Although there is a role for suppressive antibiotic treatment of selected cases of periprosthetic infection of the shoulder, there are only a few shoulders included in the published literature. The vast majority of published cases describe initial irrigation and debridement, and these are not well separated in the literature from the small number of cases of patients treated with antibiotics alone. No patient treated with antibiotics alone for shoulder PJI has had antibiotics stopped and remained infection-free, thus concerns related to efficacy, longterm toxicity and development of resistant strains are paramount with this strategy. No recommendations can be given on indication, type and duration of suppressive antibiotic treatment.

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QUESTION 4: Is there a role for oral suppressive antimicrobial therapy in the setting of retained prostheses after intravenous therapy in subacute or chronic periprosthetic joint infection (PJI)?

RECOMMENDATION: The administration of oral suppressive antimicrobial therapy may have a role in management of patients with chronic or subacute PJI who cannot undergo further surgical intervention.

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QUESTION 5: Is there a role for oral suppressive antimicrobial therapy in acute periprosthetic joint infection (PJI) in the setting of retained prostheses after initial intravenous (IV) therapy? Same duration as for lower extremity arthroplasty? Should it differ by pathogen (e.g., methicillin-sensitive *Staphylococcus aureus* (MSSA) vs. methicillin-resistant *S. aureus* (MRSA))?

RECOMMENDATION: While the role of debridement, antibiotics and implant retention (DAIR) in the treatment of acute prosthetic shoulder infection has not been well-studied, there is likely a role for oral suppressive antimicrobial therapy in the setting of retained infected shoulder prostheses after DAIR. There is no evidence to guide the optimal duration of treatment or if treatment should vary by organism.

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QUESTION 6: Should the duration of oral suppressive antimicrobial therapy differ by pathogen (e.g., methicillin-sensitive *Staphylococcus aureus* (MSSA) vs. methicillin-resistant *S. aureus* (MRSA)) in the treatment of subacute or chronic shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: There is insufficient evidence to determine whether the duration of oral suppressive antimicrobial therapy should differ by pathogen in the treatment of subacute/chronic shoulder PJI.

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QUESTION 7: What are the recommendations for the route (intravenous (IV) vs. oral (PO)) and duration of postoperative antibiotic treatment when a one-stage revision arthroplasty is performed for subacute or chronic shoulder periprosthetic joint infection (PJI) of the shoulder caused by an indolent organism (e.g., *C. acnes* or coagulase-negative *Staphylococcus*)?

RECOMMENDATION: Prior to identification of pathogenic organisms from intraoperative cultures, a course of oral antibiotics may be initiated that covers the potential organism until intraoperative cultures are finalized. If the cultures are positive and periprosthetic infection is diagnosed, then a continued course of antibiotics (up to six weeks) should be pursued. There is no evidence to support a preferred route (PO vs. IV), type and duration of antibiotic treatment.

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QUESTION 8: What are the recommendations regarding the route (intravenous (IV) vs. oral (PO)) and length of postoperative antibiotic treatment when a one-stage revision arthroplasty is performed for subacute/chronic shoulder periprosthetic joint infection (PJI) caused by a virulent organism (e.g., methicillin-sensitive *Staphylococcus aureus* (*S. aureus*), or MSSA, vs. methicillin-resistant *S. aureus* (MRSA), *E. coli*)?

RECOMMENDATION: Intravenous antibiotics or intravenous followed by oral antibiotics are both reasonable options for one-stage revision shoulder arthroplasty for subacute/chronic shoulder PJI caused by a virulent organism. As there is no consensus on the route or duration, these treatment parameters should be selected in consultation with an infectious disease specialist.

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QUESTION 9: What is the optimal antibiotic treatment for culture-negative cases with positive clinical, radiographic or intraoperative findings for acute shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: The limited data suggests treatment should consist of an empiric antibiotic regimen recommended by an infectious disease specialist considering the local organism profile.

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QUESTION 10: What is the optimal antibiotic treatment for culture-negative cases with positive clinical, radiographic or intraoperative findings for subacute or chronic shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: The limited data suggests treatment should consist of an empiric antibiotic regimen recommended by an infectious disease specialist considering the local organism profile.

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3.3. TREATMENT: BONE GRAFT

QUESTION 1: Should bone graft or cement be removed during treatment of acute shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Unknown. There are no reported investigations to guide the decision-making process regarding how to manage cement and/or autograft bone graft in the setting of shoulder PJI.

QUESTION 2: Should bone graft or cement be removed in treatment for subacute or chronic shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Unknown. There are no reported investigations to guide the decision-making process regarding how to manage cement and/or autograft bone graft in the setting of shoulder PJI. An attempt should be made to remove all loose, necrotic and foreign material.

3.4. TREATMENT: COMPONENT RETENTION

QUESTION 1: Is there a role for irrigation and debridement (I&D) with implant retention when treating acute shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: There is insufficient high-quality evidence to support or discourage the use of I&D with implant retention to treat acute shoulder PJI.

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QUESTION 2: What are the indications for irrigation and debridement (I&D) with component retention in subacute or chronic shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: I&D with component retention alone for subacute/chronic shoulder PJI in the literature is less successful than component explant, but may play a role in select patients.

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QUESTION 3: Should modular components be exchanged during irrigation and debridement (I&D) of acute shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Whilst there is logic in exchanging non-fixed modular components, such as the bearing surfaces, to allow thorough I&D of the entire effective joint space and removal of as much biofilm as possible, there is insufficient literature to provide clear guidance.

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QUESTION 4: Should modular components be exchanged during irrigation and debridement (I&D) of subacute or chronic shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: We defer to the response for the Question 5: "Should well-fixed glenoid components be removed during surgical treatment for subacute or chronic shoulder PJI?" It would seem that the recommendation, although of limited strength, would be for well-fixed components to be removed during surgical intervention for subacute/chronic shoulder PJI. Therefore, it can be extrapolated that modular components, which can be exchanged to remove biofilm with far less morbidity than well-fixed components, should likewise be either exchanged or removed and replaced with an antibiotic spacer.

QUESTION 5: Should well-fixed glenoid components be removed during surgical treatment for subacute or chronic shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Based on the higher rate of reinfection with component retention, we recommend removal of even well-fixed glenoid components in cases of single-stage revision for suspected subacute/chronic PJI. Certainly, there may be cases (i.e., high-risk surgical patients) where the patient and surgeon may choose to accept the higher failure rate with component retention in order to avoid surgical morbidity introduced by removing well-fixed components.

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QUESTION 6: Is there a role for routine exchange of all well-fixed implants in revision shoulder arthroplasty without clinical or radiographic signs of infection?

RECOMMENDATION: Unknown. Even in the setting of possible subsequent unexpected positive cultures, there is sparse literature on the routine exchange of well-fixed implants in revision shoulder arthroplasty.

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3.5. TREATMENT: IMPLANT

QUESTION 1: What is the optimal implant for treatment of acute periprosthetic joint infection (PJI): reverse total shoulder arthroplasty (TSA), anatomic total shoulder arthroplasty (aTSA) versus hemiarthroplasty?

RECOMMENDATION: The optimal implant for treatment of acute PJI is dependent on the status of the rotator cuff, humeral and glenoid bone stock, and patient factors.

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3.6. TREATMENT: RESECTION

QUESTION 1: What are the indications for resection shoulder arthroplasty in acute periprosthetic joint infection (PJI)?

RECOMMENDATION: There are no available reports on resection shoulder arthroplasty for acute PJI. At this time there is no evidence to routinely recommend this treatment for this indication.

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QUESTION 2: Is there a role for resection shoulder arthroplasty in the management of subacute or chronic periprosthetic joint infection (PJI)?

RECOMMENDATION: The available literature does not support specific indications for resection arthroplasty for subacute or chronic shoulder PJI with sufficient quality information to provide guidance. Resection arthroplasty is an acceptable salvage treatment to eradicate shoulder PJI when revision to a definitive implant is considered too risky due to patient medical co-morbidities or technical complexity.

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3.7. TREATMENT: REVISION

QUESTION 1: Is there a role for an antibiotic spacer for the treatment of shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: An antibiotic loaded cement spacer may be used as part of a shoulder two-stage exchange arthroplasty for local delivery of high concentration of antibiotics. An antibiotic loaded cement spacer may be used as a definitive/permanent treatment option in select cases.

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QUESTION 2: What are the indications for one- versus two-stage exchange arthroplasty in the management of acute shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Unknown. Single-stage exchange for shoulder PJI had a statistically significant lower reinfection rate and lower complication rate than two-stage exchange in aggregate; however, no studies exist directly comparing these treatments for acute shoulder PJI.

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QUESTION 3: What are the indications for one- versus two-stage revision in subacute or chronic shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: The indications for one-stage versus two-stage exchange are unclear at this time. The pooled data demonstrate one-stage exchange to be superior to two-stage exchange, but this may be a result of selection bias and other factors.

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QUESTION 4: Is there a role for preoperative joint aspiration prior to reimplantation during two-stage exchange for shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: There is a dearth of information on the role of preoperative joint aspiration prior to second stage revision after treatment of shoulder PJI. Furthermore, several studies have pointed to the high incidence of "dry taps" and false negative cultures from joint aspirates. Thus, there is little evidence in support of routine preoperative aspiration prior to second stage reimplantation.

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QUESTION 5: Is there a role for pre-reimplantation open or arthroscopic tissue biopsy in the evaluation during two-stage exchange of shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Unknown. There is one level IV study suggesting that open biopsy prior to second-stage revision for shoulder PJI can identify patients with persistent infection who may benefit from subsequent repeat irrigation and debridement (I&D) prior to second stage reimplantation.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

PART IV

SPINE

SECTION 1: PREVENTION

- 1.1. 一般原則
- 1.2. 抗菌薬
- 1.3. 骨移植
- 1.4. リスクファクター
- 1.5. 創傷処置

SECTION 2: DIAGNOSIS

- 2.1. 基本原則
- 2.2. バイオマーカー
- 2.3. 画像

SECTION 3: TREATMENT

- 3.1. 一般原則
- 3.2. 抗菌薬
- 3.3. インプラント
- 3.4. 創傷処置

〈監訳者〉

岩田栄一郎、山田浩司

1.1. 予防：一般原則

質問 1：脊椎手術中に不慮の汚染が発生した場合、何か出来ることはあるか？

著者：Steven Schmitt, Christopher Kepler 翻訳者：百田吉伸、岩田栄一郎

推奨：脊椎インプラントに不慮の汚染が発生した場合の感染予防として、特定の対策を支持できるデータはない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：脊椎術後に下痢が起こった場合の対応は？

著者：Maja Babic 翻訳者：百田吉伸、岩田栄一郎

推奨：手術部位に注意を払い、下痢に対する標準的なアプローチを行う。

エビデンスレベル：Consensus

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

1.2. 予防：抗菌薬

質問 1：脊椎術後に持続浸出のある患者に対する感染予防を目的とした抗菌薬内服投与は有用か？

著者：Alexander Montgomery, Rajesh Mangattil 翻訳者：山田浩司

推奨：脊椎術後に持続浸出のある患者に対する感染予防を目的とした予防抗菌薬の内服投与に関する信頼できるエビデンスはない。

エビデンスレベル：Consensus

投票結果：賛成 93%、反対 7%、棄権 0%（大多数、強いコンセンサス）

質問 2：脊椎手術で周術期の予防抗菌薬投与にゲンタマイシンを追加することは有用か？

著者：Robert Sawyer, Joseph Weistroffer, Anna White 翻訳者：山田浩司

推奨：有用でない。脊椎手術の予防抗菌薬投与でゲンタマイシンを追加することに反対である。周術期の全身予防抗菌薬投与にゲンタマイシンを追加することで SSI が減少するというデータはなく、むしろ副作用（特に腎毒性）を伴うとする強いエビデンスがある。ゲンタマイシンの局所投与を行うかどうかに関する結論は出ていない。

エビデンスレベル：Strong

投票結果：賛成 62%、反対 15%、棄権 23%（大多数、弱いコンセンサス）

質問 3：脊椎手術で術中に予防抗菌薬投与の追加投与は行うべきか？ 行うべきであれば、いつ追加投与すべきか？

著者：Yvonne Achermann, Gregory Schroeder, Daniel Tarazona 翻訳者：山田浩司

推奨：多くの単純な脊椎手術では、予防抗菌薬投与は術前の単回投与で十分である。半減期の 2 倍以上の手術時間や大量出血（出血量 >1500ml）の際は、有効な抗菌薬濃度を維持するために予防抗菌薬を術中に追加投与すべきである。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

質問 4：脊椎手術を行う患者に対して、バンコマイシンパウダーを創内散布すべきか？ 本対策に付随する潜在的な有害事象は？

著者：Steven Schmitt, Christopher Kepler 翻訳者：山田浩司

推奨：行うべきである。バンコマイシンパウダーを術中創内散布することで脊椎 SSI を軽減できるエビデンスがある。しかし、これらの研究の大半はコントロール群が設けられていなく、バンコマイシンパウダーが抗菌活性を持つその他の薬剤に比べ有用であるかどうかは不明である。本対策に付随する潜在的な有害事象に関するエビデンスは十分でない。

エビデンスレベル：Moderate

投票結果：賛成 79%、反対 14%、棄権 7%（大多数、強いコンセンサス）

質問5：脊椎手術を行う患者で最適な周術期の予防抗菌薬は何か？ 薬剤アレルギーのある症例ではどのような点に注意すべきか？

著者：Yvonne Achermann, John Koerner, Daniel Tarazona 翻訳者：山田浩司

推奨：単純な脊椎手術患者に対する最適な予防抗菌薬は第1、あるいは第2世代セフェムである。執刀開始前60分以内に点滴投与すべきである。βラクタム系抗菌薬の投与後にアナフィラキシーを起こした既往のある患者や、MRSA感染割合の高い国では、バンコマイシンを体重調整して（15 mg/kg）投与すべきである。バンコマイシンの代替薬として、クリンダマイシン600mgの点滴投与が推奨される。

エビデンスレベル：Moderate

投票結果：賛成79%、反対7%、棄権14%（大多数、強いコンセンサス）

質問6：神経因性膀胱を伴う脊椎手術患者ではどのような予防抗菌薬が適切か？

著者：Dolors Rodriguez-Pardo 翻訳者：山田浩司

推奨：脊椎手術で標準的に推奨される予防抗菌薬はセファゾリンであるが、SSIリスクの高い一部の患者では、より広域スペクトラムの予防抗菌薬が必要である可能性がある。神経因性膀胱を伴う患者では、術前の尿培養結果に伴う個別の予防抗菌薬投与がグラム陰性桿菌によるSSIの著名な軽減と関連している。

エビデンスレベル：Moderate

投票結果：賛成79%、反対14%、棄権7%（大多数、強いコンセンサス）

1.3. 予防：骨移植

質問1：同種移植片の使用で脊椎感染リスクは高くなるか？

著者：Dolors Rodriguez-Pardo 翻訳者：撫井貴弘、山田浩司

推奨：同種移植片の使用で小児や神経筋原性側弯症の感染リスクは高くなるようだが、成人変性疾患ではリスクは高くない。

エビデンスレベル：Moderate

投票結果：賛成77%、反対0%、棄権23%（大多数、強いコンセンサス）

質問2：脊椎感染の既往のある患者に対して脊椎再手術を行う際に、同種移植片、代替人工骨または自家移植片は使用できるか？

著者：Steven Schmitt, Christopher Kepler, Wesley Bronson 翻訳者：撫井貴弘、山田浩司

推奨：入手可能なデータに基づくと、同種移植片、自家骨移植、人工ケージは化膿性脊椎椎間板炎の治療において後方スクリュー固定術と長期抗菌薬治療とともに使用することはできる。このデータから同種移植片、自家移植片の使用は脊椎感染の既往のある患者に対する脊椎再手術の際にも安全であると推察される。

エビデンスレベル：Moderate

投票結果：賛成93%、反対7%、棄権0%（大多数、強いコンセンサス）

1.4. 予防：リスクファクター

質問1：結核の既往や活動性結核は、脊椎手術を受けることの妨げになるか？

著者：Koji Yamada, Yoshihirio Uchida 翻訳者：山本雄介、岩田栄一郎

推奨：結核の既往や活動性のある結核は患者が脊椎手術を受けることを妨げるものではない。

エビデンスレベル：Limited

投票結果：賛成100%、反対0%、棄権0%（満場一致、最も強いコンセンサス）

質問2：脊椎手術の術前にMRSAスクリーニングをルーチンで行うべきか？

著者：Carles Pigrau 翻訳者：山本雄介、岩田栄一郎

推奨：脊椎手術の術前にMRSAスクリーニングはルーチンで行うべきではない。しかし、脊椎術後に黄色ブドウ球菌、特にMRSAを原因とするSSIの発生率が高い施設においては、MRSAスクリーニングは有用であるかもしれない。

エビデンスレベル：Limited

投票結果：賛成86%、反対7%、棄権7%（大多数、強いコンセンサス）

質問3：脊椎手術の術前にルーチンで除菌を行うことは有効か？ もし有効であれば、適切な薬剤は何か？

著者：Alexander Vaccaro, Barrett Boody 翻訳者：山本雄介、岩田栄一郎

推奨：術前スクリーニングと MRSA 陽性患者の除菌プログラムによって SSI の発生率を低下させるエビデンスはあるが、除菌のための適切な薬剤は特定されていない。**エビデンスレベル：**Limited**投票結果：**賛成 91%、反対 0%、棄権 9%（大多数、強いコンセンサス）**質問4：疾患修飾性抗リウマチ薬(DMARD)を使用している患者の周術期管理はどのようにすべきか？**

著者：Taolin Fang 翻訳者：山本雄介、岩田栄一郎

推奨：リウマチ性疾患患者を治療する脊椎外科医は、リウマチ患者では周術期管理に特有の問題があることを認識する必要がある。DMARD の適切な周術期管理はエビデンスが十分でないため不確かであり、その多くは質の低いエビデンスと専門家の意見に基づいている。リウマチ専門医は周術期の薬物管理に携わるべきである。

- 1：メトトレキサート (MTX)、レフルノミド、ヒドロキシクロロシン、スルファサラジンなどの生物学的製剤以外の DMARDs については、周術期において、現量の継続が推奨される。
- 2：エタネルセプトなどの生物学的製剤については、投薬を保留し、各生物学的製剤の投与サイクルの終わりに待機手術を計画することが望ましい。例として、週1回の生物学的製剤の投与を受けている患者では、最終投与より2週間後に手術を計画しなければならない。これらの薬剤は創部治癒が完了するまで（典型的には約2週間）再開してはならない。例外：トファシチニブ（1日2回投与）を使用している患者では、少なくとも術前1週間の休薬を推奨する。
- 3：ミコフェノール酸モフェチル、アザチオプリン、シクロスポリンやタクロリムスなど、特に全身性エリテマトーデス（SLE）患者を対象に使用される薬剤については、術前に休薬を行うかどうかの決断は患者ごとに決めなければならない。

エビデンスレベル：Moderate**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問5：術後高血糖は感染発生の危険因子か？**

著者：Koji Yamada, Kumiko Ono 翻訳者：山本雄介、岩田栄一郎

推奨：術後高血糖と SSI の関係性はエビデンスが限られ不確かであり、さらなる研究が必要である。**エビデンスレベル：**Limited**投票結果：**賛成 93%、反対 7%、棄権 0%（大多数、強いコンセンサス）**質問6：脊椎手術で尿路感染(UTI)とSSIに関連はあるか？**

著者：Steven Schmitt, Christopher Kepler 翻訳者：山本雄介、岩田栄一郎

推奨：UTI と脊椎 SSI の関連についてのエビデンスは一樣ではなく、確定的な関係は証明されていない。同様に無症候性細菌尿と脊椎術後 SSI との確定的な関係も確立されていない。**エビデンスレベル：**Limited**投票結果：**賛成 71%、反対 21%、棄権 8%（大多数、強いコンセンサス）**質問7：脊椎術後の SSI の危険因子は何か？**

著者：Alexander Montgomery, Daniel Tarazona 翻訳者：山本雄介、岩田栄一郎

推奨：糖尿病、肥満、SSI 罹患歴、喫煙、長時間手術、後方アプローチ、固定椎間数を含む多くの危険因子が同定されている。**エビデンスレベル：**Moderate**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問8：腸腰筋膿瘍を認める全ての患者に脊椎及び股関節の感染の有無をスクリーニングすべきか？**

著者：Claus Simpfendorfer, Pouya Alijanipour, Caroline J. Granger 翻訳者：山本雄介、岩田栄一郎

推奨：多くの場合で CT および MRI を用いた横断的画像診断法によって続発性腸腰筋膿瘍の感染源を特定できる。他の感染源が特定できない場合、腸腰筋膿瘍において脊椎及び股関節の両方に CT や MRI による横断的画像診断法を検討すべきである。**エビデンスレベル：**Limited**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

1.5. 予防：創傷処置

質問1：脳脊髄液(CSF)漏出を認める患者の脊椎創部に対する陰圧閉鎖療法(NPWT)は安全か？

著者：Carles Pignatelli 翻訳者：山本雄介、岩田栄一郎

推奨：NPWTはCSF漏出を認める患者には有害である可能性があり、重度の神経学的後遺症をもたらす可能性がある。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 7%、棄権 0%（大多数、強いコンセンサス）

質問2：脊椎術後の陰圧補助閉鎖(VAC)デバイス/PICOドレッシング使用のリスクと利点は何か？

著者：Barrett Boody 翻訳者：山本雄介、岩田栄一郎

推奨：切開部 VAC 療法（PICO ドレッシングなど）を使用する機会は限られているが、後方胸腰椎変形手術の創部離開や SSI 予防を目的とした使用を支持する報告がある。

エビデンスレベル：Limited

投票結果：賛成 86%、反対 14%、棄権 0%（大多数、強いコンセンサス）

質問3：脊椎手術患者のSSIを減少させるのに最も効果的な手術ドレッシング材は何か？

著者：Jeffrey A. Rihn 翻訳者：山本雄介、岩田栄一郎

推奨：脊椎手術で陰圧閉鎖療法（NPWT）と標準的なドライドレッシングの使用を比較したランダム化試験はない。世界保健機関（WHO）は、SSI リスクを軽減するため、リスクの高い手術創には NPWT の使用を推奨している。

エビデンスレベル：Limited

投票結果：賛成 86%、反対 0%、棄権 14%（大多数、強いコンセンサス）

1.1. PREVENTION: GENERAL PRINCIPLES

QUESTION 1: What can one do if an inadvertent contamination during instrumented spine surgery occurs?

RECOMMENDATION: There is no data to support a particular strategy in preventing infection after inadvertent contamination of spinal implants.

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QUESTION 2: How should spine surgery patients with postoperative diarrhea be managed?

RECOMMENDATION: Diarrhea can be managed in a standard approach with careful attention to the surgical site.

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1.2. PREVENTION: ANTIMICROBIALS

QUESTION 1: Is there a role for oral antibiotics in the prevention of infection in patients with draining wounds following spinal surgery?

RECOMMENDATION: There is no reliable evidence for the use of prophylactic oral antibiotic therapy in patients with draining wounds after spine surgery.

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QUESTION 2: Is there a role for the addition of gentamicin to perioperative prophylactic antibiotics in spine surgery?

RECOMMENDATION: No, we recommend AGAINST the inclusion of gentamicin for perioperative prophylaxis in spine surgery. There is no data suggesting that the addition of gentamicin to systemic perioperative prophylactic antibiotic regimens decreases the rate of postoperative infections, and strong evidence showed that it is associated with harm (namely nephrotoxicity). The question of the use of local/topical gentamicin is unresolved.

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QUESTION 3: Should prophylactic antibiotic prophylaxis be repeated during spine surgery? If so, when?

RECOMMENDATION: In most uncomplicated spinal procedures, a single preoperative dose of prophylactic antibiotics is sufficient. Prophylactic antibiotics should be redosed intraoperatively for procedures lasting longer than twice the half-life of the antibiotic, or if there is excessive blood loss (blood loss > 1,500 mL) in order to ensure therapeutic levels.

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QUESTION 4: Should vancomycin powder be applied to the wound in patients undergoing spinal surgeries? Are there any potential harms associated with this practice?

RECOMMENDATION: Yes. Evidence suggests that vancomycin powder applied to the wound during spinal surgery reduces the risk of infection. However, the majority of studies lack a control arm and it is not known if vancomycin powder is better than antiseptic agents. There is insufficient evidence for or against the potential harm associated with this practice.

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QUESTION 5: What is the optimal perioperative antibiotic prophylaxis for patients undergoing spine surgery? What considerations should be made in cases of drug allergies?

RECOMMENDATION: The optimal prophylactic antibiotic for an uncomplicated spine surgery is a first- or second-generation cephalosporin given intravenously within 60 minutes of initial incision.

HAI: In patients with a history of anaphylactic reaction after use of beta lactams or in countries with a high rate of methicillin-resistant *Staphylococcal* infections, vancomycin in a weight-adjusted dose (15 mg/kg) should be used. Clindamycin 600 mg intravenously is an alternative to vancomycin.

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QUESTION 6: What are the optimal prophylactic antibiotics for patients with neurogenic bladder who are undergoing spine surgery?

RECOMMENDATION: The recommended standard perioperative antibiotic prophylaxis in spine surgery is cefazolin, but a broader-spectrum prophylaxis may be necessary in patient subpopulations more prone to acquiring surgical site infections (SSIs). In the case of neurogenic bladder, preoperative urine culture and individualized antibiotic prophylaxis are associated with a significant decrease in SSIs due to gram-negative bacilli (GNB).

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1.3. PREVENTION: BONE GRAFT

QUESTION 1: Does the use of allograft increase the risk of spinal infection?

RECOMMENDATION: The use of allograft seems to increase the risk for infection in pediatric and neuromuscular scoliosis, however there is no increased risk in the adult degenerative population.

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QUESTION 2: Can allograft, synthetic bone substitute or autograft be used during revision spinal surgery in patients with prior spine infection?

RECOMMENDATION: Based on available data, it appears that allograft, autograft and synthetic cages may be used successfully along with posterior screw fixation and prolonged antibiotic therapy in the treatment of pyogenic spondylodiscitis. This data can probably be extrapolated to also confirm that allograft and autograft safe during revision spinal surgery with prior infection.

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1.4. Prevention: RISK FACTORS

QUESTION 1: Does prior or active tuberculosis (TB) preclude patients from undergoing spine surgery?

RECOMMENDATION: Prior or active TB does not preclude patients from undergoing spine surgery.

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QUESTION 2: Should routine methicillin-resistant *Staphylococcus aureus* (MRSA) screening be in place prior to spine surgery?

RECOMMENDATION: Routine MRSA screening should not be performed prior to spine surgery. However, in hospitals with a high incidence of *S. aureus* spinal surgical site infection (SSI) and particularly high rates of MRSA infections, MRSA screening might be useful.

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QUESTION 3: Is there a role for routine decolonization of patients undergoing spine surgery? If so, what is the optimal agent(s)?

RECOMMENDATION: There is evidence to support the use of institutionalized screening and decolonization programs in methicillin-resistant *Staphylococcus aureus* (MRSA) carriers to reduce the rate of surgical site infection (SSI), however the optimum agents for decolonization have not been determined.

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QUESTION 4: How should patients currently using disease-modifying antirheumatic drugs (DMARDs) be managed in the perioperative period?

RECOMMENDATION: Spine surgeons caring for patients with rheumatic diseases must be aware that there are specific issues involved in their perioperative management. The optimal strategy for managing DMARD medications during the perioperative period of spine surgery is unknown due to the lack of evidence and it is largely based on low-quality evidence and expert opinion. A rheumatologist should be involved in the medication management around the time of surgery.

- For nonbiologic DMARDs such as methotrexate (MTX), leflunomide, hydroxychloroquine and/or sulfasalazine, continuation of the current dose throughout the perioperative period is recommended.
- For biologic DMARDs such as etanercept, we recommend that physicians withhold the biologic medication and plan elective surgery at the end of the dosing cycle for that specific medication. As an example, patients taking a weekly dose should schedule the surgery in the second week after the first withheld dose. These agents should not be restarted until external wound healing is complete, which is typically around two weeks. Exception: In patients taking tofacitinib (twice daily dose), withholding of tofacitinib for at least one week prior to surgery is recommended.
- For medications typically used for systemic lupus erythematosus (SLE) patients, such as mycophenolate mofetil, azathioprine, cyclosporine and tacrolimus, the decision to withhold medications prior to surgery should be made on an individual basis.

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QUESTION 5: Is postoperative hyperglycemia a risk factor for the development of infection following spinal surgery?

RECOMMENDATION: From the limited evidence, the association between postoperative hyperglycemia and surgical site infection (SSI) remains unclear and further study is needed.

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QUESTION 6: Is there an association between urinary tract infection (UTI) and surgical site infection (SSI) following spinal surgery?

RECOMMENDATION: Evidence regarding an association between UTI and SSI following spine surgery is conflicting and no convincing relationship has been proven. In a like fashion, no convincing relationship has been established between asymptomatic bacteriuria and SSI following spine surgery.

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QUESTION 7: What are the risk factors predisposing a patient to surgical site infections (SSI) after spine surgery?

RECOMMENDATION: Numerous risk factors for SSIs following spine surgery have been identified, including diabetes, obesity, prior SSI, smoking, longer operative times, posterior approach to spine and the number of levels fused.

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QUESTION 8: Should all patients with psoas abscesses be screened for both spine and hip infections?

RECOMMENDATION: Cross-sectional imaging with computed tomography (CT) and magnetic resonance imaging (MRI) will identify the source of secondary psoas abscesses in the majority of cases. If no other source is identified, consider cross-sectional imaging with CT or MRI for both the hip and spine in the setting of psoas abscess.

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1.5. PREVENTION: WOUND CARE

QUESTION 1: Is negative pressure wound therapy (NPWT) safe on spinal wounds in patients with a cerebrospinal fluid (CSF) leak?

RECOMMENDATION: NPWT may be harmful in patients with a CSF leak, leading to severe neurological sequelae.

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QUESTION 2: What are the risks and benefits for the use of vacuum-assisted closure (VAC) devices/PICO dressings following spine surgery?

RECOMMENDATION: The use of incisional VAC therapy (such as PICO dressings) is limited, but available literature supports its use in the prevention of dehiscence and surgical site infection (SSI) in posterior thoracolumbar deformity surgery.

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QUESTION 3: What type of surgical dressing is most effective for lowering rates of surgical site infection (SSI) in patients undergoing spine surgery?

RECOMMENDATION: There are no randomized studies comparing the use of incisional negative pressure wound therapy (NPWT) to standard dry dressings in spine surgery. The World Health Organization (WHO) recommends the use of incisional NPWT for high risk surgical wounds to reduce the risk of SSI.

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GENERAL ASSEMBLY
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2.1. 診断：基本原則

質問 1：脊椎手術での SSI の定義は？

著者：Robert Sawyer, Joseph K. Weistroffer, Anna White 翻訳者：岩田栄一郎

推奨：アメリカ疾病予防管理センター（CDC）、NHSN Patient Safety Component Manual、第 9 章：SSI イベント に記載されている定義を利用することを推奨する。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：脊椎感染の診断遅延の定義は？

著者：Claus Simpfendorfer 翻訳者：岩田栄一郎

推奨：脊椎感染症の診断遅延について、明確に確立された定義はない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：早期脊椎感染の診断を行う上で最適な時期は？

著者：John Koerner, David Kaye 翻訳者：岩田栄一郎

推奨：確立された時期はない。ただし、SSI を早期に診断し（手術から 3 ヶ月以内）手術的にデブリドマンを行った症例は、しばしばインストゥルメンテーションの温存が可能である。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 7%、棄権 0%（大多数、強いコンセンサス）

質問 4：脊椎術後の早期、遅発性の感染性合併症はどのように異なるか？

著者：Gregory Schroeder 翻訳者：岩田栄一郎

推奨：術後 30 日以内に起こる早期感染は、手術部位の痛みの増強、発赤、熱感や浸出液など局所感染所見をしばしば認める。一方、術後 90 日以降の遅発性感染は、慢性痛や固定を行っている場合はインプラント破損や偽関節など潜行性の症状を伴う。

エビデンスレベル：Moderate

投票結果：賛成 87%、反対 0%、棄権 13%（大多数、強いコンセンサス）

質問 5：椎間板ヘルニアのような変性疾患の患者で、実際に弱毒菌（例えばアクネ菌など）に感染していた症例は存在するか？

著者：Bryan Alexander 翻訳者：岩田栄一郎

推奨：アクネ菌と脊椎変性疾患の関連性は結論に達していない。

エビデンスレベル：Limited

投票結果：賛成 86%、反対 14%、棄権 0%（大多数、強いコンセンサス）

質問 6：血行性の化膿性椎体炎が疑われた時の診断アルゴリズムは？ また、アルゴリズムは結核患者で異なるか？

著者：Barrett Woods, Maja Babic 翻訳者：岩田栄一郎

推奨：2015 年の米国感染症学会（IDSA）の実践ガイドラインに基づいた診断アルゴリズムを支持する。診断アルゴリズムは、結核患者でも異なる。

エビデンスレベル：Moderate

投票結果：賛成 87%、反対 6%、棄権 7%（大多数、強いコンセンサス）

質問 7：脊椎感染を疑った際に、透視下生検/吸引を行う前に抗菌薬投与は中止すべきか？

著者：Taolin Fang 翻訳者：岩田栄一郎

推奨：脊椎感染を疑った際は、適切な培養サンプルを得るまでは、透視下生検/吸引を行う前に全ての抗菌薬を中止することを推奨する。患者が重症で手術に耐えられる状態でなかったり、神経所見が悪化している際は、生検/吸引をしないで抗菌薬投与を行うことは正当化できる。

エビデンスレベル：Consensus

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

質問8：脊椎術後の細菌性髄膜炎の発生率は？ インストゥルメンテーション使用による影響は？

著者：Koji Yamada, Alexander Montgomery, Yoshihiro Uchida, Mangattil Rajesh 翻訳者：岩田栄一郎

推奨：脊椎術後の細菌性髄膜炎の発生率は、0.1~0.4%である。インストゥルメンテーション使用が脊椎術後の細菌性髄膜炎の発生率に影響するか否かはエビデンスが不十分である。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問9：インストゥルメンテーションを使用した脊椎手術の術後早期感染性合併症には、どのようなものがあるか？

著者：Taolin Fang 翻訳者：岩田栄一郎

推奨：早期感染は、これまで術後 2~3 週で明確になる術後 1 ヶ月以内に発症したものと定義されてきた。最近の定義では、術後 90 日以内までと期間が長くなっている。

エビデンスレベル：Consensus

投票結果：賛成 60%、反対 20%、棄権 20%（大多数、弱いコンセンサス）

2.2. 診断：バイオマーカー

質問1：脊椎術後の早期 SSI 診断に役立つ診断ツールは存在するか？ また、そのツールはインストゥルメンテーションの有無で異なるか？

著者：Maja Babic 翻訳者：岩田栄一郎

推奨：CRP は、脊椎術後の早期 SSI 診断に使用することができる。インストゥルメンテーション手術と非インストゥルメンテーション手術ともに、術後 CRP 低下を認めない場合や、術後 4~7 日目の CRP 再上昇は、脊椎術後感染の指標として感度が高い。

エビデンスレベル：Moderate

投票結果：賛成 86%、反対 7%、棄権 7%（大多数、強いコンセンサス）

質問2：CRP、ESR やプロカルシトニンのような血液バイオマーカーは脊椎術後どのぐらいで正常化するのか？

著者：Maja Babic 翻訳者：岩田栄一郎

推奨：脊椎手術ではインストゥルメンテーションの有無に関わらず、CRP は術後 2~3 日目に最高値を示し、2 週以内に正常化する。ESR も術後 2 週以内に正常化する。

エビデンスレベル：Moderate

投票結果：賛成 50%、反対 29%、棄権 21%（不一致）

質問3：脊椎の SSI 診断において、血清バイオマーカーは有用か？

著者：Maja Babic 翻訳者：岩田栄一郎

推奨：CRP は脊椎術後の早期感染性合併症の診断において、予測可能で信頼できる経済的なスクリーニングツールである。ESR と白血球数は、早期 SSI の診断において非特異的な動態を示し、その有用性は劣る。

エビデンスレベル：Moderate

投票結果：賛成 67%、反対 25%、棄権 8%（大多数、弱いコンセンサス）

質問4：PCR や NGS (次世代シーケンス) のような分子技術は、脊椎手術感染の診断に有用であるか？ 有用な場合、どういった患者で行われるべきか？

著者：Bryan Alexander 翻訳者：岩田栄一郎

推奨：培養陰性の既往や培養陰性になる検査前確率の高い感染では、標準的な検査法に付随してこれらの検査を選択的に行うことは妥当である。

エビデンスレベル：Consensus

投票結果：賛成 71%、反対 14%、棄権 15%（大多数、強いコンセンサス）

質問5：透視下生検により得た検体はどの検査に提出すべきか？

著者：Glenn S. Russo, Daniel Tarazona 翻訳者：岩田栄一郎

推奨：細菌培養と病理検査を優先するべきである。疫学的に適切と判断される場合は、結核、真菌やブルセラの培養を考慮しても良い。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

質問6：脊椎感染が疑われた際に、術中組織検体は何個提出すべきか？

著者：Chad Craig, Michael Steinhaus 翻訳者：岩田栄一郎

推奨：最近の入手可能なエビデンスでは、脊椎感染を疑った場合は、少なくとも3~5個の組織検体を培養に提出することが推奨される。インストゥルメンテーションを使用する場合は、さらに培養検体の診断率を向上させるために vortexing や超音波処理のような追加手技を推奨する。

エビデンスレベル：Limited

投票結果：賛成 80%、反対 13%、棄権 7%（大多数、強いコンセンサス）

2.3. 診断：画像

質問1：脊椎感染診断における最適な画像検査は何か？ MRI禁忌の場合、どの画像検査を行うべきか？

著者：Chad Craig, Brandon Carlson 翻訳者：池尻正樹、山田浩司

推奨：MRIは脊椎感染診断におけるゴールドスタンダードであり、感度、特異度ともに90%以上である。MRIが禁忌の場合は、CT、PET-CT、SPECT + ガリウムシンチ、あるいはガリウムシンチなどの検査を組み合わせることを検討する。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：MRIが撮影できない患者で造影CTは脊椎感染の診断に有用か？

著者：John Koerner, Christopher Kepler, Anand Segar 翻訳者：池尻正樹、山田浩司

推奨：造影CT検査のルーチン撮影のエビデンスは限られるが、脊椎感染でMRIが禁忌の場合や他の画像検査ができない場合に施行する意味はある。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：脊椎感染診断において核医学検査(PET等)は有用か？

著者：Glenn S. Russo 翻訳者：池尻正樹、山田浩司

推奨：PETスキャン、特にPET-CTは、MRI検査ができない場合や不十分である場合においてMRI検査の補助として用いることができる。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：MRIでは、通常の術後変化と術後感染をどのように区別できるか？

著者：Susana Núñez-Pereira 翻訳者：池尻正樹、山田浩司

推奨：ガドリニウム増強画像によって確認される背筋や後方区画にある膿瘍は、MRI画像で最もよく報告されるSSI患者の変化である。ペディクルスクリュアのヘッド周囲の液体貯留もSSIを示唆するもう一つの所見である。

エビデンスレベル：Limited

投票結果：賛成 71%、反対 8%、棄権 21%（大多数、強いコンセンサス）

2.1. DIAGNOSIS: GENERAL PRINCIPLES

QUESTION 1: What is the definition of surgical site infection (SSI) in spinal surgery?

RECOMMENDATION: We recommend utilizing the definition provided by the Centers for Disease Control and Prevention (CDC), National Healthcare Safety Network (NHSN) Patient Safety Component Manual, Chapter 9: Surgical Site Infection (SSI) Event.

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QUESTION 2: What defines delay in the diagnosis of a spine infection?

RECOMMENDATION: There is no clear or established definition of delayed diagnosis for spine infection.

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QUESTION 3: Is there an optimal window for diagnosis of an early spine infection?

RECOMMENDATION: There is no defined window, but early diagnosis of a postoperative spine infection (up to three months from time of surgery) treated with surgical debridement and antibiotics often allows for retention of instrumentation.

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QUESTION 4: How do early and late infectious complications differ following spine surgery?

RECOMMENDATION: Early infections, defined as occurring within 30 days of surgery, often present with local signs of infection such as increased surgical site pain, erythema, warmth and wound drainage. Conversely, late infections (> 90 days after surgery) commonly present with an insidious onset of chronic pain and implant failure/ pseudarthrosis if following a fusion.

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QUESTION 5: Are there patients with degenerative pathology, such as disc herniations, who are actually infected with a low-grade infection (e.g., *Propionibacterium acnes*)?

RECOMMENDATION: The association between the *Cutibacterium acnes* (C. acnes) (formerly P. acnes) and degenerative spinal disease is inconclusive.

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QUESTION 6: What is the diagnostic algorithm of patients with suspected hematogenous vertebral osteomyelitis? Is the algorithm different for patients with tuberculosis (TB)?

RECOMMENDATION: We support the diagnostic algorithm for suspected hematogenous vertebral osteomyelitis per Infectious Disease Society of America (IDSA) Clinical Practice Guidelines, 2015. Diagnostic algorithm is not different for patients with TB.

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QUESTION 7: Should antibiotics be held prior to image-guided biopsy/aspiration for a suspected spine infection?

RECOMMENDATION: We recommend that prior to image-guided biopsy/aspiration for a suspected spine infection, all antibiotics should be withheld until after appropriate culture samples are obtained. Antibiotic administration, without aspiration/biopsy may be justified in patients who are critically ill and cannot withstand intervention or in patients with deteriorating neurological conditions.

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QUESTION 8: What is the incidence of infectious bacterial meningitis (PBM) following spinal surgery? Does the use of instrumentation affect this?

RECOMMENDATION: The incidence of PBM following spinal surgery varies from 0.1–0.4%. There is insufficient evidence to make any observations as to whether the use of instrumentation affects the incidence of PBM following spinal surgery.

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QUESTION 9: What are the early infectious complications after operations on the spine following the use of instrumentation?

RECOMMENDATION: Early infections are traditionally defined as those occurring within a month after surgery, typically becoming evident within two to three weeks of surgery. Recently, the definition has been broadened to include infection within 90 days of surgery.

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2.2. DIAGNOSIS: BIOMARKERS

QUESTION 1: Are there any diagnostic tools that are useful for early surgical site infection (SSI) detection following spinal surgery? Does this differ whether or not there was instrumentation?

RECOMMENDATION: C-reactive protein (CRP) can be used to diagnose early SSI following spinal surgery. A failure of CRP to decline or a second rise on postoperative days four to seven is a sensitive marker for infection following spine surgery, including both instrumented and non-instrumented spine surgery.

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QUESTION 2: When do common blood biomarkers such as C-reactive protein (CRP), erythrocyte sedimentation rate (ESR) or Procalcitonin normalize after spine surgery?

RECOMMENDATION: Following spinal surgery with or without instrumentation, CRP values peak on days 2-3 postoperatively and normalize within 14 days. ESR also normalizes within 14 days.

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QUESTION 3: Is there a role for the use of serum biomarker for the diagnosis of spinal surgical site infection (SSI)?

RECOMMENDATION: Yes, C-reactive protein (CRP) is a predictable, reliable and economical screening tool for early infectious complications following spine surgery. Erythrocyte sedimentation rate and white blood cell count have nonspecific kinetics that are less helpful in identifying early SSI.

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QUESTION 4: Is there a role for molecular techniques such as polymerase chain reaction (PCR) or next-generation sequencing (NGS) for the diagnosis of spinal surgery infection? If so, in which group of patients should this be done?

RECOMMENDATION: It is reasonable to selectively incorporate these diagnostic modalities as an adjunct to standard methodologies where there is a history or high pre-test probability for culture negative infection.

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QUESTION 5: For which investigations should samples obtained by image-guided biopsy be sent?

RECOMMENDATION: A priority should be placed on obtaining bacterial cultures and pathohistology. In the appropriate epidemiological setting, mycobacterial, fungal and brucellar cultures can be considered.

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QUESTION 6: How many intraoperative tissue samples should be sent for culture in suspected spinal surgery infection?

RECOMMENDATION: With the currently-available evidence, it is recommended that at least three to five tissue samples be sent for culture in cases of suspected spinal infection. In the setting of instrumentation, we recommend additional techniques, such as vortexing and sonification, to increase the yield of culture samples.

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2.3. DIAGNOSIS: IMAGING

QUESTION 1: What is the optimal mode of imaging in the diagnosis of spine infections? If magnetic resonance imaging (MRI) is contraindicated, what imaging modality should be used?

RECOMMENDATION: MRI remains the gold standard for the diagnosis of spinal infection, with sensitivity and specificity above 90%. In the presence of MRI contraindications, consider a combination of modalities, such as computed tomography (CT), positron emission tomography-CT (PET-CT), and single photon emission CT (SPECT)+67Gallium or Gallium-67.

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QUESTION 2: Is there a role for computed tomography (CT) scan with contrast in the diagnosis of spinal infections in patients who cannot undergo magnetic resonance imaging (MRI)?

RECOMMENDATION: Although evidence is limited for the routine use of CT scan with contrast, there is a role for it to be used in the presence of spine infection where MRI is contraindicated or when other advanced imaging is not available.

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QUESTION 3: Is there a role for nuclear imaging (e.g., positron emission tomography scan (PET)) in the diagnosis of spinal infections?

RECOMMENDATION: PET scan, preferably PET-computed tomography (PET-CT), can be used as an adjunct to magnetic resonance imaging (MRI) to diagnose spinal infections when an MRI cannot be performed or is inconclusive.

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QUESTION 4: How can postoperative infections be distinguished from normal postoperative changes on magnetic resonance imaging (MRI)?

RECOMMENDATION: The presence of an abscess in the back muscles or posterior site, confirmed by gadolinium enhancement, is the most frequently-reported change on MRI of patients with surgical site infection (SSI). The presence of a collection of fluid outside the head of the pedicle screws is another sign of SSI.

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PEDIATRICS
BIOFILM

3.1. 治療：一般原則

質問 1：脊椎術後感染治療で非手術的アプローチは可能か？ もし可能ならば、良い治療成績を予見する因子は何か？

著者：Claus Simpfendorfer 翻訳者：前川勇人、岩田栄一郎

推奨：脊椎術後感染は洗浄とデブリドマン（インプラント抜去に関わらず）を行い、続けて適切な抗菌薬で治療すべきである。患者が手術適応でない場合や、インプラント抜去前に骨癒合を得たい場合は、手術的介入は行わずに抗菌薬抑制療法を試みるべきである。

エビデンスレベル：Strong

投票結果：賛成 80%、反対 7%、棄権 13%（大多数、強いコンセンサス）

質問 2：脊椎感染が疑われる患者はいつ感染症内科に紹介すべきか？

著者：Susana Núñez-Pereira 翻訳者：前川勇人、岩田栄一郎

推奨：感染症内科に紹介するタイミングや必要性についてのデータはない。脊椎感染症診療では、集学的アプローチを支持する。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：どのような化膿性脊椎炎の患者であれば外来での治療が可能か？ その判断に役立つ基準はあるか？

著者：Dolors Rodriguez-Pardo, Gregory Schroeder 翻訳者：前川勇人、岩田栄一郎

推奨：どのような化膿性脊椎炎患者であれば外来で治療可能かを特定するための研究はない。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 7%、棄権 0%（大多数、強いコンセンサス）

質問 4：アクネ菌 (*Propionibacterium acnes*) による脊椎感染症の最適な治療法は？

著者：Chad Craig, Dolors Rodriguez-Pardo, Evan Sheha 翻訳者：前川勇人、岩田栄一郎

推奨：アクネ菌 (*Cutibacterium acnes/Propionibacterium acnes*) 感染では、特に遅発性感染の時には、可能であればインプラントを完全に抜去するべきである。典型的な抗菌薬のレジメンは、特定の抗菌薬を 2 週間以上点滴投与し、複数の抗菌薬を点滴あるいは経口で 6 週間投与するのが最も一般的である。しかし、抗菌薬の投与期間は非常に多様である。どのような患者が抗菌薬単独で奏功し、インプラントが温存できるかは明確ではない。現在ペニシリンが標準治療薬であるが、他の非 β -ラクタム系抗菌薬も感受性に基づいて考慮されるべきである。

エビデンスレベル：Limited

投票結果：賛成 73%、反対 7%、棄権 20%（大多数、強いコンセンサス）

3.2. 治療：抗菌薬

質問 1：早期脊椎 SSI で抗菌薬の内服治療は有用か？

著者：John Koerner, Katherine Belden 翻訳者：山田浩司

推奨：一部の条件下では、早期脊椎 SSI に対して生物学的利用性の高い内服抗菌薬投与が有用である可能性がある。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：急性と慢性の脊椎感染症に対して内服の抗菌薬治療は有用か？

著者：Yvonne Achermann 翻訳者：山田浩司

推奨：一部の条件下では、急性や慢性の脊椎感染症治療で生物学的利用性の高い内服抗菌薬投与が有用である可能性はある。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：脊椎感染でインプラントを温存した患者に対して、抗菌薬の長期再発抑制療法は有用か？

著者：Susana Núñez-Pereira 翻訳者：山田浩司

推奨：抗菌薬の長期再発抑制療法はこれまで十分に研究がなされていない。しかしながら、インプラントを抜去できない患者や様々な併存症のために追加

手術を行うことができない患者に対しては、一つのオプションとなりうる。

エビデンスレベル：Consensus

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

質問4：脊椎術後のSSI患者に対する治療で、抗菌薬の併用療法(2剤、あるいは3剤など)は有用か？

著者：Alexander Vaccaro, Anand Segar 翻訳者：山田浩司

推奨：脊椎術後の感染に対して、ルーチンで抗菌薬の併用療法を行うことを推奨できる十分なエビデンスはない。特定の原因菌による特定の状況下では、併用療法は有用である可能性はある。

エビデンスレベル：Consensus

投票結果：賛成 87%、反対 13%、棄権 0%（大多数、強いコンセンサス）

質問5：脊椎の急性期SSIでは、手術的デブリドマン後にどの程度の期間抗菌薬を投与すべきか？

著者：Yvonne Achermann 翻訳者：山田浩司

推奨：化膿性脊椎炎では、抗菌薬の点滴投与を1~2週間行い、続いて内服投与を4~5週間行い合計6週間投与とする。深部SSIでは、抗菌薬の適正な投与期間やどのような抗菌薬を点滴あるいは内服で投与すべきかに関する情報は限られている。PJIに関する研究や脊椎感染症の後方視的研究から得られた知見から推測すると、早期感染やインプラントを温存する患者では12週間の抗菌薬投与が推奨できる。インプラントが抜去されていれば6週間、遅発性感染でインプラントを抜去しないときは長期再発抑制療法が推奨できる。

エビデンスレベル：Moderate for vertebral osteomyelitis. Limited for surgical site infections after spine surgery

投票結果：賛成 80%、反対 13%、棄権 7%（大多数、強いコンセンサス）

質問6：脊椎創部を二期的な創傷治療を期待し開放創としている場合、どの程度の期間抗菌薬を投与すべきか？

著者：Gregory Schroeder, Mayan Lendner 翻訳者：山田浩司

推奨：標準的な予防抗菌薬投与を推奨する。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

質問7：脊椎感染でインプラントが温存されている場合、抗菌薬の適正な治療投与期間は？ インプラントのない脊椎感染と比べ、抗菌薬の投与方法は異なるか？

著者：Susana Núñez-Pereira, Rabih Darouiche 翻訳者：山田浩司

推奨：脊椎感染でインプラントが温存されている症例に対する治療で、抗菌薬の適正な投与期間に関しエビデンスに基づく推奨を行えるだけのケースコントロール研究はない。最も一般的な抗菌薬の投与期間は3か月である。しかし、投与期間はすべての研究で大きく異なっていた。インストゥルメンテーションを行っていない患者では、投与期間が短くても成績は良好であった。

エビデンスレベル：Consensus

投票結果：賛成 93%、反対 7%、棄権 0%（大多数、強いコンセンサス）

質問8：脊椎感染患者に対する抗菌薬治療の効果判定を行うためには、どのような検査をするべきか？

著者：Maja Babic 翻訳者：山田浩司

推奨：血清CRPは脊椎感染の臨床像ととても関連しており、治療効果判定を行う上で好まれる検査である。

エビデンスレベル：Moderate

投票結果：賛成 93%、反対 7%、棄権 0%（大多数、強いコンセンサス）

質問9：キノロン耐性のグラム陰性菌による急性脊椎術後感染に対して、代替となる最適な抗菌薬療法は？

著者：Dolors Rodriguez-Pardo 翻訳者：山田浩司

推奨：抗菌薬の選択は、原因菌とその感受性に基づいて行うべきである。

エビデンスレベル：Moderate

投票結果：賛成 93%、反対 7%、棄権 0%（大多数、強いコンセンサス）

質問10：脊椎インプラント感染で、バンコマイシンビーズとバンコマイシンパウダーの有効性に差はあるか？

著者：Steven Schmitt, Christopher Kepler 翻訳者：山田浩司

推奨：脊椎インプラント感染で、バンコマイシンビーズとバンコマイシンパウダーの有効性に差があるかどうかは不明である。

エビデンスレベル：Consensus

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

3.3. 治療：インプラント

質問1：脊椎術後感染の患者ではケージを抜去すべきか？

著者：Pouya Alijanipour, Caroline Granger 翻訳者：定拓矢、山田浩司

推奨：抜去すべきではない。ケージのゆるみや移動、もしくは神経血管への圧迫が臨床的にも画像的にも認めない場合、椎体間ケージは温存できる。しかし、抗菌薬の静脈内投与に加え、洗浄やデブリドマンなどのサルベージが行われているにもかかわらず感染が持続する場合は、ケージを抜去すべきである。

エビデンスレベル：Limited

投票結果：賛成 73%、反対 0%、棄権 27%（大多数、強いコンセンサス）

質問2：インプラントを取り除くべき感染期間はあるか？

著者：Christopher Kepler, Barrett Boody 翻訳者：定拓矢、山田浩司

推奨：データによると早期感染は通常インプラントを温存したまま、デブリドマンや抗菌薬の静脈内投与（IV）及び経口投与で治療できる。固定椎間の骨癒合を認める場合、インプラントは安全に抜去することができる。偽関節の場合は、感染を制御するためにインプラントを抜去し、その後に再度インストゥルメンテーション手術を考えるべきである。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：脊椎SSIの患者では移植骨を取り除くべきか？ また、取り除く場合は同種骨と自家骨で何か異なるか？

著者：Wesley Bronson 翻訳者：定拓矢、山田浩司

推奨：特に部分的な感染では、洗浄やデブリドマンの際に必ずしも移植骨を取り除く必要はない。しかし、移植骨がゆるんでいる場合や膿性の場合は、移植骨の除去を考慮すべきである。同種骨の温存は、自家骨と比較して、再度デブリドマンを必要とするリスクが増加する可能性がある。

エビデンスレベル：Limited

投票結果：賛成 87%、反対 0%、棄権 13%（大多数、強いコンセンサス）

質問4：脊椎感染においてインプラントの温存、または抜去の適応は？

著者：Yvonne Achermann 翻訳者：定拓矢、山田浩司

推奨：早期、あるいは急性期感染の場合は、インプラント抜去は偽関節リスクを大きく高めるため、たとえ慢性の弱毒性感染とインプラントのゆるみにつながるリスクがあっても、デブリドマン後はインプラントを温存できる可能性があり常に試みるべきである。遅発性感染では、可能であればインプラントの抜去を推奨する。

エビデンスレベル：Consensus

投票結果：賛成 87%、反対 7%、棄権 6%（大多数、強いコンセンサス）

質問5：脊椎感染でインプラントの一次的な入れ替えを行う意義はあるか？

著者：Barrett Woods, Maja Babic 翻訳者：定拓矢、山田浩司

推奨：脊椎感染でインプラントの一次的な入れ替えを行うことについてのデータは不十分である。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

3.4. 治療：創傷処置

質問1：感染創は一次的に縫合すべきか二期的に縫合すべきか？

著者：Carles Pigrau, Gregory Schroeder 翻訳者：定拓矢、岩田栄一郎

推奨：ほとんどの脊椎術後感染において、一次的な縫合が現在推奨されている。しかし、一次的縫合を行うことができない場合や好ましくない場合がある。

例えば、外傷で重度の汚染を伴う場合、持続的浸出に対する対応が上手くいかなかった場合や一期的縫合を行うことができない重度の軟部組織欠損などである。

エビデンスレベル：Consensus

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

質問2：脊椎感染患者において前進筋皮弁を行う適応は何か？

著者：Wesley Bronson 翻訳者：定拓矢、岩田栄一郎

推奨：前進筋皮弁は、インプラントが露出した創部や局所治療や陰圧閉鎖（VAC）療法で治癒しえない創の閉創や感染制御に有効である。

エビデンスレベル：Consensus

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

質問3：脊椎の清潔手術、あるいは感染手術において、最適な洗浄方法(量、種類、頻度)は何か？

著者：Koji Yamada, Kazuhiro Kohata 翻訳者：定拓矢、岩田栄一郎

推奨：1. 脊椎の清潔手術では、SSI を予防する目的で閉創前に生理食塩水洗浄を行うべきか否かについてエビデンスは不十分である。
2. 脊椎の清潔手術では、SSI 予防を目的とした適切な洗浄量、洗浄の種類、洗浄の頻度について推奨を行うだけの十分なエビデンスはない。
3. 脊椎の清潔手術では、SSI 予防を目的として、閉創前にポビドンヨード水溶液での洗浄を検討すべきである。
4. 脊椎の清潔手術では、SSI 予防を目的とした、クロールヘキシジンあるいは抗菌薬含有洗浄液での創洗浄を推奨するだけの十分なエビデンスはない。
5. 脊椎感染手術において、特定の洗浄方法（量、種類、頻度）を推奨するだけの十分なエビデンスはない。

エビデンスレベル：

- 1. Consensus
- 2. Limited
- 3. Moderate
- 4. Consensus
- 5. Consensus

投票結果：賛成 73%、反対 7%、棄権 20%（大多数、強いコンセンサス）

質問4：二期的治癒を期待した開放創の治療に陰圧閉鎖療法(NPWT)は有効か？

著者：Carles Pigrau 翻訳者：定拓矢、岩田栄一郎

推奨：二期的治癒を期待した開放創の治療において、NPWT が従来の標準的なドレッシングよりも優れているというエビデンスはない。

エビデンスレベル：Limited

投票結果：賛成 60%、反対 20%、棄権 20%（大多数、弱いコンセンサス）

3.1. TREATMENT: GENERAL PRINCIPLES

QUESTION 1: Can a non-surgical approach be used to treat postoperative spine infections? If so, what factors predict a successful outcome?

RECOMMENDATION: Postoperative spine infections should be treated with irrigation and debridement (with or without implant removal) followed by appropriate antibiotic therapy. Antibiotic suppression without surgical intervention should be attempted in cases where the patient is not a surgical candidate, or in attempt to achieve spinal fusion prior to implant removal.

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QUESTION 2: When should patients with suspected infections of the spine be referred to an infectious disease department?

RECOMMENDATION: There is no data on the timing or need for a referral to an infectious disease department. We support a multidisciplinary approach to managing clinical spine infections.

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QUESTION 3: Which patients with vertebral osteomyelitis (VO) are suitable for outpatient management? Does any criteria exist to aid in this decision-making?

RECOMMENDATION: There are no studies aiming to identify which patients diagnosed with VO can be treated on an outpatient basis.

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QUESTION 4: What is the optimal treatment of spinal infections caused by *Propionibacterium acnes* (P. acnes)?

RECOMMENDATION: When possible, patients should undergo complete removal of implants after *Cutibacterium acnes* (C. acnes) (formerly P. acnes) infection, especially in the setting of latent infection. Antibiotic regimens typically involve specific parenteral antibiotics for a period of greater than two weeks, with the most common antibiotic duration being six weeks of multiple parenteral and/or oral agents. However, the duration of antibiotic treatment is highly variable. It is unclear in which setting patients may be successfully treated with antibiotic therapy alone and instrumentation may be retained. Penicillin is currently the standard of care, but other non beta-lactam antibiotics should be considered based on the susceptibility profile.

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3.2. TREATMENT: ANTIBIOTICS

QUESTION 1: Is there a role for oral antibiotics in the treatment of early postoperative spine infections?

RECOMMENDATION: There may be a role for highly bioavailable oral antibiotics in the treatment of early postoperative spine infection in select circumstances.

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QUESTION 2: Is there a role for the use of oral antibiotic in treatment of acute and chronic spinal infections?

RECOMMENDATION: There may be a role for highly bioavailable oral antibiotics in the treatment of acute and chronic spine infection in select circumstances.

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QUESTION 3: Is there a role for chronic antibiotic suppression after treating patients with retained infected spinal hardware?

RECOMMENDATION: The use of chronic antibiotic suppression (CAS) has not been clearly investigated until now. However, it can be an option for patients whose implants cannot be removed or who refuse further surgeries because of comorbidities.

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QUESTION 4: Is there a role for combination antibiotics (i.e., dual or triple) in treating patients with surgical site infection (SSI) following spinal surgery?

RECOMMENDATION: There is insufficient evidence to recommend the routine use of combination antibiotics in the setting of postoperative spine infections. However, there may be a role for combination antibiotics in certain circumstances related to specific pathogens.

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QUESTION 5: How long should antibiotics be administered after surgical debridement for an acute postsurgical spinal infection?

RECOMMENDATION: For vertebral osteomyelitis: Initial intravenous treatment for one to two weeks, followed by an oral treatment of four to five weeks to reach a total treatment duration of six weeks.

For deep surgical site infections: There is limited knowledge about the ideal duration of antibiotic treatment and which intravenous and/or oral agents should be given. As extrapolated from studies in periprosthetic joint infections (PJIs) and retrospective studies in spine infections, 12 weeks of antibiotic treatment can be recommended in cases with early infection and implant retention, six weeks if the implant is removed and prolonged suppressive treatment in delayed infections without removal of the implant.

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QUESTION 6: How long should antibiotics be continued when spinal wounds are left to heal by secondary intention?

RECOMMENDATION: Only standard perioperative antibiotic prophylaxis is recommended.

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QUESTION 7: What is the optimal duration of antibiotic treatment following spine infection in patients within whom hardware is retained? Is the antibiotic treatment different for those with spine infection without hardware?

RECOMMENDATION: There are no case-control studies allowing for an evidence-based recommendation on the optimal length of antibiotic treatment following spine infections in the presence of retained hardware. The most commonly implemented antibiotic regime is three months. However, duration of treatment was highly variable among all studies. Patients with non instrumented surgeries did well with a shorter course of antibiotics.

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QUESTION 8: What tests should be used to monitor response to antibiotic treatment in patients with spine infection?

RECOMMENDATION: Serum C-reactive protein (CRP) levels are closely related to clinical response in spine infections and are therefore the preferred marker in monitoring the therapeutic course.

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QUESTION 9: Which is the best alternative antimicrobial therapy for fluoroquinolone-resistant gram-negative acute post-surgical infection in spinal surgery?

RECOMMENDATION: The choice of antimicrobial therapy should be based on the pathogen and the susceptibility profile.

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QUESTION 10: Is there a difference in the efficacy of vancomycin beads versus vancomycin powder for spinal implant infections?

RECOMMENDATION: It is unclear whether there is a difference in the efficacy of vancomycin beads versus vancomycin powder for spinal implants infections.

3.3. TREATMENT: IMPLANTS

QUESTION 1: Should a cage be removed in patients with postoperative spine infection?

RECOMMENDATION: No. The interbody cage can be maintained in the absence of clinical and radiographic signs of loosening or displacement of the cage or compression on neural and vascular structures. However, the cage should be removed if the infection persists despite salvage attempts consisting of irrigation and debridement procedures combined with intravenous antibiotic treatment.

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QUESTION 2: Is there a length of time of infection beyond which instrumentation should be removed?

RECOMMENDATION: The data suggests that early infection can commonly be treated with implant retention and debridement followed by intravenous (IV) antibiotics and common oral antibiotic treatment. If the patient has achieved spinal fusion, the implants can be safely removed. In the setting of pseudarthrosis, thought should be given to removal of implants to eradicate infection followed by re-instrumentation.

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QUESTION 3: Should bone graft be removed in patients with postoperative spine infection? If yes, should a distinction be made between allograft and autograft?

RECOMMENDATION: Bone graft need not be routinely removed following irrigation and debridement, especially if partially incorporated. However, loose or purulent graft should be considered for removal. Retained allograft may increase the risk for requiring repeat debridement compared to autograft.

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QUESTION 4: What are the indications for implant retention or removal of hardware in spinal infections?

RECOMMENDATION: In early or acute infections, debridement with retention of the implant might be possible and should always be favored, as removal of the implant carries a great risk for non-fusion despite the risk of chronic low-grade infections with possible implant loosening. In late infections, removal is recommended if feasible.

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QUESTION 5: Is there a role for one-stage exchange of hardware in the presence of spinal infections?

RECOMMENDATION: There is insufficient data on one-stage exchange of hardware in the presence of spine infection.

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3.4. TREATMENT: WOUND CARE

QUESTION 1: Should infected wounds undergo primary closure or a two-stage closure?

RECOMMENDATION: The current recommended practice for spine wounds remains primary closure in the majority of postoperative infections. However, there may be circumstances when primary closure of the wound may not be possible or preferred. This may include patients with grossly contaminated traumatic wounds, patients with persistent wound drainage when attempts to address drainage have failed or patients with severe soft tissue loss when primary closure is not possible.

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QUESTION 2: What is the indication for muscle advancement flaps in patients with spinal infections?

RECOMMENDATION: Muscle advancement flaps are useful to help close wounds with exposed hardware as well as those which fail local treatment/vacuum-assisted closure (VAC) therapy and to help improve infection eradication.

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QUESTION 3: What is the optimal irrigation solution (volume, type and frequency) during clean or infected spinal surgery cases?

RECOMMENDATION:

1. There is insufficient evidence to recommend for or against normal saline irrigation before closure for the purpose of preventing surgical site infection (SSI) in clean spinal surgery.
2. There is insufficient evidence to support recommendations for optimal volume, type and frequency of irrigation to prevent SSI in clean spinal surgery.
3. Consider the use of irrigation with an aqueous povidone-iodine solution before closure for the purpose of preventing SSI in clean spinal surgery.
4. There is insufficient evidence to recommend for or against chlorhexidine and antibiotic solution irrigation of incisional wounds for the purpose of preventing SSI in clean spinal surgery.
5. There is insufficient evidence to recommend a specific solution (volume, type and frequency) for irrigation in infected spinal surgery.

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QUESTION 4: Is negative pressure wound therapy (NPWT) effective in the treatment of wounds that are left to heal by secondary intention?

RECOMMENDATION: There is no evidence that NPWT is superior to conventional standard dressing changes in the treatment of wounds that are left to heal by secondary intention.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
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PART V

TRAUMA

SECTION 1: PREVENTION

- 1.1. 患者因子
- 1.2. リスクの軽減

SECTION 2: DIAGNOSIS

SECTION 3: TREATMENT

- 3.1. 抗菌薬と保存加療
- 3.2. 術者とチーム医療
- 3.3. リスク因子
- 3.4. 術式関連
- 3.5. インプラント管理
- 3.6. 創被覆
- 3.7. 結果

〈監訳者〉

河村健二、田中康仁

1.1. 予防：患者因子

質問 1：喫煙は骨折手術時の感染に影響を及ぼすか？ 過去の喫煙歴と現在の喫煙のどちらが重要か？ 喫煙の中断は合併症の発生率を減らすか？

著者：Carlos A. Sanchez Correa, Mustafa Citak, Carl Haasper, Niklas Unter Ecker 翻訳者：上野優樹、河村健二

推奨：喫煙は骨折手術時の感染の発生率上昇の原因となると思われる。喫煙歴と現在の喫煙のどちらが重要なのかについては定かではない。また、喫煙の中断によって骨折手術時の合併症の発生率が減少するかについても定かではない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：骨折急性期において、栄養補充は感染予防に効果があるか？

著者：Kazuhiko Matsushita, Paul Stangl 翻訳者：上野優樹、河村健二

推奨：(1) 栄養状態のよい患者において栄養補充が感染予防に効果があるというエビデンスはない。(2) しかし、栄養失調や異化状態にある患者において栄養補充をすることで感染の発生率を下げる可能性があるとする報告はある。

エビデンスレベル：(1) Limited (2) Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：術前の肺炎や尿路感染症(UTI)や栄養障害性潰瘍は人工骨頭置換術やTHAの行われる大腿骨頸部骨折患者におけるPJI/SSIのリスクとなるか？

著者：Stephen Kates 翻訳者：上野優樹、河村健二

推奨：肺炎や尿路感染症や栄養障害性潰瘍が人工骨頭置換術やTHAの行われる大腿骨頸部骨折患者のSSI/PJIのリスクになるかについて研究した報告はほとんどない。

エビデンスレベル：Limited

投票結果：賛成 91%、反対 0%、棄権 9%（大多数、強いコンセンサス）

質問 4：外傷患者における急性期感染において微生物特有の危険因子は存在するか(例えば、MRSAの鼻腔内保菌は外傷後のMRSA感染の危険因子となるか)？

著者：Mauro Jose Costa Salles, Mario Morgenstern, William T. Obremskey 翻訳者：上野優樹、河村健二

推奨：現在のエビデンスでは、MRSAのコロニー形成、創外固定の存在、手術の解剖学的部位、重症開放骨折など様々な危険因子により感染リスクは増えるとされている。これらの場合において予防投与する抗菌薬の変更を考慮してもよい。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 5：人工関節周囲骨折はPJIの発症リスクとなるか？

著者：Arjun Saxena 翻訳者：上野優樹、河村健二

推奨：THAやTKAの行われた大腿骨の人工関節周囲骨折に対して再手術を行う患者ではSSIの発生率が増加するというエビデンスレベルⅢからⅣの研究がある。人工関節周囲の白蓋や脛骨の骨折に関する論文は限られる。人工関節周囲骨折の治療結果についてはさらなる研究が求められる。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 6：大腿骨頸部骨折に関節形成術を行う際に同種輸血(ABT)の必要性に関する予測因子はあるか？

著者：Paddy Kenny, Giedrius Kvederas, Arjun Saxena, John Gibbons 翻訳者：上野優樹、河村健二

推奨：同種輸血の必要性に関する術前予測因子として、(1) 貧血 (2) 認知症や低アルブミン血症がある。(3) 抗凝固薬や抗血小板薬の内服は同種輸血の必要性の予測因子とはならない。同種輸血の必要性に関して人工骨頭置換術とTHAを比較したものについては相反するデータが存在する。

エビデンスレベル：(1) Strong (2) Limited (3) Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

1.2. 予防：リスクの軽減

質問1：外傷例においてMRSAの鼻腔内保菌者に対する除菌は効果があるか？

著者：Yousef Abuodeh, Per Akesson, Osama Aldahamsheh 翻訳者：鍛冶大祐、河村健二

推奨：外傷患者に対する除菌はSSIを軽減するかどうかは不明である。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：開放されたままの開放骨折の創傷に対して二次感染や院内感染を予防する理想的な治療戦略は？

著者：Robert O'Toole, Nathan O'Hara 翻訳者：鍛冶大祐、河村健二

推奨：抗菌薬の局所投与や早期創閉鎖が開放創の感染を減らすことをデータが支持している。

追記：前述の推奨は原著とは異なるため、後述の根拠と完全に同じとはいえない。早期創閉鎖に関する根拠はSection 3.6の質問2を参照。陰圧閉鎖療法（NPWT）に関する根拠はSection 3.6の質問4を参照。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：人工関節周囲骨折に対する内固定と創外固定ではPJIのリスクに違いはあるか？

著者：Mitch Harris, Sofiene Kallel, Abhiram R. Bhashyam, Andre Shaffer 翻訳者：鍛冶大祐、河村健二

推奨：リスクの違いは不明である。人工関節周囲骨折に対する内固定と創外固定によるPJIのリスクを比較したエビデンスは限られる。刺入部感染の可能性、特に関節内に迷入した場合を考慮すると、ほとんどの症例で内固定が好ましいと考えられる。

エビデンスレベル：Limited

投票結果：賛成 90%、反対 5%、棄権 5%（大多数、強いコンセンサス）

質問4：開腹状態にある多発外傷患者の骨折に対する最終的な内固定は、閉腹されるまで遅らせるべきか？

著者：Maria Fernanda Garcia 翻訳者：鍛冶大祐、河村健二

推奨：開腹状態にある患者の骨折に対する最終的な内固定は、手術可能な状況であれば遅らせるべきではなく安全に行えるであろう。

エビデンスレベル：Limited

投票結果：賛成 95%、反対 5%、棄権 0%（満場一致、最も強いコンセンサス）

1.1. PREVENTION: HOST FACTORS

QUESTION 1: What is the relationship between smoking and infection in fracture procedures? Is smoking history or only current smoking important? Does nicotine cessation at time of fracture reduce complication rates?

RECOMMENDATION: Smoking seems to increase the risk of infection in fracture procedures. The importance of smoking history versus current smoking status is unknown. It is also unknown if nicotine cessation (smoking) at time of fracture treatment reduces complication rates.

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QUESTION 2: What is the role of nutritional supplementation (NS) in avoiding infection in acute fracture cases?

RECOMMENDATION: (1) Evidence does not support the role of NS for avoiding infections in well-nourished individuals. (2) However, the literature has stated that in patients with a nutritional deficiency or catabolic state restoring nutritional parameters might reduce the risk of infection.

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QUESTION 3: Do preoperative pneumonia/urinary tract infections (UTIs)/trophic ulcers increase periprosthetic joint infection/surgical site infection (PJI/SSI) risk in femoral neck fracture patients treated by partial/total hip arthroplasty (THA)?

RECOMMENDATION: There is a paucity of literature examining whether pneumonia/UTI/trophic ulcers increase SSI/PJI risk for patients with femoral neck fracture treated by hemi- or THA.

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QUESTION 4: Are there microorganism-specific risk factors for acute infection in trauma patients (i.e., does being a nasal carrier of methicillin-resistant *Staphylococcus aureus* (*S. aureus*), or MRSA, increase the risk for MRSA infection after trauma?)

RECOMMENDATION: The current evidence of an increased risk of infection is based on several risk factors, including MRSA colonization, presence of external fixator, anatomical location of surgery and severe open fractures. In these situations, alterations in antibiotic prophylaxis could be considered.

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QUESTION 5: Is periprosthetic fracture a risk for the development of a periprosthetic joint infection (PJI)?

RECOMMENDATION: Infection rates from level III and IV evidence studies suggest an increased surgical site infection in patients who undergo re-operation for treatment of periprosthetic fracture of the femur after total hip and knee arthroplasty. There is limited literature available on periprosthetic acetabular and tibial fractures. Further study investigating the outcomes for treatment of periprosthetic fracture is recommended.

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QUESTION 6: Are there predictors of the need for allogeneic blood transfusion (ABT) in patients undergoing arthroplasty for acute hip fractures?

RECOMMENDATION: Preoperative predictors for the need for ABT include (1) anemia and (2) dementia and hypoalbuminemia. (3) Anticoagulation or anti-platelet medications do not predict the need for ABT. There is conflicting data with regard to the need for ABT when comparing hemiarthroplasty (HA) to total hip arthroplasty (THA).

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1.2. PREVENTION: RISK MITIGATION

QUESTION 1: Is there a role for bacterial decolonization (i.e., of methicillin-resistant *Staphylococcus aureus* (*S. aureus*), or MRSA, in nares) in trauma cases?

RECOMMENDATION: It is unknown if bacterial decolonization in trauma patients reduces surgical site infection (SSI).

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QUESTION 2: What are the ideal strategies to prevent secondary and nosocomial contamination of open fracture wounds which are left open?

RECOMMENDATION: Data support local antibiotics and early wound closure to reduce contamination of open fracture wounds.

NOTE: The recommendation above was changed from the original version so the rationale below does not completely align with this recommendation.

Please see Section 3:6, Question 2 for rationale for early wound closure. The rationale below regarding negative pressure wound therapy (NPWT) applies to Section 3:6, Question 4.

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QUESTION 3: Is there a difference in the risk of periprosthetic joint infection (PJI) with use of internal versus external fixation for treatment of periprosthetic fractures?

RECOMMENDATION: Unknown. There is limited evidence comparing the risk of PJI with use of internal versus external fixation to treat periprosthetic fracture. The potential for pin tract infection, particularly with inadvertently placed intra-articular pins, make internal fixation the preferable treatment option in most cases.

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QUESTION 4: Should definitive fixation of fracture in a polytrauma patient and open abdomen be delayed until the abdomen is closed?

RECOMMENDATION: Definitive fracture fixation in the presence of an open abdomen should not be delayed and could be performed safely if the patient is suitable to undergo surgery.

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質問 1：検者間再現性や結果の予測性において、近年汎用されている開放骨折の分類である Gustilo-Anderson 分類と Orthopaedic Trauma Association's open fracture 分類 (OTA-OFC) ではどちらが好ましいか？

著者：Andres Pinzon, Kenneth Egol 翻訳者：倉田慎平、河村健二

推奨：OTA-OFC が好ましい。最近のデータによると、OTA-OFC は検者間一致している明確な損傷程度の説明を、Gustilo-Anderson 分類と比較して同等もしくはそれ以上に提供している。さらに OTA-OFC は細分類されており、早期切断の可能性や補助治療の必要性などの結果を予測できるかもしれない。

エビデンスレベル：Limited

投票結果：賛成 95%、反対 0%、棄権 5%（満場一致、最も強いコンセンサス）

質問 2：どの診断基準が、整形外科外傷において SSI や骨折関連感染 (FRI) の診断基準を満たすか (創外固定治療を含めて)？

著者：Carl Haasper, Jaime A. Leal, Willem-Jan Metsemakers 翻訳者：倉田慎平、河村健二

推奨：2017 年に ICG により出版された診断基準が骨折関連感染を診断するために用いられるべきである。骨折から 4 週間以上経過している場合で、組織学的に強拡大像で 5 個以上の好中球を認めた場合は感染と診断する。

エビデンスレベル：Consensus

投票結果：賛成 85%、反対 5%、棄権 10%（大多数、強いコンセンサス）

質問 3：長管骨の感染性偽関節を定義する診断基準は何か？

著者：Arnold Suda, Willem-Jan Metsemakers 翻訳者：倉田慎平、河村健二

推奨：科学的根拠がないために単独で確かな証拠に基づく診断基準は開発されていない。骨折関連感染 (FRI) のコンセンサス定義を偽関節に組み合わせることは、理にかなったスタート地点であるが、偽関節の定義は変化するため、FRI の定義や長管骨偽関節の提案基準の科学的検証を要する。

エビデンスレベル：Moderate

投票結果：賛成 86%、反対 9%、棄権 5%（大多数、強いコンセンサス）

質問 4：骨髓炎が急性か慢性かをどのようにして区別するのか？ 区別することは臨床的に重要であるか？

著者：Peter Giannoudis, Costas Papakostidis 翻訳者：倉田慎平、河村健二

推奨：最近の文献では急性感染と慢性感染を区別するはっきりとした時期に関する整合性のある基準は認めない。急性感染と慢性感染を区別することは治療計画や最終的な予後において実用的な意義を持つかもしれない。

エビデンスレベル：Limited

投票結果：賛成 95%、反対 5%、棄権 0%（満場一致、最も強いコンセンサス）

質問 5：滑液や骨折による血腫は常に無菌であるか？ もしそうでなければ ORIF 後の急性感染や PJI おいて一役を担う可能性があるのか？

著者：Mitch Harris, Abhiram R. Bhashyam, Andre Shaffer 翻訳者：倉田慎平、河村健二

推奨：骨折後の血腫は常に無菌状態ではない。滑液が常に無菌かどうかはわからない。さらに、ORIF 後の急性感染や骨折関連感染 (FRI) にこれらが関与するかは不明である。

エビデンスレベル：Moderate

投票結果：賛成 95%、反対 5%、棄権 0%（満場一致、最も強いコンセンサス）

質問 6：開放骨折における陰圧閉鎖療法 (VAC) 下での金属インプラントと細菌のコロニー形成にはどのような関連性があるか？

著者：Pedro Caba, Mitchell R. Klement 翻訳者：倉田慎平、河村健二

推奨：露出した整形外科インプラントの上で陰圧閉鎖療法 (NPWT もしくは VAC) を用いることに関する報告はあるが、その役割はよく知られていない。さらに開放骨折における金属インプラントでの細菌のコロニー形成に対する NPWT の影響に関するエビデンスは存在しない。この質問に対するさらなる見識を得るためにはさらなる研究が必要である。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

QUESTION 1: Which open fracture classification system currently used (Gustilo-Anderson classification or the Orthopaedic Trauma Association's open fracture classification (OTA-OFC)) is preferred, based on interobserver reproducibility and predictiveness of outcomes?

RECOMMENDATION: OTA-OFC is preferred. Based on currently-available data, the OTA-OFC provides a more robust description of the injury with interobserver agreement that is comparable or superior to the Gustilo-Anderson classification. Additionally, the OTA-OFC, according to its subcategories, may predict outcomes such as the likelihood of early amputation and need for adjuvant treatments.

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QUESTION 2: What diagnostic criteria must be fulfilled to diagnose surgical site infection (SSI) or fracture related infection (FRI) in orthopaedic trauma (including external fixators)?

RECOMMENDATION: Diagnostic criteria proposed by the International Consensus Group on FRI (published in 2017) should be used to diagnose infection in fracture cases. In cases, more than four weeks from fracture, histological confirmation of > 5 neutrophils per high power field is confirmatory of infection.

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QUESTION 3: What diagnostic criteria define infected non-union of long bone?

RECOMMENDATION: The lack of scientific evidence precludes the development of diagnostic criteria that are solely based on sound evidence. The combination of the consensus definition of fracture-related infection (FRI) with a nonunion is a reasonable starting place, however definitions of nonunion vary and both the FRI definition and any proposed criteria for long bone nonunion will need scientific validation.

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QUESTION 4: What differentiates acute from chronic osteomyelitis (OM)? Is it clinically important to distinguish one from the other?

RECOMMENDATION: Current literature is lacking consistent criteria for a distinct time point that differentiates the acute and chronic forms of infection. Differentiating between acute and chronic types may have practical implications on treatment plan and final prognosis.

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QUESTION 5: Is synovial fluid or fracture hematoma always aseptic? If not, could this play a role in acute infection or periprosthetic joint infection (PJI) after open reduction and internal fixation (ORIF)?

RECOMMENDATION: Fracture hematoma is not always aseptic. It is unknown if synovial fluid is always aseptic. In addition, it is unclear if this plays a role in acute infection or fracture-related infection (FRI) after ORIF.

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QUESTION 6: What is the relationship between implanted metal and colonization under a vacuum-assisted closure (VAC) in open fractures?

RECOMMENDATION: The use of negative pressure wound therapy (NPWT or VAC) over exposed orthopaedic implants has been reported but its role remains unknown. Furthermore, no evidence exists regarding the effect of NPWT on the colonization of metal implants in open fractures. Further research is required to provide more insight into this question.

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3.1. 治療：抗菌薬と保存加療

質問1：長管骨の開放骨折に対する最適な抗菌薬およびその投与期間は？

著者：Willem-Jan Metsemakers, Charalampos Zalavras 翻訳者：本田賢二、河村健二

推奨：長管骨の開放骨折に対する抗菌薬投与は早期感染の予防に有効である。抗菌薬は受傷後できる限り早期に投与するべきである。ターゲットはグラム陽性菌とし、高エネルギーの開放骨折ではグラム陰性菌もカバーするべきである。抗菌薬投与は創閉鎖後72時間以上続けるべきではない。

エビデンスレベル：

- ・抗菌薬予防投与の有効性—Strong
- ・予防投与のタイミング—Moderate
- ・抗菌薬の選択—Limited
- ・投与期間—Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：低エネルギーの開放骨折に対してどの抗菌薬を使用すべきか？ 高エネルギーや汚染の強い開放骨折に対してはどの抗菌薬を使用すべきか？

著者：Rodrigo Pesantez, Cristina Suarez 翻訳者：本田賢二、河村健二

推奨：

1. 全ての開放骨折に対して、グラム陽性菌をターゲットとした抗菌薬はできる限り早期に投与するべきである。
2. 高エネルギー外傷および汚染の強い開放性骨折に対しては、グラム陰性菌もカバーする抗菌薬を追加するべきである。

エビデンスレベル：1. Strong ; 2. Limited

投票結果：賛成 95%、反対 0%、棄権 5%（満場一致、最も強いコンセンサス）

質問3：汚染創あるいは感染創に対する局所抗菌薬の最適な投与法は何か？

著者：Willem-Jan Metsemakers, Mario Morgenstern 翻訳者：本田賢二、河村健二

推奨：汚染創あるいは感染創に対して局所抗菌薬投与を支持する中等度のエビデンスがある。知見を深めるためには今後のデータ収集が重要である。

エビデンスレベル：Moderate

投票結果：賛成 75%、反対 15%、棄権 10%（大多数、強いコンセンサス）

質問4：汚染創を伴う開放骨折の治療において抗菌薬の局所投与と全身投与を併用する意義はあるのか？

著者：Warren Haggard, Arvind Nana 翻訳者：本田賢二、河村健二

推奨：汚染創を伴う開放骨折に対して抗菌薬の局所投与と全身投与の併用は有効である。

エビデンスレベル：Moderate

投票結果：賛成 87%、反対 4%、棄権 9%（大多数、強いコンセンサス）

質問5：慢性骨髓炎に最適な抗菌薬治療は何か？

著者：Stephen Kates, Edward Hendershot 翻訳者：本田賢二、河村健二

推奨：可能であれば、抗菌薬の選択は培養結果に基づいて行われるべきである。12-16週の長期投与が、4-6週の短期投与と比較して有効であるという明確なエビデンスはない。さらに静脈投与が経口投与より優れているとするエビデンスも明らかではない。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 4%、棄権 0%（満場一致、最も強いコンセンサス）

質問6：内固定後にインプラント抜去が不可能な時期に慢性骨髓炎を発症した場合に推奨される感染制御治療は？

著者：Michael Patzakis, Kevin Tetsworth, Mauro Jose Costa Salles, Rajendra Shetty 翻訳者：本田賢二、河村健二

推奨：インプラント抜去による最終的な感染治療の前に、培養結果に基づいた抗菌薬治療を骨折の治療を促すことを目的に行う。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問7：慢性骨髓炎やインプラント周囲感染に対する高圧酸素療法(HBOT)やその他の抗菌薬以外の治療法の意義は？

著者：Leonard Marais 翻訳者：本田賢二、河村健二

推奨：外傷後の骨感染の治療において、高圧酸素（HBO）が有効であるエビデンスは限定的である。

エビデンスレベル：Limited

投票結果：賛成 86%、反対 5%、棄権 9%（大多数、強いコンセンサス）

3.2. 治療：術者とチーム医療

質問1：すべての感染性偽関節を感染症専門センターで治療すべきか？

著者：Konstantinos Malizos, Georgios Komnos 翻訳者：小西浩允、河村健二

推奨：症例報告や観察研究が多いが、最近の文献では、「感染症専門手術センター」が感染性偽関節を治療するべきであるとは支持していない。しかし、感染性偽関節は治療が複雑であり、専門施設での治療は最良の結果をもたらすかもしれない。

エビデンスレベル：Limited

投票結果：賛成 70%、反対 21%、棄権 9%（大多数、弱いコンセンサス）

質問2：術者が良好な結果を出すために経験すべき1年あたりの複雑な骨髓炎症例の最小値はあるか？

著者：Vicky Gutierrez, Gerard Chang 翻訳者：小西浩允、河村健二

推奨：術者が良好な結果を出すために経験すべき1年あたりの複雑な骨髓炎症例の最小値を明記した文献はない。多くの紹介を受ける施設、優秀な施設、複雑な骨髓炎の治療のための多分野のチームによる治療は結果の改善につながる可能性がある。

エビデンスレベル：Consensus

投票結果：賛成 76%、反対 14%、棄権 10%（大多数、強いコンセンサス）

質問3：感染した骨折や偽関節を治療するための多分野チームにおいて不可欠なメンバーは誰か？

著者：Willem-Jan Metsemakers, Jaime A. Leal 翻訳者：小西浩允、河村健二

推奨：感染した骨折や偽関節を治療する多分野チームにおける不可欠なメンバーには、骨再建、軟部組織再建、微生物学、抗菌薬治療、および高度な画像検査に関する専門知識が要求される。グループのメンバーおよび必要とされる他の専門家は、最終的に患者のニーズおよび地域特性に依存することに注意しなければならない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

3.3. 治療：リスク因子

質問1：人工関節周囲骨折における同種輸血(ABT)の必要性の予測因子は何か？

著者：Paddy Kenny, Giedrius Kvederas, John Gibbons 翻訳者：小西浩允、河村健二

推奨：同種輸血の予測因子は、人工関節再置換術、術前貧血、高齢者、高い合併症指数、低いBMI、女性、長時間手術、股関節の手術である。

エビデンスレベル：Limited

投票結果：賛成 95%、反対 5%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：急性大腿骨頸部骨折は、THAを受ける患者における感染の危険因子であるか？

著者：Arjun Saxena 翻訳者：小西浩允、河村健二

推奨：原発性変形性関節症に対するTHAと比較して、急性大腿骨頸部骨折に対するTHAは、感染の発生率が高いようである。報告されている感染率には大きな差があるため、PJIの真の発生率を決定するためには、このような患者群に対する前向き研究を実施するべきである。

エビデンスレベル：Limited

投票結果：賛成 96%、反対 4%、棄権 0%（満場一致、最も強いコンセンサス）

3.4. 治療：術式関連

質問1：開放骨折に対してデブリドマンを行うべきタイミングは？

著者：Pedro Caba 翻訳者：河村健二

推奨：開放骨折に対して受傷からデブリドマンを行うまでの至適時間を明確に定めることは困難である。抗菌薬の予防投与と適切なデブリドマンの方が、デブリドマンを行うまでの時間よりも重要である。しかし、患者と手術室の状況が整えば出来るだけ早急にデブリドマンを行うことを推奨する。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：救急診療室(ED)での開放骨折に対して推奨される洗浄液の量は？

著者：Yousef Abuodeh, Sofiene Kallel, Gerard Chang, Osama Aldahamsheh 翻訳者：河村健二

推奨：開放骨折に対してはEDにおいて肉眼的に確認できる汚染はすべて十分な洗浄液で取り除くべきである。

エビデンスレベル：Consensus

投票結果：賛成 75%、反対 15%、棄権 10%（大多数、強いコンセンサス）

質問3：開放骨折や開放創に対して手術室で使用する洗浄液の量と構成の推奨は？

著者：Brianna Fram, Paul Tornetta III, Roman Natoli 翻訳者：河村健二

推奨：開放骨折に対する洗浄は生理食塩水により重力フローで行うべきであり、3～9Lが適切な使用量である。クロルヘキシジンまたはポビドンヨードのような薬品を含む殺菌洗浄の有効性は、整形外傷患者においては十分に研究されておらず、基礎研究においては殺菌洗浄による組織損傷が懸念されている。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：安定した骨折内固定後の早期感染(完全な創治癒が得られる前)に対する最も適切な治療は何か？

著者：Janet Conway, Mario Morgenstern, Hamed Vahedi 翻訳者：河村健二

推奨：外傷患者の術後早期感染に対して最も受け入れられている治療戦略は、安定したインプラントは留置した状態で適切な洗浄とデブリドマンを行い、抗菌薬静脈内投与を行った後に抗菌薬内服加療を行うことである。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問5：不安定な骨折内固定後の早期感染(完全な創治癒が得られる前)に対する最も適切な治療は何か？

著者：Rodrigo Pesantez, Maria Piedad Bautista, Charalampos Zalavras 翻訳者：河村健二

推奨：不安定な骨折内固定後の早期感染（完全な創治癒が得られる前）に対して最も適切な治療は、インプラント抜去とデブリドマン、骨折の安定化、抗菌薬治療、必要であれば軟部組織の被覆を行うことである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問6：創外固定から内固定へ変更する適切な時期は？ 刺入部感染によってその時期は変わるか？

著者：Pedro Caba 翻訳者：中野健一、河村健二

推奨：外傷の特性や受傷部位だけではなく、合併損傷や受傷前の健康状態や機能など、患者の状態によって変更の時期を決定すべきである。1回での変更は、2回に分けた変更と比較して感染率は同等かより低い。刺入部感染がなければ、より早期の変更が望ましい。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問7：感染性偽関節に対する分節骨切除に代わる治療法は何か？

著者：Arnold Suda, Stephen Quinnan, Brendan Gleason 翻訳者：中野健一、河村健二

推奨：分節骨切除に代わる手術法は、骨移植、病変部の開放、皮質骨除去、仮骨延長、髄腔リーミングである。すべての壊死骨と壊死組織は除去されなければならない。

エビデンスレベル：Limited

投票結果：賛成 91%、反対 0%、棄権 9%（大多数、強いコンセンサス）

質問8：異なる長管骨(脛骨、大腿骨、上腕骨など)で、感染後の骨欠損に対する最適な治療法(Masquelet法、bone transport)は何か？ 骨欠損のタイプ(円錐状 vs. 円柱状)により治療法は変わるか？

著者：Janet Conway, Stephen Quinnan 翻訳者：中野健一、河村健二

推奨：骨欠損のタイプ(円錐状 vs. 円柱状)によって治療方法が決まることはない。その代わり、部分欠損か完全分節欠損かによって治療法が異なる。いずれの長管骨においても安定化が望まれる。

エビデンスレベル：Moderate

投票結果：賛成 95%、反対 0%、棄権 5% (満場一致、最も強いコンセンサス)

質問9：感染性偽関節に対する段階的治療において、骨移植までの適切な待機期間は？

著者：Kevin Tetsworth, Peter Giannoudis, Rajendra Shetty, G. Kleftouris 翻訳者：中野健一、河村健二

推奨：第1段階と第2段階の間隔は、一定の期間というよりは患者の感染コントロールおよび局所の軟部組織の状態によって決まる。そのため、正確な期間は不明である。状態が良ければ第1段階から6～8週の間隔をあけて第2段階の手術を行うことが推奨される。この推奨はMasquelet法には適用されない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

3.5. 治療：インプラント管理

質問1：外傷手術でのSSIに対してインプラントを抜去するタイミングは？

著者：J. Tracy Watson 翻訳者：長谷川英雄、河村健二

推奨：臨床経過によって抜去のタイミングを決定すべきで、感染の範囲とインプラントの安定性を考慮する必要がある。病原体、宿主因子、軟部組織欠損、骨欠損に対して系統的なアプローチが要求され、徹底的なデブリドマン、死腔の処理、確立された再建のはじごの原則に従った軟部組織再建および骨再建を施行しなければならない。

エビデンスレベル：Moderate

投票結果：賛成 95%、反対 0%、棄権 5% (満場一致、最も強いコンセンサス)

質問2：脛骨開放骨折にはプレート、髄内釘、創外固定のどれを使用すれば感染率が低いか？

著者：Nando Ferreira, Arvind Nana, Michael T. Archdeacon 翻訳者：長谷川英雄、河村健二

推奨：Gustilo type I と II に対しては、創外固定と髄内釘固定で感染率に差は無い。Gustilo type III A および III B に対しては、創外固定が他の方法と比べて最も感染率が低い。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

質問3：髄内釘固定でリーミングの有無は感染率と関係があるか？

著者：Mark F. Swiontkowski, Alexander J. Shope 翻訳者：長谷川英雄、河村健二

推奨：現在のエビデンスでは長管骨骨折に対するリーミングの有無で感染率に差はない。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

質問4：抗菌コーティングロッドと抗菌コーティングプレートは従来の抗菌薬含有セメントの代替手段となるか？

著者：Volker Alt, J. Tracy Watson 翻訳者：長谷川英雄、河村健二

推奨：抗菌薬含有ポリメタクリル酸メチル樹脂スパーサーは骨髄炎やインプラント感染で確立された治療法といえる。感染性偽関節に対して抗菌作用と固定性を加えて骨癒合を目指す場合にのみ、抗菌コーティングロッドと抗菌コーティングプレートが推奨される。

エビデンスレベル：Limited

投票結果：賛成 91%、反対 5%、棄権 4% (大多数、強いコンセンサス)

質問5：抗菌薬含有髓内釘の理想的な構成は？

著者：Jorge Manrique, Francisco Reyes, Mustafa Citak, Carl Haasper, Charalampos Zalavras, Eduardo M. Suero, Gerson Amaris

翻訳者：長谷川英雄、河村健二

推奨：抗菌薬含有髓内釘の理想的な構成はよく知られていない。エンダー釘、イリザロフ創外固定器、インターロッキング髓内釘、カーボンファイバーネイルなどの強固な構造物で構成されるべきである。ポリメタクリル酸メチルセメント 40g に対して最低 2g のバンコマイシンと 2.4g のアミノグリコシドを付加することを推奨する。ただし、原因菌が判明している場合は、原因菌をターゲットとした抗菌薬も含むべきである。

エビデンスレベル：Consensus

投票結果：賛成 86%、反対 9%、棄権 5%（大多数、強いコンセンサス）

質問6：外傷後の感染巣に挿入する理想的な抗菌薬含有セメントビーズの理想的な構成は？ 術前の原因菌同定は必要か？

著者：Leonard Marais 翻訳者：長谷川英雄、河村健二

推奨：外傷後の感染巣への理想的な抗菌薬含有ポリメタクリル酸メチル（PMMA）ビーズの構成と術前の原因菌同定の必要性に関するエビデンスは限定的である。経験的に 40g の PMMA に対して最低 2g のバンコマイシンを付加（ゲンタマイシン有り、または無し）することで効率に感染を鎮静化し骨癒合を促進するというデータがある。術前の原因菌の同定が有効とするエビデンスはない。

エビデンスレベル：Limited

投票結果：賛成 95%、反対 0%、棄権 5%（満場一致、最も強いコンセンサス）

質問7：抗菌薬含有セメントロッドは永久に留置すべきか？

著者：Volker Alt 翻訳者：長谷川英雄、河村健二

推奨：感染制御のために一時的に挿入されただけの抗菌薬含有セメントロッドは抜去して強固な内固定材（ロッキング髓内釘など）に置き換えられるべきである。もし抗菌薬含有セメントロッドが抗菌薬の局所投与だけでなく、偽関節部に固定性を有している場合には留置したままにすることも可能である。

エビデンスレベル：Limited

投票結果：賛成 70%、反対 30%、棄権 0%（大多数、弱いコンセンサス）

3.6. 治療：創被覆

質問1：脛骨開放骨折に対する皮弁移植に関して、皮弁のタイプでいずれかが優れていることを支持するエビデンスはあるか(例えば、筋膜皮弁より筋弁が優れているなど)？

著者：Konstantinos Malizos, Martin McNally, Efstratios Athanasis, James Chan 翻訳者：前川尚宜、河村健二

推奨：脛骨開放骨折に対してどのタイプの皮弁を用いても、皮弁生着、骨癒合、疲労骨折、感染、慢性骨髄炎、ドナー障害に関して本質的に同等の結果である。局所皮弁は、利用可能な場合であっても低エネルギーの外傷で考慮されるべきである。皮弁の種類は、軟部組織欠損の大きさ、深達度ならびに骨折の位置に基づいて選択されなければならない。高エネルギー外傷に伴う脛骨骨折に対しては、筋弁移植は失敗と再手術率が少ない信頼性の高い再建法かもしれない。

エビデンスレベル：Moderate

投票結果：賛成 95%、反対 5%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：軟部組織欠損を伴う開放骨折に対する皮弁による被覆の最適な時期はいつか？

著者：David Lowenberg 翻訳者：前川尚宜、河村健二

推奨：皮弁による被覆の最適な時期は、創傷が適切に浄化され、“生きている創”になったと判断される時期に最終的に影響される。患者および創傷が適切である場合、理想的には 3～7 日以内の早期の皮弁での被覆が望ましい。

エビデンスレベル：Strong

投票結果：賛成 95%、反対 5%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：開放骨折の創を一次的に閉鎖するべきか、それとも二次的に閉鎖するべきか？ 一次的閉鎖する場合は、どのようなものに対して何の基準で行うのか？

著者：Nathan O'Hara, David Lowenberg, Robert O'Toole 翻訳者：前川尚宜、河村健二

推奨：デブリドマン技術の向上、骨折安定化法の改良、および早期に抗菌薬全身投与が行なえる現在では、多くの開放性骨折の一次的閉鎖は安全で有用な治療戦略である。重症度の低い開放骨折と重症度の高い開放骨折の一部は、臨床的に創傷が一次的閉鎖に適していると思われる場合は安全であると言える。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 4：開放骨折や創傷に対する陰圧閉鎖療法 (NPWT) の使用に関してエビデンスに基づいた推奨は何か？

著者：Daniel R. Schlatterer, Martin McNally, Gerard Chang, James K.K. Chan 翻訳者：前川尚宜、河村健二

推奨：NPWT は開放骨折に伴う複雑な創傷に対して最終的な軟部組織の閉鎖前に、短期管理（7 日以内）に適した創被覆材である。NPWT は他の密封被覆材より優れているわけではなく、初期費用が高くなる。

エビデンスレベル：Moderate

投票結果：賛成 86%、反対 9%、棄権 5%（大多数、強いコンセンサス）

追記：Section 1.2 の質問 2（予防：リスクの軽減、NPWT に関する理論根拠）を参照。

3.7. 治療：結果

質問 1：早期骨折固定後感染 (IAFF) 治療に最適なアウトカムの指標 (臨床、放射線、採血検査など) は何か？

著者：Mustafa Citak, Carl Haasper, Kenneth Egol, William T. Obrebskey, Hussein Abdelazia, Philip Linke 翻訳者：前川尚宜、河村健二

推奨：IAFF に対する治療をモニターする方法としては、骨折治癒および感染制御が最適なアウトカム指標であると思われる。骨折固定後感染の治療は、患者の臨床像と ESR や CRP などの臨床検査との組み合わせで最も良く評価される。

エビデンスレベル：Consensus

投票結果：賛成 70%、反対 10%、棄権 20%（大多数、弱いコンセンサス）

3.1. TREATMENT: ANTIBIOTICS AND NONOPERATIVE MANAGEMENT

QUESTION 1: What is the most optimal prophylactic antibiotic coverage and treatment duration for open fractures of long bones?

RECOMMENDATION: The use of prophylactic antibiotics for open fractures of long bones has a protective effect against early infection. Antibiotics should be administered as soon as possible after the injury. The antibiotic of choice should target gram-positive organisms. Additional coverage for gram-negative organisms should be considered for patients with high-energy open fractures. Antibiotics should not be continued for more than 72 hours after wound closure.

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QUESTION 2: What antibiotic(s) should be used for low-energy open fractures? What antibiotic(s) should be used for high-energy open and grossly-contaminated fractures?

RECOMMENDATION:

- Antibiotic treatment targeting gram-positive organisms is recommended as soon as possible for all open fractures; low- and high-energy.
- In high-energy or grossly-contaminated open fractures, additional antibiotics should be considered for gram-negative coverage.

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QUESTION 3: What is the optimal mechanism for delivery of local antibiotics in contaminated or infected wounds?

RECOMMENDATION: There is moderate evidence to support the use of local antibiotic delivery in contaminated or infected wounds. Future data collection seems important to improve our knowledge on this topic.

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QUESTION 4: Is there a role for a combination of local and systemic antibiotic delivery systems to treat open fractures with overlying contaminated wounds?

RECOMMENDATION: The administration of systemic antibiotic and a local antibiotic delivery device (system) is an effective treatment strategy for open bone fractures with contaminated wounds.

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QUESTION 5: What is the most optimal antibiotic treatment for chronic osteomyelitis?

RECOMMENDATION: Antibiotic selection should be culture-specific, if possible. No clear evidence exists to suggest that longer duration of therapy (12 to 16 weeks) is superior to shorter duration (4 to 6 weeks). In addition, there is no evidence to support the proposition that intravenous (IV) antibiotic treatment is superior to oral treatment.

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QUESTION 6: What is the recommended suppressive antibiotic therapy for the treatment of chronic osteomyelitis after fracture fixation when the implant cannot be removed?

RECOMMENDATION: Suppressive therapy with culture-specific antibiotics is aimed at allowing fracture healing prior to implant removal and definitive infection management.

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QUESTION 7: Is there a role for hyperbaric oxygen therapy (HBOT) and other non-antibiotic methods for the treatment of chronic osteomyelitis/implant infections?

RECOMMENDATION: There is limited evidence for the efficacy of hyperbaric oxygen (HBO) in the treatment of post-traumatic bone infections.

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3.2. TREATMENT: SURGEON AND CARE TEAM

QUESTION 1: Should all infected non-unions be treated in specialized septic centers?

RECOMMENDATION: The current literature, although rich in case series and observational studies, does not lend support to the recommendation that “specialized septic surgery centers” should care for infected non-unions. However, because of the complexities of infected non-unions, care in specialized centers may yield the best possible outcome.

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QUESTION 2: Is there a minimum number of complex osteomyelitis procedures a surgeon should perform annually to ensure proper outcomes?

RECOMMENDATION: There is no literature supporting a minimum number of complex osteomyelitis procedures a surgeon should perform annually to ensure proper outcomes. Higher-volume referral centers, centers of excellence and multidisciplinary teams for the treatment of complex osteomyelitis may result in improved outcomes.

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QUESTION 3: Who are the essential members of the multidisciplinary team required to manage infected fractures and non-unions?

RECOMMENDATION: The essential members of the multidisciplinary team managing infected fractures and non-unions require expertise in bone reconstruction, soft tissue reconstruction, microbiology, antibiotic treatment and advanced imaging. It is important to note that the exact members of the group and other specialists required will eventually depend on patient needs and local preferences.

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3.3. TREATMENT: RISK FACTORS

QUESTION 1: What are predictors of the need for allogeneic blood transfusion (ABT) in periprosthetic fractures?

RECOMMENDATION: Predicting factors for allogeneic blood transfusion are: revision arthroplasty, preoperative anemia, increasing age, higher comorbidity index, lower Body Mass Index (BMI), female gender, longer surgical time and hip surgery.

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QUESTION 2: Is acute femoral neck fracture a risk factor for infection in patients undergoing hip arthroplasty?

RECOMMENDATION: There appears to be a higher incidence of infection in patients undergoing arthroplasty for acute femoral neck fracture compared to hip arthroplasty for primary osteoarthritis. The reported rate of infection has a wide range; prospective studies should be performed to determine the true rate of periprosthetic joint infection (PJI) in this subset of patients.

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3.4. TREATMENT: PROCEDURE-RELATED

QUESTION 1: What is the optimal timing of surgical debridement in open fractures?

RECOMMENDATION: It is not possible to establish a clear cut-off for optimal timing of open fracture surgical debridement after injury. Administration of antibiotic prophylaxis and adequacy of debridement is more important than time to debridement. However, we recommend debridement as soon as the patient and operative conditions are optimal.

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QUESTION 2: What is the recommended volume of irrigating fluid in the emergency department (ED) for open fractures?

RECOMMENDATION: In the ED setting, open fractures should be irrigated sufficiently to remove all visible contamination and debris prior to applying dressings.

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QUESTION 3: What is the recommended volume and composition of irrigating fluid in the operating room for open fractures and post-traumatic wounds?

RECOMMENDATION: Irrigation in open fractures should be performed with normal saline and gravity flow irrigation. 3-9L is a reasonable volume to use. Bactericidal washes with agents like chlorhexidine or povidone-iodine have not been adequately studied in orthopaedic trauma patients, but basic science studies raise concern that they may damage tissues.

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QUESTION 4: What is the most appropriate management of early (prior to complete wound healing) infection after fracture fixation with stable fixation?

RECOMMENDATION: The most acceptable treatment strategy for trauma patients with early postoperative infection is to perform proper irrigation and debridement, administer intravenous (IV) followed by oral antibiotic therapy and retain stable hardware in place.

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QUESTION 5: What is the most appropriate management of early (before complete wound healing) infection after fracture fixation with unstable fixation?

RECOMMENDATION: The most appropriate management of early (prior to complete healing) infection after fracture fixation with unstable fixation consists of surgical debridement with removal of fixation implants, fracture stabilization, antibiotic therapy and soft tissue coverage, if needed.

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QUESTION 6: What is the appropriate timing of conversion to internal fixation (in-fix) following external fixation (ex-fix)? How is this altered by pin site infection?

RECOMMENDATION: Timing of conversion should be based on patient characteristics including concurrent injuries and premorbid health and function, as well as injury features and location. One-stage conversion appears to have similar or even lower infection rates compared to two-stage conversion. In the absence of pin site infection, early conversion is preferred.

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QUESTION 7: What are the alternatives to segmental resection in septic non-union?

RECOMMENDATION: Surgical alternatives to segmental resection include bone grafting, unroofing, decortication, distraction osteogenesis or intramedullary reaming to address the site of osteomyelitis. All dead bone and soft tissue should be removed.

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QUESTION 8: What is the optimal management (Masquelet technique, bone transport) of postinfective bone defects in different long bones (tibia, femur, humerus, etc.)? How does this vary by type of defect (conical vs. cylindrical)?

RECOMMENDATION: The type of defect (cylindrical vs. conical) was not determined to be relevant to the treatment method. Instead, optimal management of partial vs. full segmental defects is relevant. Each long bone requires different preferred methods of stabilization.

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QUESTION 9: What is the optimum waiting time for bone grafting in staged management of septic nonunion?

RECOMMENDATION: The interval between the first and second stages should be dependent upon infection control and the status of the local soft tissue of the individual patient, rather than any specific time. Therefore, the precise time is unknown. The current recommendations are that if conditions are favorable, the second stage can be performed between 6 and 12 weeks after the first stage. This recommendation may not apply to the Masquelet technique.

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3.5. TREATMENT: MANAGEMENT OF HARDWARE

QUESTION 1: When should hardware be removed when treating surgical site infection (SSI) in orthopaedic trauma?

RECOMMENDATION: The decision to retain or remove hardware differs by clinical scenario and must take into account extent of the infection and stability of the hardware and fracture.

A methodical approach that addresses the pathogen, host factors and bony and soft tissue deficiencies is required, and includes thorough debridement, dead-space management and soft tissue and bony reconstruction using the established principles of the reconstruction ladder.

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QUESTION 2: Which surgical treatment (plate, nail or external fixator) for open tibial shaft fractures results in lower rate of infection?

RECOMMENDATION: There is little to no difference in terms of infection rates for Gustilo-Anderson types I–II treated by either circular external fixator, unreamed intramedullary nail or reamed intramedullary nail. For Gustilo-Anderson IIIA–B fractures, circular external fixation appears to provide the lowest infection rates when compared to all other fixation methods.

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QUESTION 3: When performing intramedullary (IM) fixation, what is the evidence regarding reaming versus non-reaming and the association with infection?

RECOMMENDATION: Based on the current evidence, there is no difference in infection rates following IM fixation of long bone fractures using a reamed or non-reamed technique.

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QUESTION 4: Are antibiotic coated rods (ACRs) and antibiotic coated plates (ACPs) an acceptable alternative to cement only implants?

RECOMMENDATION: Antibiotic-loaded polymethyl methacrylate (AL-PMMA) spacers can be considered an established treatment concept for local antibiotic delivery in osteomyelitis and implant-associated infections. ACRs and ACPs can also be of value in specific indications, mainly infected non-unions, in order to address both local delivery of antibiotics and biomechanically stable fixation of the non-union site to allow for possible spontaneous bone consolidation.

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QUESTION 5: What is the ideal composition of antibiotic-impregnated intramedullary (IM) nails?

RECOMMENDATION: The ideal composition of antibiotic-impregnated IM nails is unknown. The core should consist of a rigid structure such as an Ender's IM nail, Ilizarov threaded rods, IM locked nails, carbon fiber nails or sectioned pins or guidewires. We recommend at least 2 grams of vancomycin and 2.4 grams of an aminoglycoside be added to each pack (40 grams) of polymethyl methacrylate cement. If a specific microorganism is isolated, targeted antibiotic therapy should be included.

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QUESTION 6: What is the ideal composition of antibiotic impregnated (ABI) spacers beads in post-traumatic infections? Is preoperative microbial identification necessary?

RECOMMENDATION: There is currently limited evidence with regards to the ideal composition of ABI polymethyl methacrylate (PMMA) spacer beads in post-traumatic infections and the need for preoperative identification of the causative organism. Available data suggests that PMMA spacers, empirically impregnated with at least 2 gm of vancomycin per 40 mg of PMMA (with or without gentamycin), may result in quiescence of infection in a high percentage of cases with an acceptable associated rate of bony union. Preoperative microbial identification is of unclear utility.

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QUESTION 7: Should antibiotic cement rods (ACRs) be left permanently in situ?

RECOMMENDATION: If the ACR is used as a temporary non-locked implant for infection control, it should be removed and replaced by a biomechanically stable construct (e.g., locked intramedullary nail). If the ACR is used as a locked implant for both local delivery of antibiotics and provision of stable biomechanical conditions for consolidation of the non-union site, it can be left in place.

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3.6. TREATMENT: WOUND COVERAGE

QUESTION 1: Is there evidence to support one type of flap coverage over another (e.g., muscle over fasciocutaneous flap) after open tibial fractures?

RECOMMENDATION: Different types of flap coverage after open tibial fractures have essentially equivalent and comparable outcomes in terms, of flap survival, bone healing, stress fracture, infection, chronic osteomyelitis and donor site morbidity. Local flaps should be considered in low energy trauma, when available. The type of flap should be tailored based on the extent and the depth of the soft tissue defect and the location of the fracture. In high energy fractures of the tibia, muscle flaps may offer a more reliable reconstruction with fewer flap failures and fewer reoperation rates.

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QUESTION 2: What is the appropriate timing for flap coverage of open fractures and traumatic wound defects?

RECOMMENDATION: The optimal time for wound coverage ultimately reflects when the wound has been appropriately cleaned and converted to a “living wound.” Early flap coverage is preferred, ideally within 3-7 days, when patient and wound are suitable.

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QUESTION 3: Should open fracture wounds be closed primarily or closed secondarily? If closed primarily, which ones and under what criteria?

RECOMMENDATION: Yes. Primary wound closure of many open fracture wounds appears to be a safe and likely beneficial strategy in the modern setting of improved debridement techniques, better methods of fracture stabilization, and improved utilization of early systemic antibiotic administration. It appears safe for lower grade open fractures and a subset of higher-grade open fractures when the wound is deemed appropriate for primary closure on a clinical basis.

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QUESTION 4: What are the evidence-based recommendations for the use of negative pressure wound therapy (NPWT) in open fractures and traumatic wounds?

RECOMMENDATION: NPWT is an appropriate dressing in the short-term management (< 7 days) of complex traumatic wounds over open fractures, prior to definite soft tissue closure. NPWT is not superior to other sealed dressings and has increased initial cost.

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3.7. TREATMENT: OUTCOMES

QUESTION 1: What is the most appropriate outcome measurement (clinical, radiographic, laboratory, etc.) for management of early infection after fracture fixation (IAFF)?

RECOMMENDATION: Fracture healing and infection control seem to be the most appropriate outcome measure to monitor the response to management of early IAFF. Secondly, treatment success following infection management after fracture fixation is best assessed using a combination of the patient's clinical picture and laboratory examinations such as tissue cultures, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP).

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PART VI

FOOT AND ANKLE

SECTION 1: PREVENTION

- 1.1. 人工足関節置換術
- 1.2. 非人工足関節置換術

SECTION 2: DIAGNOSIS

- 2.1. 人工足関節置換術
- 2.2. 非人工足関節置換術

SECTION 3: TREATMENT

- 3.1. 人工足関節置換術
- 3.2. 非人工足関節置換術

〈監訳者〉

田中康仁、谷口晃

1.1. 予防：人工足関節置換術（TAA）

質問1：TAA後に感染を起こす患者の重要なリスク因子は何か？

著者：Eric Senneville, Amiethab Ayier, Niall Smyth 翻訳者：森田成紀、田中康仁

推奨：以下のリスク因子には、TAA後に感染を誘発するであろうエビデンスがある：

炎症性関節炎、足関節への手術既往、BMI < 19、末梢血管疾患

一方、以下のリスク因子も意見の相違はあるもののTAA後に感染を誘発する可能性があるというエビデンスがある：

肥満（BMI > 30）、喫煙、糖尿病、手術時間、年齢が65歳未満、甲状腺機能低下症、術前AOFAS足関節・後足部スコア低値、慢性肺疾患

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：コルチコステロイドの足関節内注射は、TAA後のPJIのリスクを増加させるか？

著者：Ilker Uçkay, Christopher Hirose, Mathieu Assal 翻訳者：森田成紀、田中康仁

推奨：全ての足関節腔内注射は、TAA後のPJIを含む感染と潜在的に関連する侵襲的な処置である。限られた文献からでは症候性の足関節に対してコルチコステロイド注射を行った後にTAAを行う理想的なタイミングについては不明である。コンセンサスワーキンググループでは、TAAを行う少なくとも3か月以上前に、コルチコステロイド注射を終了することを推奨している。

エビデンスレベル：Limited

投票結果：賛成 92%、反対 8%、棄権 0%（大多数、強いコンセンサス）

質問3：TAAを行う前に、ルーティンでMRSAのスクリーニングを行うべきか？

著者：Jonathan Kaplan, Gaston Slullitel, Valeria Lopez 翻訳者：森田成紀、田中康仁

推奨：TAA前にMRSAのスクリーニングや除菌を行う意義は不明である。これらを支持するには、さらなるデータが必要であるが、コスト的にも論理的にもデータ収集は困難であろう。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：TAAを行う患者におけるSSIもしくはPJIのリスクを減らすために、どういった術前の最適化をおこなうべきか？

著者：Khaled Emara, Christopher Hirose, Ryan Rogero 翻訳者：森田成紀、田中康仁

推奨：TAAの待機患者に対しては、術前の皮膚洗浄、栄養状態の改善、血糖コントロール、BMIの最適化、禁煙、免疫系の併存疾患のコントロールによって、術前の最適化を行うことを推奨する。手術時には、アルコール含有薬剤により術野の最適な準備を行い、適切なタイミングで体重に基づく量の抗菌薬予防投与、手術室での混雑軽減が行われるべきであるという、強いエビデンスがある。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問5：TAAを受ける患者の周術期にはどういった抗菌薬（種類、量、経路）を投与すべきか？

著者：Marisa Sanchez, Cecilia Losada 翻訳者：森田成紀、田中康仁

推奨：TAA術前に抗菌薬予防投与を行うことで、SSIやPJIのイベントを減らせる可能性がある。術前60分前に体重に応じたセファゾリン（少なくとも2g）を経静脈的に投与することは、予防投与として良いと思われる。

もし患者がベータラクタム系抗菌薬に対してアレルギーを持つ場合には、ブドウ球菌に感受性のある適切な代替薬を投与することが勧められる。抗菌薬予防投与を、1回だけ行うか複数回行うべきかは明確でない。

エビデンスレベル：Strong

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問6：感染性関節炎の既往がある患者が、TAAを受ける場合に理想的な対処法は何か？

著者：Brian Winters, Ferdinando Da Rin de Lorenzo, Jake O'Neil 翻訳者：森田成紀、田中康仁

推奨：細菌性関節炎、骨髄炎ならびに周囲軟部組織感染など、感染形態は何であっても、足関節に感染の既往がある患者に対してTAAを行うことに関するデータは不足している。患側の足関節に感染の既往がある患者に対しては、既往歴や身体所見はもちろんのこと、血液検査や関節穿刺実施など、感染に対して十分備えなければならない。感染の既往を持つ患者へのTAAでは、セメント（使用する場合）内への抗菌薬混入や徹底的な関節洗浄を行うべきである。骨や軟部組織の術中培養も行うべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 7：TAAのためのドレーピングにおいて、足はカバーすべきか？ もしくは術野に出してもよいか？

著者：Jonathan Kaplan, John M. Embil 翻訳者：森田成紀、田中康仁

推奨：TAA の間、足趾をカバーする長所・短所について述べられている十分なデータがない。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 8：初回の TAA において、抗菌薬含有セメントを使用すべきか？

著者：Jens Richter 翻訳者：森田成紀、田中康仁

推奨：わからない。初回の TAA において、抗菌薬含有セメントをルーティンで使用する事へのエビデンスは十分でない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

1.2. 予防：非人工足関節置換術

質問 1：TAA や他の足外科領域の手術において、創部にバンコマイシンパウダーを使用する利点とリスクは何か？

著者：Gaston Slullitel, Yasuhito Tanaka, Ryan Rogero, Valeria Lopez, Eiichiro Iwata, Yusuke Yamamoto 翻訳者：森田成紀、田中康仁

推奨：糖尿病患者における足外科領域の手術において、バンコマイシンの局所投与が深部感染率を減らせることを示した研究が一つあるが、そうでない一般の人に対する TAA や他の足外科領域の処置に対して、バンコマイシンの粉末を使用することで得られる利点とリスクを示すことができる十分なエビデンスがない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：TAA や他の足外科領域の手術において、希薄ポビドンヨード(ベタジン)洗浄液や他の殺菌洗浄液を使用する意味はあるか？

著者：Kristin Englund, Nima Heidari 翻訳者：森田成紀、田中康仁

推奨：TAA に対して、ベタジン使用を勧めるエビデンスは不十分である。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：足外科領域の手術の前に血行再建を行うことで、SSI の発生は減少するか？

著者：Nima Heidari, Alexander Charalambous, Iris Kwok, Alexandros Vris, Yueyang Li 翻訳者：森田成紀、田中康仁

推奨：創傷治癒や SSI に対する末梢血管疾患（PVD）の関与を述べた研究はいくつか存在する。しかし外傷もしくは待機的な足外科領域の手術前に、SSI 予防として血行再建を行う効果について証明した研究は見当たらない。血行再建に関する研究の大部分は、糖尿病による足部の感染や明らかな虚血肢に対してのものである。足・足関節領域の血流が不十分な場合、待機的な手術の前に血流の改善が推奨される。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 4：ハンマー趾のような前足部の単独手術に対して、周術期の予防的抗菌薬投与は必要か？

著者：Irvin Oh, Kristin Englund 翻訳者：森田成紀、田中康仁

推奨：限られた臨床データによるが、免疫不全や糖尿病のようなリスクがなければ前足部の単独手術に対して周術期の抗菌薬投与は必要ではない。

エビデンスレベル：Moderate

投票結果：賛成 67%、反対 25%、棄権 8%（大多数、弱いコンセンサス）

1.1 PREVENTION: TOTAL ANKLE ARTHROPLASTY-SPECIFIC

QUESTION 1: What are the important risk factors that predispose a patient to infection after total ankle arthroplasty (TAA)?

RECOMMENDATION: There is evidence indicating that the following risk factors may predispose a patient to an infection after a TAA: inflammatory arthritis, prior ankle surgery, body mass index (BMI) < 19 and peripheral vascular disease. Meanwhile, there is conflicting evidence (which may be due to patient selection bias) indicating that the following risk factors may predispose a patient to infection after a TAA: obesity (BMI > 30), tobacco use, diabetes, duration of surgery, age < 65 years, hypothyroidism, low preoperative American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score and chronic lung disease.

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QUESTION 2: Does intra-articular injection of the ankle with corticosteroids increase the risk of subsequent periprosthetic joint infection (PJI) following total ankle arthroplasty (TAA)?

If so, how long after a prior intra-articular injection can TAA be safely performed?

RECOMMENDATION: Every intra-articular injection of the ankle is an invasive procedure associated with potential healthcare-associated infections, including periprosthetic joint infection (PJI) following TAA. Based on the limited current literature, the ideal timing for elective TAA after corticosteroid injection for the symptomatic native ankle joint is unknown. The consensus workgroup recommends that at least three months pass after corticosteroid injection and prior to performing TAA.

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QUESTION 3: Should routine methicillin-resistant *Staphylococcus aureus* (*S. aureus*), or MRSA, screening be in place prior to total ankle arthroplasty (TAA)?

RECOMMENDATION: Unknown. The role of screening for MRSA and decolonization prior to TAA remains unclear. Further data is needed to support this practice in TAA, which can be costly and logistically difficult to implement.

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QUESTION 4: What preoperative optimization should be implemented to reduce the risk of surgical site infection/periprosthetic joint infection (SSI/PJI) in patients undergoing total ankle arthroplasty (TAA)?

RECOMMENDATION: We recommend that patients awaiting TAA be optimized prior to surgery by implementing skin cleansing, nutritional status enhancement, glycemic control, body mass index (BMI) optimization, smoking cessation, and management of immune-modulating comorbidities.

At the time of surgery, there is strong evidence that optimal preparation of the surgical site with an alcohol-containing agent, weight-based and timely administration of antibiotic prophylaxis, and reducing operating room traffic should also be put in place.

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QUESTION 5: What prophylactic antibiotic (type, dose and route of administration) should be administered perioperatively for patients undergoing total ankle arthroplasty (TAA)?

RECOMMENDATION: The administration of prophylactic antibiotics before TAA potentially reduces the incidence of surgical site infection (SSI) and/or periprosthetic joint infection (PJI). Weight-based (of at least 2 gm) Cefazolin administered intravenously within 60 minutes prior to the procedure can be an adequate choice for antibiotic prophylaxis.

If the patient has a beta-lactam anaphylaxis, we recommend an appropriate alternative antibiotic effective against *Staphylococcus*.

It is unclear whether prophylaxis should be given as a single dose or as multiple doses.

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QUESTION 6: What is the optimal management of patients with prior septic arthritis of the ankle who are undergoing total ankle arthroplasty (TAA)?

RECOMMENDATION: There is a paucity of data regarding TAA in patients with prior infection involving the ankle, whether it be septic arthritis, osteomyelitis or infection of the surrounding soft tissues.

We recommend that patients with prior infections in the affected ankle be worked up for infection, including a thorough history and physical examination, as well as ordering serological tests and possible aspiration of the joint. During ankle arthroplasty in patients with prior infection, antibiotics should be added to the cement (if used), and the joint should be thoroughly cleansed. Intraoperative cultures of bone and soft tissue should also be obtained.

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QUESTION 7: During draping for total ankle arthroplasty (TAA), should the foot be prepped into the surgical field or be covered?

RECOMMENDATION: There is insufficient data demonstrating any advantage or disadvantage to covering the toes during TAA.

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QUESTION 8: Should antibiotic-impregnated cement be used during primary total ankle arthroplasty (TAA)?

RECOMMENDATION: Unknown. There is insufficient evidence for the routine use of antibiotic-impregnated cement during primary TAA.

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1.2. PREVENTION: NON-TOTAL ANKLE ARTHROPLASTY-SPECIFIC

QUESTION 1: What are the benefits and risks associated with the use of vancomycin powder in the wound during total ankle arthroplasty (TAA) or other foot and ankle procedures?

RECOMMENDATION: Though one study supporting topically-applied vancomycin has shown it to reduce the rate of deep infection in diabetic patients undergoing foot and ankle surgery, there is insufficient evidence to show benefits or to show any risks associated with the use of vancomycin powder during TAA or other foot and ankle procedures in a general population.

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QUESTION 2: Is there a role for the use of dilute povidone-iodine (betadine) irrigation or other antiseptic irrigation solutions during total ankle arthroplasty (TAA) or other foot and ankle procedures?

RECOMMENDATION: With regards to TAA, there is a lack of evidence to recommend for or against the use of betadine solution.

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QUESTION 3: Does revascularization prior to foot and ankle surgery reduce the incidence of surgical site infection (SSI)?

RECOMMENDATION: Several studies support the effect of peripheral vascular disease (PVD) on wound healing and SSI. Despite this, there have been no specific studies proving the beneficial effect of revascularization on SSI prior to surgical intervention in the setting of traumatic or elective foot and ankle surgery. The majority of studies on revascularization are in the setting of diabetic foot infection or established ischemia.

We recommend that in the presence of an inadequate vascularization in the foot and ankle, vascular optimization should be undertaken prior to elective surgery.

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QUESTION 4: Are prophylactic perioperative antibiotics required for isolated forefoot procedures, such as hammertoes?

RECOMMENDATION: Though limited clinical data exists, the administration of perioperative antibiotics is not required for isolated forefoot procedures in the absence of any risk factors, such as immunodeficiency or diabetes mellitus.

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2.1. 診断：人工足関節置換術（TAA）

質問1：TAA後のPJIに対する急性期と慢性期の定義は何か？

著者：Michael Aynardi, Milena M. Plöger, K.C. Walley, C.B. Arena 翻訳者：黒川紘章、田中康仁

推奨：TAA後の急性期または慢性期のPJIの定義に関する文献的な情報は乏しい。TAA後のPJIに関する議論は、TKAやTHAの関節形成術に関する文献に全面的に従うべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：TAA後感染の診断に必要なアルゴリズムは何か？

著者：Nima Heidari, Irvin Oh, Francesc Malagelada 翻訳者：黒川紘章、田中康仁

推奨：PJIを疑う臨床症状や創部周囲の疼痛、紅斑、熱感、瘻孔、膿瘍形成などの感染兆候を認めるような場合や、距腿関節や距踵関節と交通する瘻孔を認めるような症例ではTAA術後感染の可能性が高い。また、瘻孔形成は認めないものの、ESRやCRPなどの炎症マーカーの上昇を認める症例では白血球数のカウントや細菌検査、細菌培養のために、ただちに関節穿刺を施行する。関節穿刺は繰り返し施行する。最低2つの検体から同一の細菌が認められた場合、感染と診断される。2回目以降の穿刺で陰性であった場合でも、追加検査が好ましい。その他の理由で外科的処置が必要でない患者に対しては核医学検査が勧められる。もし手術が行われた場合は、外科的処置で得られた病理検体（1視野に5個以上の好中球を認める）または滑液検査を基に感染が診断される。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：TAAの感染の可能性を調べるにはどのような検査が有用か？ その閾値は何か？

著者：Ilker Uçkay, David Pedowitz, Mathieu Assal, Justin D. Stull 翻訳者：黒川紘章、田中康仁

推奨：潜在性のTAA感染の診断に特異的な検査はなく股関節や膝関節など他の関節におけるPJIと同様と考える。TAA感染に対する新しい特有の診断方法はない。関節穿刺や術中標本を基にした細菌培養がTAA感染を疑う最も重要な診断検査である。TAAに特異的なデータはないので閾値は股関節や膝関節の文献的考察を鑑みる必要がある。

エビデンスレベル：Strong

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：TAA感染の可能性のある足関節に対する関節穿刺の適応はどのようなものか？

著者：Milena M. Plöger, Amiethab Aiyer 翻訳者：黒川紘章、田中康仁

推奨：THAやTKAと同様に、TAA術後に臨床的にPJIが疑われた際には、特にESRやCRPといった炎症マーカーの上昇を伴う場合には関節穿刺が適応とされる。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問5：TAA術後患者に対する足関節穿刺方法として最適な方法は何か？

著者：Rachel Shakked 翻訳者：黒川紘章、田中康仁

推奨：エビデンスはないもののPJI診断目的の場合は無菌操作での前内側から関節穿刺を施行するのが好ましい。可能であれば超音波ガイド下に穿刺するが、必須ではない

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問6：再置換術前に抗菌薬含有スプレーヤーが挿入されている足関節に対して穿刺検査をしておくことは望ましいか？

著者：Daniel Fuchs, Selene Parekh 翻訳者：黒川紘章、田中康仁

推奨：我々は再置換術前に抗菌薬含有スプレーヤーを挿入中の足関節に対して穿刺しておくことを強く勧める。文献的には、このような状況下で培養陽性となることは感染の残存を示唆する。また、たとえ陰性であったとしても、完全に否定することはできないので他の臨床所見や検査値と合わせて評価することが好ましい。

エビデンスレベル：Consensus

投票結果：賛成 92%、反対 8%、棄権 0%（大多数、強いコンセンサス）

質問7：TAA感染の診断のために滑液のバイオマーカーの測定意義はあるか？

著者：Khaled Emara, John M. Embil 翻訳者：黒川紘章、田中康仁

推奨：THA や TKA の文献をみるとバイオマーカーの測定は TAA 術後感染診断の一助となりうる。臨床像に合致する状況において、妥当な菌が培養同定された場合、TAA における PJI は診断される。培養が陽性でなかった場合は滑液のバイオマーカーが診断の助けになる。

エビデンスレベル：Moderate

投票結果：賛成 92%、反対 8%、棄権 0%（大多数、強いコンセンサス）

質問8：TAA感染症例において、原因菌のDNA検索(PCRや次世代シーケンサー)を行う分子医学検査の意義は何か？

著者：Khaled Emara, Amiethab Aiyer, Ryan Rogero 翻訳者：黒川紘章、田中康仁

推奨：十分な臨床的根拠には欠けるが、特に次世代シーケンサーや Ibis T5000 技術などの分子医学検査は TAA 感染の診断に今後重要な意義を担う可能性がある。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問9：TAA再置換術時には、培養検体の採取は必須か？

著者：Daniel Fuchs 翻訳者：黒川紘章、田中康仁

推奨：我々は TAA 再置換術時に培養検体を採取することを勧める。術中採取した標本の結果は、感染兆候を示唆する臨床症状や、血液検査、画像検査の結果と合わせて評価すべきである。したがって、複数個の標本の採取が好ましい。TAA 再置換術に採取した標本において特異的な文献的根拠がある所見が存在するわけではないが、THA や TKA における文献的根拠を鑑みた結果である。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

2.2. 診断：非人工足関節置換術

質問1：足・足関節の感染に対する手術の際に採取すべき最適な培養検体の数は？

著者：Yasuhito Tanaka, Amiethab Aiyer, Eiichiro Iwata, Yusuke Yamamoto, Michael R. Mijares 翻訳者：黒川紘章、田中康仁

推奨：足・足関節の感染に対する手術の際に採取すべき最適な培養検体の数は不明である。したがって多数の標本採取を勧める。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：足・足関節の感染症例で起因菌を同定するためにどのような手法が用いられるか？

著者：Kent Ellington, Steven Raikin, Thomas B. Bemenderfer 翻訳者：黒川紘章、田中康仁

推奨：滑液穿刺液を血液培養容器にいれて運ぶこと、深部の組織や骨から生検した検体を用いること、多数の検体を採取すること、培養期間を増やすこと、培養結果が陰性の場合には分子医学検査を施行することが、足・足関節感染症例における原因菌同定の精度を上げるために役立つ手法である。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：足・足関節の感染症例に対する骨生検の適切な方法(採取方法や部位、画像使用など)は何か？

著者：Joseph T. O'Neil 翻訳者：黒川紘章、田中康仁

推奨：外科的なデブリドマンが不要と考えられている患者では、骨生検は一般的に経皮的に施行したほうが良い。外科的デブリドマンが必要な患者の場合には、一連の処置のなかで観血的に骨生検を施行する。経皮的骨生検は無菌術野で放射線科医か画像ガイド下での穿刺に習熟している医師によって施行されるべきである。生検部位は臨床症状や画像検査を基に、周囲軟部組織に対して最小侵襲かつ、最も効果的な部位を穿刺するべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：急性期の足部Charcot関節症と急性期の足部感染症を鑑別する最良の方法は何か？

著者：Nima Heidari, Irvin Oh, Yueyang Li, Alexandros Vris, Iris Kwok, Alexander Charalambous, Ryan Rogero 翻訳者：黒川紘章、田中康仁

推奨：急性期の足部 Charcot 関節症と急性期の感染や骨髓炎との鑑別は複雑で、複数の診断基準を満たす必要がある。その診断基準は神経障害の有無や、

現病歴、身体所見に重点が置かれている。皮膚に創傷がないことや足を上げることにより腫脹あるいは紅斑が改善することは感染の可能性がかなり低いことを示唆する。鑑別しにくい症例において血液検査や病理組織検査、骨生検の培養、シンチグラフィー、MRIなどの画像検査が有効な可能性がある。

エビデンスレベル: Moderate

投票結果: 賛成 100%、反対 0%、棄権 0% (満場一致、最も強いコンセンサス)

2.1 DIAGNOSIS: TOTAL ANKLE ARTHROPLASTY-SPECIFIC

QUESTION 1: What is the definition of acute and chronic periprosthetic joint infection (PJI) of total ankle arthroplasty (TAA)?

RECOMMENDATION: There is a paucity of data for defining acute or chronic PJI following TAA in the literature. Any discussion of PJI after ankle replacement is entirely reliant on the literature surrounding knee and hip arthroplasty.

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QUESTION 2: What is the diagnostic “algorithm” for infected total ankle arthroplasty (TAA)?

RECOMMENDATION: Patients who present with clinical symptoms and signs of periprosthetic ankle infection (pain, erythema, warmth, sinus tract, abscess around the wound) and sinus tracts communicating with the ankle/subtalar joint are likely to have TAA infection.

In the absence of a sinus tract, elevated inflammatory markers (erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP)) should prompt ankle joint aspiration for cell count, differential and culture. The joint aspiration is to be repeated.

If the same organism is identified in at least two cultures of synovial fluid, the patient is diagnosed to have an infection. If the repeat aspiration is negative, further investigation is warranted.

In patients not requiring surgical intervention for other reasons, nuclear imaging should be considered for diagnosis. If an operation is indicated, histologic examination (> 5 neutrophils/high-power field) or synovial fluid analysis is conducted to confirm infection.

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QUESTION 3: What tests are useful to investigate a possible infection of total ankle arthroplasty (TAA)? What are their thresholds?

RECOMMENDATION: Overall, the approach to a potentially infected TAA does not change compared to other periprosthetic joint infections (PJIs). There are no novel or unique diagnostic procedures for TAA infection, specifically. Joint aspiration or intraoperative tissue/synovial biopsies with microbiological cultures are the most important diagnostic tests for suspected TAA infections. In the absence of specific data related to TAA, the threshold for these tests should be derived from the hip and knee PJI literature.

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QUESTION 4: What are the indications for aspiration of a possibly infected total ankle arthroplasty(TAA)?

RECOMMENDATION: Whenever a periprosthetic joint infection (PJI) of a TAA is clinically possible or suspected, especially when elevated erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP) levels exist, and in correspondence to the literature on PJI in total hip and knee arthroplasties, joint aspiration is indicated.

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QUESTION 5: What is the best technique for performing aspiration of patients with total ankle arthroplasty (TAA)?

RECOMMENDATION: In the absence of evidence, we recommend that ankle joint aspiration to evaluate for periprosthetic joint infection (PJI) be performed under sterile conditions via the anteromedial approach. Ultrasound guidance may be used if available but is not necessary to obtain an acceptable synovial fluid sample.

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QUESTION 6: Should aspiration of the ankle with an antibiotic spacer be performed prior to reimplantation?

RECOMMENDATION: We recommend that aspiration of the ankle with an antibiotic spacer prior to a second-stage reimplantation should be strongly considered. Available studies indicate that a positive culture of the aspirate in this setting is predictive of residual infection, while a negative aspirate culture does not rule out infection and should be interpreted in light of other clinical indicators and laboratory values.

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QUESTION 7: Is there a role for measuring synovial biomarkers for diagnosis of infected total ankle arthroplasty (TAA)?

RECOMMENDATION: Based on the hip and knee arthroplasty literature, measuring synovial biomarkers may play a role in the diagnosis of infected TAA. The diagnosis of periprosthetic joint infection (PJI) in the setting of a TAA can be confirmed with cultures, provided that a plausible pathogen is recovered in the context of a compatible clinical picture. In the absence of a positive culture, synovial biomarker analysis may help in establishing the diagnosis.

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QUESTION 8: What is the role of molecular techniques for detection of pathogen deoxyribonucleic acid (DNA) (polymerase chain reaction (PCR) or next-generation sequencing) in patients with infected total ankle arthroplasty (TAA)?

RECOMMENDATION: Molecular techniques, particularly next-generation sequencing and the Ibis T5000 technology, have the potential to be used as an important adjunct in the diagnosis of bacterial infection following TAA, although sufficient clinical evidence is lacking.

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QUESTION 9: Should culture samples be taken during all revision total ankle arthroplasty (TAA)?

RECOMMENDATION: We recommend that intraoperative cultures be taken during revision TAA. The result of intraoperative cultures should be interpreted together with clinical suspicion for infection and the results of the laboratory and imaging investigations. We also recommend that multiple tissue specimens be collected. Given a lack of evidence for routine intraoperative cultures for revision TAA literature, this recommendation is based on analogous evidence in the total hip and knee replacement literature.

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2.2. DIAGNOSIS: NON-TOTAL ANKLE ARTHROPLASTY-SPECIFIC

QUESTION 1: What is the optimal number of samples for culture in patients undergoing surgery for foot and ankle infections?

RECOMMENDATION: The optimal number of samples for culture in patients undergoing surgery for foot and ankle infections is unknown. We recommend that multiple tissue samples be taken.

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QUESTION 2: What strategies can be implemented to help isolate the causative organism in patients with infection of the foot and ankle?

RECOMMENDATION: Transfer of synovial aspirate in blood culture bottles, obtaining deep biopsy of tissues and bone, obtaining multiple samples, increasing incubation period of cultures and the use of molecular techniques for culture negative cases are some of the strategies that can help improve the ability to isolate the causative organism(s) in infections of foot and ankle.

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QUESTION 3: What is the optimal method to perform bone biopsy (method, location, imaging use) for patients with foot and ankle infections?

RECOMMENDATION: A bone biopsy should generally be performed in a percutaneous fashion, particularly in cases where surgical debridement is not considered necessary.

If surgical debridement is considered necessary, then an open biopsy can be performed as part of the debridement.

Percutaneous biopsy should be performed under sterile conditions by an interventional radiologist or other physician trained in imageguided techniques.

The location of the biopsy will depend upon the clinical and radiographic evaluations, with a goal of maximizing the yield of the biopsy while minimizing the risk of injury to surrounding and/or overlying soft tissue structures.

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QUESTION 4: What is the best method to differentiate acute Charcot foot from acute infection?

RECOMMENDATION: Differentiation between acute Charcot neuroarthropathy (CN) and acute infection/osteomyelitis is complex and requires multiple (> 1) diagnostic criteria. These criteria include an emphasis on the presence of neuropathy, history and physical examination. The absence of skin wounds and resolution of swelling/erythema with elevation makes the likelihood of infection very low.

In unclear cases, laboratory testing, histological examination and culturing of bone specimens, scintigraphy, and imaging, especially magnetic resonance imaging (MRI), may be of benefit.

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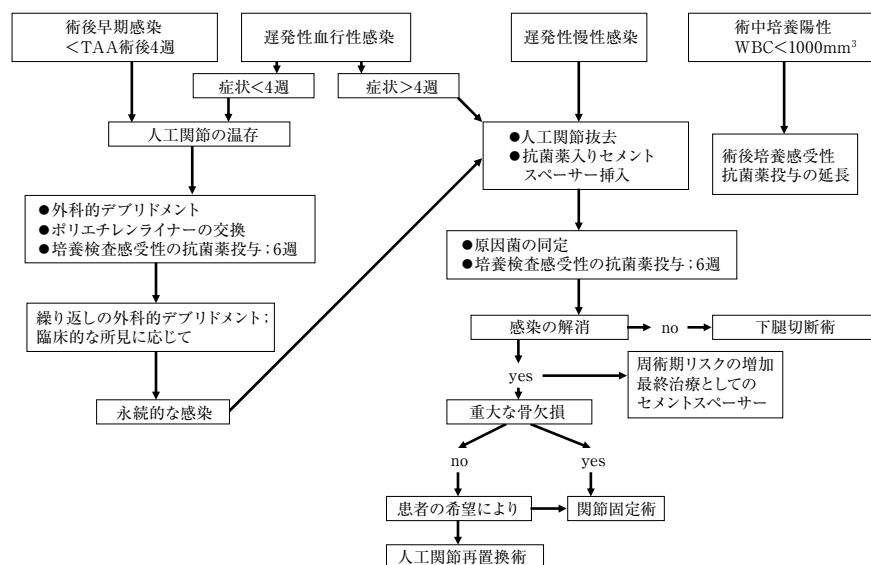
GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

3.1. 治療：人工足関節置換術（TAA）

質問1：感染を起こしたTAAの治療アルゴリズムはどのようなものか？

著者：Steven Raikin, Selene Parekh, Elizabeth McDonald 翻訳者：谷口晃、田中康仁

推奨：感染を起こしたTAAの治療は感染の激しさによって大きく影響される。TAA用に改編された以下の治療アルゴリズムが推奨される。



エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：感染を起こしたTAA施行患者に対して（種類、用量、投与方法に関して）最適な抗菌薬治療はどのようなものか？

著者：John M. Embil, Joseph T. O'Neil 翻訳者：谷口晃、田中康仁

推奨：TAAに限定した文献は見当たらないが、人工股関節、人工膝関節の管理において推奨される方針に鑑みて判断すると、原因菌の同定と感度に基づいて抗菌薬が選択されるべきである。用量や投与頻度、投与方法に関しては感染管理の専門医に相談し、患者の体重や腎疾患、薬剤耐性記録などの並存障害を考慮に入れて決定されるべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：外科的治療を受けるTAAのPJI患者において、抑制型抗菌薬の担う役割はあるか？

著者：Selene Parekh 翻訳者：谷口晃、田中康仁

推奨：培養検査を経て選択された抗菌薬治療は感染を起こしたTAAに対して観血的治療をうけた患者に対して薦められる。抑制型抗菌薬のルーチン投与は人工足関節が挿入されている患者に対して正当な理由がない。しかし特殊な臨床的環境下では有益かもしれない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：感染を起こしたTAA患者に挿入するセメントスパーサーに混ぜるべき抗菌薬の種類や量は何を元に決定されるか？

著者：Rachel Shakked, Ferdinando Da Rin de Lorenzo 翻訳者：谷口晃、田中康仁

推奨：もし感染を起こしている組織が同定されるのであれば、TKAやTHAで典型的に行われているようにセメントスパーサーに混入する抗菌薬は症例にあわせて調整することを推奨する。そうでなければ、広域スペクトラムの抗菌薬が用いられる。合併症は常に考慮されるべきで、とりわけ腎機能やアレルギーの既往には注意を払われるべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問5：感染を起こしたTAA患者に対してDAIRの適応と禁忌は？

著者：Ett ore Vulcano, Jimmy J. Chan, Amin Mohamadi, Samantha Walsh 翻訳者：谷口晃、田中康仁

推奨：感染したTAA患者において再発性の感染が認められたとしても、ポリエチレンを交換した上でのDAIRは早期（術後4週以内）の術後感染症と急性（症状発現後4週以内）の血行性感染に対して適応されうる。十分な臨床的根拠には欠けている。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問6：感染を起こしたTAA患者に対してDAIRの最適なプロトコールはどのようなものか？（洗浄液の種類や量などに関して）

著者：Ilker Uçkay, David Pedowitz, Mathieu Assal, Justin D. Stull 翻訳者：谷口晃、田中康仁

推奨：急性期のTAA術後感染症に対するDAIRは許容される治療の選択肢となりうる。もしDAIRが行われるならば、慎重に行われなくてはならず、すべての壊死組織や感染した組織が除去され、交換できる部品は交換されたことを確認する。感染が波及した関節は抗菌薬入りの洗浄液を用いて洗浄されるべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問7：感染したTAAにおいてインプラントの入れ替えを行う場合、一次的に行うか二次的に行うかの適応はいかなるものか？

著者：Kent Ellington, Thomas B. Bemenderfer 翻訳者：谷口晃、田中康仁

推奨：感染を起こしたTAAの場合、大多数の症例で二次的なインプラント入れ替えが推奨される。一次的な関節形成術は、急性期の感染で、術前から弱毒菌であることや患者要因としても低リスクであることが判明している限られた症例にのみ適応される。

エビデンスレベル：Consensus

投票結果：賛成 92%、反対 8%、棄権 0%（大多数、強いコンセンサス）

質問8：感染を起こしたTAAに対して二期的手術の一環として行われた切除関節形成術後の患者に対して、再度インプラント挿入を行う最適なタイミングを判断するのに用いられる基準は何か？

著者：Eric Senneville, Gaston Slullitel, Valeria Lopez 翻訳者：谷口晃、田中康仁

推奨：感染を起こしたTAAに対して、インプラント再挿入の最適なタイミングを決定するための基準を判断する決定的なデータは存在しない。私たちは、インプラント再挿入は感染が解消したという臨床的な徴候（良好に治癒した手術創、あるいは紅斑の消失など）や血清学的マーカーが（感染と診断されたときに測定された）ベースラインから十分に減少（> 40%）していることを（判断基準として）推奨する。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問9：感染したTAAに対する二次的なインプラント交換が行われている患者において、治療の失敗を予測する因子は何か？

著者：Elizabeth McDonald 翻訳者：谷口晃、田中康仁

推奨：感染したTAAに対して二次的なインプラント交換が行われている患者において、治療の失敗を予測する因子としては、易感染性の軟部組織（例えば瘻孔や露出した金属など）、重大な骨病変もしくは骨髓炎、そしてインプラント再挿入前の不適切なタイミングでの抗菌薬の投与などが挙げられる。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問10：TAAが施行された患者において術後の蜂窩織炎はどのように対処されるべきか？

著者：Milena M. Plöger, Christopher D. Murawski 翻訳者：谷口晃、田中康仁

推奨：根拠には欠けるが、私たちはTAAを施行した患者において（1）術後に蜂窩織炎が発生した場合にはPJIを除外するために評価を行い、（2）蜂窩織炎のみであれば炎症反応の増減をモニタリングしながら抗菌薬による治療を行うことを推奨する。

エビデンスレベル：Consensus

投票結果：賛成 92%、反対 0%、棄権 8%（大多数、最も強いコンセンサス）

質問11：TAA術後の慢性的な深部感染症はインプラント抜去が必要か？

著者：Jonathan Kaplan, Steven Raikin 翻訳者：谷口晃、田中康仁

推奨：必要である。TAA 術後の慢性的な深部感染症に対しては、他に手術禁忌となる理由がない限りはインプラント抜去が必要とされる。

エビデンスレベル：Strong

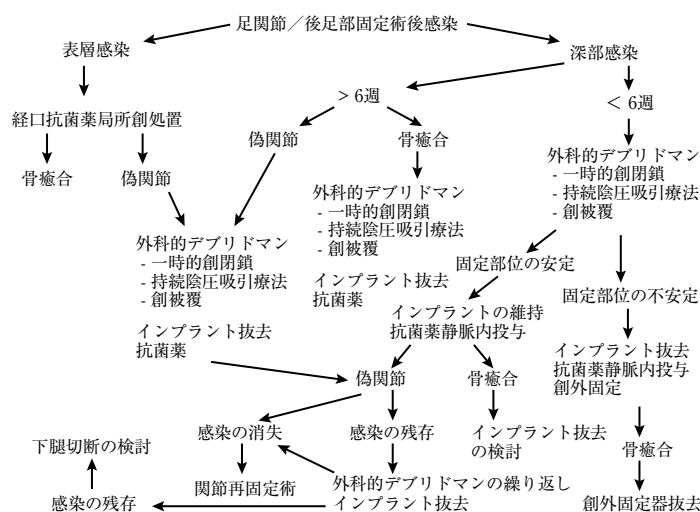
投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

3.2. 治療：非人工足關節置換術

質問1：足関節もしくは後足部固定術の術後感染症に対する治療アルゴリズムはどのようなものか？

著者：Kent Ellington, Christopher Hirose, Thomas B. Bemenderfer 翻訳者：谷口晃、田中康仁

推奨：感染を起こした足関節もしくは距骨下関節固定術に言及した普遍的なアルゴリズムは存在しない。コンセンサスが得られた潜在的なアルゴリズムは、(下図)。



エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：感染を起こした足部/足関節骨折もしくは固定術後患者に対して(種類、用量、投与方法に関して)最適な抗菌薬治療はどのようなものか？

著者：David Pedowitz, Justin Stull 翻訳者：谷口晃、田中康仁

推奨：足部／足関節の骨折もしくは固定術後患者に対して最適な抗菌薬治療は、細菌培養の結果に基づいて決定されるべきである。細菌培養結果がない場合には、投与される抗菌薬は黄色ブドウ球菌などの一般的な病原菌をカバーするものが含まれるべきである。

エビデンスレベル：Strong

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：アキレス腱修復/再建術後の感染症に対する治療アルゴリズムはどのようなものか？

著者：Brian Winters, Ferdinando Da Rin de Lorenzo, David Beck 翻訳者：谷口晃、田中康仁

推奨：アキレス腱再建術後感染の初期対応には、縫合糸や異物の除去を含めたすべての感染性組織に対する完璧なデブリドマンを含めるべきである。デブリドマンに際しては細菌培養検査が行われるべきで、抗菌薬投与は培養結果によって行われるべきで、炎症マーカーや臨床症状が正常化するまで継続すべきである。重大な軟部組織欠損が残る場合には、軟部組織被覆を併用した腱再建もしくは腱移行、あるいはその併用についての選択が術者の好みや経験を基に決定されるべきである。再手術としての再建術は感染が消失するまで延期されるべきである。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：糖尿病性足部骨髄炎の治療は骨生検を基に行われるべきか？

著者：Nima Heidari, Iris Kwok, Alexandros Vris, Li, Alexander Charalambous 翻訳者：谷口晃、田中康仁

推奨：行われるべきである。骨生検は糖尿病による足部感染症の管理において、確定的な診断としての役割と治療介入としての役割を併せ持つ。一方骨生検はすべての糖尿病性足部感染症において必要とされるわけではなく、最も重要な役割は糖尿病性足部骨髄炎患者において、表在性の軟部組織検体よりも

正確な微生物学的情報を提供することにより、適切な抗菌薬治療を選択する指標となることである。

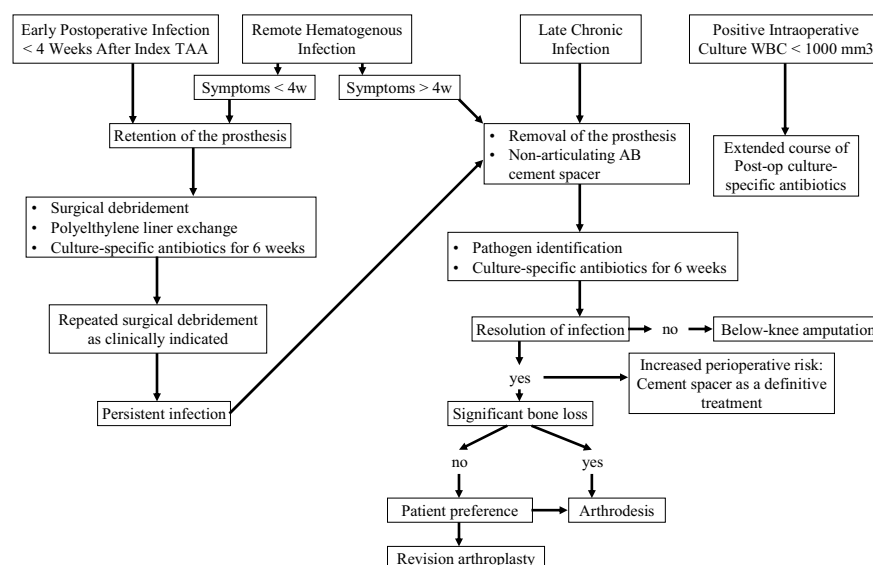
エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

3.1 TREATMENT: TOTAL ANKLE ARTHROPLASTY-SPECIFIC

QUESTION 1: What is the treatment “algorithm” for an infected total ankle arthroplasty (TAA)?

RECOMMENDATION: The treatment of an infected TAA is largely dictated by the acuity of the infection. The following treatment algorithm modified for TAA is recommended [1].



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QUESTION 2: What is the optimal (type, dose and route of administration) antibiotic treatment for patients with infected total ankle arthroplasty (TAA)?

RECOMMENDATION: Though literature specific to TAA is lacking, based on recommendations for the management of hip and knee arthroplasties, the choice of antibiotic should be made based on the identification and sensitivities of the infecting organism(s). Dosing, frequency and route of administration of antibiotics may be determined in consultation with an infectious disease specialist and by taking into account the patient's weight and comorbidities, such as renal impairment and the antibiogram.

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QUESTION 3: Is there a role for suppressive antibiotics in patients with perioperative joint infection (PJI) of total ankle arthroplasty (TAA) who have undergone surgical treatment?

RECOMMENDATION: Culture-directed antibiotic therapy is recommended for patients undergoing surgical treatment of infected TAA. Routine administration of suppressive antibiotics in patients with an ankle prosthesis in place is not warranted; however, in certain clinical circumstances, this may be of benefit.

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QUESTION 4: What determines the type and dose of antibiotic that is needed to be added to the cement spacer in patients with infected total ankle arthroplasty (TAA)?

RECOMMENDATION: We recommend tailoring the antibiotic in cement spacers to the infecting organism if it has been identified, as is typically done in total knee and hip arthroplasty. Otherwise, broad-spectrum antibiotics may be utilized. Medical comorbidities should always be considered, especially with regard to renal function and allergy profile. A thermostable antibiotic should be added to cement.

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QUESTION 5: What are the indications and contraindications for irrigation and debridement and retention of prosthesis (DAIR) in patients with infected total ankle arthroplasty (TAA)?

RECOMMENDATION: DAIR with polyethylene exchange may be indicated in early postoperative infection (< four weeks) or acute hematogenous infection (< four weeks of symptoms) in patients with infected TAA, although recurrent infection has been seen. Sufficient clinical evidence is lacking.

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QUESTION 6: What is the optimal protocol for performing debridement, antibiotics and implant retention (DAIR) in an infected total ankle arthroplasty (TAA) (type and volume of irrigation solution, and so on)?

RECOMMENDATION: DAIR in acute TAA infections may be an acceptable treatment option. If performed, DAIR should be done meticulously, ensuring that all necrotic or infected tissues are removed and modular parts of the prosthesis, if any, exchanged. The infected joint should also be irrigated with antiseptic solutions.

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QUESTION 7: What are the indications for one-stage versus two-stage exchange arthroplasty in management of the infected total ankle arthroplasty (TAA)?

RECOMMENDATION: Two-stage exchange arthroplasty is recommended in the majority of cases following infected TAA. One-stage arthroplasty is only indicated in a limited patient population with acute infection, preoperatively identified low-virulence organisms and low-risk patient factors.

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QUESTION 8: What metrics can be used to determine the optimal timing of reimplantation in patients who have undergone resection arthroplasty as part of a two-stage exchange for infected total ankle arthroplasty (TAA)?

RECOMMENDATION: There is no conclusive data regarding what metrics can be used in order to determine the optimal timing of reimplantation for an infected TAA. We recommend that reimplantation is performed when there are clinical signs of resolution of infection (well-healed wound, lack of erythema, etc.), and the serological markers have substantially declined (> 40%) from baseline (measured at the time of diagnosis of infection).

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QUESTION 9: What are the predictors of treatment failure in patients who have undergone twostage exchange for infected total ankle arthroplasty (TAA)?

RECOMMENDATION: Predictors for treatment failure in patients undergoing two-stage exchange for infected TAA include compromised soft tissues (e.g., sinus tract, exposed hardware, etc.), significant bone involvement/osteomyelitis and insufficient timing of antibiotic course before reimplantation.

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QUESTION 10: How should postoperative cellulitis be treated in patients with total ankle arthroplasty (TAA) in place?

RECOMMENDATION: In the absence of evidence, we recommend that (1) patients with TAA in place who develop postoperative cellulitis be evaluated thoroughly to rule out periprosthetic joint infection of the ankle, and (2) that isolated cellulitis may be treated with antibiotics, elevation and close monitoring. Aspiration can be considered in certain cases, with the potential risk of introducing deep space infection.

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QUESTION 11: Does deep chronic infection after total ankle arthroplasty (TAA) require implant removal?

RECOMMENDATION: Yes. Deep chronic infection after TAA requires implant removal unless otherwise contraindicated.

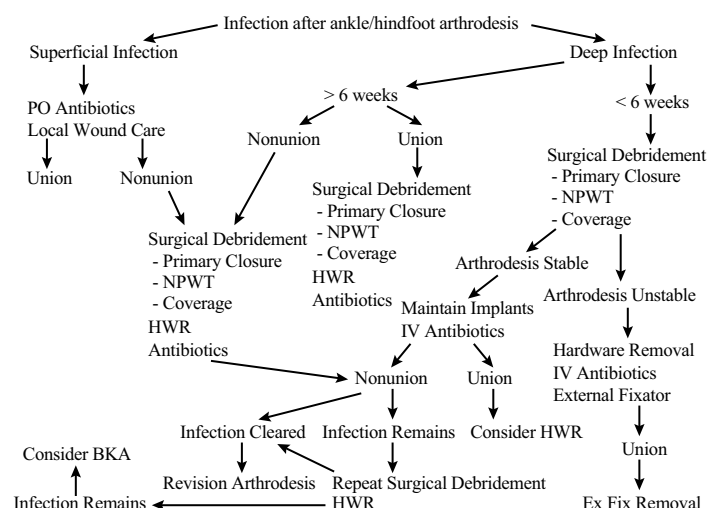
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3.2. TREATMENT: NON-TOTAL ANKLE ARTHROPLASTY-SPECIFIC

QUESTION 1: What is the treatment “algorithm” for infection after ankle or hindfoot arthrodesis?

RECOMMENDATION: There is no universal algorithm for addressing the infected ankle or subtalar arthrodesis. A potential algorithm created by consensus is:



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QUESTION 2: What is the optimal antibiotic (type, dose and route of administration) treatment for infections after foot/ankle fracture or fusion procedures?

RECOMMENDATION: The optimal antibiotic treatment after foot/ankle fractures or fusion should be determined based on the result of culture. In the absence of culture results, administered antibiotics should include coverage against common pathogens such as *Staphylococcus aureus*.

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QUESTION 3: What is the treatment “algorithm” for infection after Achilles tendon repair/reconstruction?

RECOMMENDATION: The initial treatment of an infected Achilles tendon reconstruction should include thorough debridement of all infected tissues with the removal of retained sutures or foreign material. Cultures should be taken at the time of debridement and antibiotic administration should be dictated by the result of culture and continued until inflammatory markers and clinical symptoms normalize. If significant soft tissue defect in the overlying area remains, the choice of tendon reconstruction and/or transfer with soft tissue coverage should be left up to the discretion of the treating surgeon based on preference and expertise. Revision reconstruction should be delayed until the infection is cleared.

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QUESTION 4: Should treatment of diabetic foot osteomyelitis be based on bone biopsies?

RECOMMENDATION: Yes. Bone biopsies play both a crucial diagnostic and interventional role in the management of diabetic foot infection.

While bone biopsies are not required in every case of diabetic foot infection, their most important role is in guiding accurate antibiotic treatment, as they provide more accurate microbiological information than superficial soft tissue samples in patients with diabetic foot osteomyelitis.

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PART VII

ONCOLOGY

SECTION 1: PREVENTION

- 1.1. 予防的抗菌薬
- 1.2. 化学療法
- 1.3. 研究関連事項
- 1.4. 手術手技

SECTION 2: TREATMENT

- 2.1. 洗浄とデブリドマン
- 2.2. 一期的再置換術
- 2.3. 研究関連事項
- 2.4. 二期的再置換術

〈監訳者〉

林克洋、土屋弘行、森井健司

1.1. 予防：予防的抗菌薬投与

質問 1：腫瘍切除術および腫瘍型人工関節置換術において、手術時間はSSI/PJIのリスクと相関するか？ もしそうであるなら、そうした患者群において術後の抗菌薬投与期間を延長すべきか？

著者：Christina Gutowski, Michelle Ghert, Qiaojie Wang 翻訳者：三輪真嗣、土屋弘行

推奨：過去の人工関節置換術に関する多くの報告によれば、手術時間の延長は術後感染のリスクの上昇と相関するエビデンスがある。しかしながら、術後抗菌薬の投与期間延長が、術後感染のリスクを低下させるというエビデンスは乏しい。したがって、時間が長い手術を受ける骨軟部腫瘍患者において、術後抗菌薬投与の延長を支持するエビデンスはない。手術時間が予防抗菌薬の半減期の2倍を超える場合には、血清または組織における適切な抗菌薬の濃度を維持するため、術中再投与が必要である。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：術前放射線照射の有無、軟部組織・骨組織のいずれを切除するか、金属インプラント・同種骨移植のいずれで再建するかなどは、予防抗菌薬の投与量や投与期間に影響を与えるか？

著者：Rodolfo Capanna, Ivan Bohacek, Lorenzo Andreani 翻訳者：三輪真嗣、土屋弘行

推奨：知見はない。骨軟部腫瘍の手術における予防抗菌薬の投与方法を示すエビデンスやガイドラインは存在していない。抗菌薬投与期間の延長は、深部感染のリスクを低下させる可能性はあるが、広範な再建を行う患者において予防抗菌薬投与方法の変更を推奨する十分なエビデンスはない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：腫瘍型人工関節を有する患者は、歯科治療の際に予防抗菌薬が必要か？

著者：Mitchell Schwaber, Yaakov Dickstein, Elizabeth Temkin 翻訳者：三輪真嗣、土屋弘行

推奨：必ずしも必要ではない。歯科医および整形外科医によるエビデンスにもとづいたガイドラインによると、人工関節を有する患者に対して、歯科治療の際に予防抗菌薬を必要とすることは少ない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 4：腫瘍型人工関節置換術後の患者において、術後化学療法による好中球減少症が発生した場合、予防抗菌薬を投与すべきか？

著者：Mitchell Schwaber, Yaakov Dickstein, Elizabeth Temkin 翻訳者：三輪真嗣、土屋弘行

推奨：必ずしも必要ではない。エビデンスに基づいたガイドラインでは、予防抗菌薬の常用は、化学療法による好中球減少症を合併した高リスク患者に限定することを推奨している。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 5：化学療法および／又は放射線照射を施行後または施行前の患者に対して腫瘍型人工関節による再建を行う場合、予防抗菌薬の種類、用量、投与期間は？

著者：Mitchell Schwaber, Yaakov Dickstein, Elizabeth Temkin 翻訳者：森井健司

推奨：抗菌薬予防投与は、標準的人工関節置換術およびそれ以外の人工物を留置する整形外科手術に関して現在報告されているガイドラインに準じてなされるべきである。

エビデンスレベル：Consensus

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

質問 6：通常のTJAで使用されている予防抗菌薬の種類、投与量、投与期間は、腫瘍型TJAを受ける患者において、変更すべきか？

著者：Mitchell Schwaber, Yaakov Dickstein, Elizabeth Temkin 翻訳者：三輪真嗣、土屋弘行

推奨：変更の必要はない。通常のTJAにおいて投与されている抗菌薬の種類・投与量・投与期間を、腫瘍型TJAを受ける患者において変更することは推奨されない。

エビデンスレベル：Consensus

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

1.2. 予防：化学療法

質問 1：腫瘍型人工関節置換術後の PJI リスクを評価する場合、化学療法施行後の患者における腸管および皮膚の細菌叢を評価すべきか？

著者：R. Lor Randall, Brian M. Smith, Karan Goswami, John S. Groundland, Antonios I. Papadopoulos, Panayiotis J. Papagelopoulos

翻訳者：森井健司

推奨：知見はない。化学療法後の腸管および皮膚の細菌叢の評価が、腫瘍型人工関節による患肢温存術の感染のリスク評価に有益であることを示唆したエビデンスはない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：化学療法を受けた患者が患肢温存術を受ける際、好中球数が $1000/\text{mm}^3$ より多いことは必須であるか？

著者：Andreas F. Mavrogenis, Takeshi Morii, Jorge Manrique 翻訳者：森井健司

推奨：必須である。化学療法施行後に患肢温存術を受ける患者において、好中球数が $1000/\text{mm}^3$ より多いことは必須である。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：直近に化学療法を受けた患者に腫瘍型人工関節置換術を施行する際、血清白血球数に留意すべきか？

著者：Michiel van de Sande, Hiroyuki Tsuchiya, Daisuke Inoue, John Strony 翻訳者：三輪真嗣、土屋弘行

推奨：化学療法と腫瘍型人工関節置換術後感染の関係は、不明である。しかしながら、様々な治療方針決定プロセスの一つとして、腫瘍型を施行する前に血清白血球数に留意することは有益かもしれない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 4：SSI/PJI の発生率を最小とする術前化学療法／放射線療法から腫瘍切除術までの待機期間は？

著者：Germán Luis Farfalli, Peter Choong, Sam Francis 翻訳者：三輪真嗣、土屋弘行

推奨：知見はない。SSI/PJI の発生率を最小とする術前化学療法／放射線療法から腫瘍切除までの最適な待機期間を示唆するデータは存在しない。個々の患者における複数の因子が、術前療法後に腫瘍型人工関節置換術を行う最適な待機期間の決定に関与する可能性がある。創合併症の発生に関して、術前放射線療法と手術の時期との間に有意な相関は示されていないが、放射線治療後 3 ～ 6 週で手術が施行されると創合併症の発生率が低い傾向にある。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 5：化学療法または放射線療法を受けた患者に腫瘍型人工関節置換術を行う場合、SSI/PJI のリスクを最小とするためには、どのような対策を講ずるべきか？

著者：João Paulo Fonseca de Freitas, Diogo Moura, Arash Aalirezaie, John Abraham,* John Strony,* Keenan Sobol*

翻訳者：三輪真嗣、土屋弘行

推奨：化学療法または放射線療法を受けた後に腫瘍型人工関節置換術を行う患者に対して適切な感染予防対策を講ずるべきである。抗菌加工インプラント、第 1 世代セファロスポリンやアミノグリコシドおよび／またはバンコマイシンのような術後予防抗菌薬の投与期間延長（術後 24 時間以上）と増量、そして軟部組織再建の追加を考慮してよい。また、こうした患者に対する手術は迅速に行い、軟部組織の剥離は愛護的かつ最小限とすべきである。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

1.3. 予防：研究関連事項

質問 1：悪性骨腫瘍切除後の腫瘍型人工関節における SSI/PJI の有意な危険因子は？

著者：Rodolfo Capanna, Ivan Boháček, Lorenzo Andreani 翻訳者：森井健司

推奨：SSI/PJI の危険因子として、患者関連因子では BMI が大きいこと、並存疾患群の存在、表在感染あるいは皮膚壊死の存在、術前低ヘモグロビン値お

よび低アルブミン値が挙げられる。疾患関連因子として、脛骨近位、骨盤、または大腿骨近位から骨盤へ伸展する病変が挙げられる。さらに、治療関連因子として、術前 48 時間以上の在院、脛骨近位 37% 以上の切除、大腿骨遠位例において大腿四頭筋の 3 頭以上の切除、長い手術時間（2.5 時間以上）、腫瘍型人工関節のセメント固定、術後集中治療室への入室、多い術後輸血量（2 単位以上）、術後血腫、メガプロステシスによる再建後追加的の外科処置が挙げられる。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：腫瘍型人工関節抜去後、再置換術を行う最適な時期の決定に用いるべき指標は？

著者：Roberto Velez, Michelle Ghert, James Yan, Matias Vicente 翻訳者：森井健司

推奨：腫瘍型人工関節抜去後の再挿入を行うにあたって、手術部位から感染が消失したことを確認しなければならない。これは、抗菌薬投与後の関節腔からの吸引物が無菌であることで検証される。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

1.4. 予防：手術手技

質問 1：骨軟部腫瘍手術でドレーンチューブを用いると、SSI/PJI のリスクは増加するか？

著者：Aare Mårtson, Oscar Ares, Jacek Markuszewski, Ignacio Moya, Andrea Sallent 翻訳者：森井健司

推奨：骨軟部腫瘍手術をうける患者に対するドレーンは、症例を選別して適応すべきである。使用する場合には、継続的なモニタリングを行い、排液が十分に減少したと臨床的に判断したなら、早急に抜去すべきである。現在証明されていないが、ドレーンの使用と人工物を挿入する整形外科手術後の SSI/PJI リスク増加には、関連性がある可能性がある。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 2：腫瘍型人工関節置換術の SSI/PJI のリスクを低下させるには、ドレーンを抜去する最適な時期は？

著者：Christina Gutowski, Michelle Ghert, Anthony Bozzo, Marc Levine 翻訳者：三輪真嗣、土屋弘行

推奨：術後 24 時間以内のドレーン抜去を推奨する。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 3：腫瘍型人工関節の固定法(セメント vs 非セメント)は SSI/PJI の発生率に影響を与えるか？

著者：Richard O'Donnell, John Strony 翻訳者：林克洋、土屋弘行

推奨：この話題に対しては、相反するエビデンスがある。多くの研究結果が、セメント使用の腫瘍型人工関節の優位性を示している一方、非セメント固定の腫瘍型人工関節の優位性を示した報告も見受けられる。したがって、固定法は、SSI/PJI に与える影響よりも、臨床的適応に基づいて決定されるべきである。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 4：抗菌材料(ヨード)を含有した粘着ドレープは、骨軟部腫瘍手術における SSI/PJI のリスクに影響するか？

著者：Takeshi Morii, Timothy L. Tan 翻訳者：森井健司

推奨：抗菌材料を含有した粘着ドレープにより、術野の細菌が減少するというエビデンスがある。しかし、この処置により SSI/PJI のリスクが低下するというエビデンスは乏しい。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 5：腫瘍型人工関節による再建を受ける患者において、軟部組織縫着に使用されるメッシュは、PJI のリスクを増加させるか？

著者：Aare Mårtson, Irene Kalbian 翻訳者：林克洋、土屋弘行

推奨：現在報告されている文献では、軟部組織縫着のために使用されたメッシュは PJI のリスクを増加させないとしている。しかしながら、腫瘍の種類または手術部位を揃えた条件下で、メッシュ使用と非使用群を直接比較した報告はほとんどない。したがって、メッシュの使用が PJI に関係しないことを明言するためには、さらなる包括的な研究が必要である。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問6：腫瘍型人工関節や同種骨は、挿入前に抗菌薬含有液や消毒液に浸すべきか？

著者：R. Lor Randall, Antonios I. Papadopoulos, John S. Groundland 翻訳者：林克洋、土屋弘行

推奨：知見はない。挿入前に腫瘍型人工関節や同種骨を抗菌薬含有液や消毒液に浸したことで、SSI/PJI を低下させたことを支持するエビデンスはない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問7：原発性骨腫瘍切除術をうける患者において、銀またはヨード(Silver/iodine)をコーティングした人工関節が使われるべきか？

著者：Muhammad Ather Siddiqi, A. Mazhar Tokgözoğlu 翻訳者：林克洋、土屋弘行

推奨：使用されるべきである。原発性骨腫瘍切除術後感染を予防するという点において、銀またはヨードコーティングの人工関節は、良好な結果を示している。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問8：抗菌薬含有セメント、銀コーティングインプラント、ヨードコーティングインプラント、バンコマイシンパウダー局所散布、ドレーンチューブなどからの抗菌薬注入などのうち、患肢温存術における最適な局所感染制御法は？

著者：Mitchell Schwaber, Yaakov Dickstein, Elizabeth Temkin 翻訳者：林克洋、土屋弘行

推奨：知見はない。患肢温存術を受ける腫瘍患者において、局所感染制御法を直接比較した報告はない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

1.1. PREVENTION: ANTIBIOTIC PROPHYLAXIS

QUESTION 1: Is there a correlation between operative time and the risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI) in patients undergoing tumor resection and endoprosthetic reconstruction? If so, should postoperative antibiotics be prolonged in these patients?

RECOMMENDATION: Based largely on the arthroplasty literature, there is considerable evidence that prolonged operative time is associated with an increased risk for postoperative infection. However, there is insufficient evidence to suggest that a prolonged postoperative antibiotic regimen can mitigate this risk. Therefore, there is no evidence to support prolonged postoperative antibiotics in orthopaedic oncology patients undergoing surgeries of prolonged duration. If the duration of the procedure exceeds two half-lives of the prophylactic antimicrobial, intraoperative redosing is needed to ensure adequate serum and tissue concentrations of the antimicrobial.

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QUESTION 2: Should factors like preoperative radiation, soft tissue vs. bone resection, presence of metal vs. structural allograft and other factors influence the dose and duration of antibiotic prophylaxis?

RECOMMENDATION: Should factors like preoperative radiation, soft tissue vs. bone resection, presence of metal vs. structural allograft and other factors influence the dose and duration of antibiotic prophylaxis?

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QUESTION 3: Should patients with an oncologic endoprosthesis in place receive antibiotic prophylaxis during dental procedures?

RECOMMENDATION: Not routinely. Evidence-based guidelines by dentists and orthopaedic surgeons state that antibiotic prophylaxis is rarely appropriate for patients with prosthetic joints.

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QUESTION 4: Should prophylactic antibiotics be started in patients with an oncologic endoprosthesis who develop neutropenia secondary to postoperative chemotherapy?

RECOMMENDATION: Not routinely. Evidence-based guidelines recommend limiting the routine use of prophylactic antibiotics to high-risk patients with chemotherapy-induced neutropenia.

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QUESTION 5: What type, dose and duration of prophylactic antibiotic(s) should be administered to patients undergoing oncologic endoprosthetic reconstruction who have received or will be receiving chemotherapy and/or radiation?

RECOMMENDATION: Antibiotic prophylaxis should be given in accordance with existing guidelines for standard arthroplasty surgery and other orthopaedic surgical procedures with foreign body placement.

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QUESTION 6: Does the type, dose, and duration of antibiotic prophylaxis differ for patients undergoing oncologic endoprosthetic reconstruction compared to conventional total joint arthroplasty (TJA)?

RECOMMENDATION: No. There is no recommendation to adjust type, dose or duration of antibiotic prophylaxis in patients undergoing oncologic endoprosthetic reconstruction from that which is routinely administered in conventional TJA.

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1.2. PREVENTION: CHEMOTHERAPY

QUESTION 1: Do we need to evaluate the gut and skin microbiome of patients after chemotherapy to assess the risk for potential infection after endoprosthetic reconstruction?

RECOMMENDATION: Unknown. There is no evidence in the literature to suggest that evaluation of the gut and/or skin microbiome following chemotherapy aids with risk stratification for potential infection in patients undergoing endoprosthetic limb salvage surgery.

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QUESTION 2: Should an absolute neutrophil count of $> 1000/\text{mm}^3$ be the minimum for patients undergoing limb salvage surgery after receiving chemotherapy?

RECOMMENDATION: Yes. An absolute neutrophil count of $> 1000/\text{mm}^3$ should be the minimum for patients undergoing limb salvage surgery after receiving chemotherapy.

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QUESTION 3: Should the serum white blood cell (WBC) count be taken into account prior to endoprosthetic reconstruction in patients who have undergone recent chemotherapy?

RECOMMENDATION: The association between chemotherapy and infection following endoprosthetic reconstruction remains controversial. However, in a multifactorial decision making process, there may be some benefit in accounting for the serum WBC count prior to endoprosthetic reconstruction.

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QUESTION 4: What should be the time delay between preoperative chemo/radiotherapy and a surgical tumor resection in order to minimize incidence of surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Unknown. There is no data that supports the best time delay between preoperative chemo/radiotherapy and a surgical tumor resection to minimize the incidence of SSI/PJI. There are multiple intrinsic factors of each patient that can determine the best time to implant an endoprosthesis after a neoadjuvant treatment. Although no significance was seen between preoperative radiotherapy and surgical timing on wound complications (WC), trends suggest rates are lower if surgery is performed between 3 and 6 weeks following radiotherapy.

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QUESTION 5: What strategies should be implemented to minimize the risk of surgical site infection/periprosthetic joint infection (SSI/PJI) in patients who have received chemotherapy or radiation therapy and are undergoing endoprosthetic reconstruction?

RECOMMENDATION: We believe patients who have received either chemotherapy or radiotherapy prior to endoprosthetic reconstruction should undergo extensive medical optimization. Consideration may also be given to the use of antimicrobial coated implants, extended (>24 h) and augmented postoperative antibiotic prophylaxis consisting of a first-generation cephalosporin and an aminoglycoside and/or vancomycin, as well as use of enhanced soft tissue reconstruction techniques. Surgery should also be expeditious in these patients minimizing dissection of soft tissues with gentle handling.

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1.3. PREVENTION: RESEARCH CAVEATS

QUESTION 1: What are the significant risk factors for surgical site infection/periprosthetic joint infection (SSI/PJI) of an oncologic endoprosthesis following resection of a malignant bone tumor?

RECOMMENDATION: Patient-related risk factors for SSI/PJI of an oncologic endoprosthesis include increased patients' body mass index, overall presence of comorbidities, coexistence of superficial SSI or skin necrosis and lower preoperative hemoglobin or albumin levels. Disease-related risk factors for SSI/PJI of an oncologic endoprosthesis include lesion localization in proximal tibia, pelvis and lesion extending to pelvis from proximal femur. In addition, procedure related risk factors for SSI/PJI include preoperative hospitalization longer than 48 hours, resection of greater than 37% of the proximal tibia, resection of 3 or 4 heads of the quadriceps muscle in distal femoral lesions compared to 1 or 2 heads, increasing surgical time (longer than 2.5 h), use of cemented oncologic endoprosthesis, need for postoperative admission to the intensive care unit, increased postoperative blood transfusion requirement (2 or more units of allogeneic packed cells), presence of postoperative hematoma and the need for additional surgical procedures after the megaprosthesis implantation.

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QUESTION 2: What metrics should be used to determine the optimal timing of reimplantation for patients with a resected oncologic endoprosthesis?

RECOMMENDATION: Prior to reimplantation of an oncologic endoprosthesis after a previous resection, surgeons must ensure that the infection has been eradicated from the surgical bed. This would be determined via a sterile aspirate from the joint cavity following the antibiotic treatment.

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1.4. PREVENTION: SURGICAL TECHNIQUE

QUESTION 1: Is there an increased risk for subsequent surgical site infection/periprosthetic joint infection (SSI/PJI) when a drainage tube is used in musculoskeletal tumor surgery?

RECOMMENDATION: Surgical drains should be used selectively in patients undergoing musculoskeletal tumor surgery. If used, they should be continuously monitored and removed immediately once output has decreased adequately per clinical judgment. There is a potential, yet.

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QUESTION 2: When should a surgical drain be removed to minimize the risk of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI) in patients who have received endoprosthetic reconstruction (EPR) following resection of a musculoskeletal tumor?

RECOMMENDATION: Based on the available literature, we recommend drains be removed within 24 hours of surgery.

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QUESTION 3: Does the type of fixation (cemented vs. uncemented) of an oncologic endoprosthesis influence the incidence of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: There is conflicting evidence surrounding this topic. Multiple studies have demonstrated superiority with cemented fixation of an oncologic endoprosthesis while others have suggested superiority with uncemented fixation. Therefore, the choice of the method of fixation should be made on the basis of all clinical indications, other than the influence of fixation on subsequent SSI/PJI.

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QUESTION 4: Does the use of incise draping with antibacterial agents (iodine) influence the risk for subsequent surgical site infection/periprosthetic joint infection (SSI/PJI) in patients undergoing musculoskeletal tumor surgeries?

RECOMMENDATION: There is some evidence claiming that antimicrobial-impregnated incise drapes result in a reduction in bacterial contamination at the surgical site. However, there is little evidence to demonstrate that it results in a subsequent reduction in the incidence of SSI and/or PJI.

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QUESTION 5: Does the use of soft tissue attachment meshes increase the risk for subsequent periprosthetic joint infection (PJI) in patients undergoing oncologic endoprosthetic reconstruction?

RECOMMENDATION: The current literature indicates that there is no increased risk of PJI in this patient population with the use of soft tissue attachment meshes. However, there are few studies directly comparing the use of mesh vs. not using mesh in comparable tumors/surgical locations, so further comprehensive study on the topic is necessary to say with reasonable certainty that there is no connection.

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QUESTION 6: Should endoprosthesis and/or allograft bone be soaked in antibiotic solution or antiseptic solutions prior to implantation in patients?

RECOMMENDATION: Unknown. There is no evidence to suggest that the use of a pre-implantation antibiotic or antiseptic soak of an endoprosthesis or massive allograft would reduce the rate of surgical site infection/periprosthetic joint infection (SSI/PJI).

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QUESTION 7: Should a coated prosthesis (silver/iodine) be used for reconstruction of patients undergoing primary bone tumor resection?

RECOMMENDATION: Yes, silver coating and iodine coating of prosthesis show good results in prevention of infection after reconstruction following primary tumor resection.

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QUESTION 8: What is the most optimal local antimicrobial delivery strategy during limb salvage: antibiotic cement, silver-coated implant, iodine-coated implant, topical vancomycin powder, injection of antibiotics via drain tubing or other?

RECOMMENDATION: Unknown. No direct comparison has been made of different antimicrobial delivery strategies in oncological patients undergoing limb salvage procedures.

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2.1. 治療：洗浄とデブリドマン

質問1：感染した腫瘍型人工関節に対して洗浄デブリドマン(I&Ds)を何回行ったら人工関節を抜去すべきか？

著者：Oscar Ares, John Abraham, John Strony, Keenan Sobol, Ignacio Moya, Andrea Sallent 翻訳者：森井健司

推奨：DAIRを繰り返すか否かの決定は、合併症、細菌の病原性、再建法の難易度および軟部組織の状態に基づいてなされるべきである。2ないし3回を超えるDAIRは成功困難であると考ええる。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：腫瘍型人工関節の急性再感染に対してどのように治療すべきか？

著者：João Paulo Fonseca de Freitas, Faiz Shivji, Scot A. Brown, Diogo Moura, Isabel Ferreira, Michael J. Petrie, John Strony

翻訳者：林克洋、土屋弘行

推奨：腫瘍型人工関節をもつ患者の急性再感染に対しては、抗菌薬の長期投与単独での治療は不十分であるため、観血的治療を必要とする。急性再感染の場合の最も適切な治療は、コンポーネントの置換とDAIRである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、強いコンセンサス）

質問3：腫瘍型人工関節の急性PJIの治療において、洗浄デブリドマンとモジュラー交換は治療のオプションとなるか？ もしそうであるならば、適応の条件は？

著者：Paul Jutte, Hesham Abdelbary, Claudia Löwik 翻訳者：森井健司

推奨：オプションとなりうる。人工関節の一部を体内に残してDAIRを行うことは、感染した人工関節をもつ患者を管理する上でのオプションである。この方法は、早期（術後3ヶ月以内）表在感染例、症状の発現が短期（3週間以内）である場合、インプラントが強固に固定されている症例、（抗菌薬に）高い感受性があり特性が十分同定されている原因菌である場合に選択肢となりうる。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

2.2. 治療：一期的再置換術

質問1：感染した腫瘍型人工関節をもつ患者に対して、ヨードコーティングまたは銀コーティングのインプラントは一期的置換術を可能にするか？

著者：Michiel van de Sande, Hiroyuki Tsuchiya, Daisuke Inoue 翻訳者：林克洋、土屋弘行

推奨：知見はない。最近の文献では、インプラント表面に処理を施したインプラント（つまり銀コーティングやヨードコーティングインプラント）の優位性が示されている。近年施行されたエビデンスレベルが低く小規模な解析において、感染した腫瘍型人工関節の治療のための一期的再置換術において、表面処理したインプラントの有用性が示唆されている。現時点ではエビデンスが十分とはいえず、今後の大規模かつ質の高い研究が必要とされる。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：腫瘍型人工関節に感染を発生した患者において、一期的人工関節再置換術は有用か？

著者：Michelle Ghert, Roberto Velez, Johnathan R. Lex, Andrea Sallent, Philip Linke 翻訳者：森井健司

推奨：エビデンスは不十分であるが、原則として、一期的再置換術を行う際の一般的要件を満たす場合には、感染した腫瘍型人工関節に対し一期的再置換術を適応しうる。ただし、人工関節の抜去で、より良好な感染管理を得ることができるので、アンカーを抜去せずに一期的再置換術を行うことを推奨しない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

2.3. 治療：研究関連事項

質問1：腫瘍型人工関節に発生したPJIの管理法は、通常型の表面置換型人工関節に発生した場合と違う方法をとるべきであるか？

著者：Germán Luis Farfalli, Peter Choong, Sam Francis 翻訳者：森井健司

推奨：変更すべきでない。腫瘍型人工関節に発生したPJIの管理法は、表面置換型人工関節に発生した場合と同様である。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

2.4. 治療：二期的再置換術

質問1：感染した腫瘍型人工関節を持つ患者において、二期的再置換術の成績の改善に関与する因子は？

著者：Paul Jutte, Hesham Abdelbary, Claudia Löwik 翻訳者：林克洋、土屋弘行

推奨：二期的再置換術の治療成績改善に関与する因子は、一般的な再置換術に関連するものと、腫瘍切除後という特殊な状況に関連するものが、複数存在している。これらには、宿主関連因子（例えば、貧血、低栄養、高血糖、免疫不全状態などのような宿主状態の最適化）、細菌関連因子（例えば、適切な全身または局所への抗菌薬投与）、手術関連因子（徹底的な骨軟部組織のデブリドメント、軟部組織の最適な管理、術後合併症の予防など）が含まれる。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、強いコンセンサス）

質問2：感染した同種骨に対する最も適切な再建法は？

著者：Muhammad Ather Siddiqi, A. Mazhar Tokgözoğlu 翻訳者：林克洋、土屋弘行

推奨：感染した同種骨に対する最もよい再建法は、感染した同種骨の除去と、人工関節による再建（二期的再置換術が望ましい）である。

エビデンスレベル：Moderate

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

質問3：腫瘍型人工関節に発生した慢性感染の最適な外科的治療法は？ この方法は化学療法および／又は放射線療法の施行中または施行直後、変更されるか？

著者：John Abraham, Joseph Benevenia, John Strony, Keenan Sobol 翻訳者：森井健司

推奨：腫瘍型人工関節の慢性期感染の治療法として、二期的再置換術を推奨する。しかし我々は一期的再置換術の推奨が増えていることも認識している。化学療法および／又は放射線療法の施行中または施行直後、推奨変更の必要性を示唆した研究はない。

エビデンスレベル：Limited

投票結果：賛成 93%、反対 0%、棄権 7%（大多数、強いコンセンサス）

2.1. TREATMENT: IRRIGATION AND DEBRIDEMENT

QUESTION 1: How many irrigation and debridements (I&Ds) of an infected oncologic endoprosthesis are reasonable before consideration should be given to resection arthroplasty?

RECOMMENDATION: Decision to repeat irrigation and debridement and retention of an infected endoprosthesis (DAIR) should be made based on comorbidities of the host, virulence of the organism, complexity of the reconstruction and status of the soft tissues. We believe DAIR performed more than two or three times is unlikely to be successful.

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QUESTION 2: How should acute reinfection of an oncologic endoprosthesis be treated?

RECOMMENDATION: Acute reinfections in patients with oncologic endoprostheses demand treatment by surgical methods because the long-term administration of antibiotics alone is not sufficient. The most appropriate treatment modality for acute re-infection is debridement, antibiotics and implant retention (DAIR) with exchange of components.

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QUESTION 3: Is irrigation and debridement and exchange of modular parts a viable option for treatment of acute periprosthetic joint infection (PJI) involving oncologic endoprosthesis? If so, what are the indications?

RECOMMENDATION: Yes. Irrigation and debridement with retention of prosthesis (DAIR) is a viable option for management of patients with infected endoprosthesis. The procedure may be offered to patients with superficial early infection (< 3 months), short duration of symptoms (< 3 weeks), well-fixed implants and well-characterized organism demonstrating a highly susceptible pathogen.

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2.2. TREATMENT: ONE-STAGE EXCHANGE

QUESTION 1: Does the use of iodine-coated or silver-coated implants make one-stage exchange arthroplasty possible in the management of patients with infected oncologic endoprosthesis?

RECOMMENDATION: Unknown. Current literature has advocated the advantages of surface-modified coating (e.g., silver-coated, iodine-supported implants). Recently, there have been several low-quality, small-scale studies showing promising results for using surface-modified implants in one-stage exchange arthroplasty to treat infected oncologic endoprosthesis. However, to date there remains unsubstantiated evidence and large-scale, high-level evidence studies are necessitated.

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QUESTION 2: Is there a role for single-stage exchange arthroplasty for patients with infected oncologic endoprosthesis?

RECOMMENDATION: In principle, despite the lack of sufficient evidence, single-stage exchange arthroplasty can be performed in patients with infected oncologic endoprosthesis if the general requirements to perform a single-stage procedure are fulfilled. However, a single-stage revision without removing the anchorage components is not recommended, since better infection control can be achieved when prostheses were removed rather than salvaged.

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2.3. Treatment: RESEARCH CAVEATS

QUESTION 1: Should the management of periprosthetic joint infection (PJI) involving an oncologic endoprosthesis differ from that of conventional joint replacement prostheses?

RECOMMENDATION: No. The management of PJI involving an oncologic endoprosthesis is similar to that of conventional joint replacement prosthesis.

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2.4. TREATMENT: TWO-STAGE EXCHANGE

QUESTION 1: What factors may improve the outcome of a two-stage exchange arthroplasty in patients with an infected oncologic endoprosthesis?

RECOMMENDATION: There are numerous factors that improve the outcome of two-stage exchange arthroplasty in general, and after oncologic reconstruction in particular. These include host-related factors (such as host optimization by treating anaemia, malnutrition, hyperglycemia, immunosuppressive state and so on), organism-related factors (such as administration of appropriate systemic and local antibiotics) and surgery-related factors (such as aggressive debridement of soft tissue and bone, optimal soft tissue management and prevention of postoperative complications).

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QUESTION 2: What is the best reconstruction technique for an infected allograft?

RECOMMENDATION: The best reconstruction technique for an infected allograft is resection of the infected allograft and reconstruction (preferable two-stage) with an endoprosthesis.

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QUESTION 3: What is the best surgical treatment for management of a chronically infected oncologic endoprosthesis? Does this change if the patient is receiving or has received recent chemotherapy and/or irradiation?

RECOMMENDATION: We recommend a two-stage revision in the management of a chronically infected oncologic endoprosthesis; however, we acknowledge that support for a one-stage exchange is increasing. There is no study to suggest that this recommendation should change if the patient is receiving or has received recent chemotherapy and/or irradiation.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

PART VIII

SPORTS

SECTION 1: PREVENTION

SECTION 2: DIAGNOSIS

SECTION 3: TREATMENT

〈監訳者〉

稲垣有佐、田中康仁

質問1：インプラントや移植腱を用いない関節鏡視下手術周術期の予防投与において、どのような抗菌薬が使用されるべきか？ 非アナフィラキシー性またはアナフィラキシー性のペニシリンアレルギー患者ではどう選択されるべきか？

著者：Raul García-Bógalo, Sachin Tapasvi, L. Horna-Castineira, Shantanu Patil 翻訳者：稲垣有佐

推奨：文献的には、インプラントや移植腱を用いない定型的な関節鏡視下手術時の抗菌薬予防投与は支持も反対もされていない。易感染性ではない患者に対する、インプラントを挿入しない関節鏡視下手術時は、抗菌薬予防投与は必要でない。感染のリスクを高めるとされる合併症を有する患者においては、抗菌薬予防投与は有用かもしれない。非アナフィラキシー性のペニシリンアレルギーを有する患者においては、第1世代(セファゾリン)または第二世代(セフトキシム)セファロスポリンが第一選択として使用されうる。アナフィラキシー性のペニシリンアレルギーを有する患者では、バンコマイシン、クリンダマイシン、テイコプラニンといった他の抗菌薬が使用されうる。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：スポーツ傷害に対する手術施行予定の患者に対して、MRSAに対するルーチンのスクリーニングは行われるべきか？

著者：Nirav K. Patel, Andy O. Miller 翻訳者：稲垣有佐

推奨：スポーツ傷害に対する手術施行予定の患者に対して、MRSA に対するルーチンのスクリーニングは必要ではない。スクリーニングは、高リスク患者やより複合的な手術予定患者に関しては適切かもしれない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：MRSA 保因者に対する関節鏡視下手術施行時は、どのような周術期抗菌薬予防投与がされるべきか？

著者：Jacek Kruczyński, António Nogueira de Sousa, Pawel Chodór, Tomasz Andrzejewski, Paweł Kokoszka, Luisa Vital, Joao Lobo

翻訳者：稲垣有佐

推奨：感染に対する高リスク状態や、インプラント・移植腱を用いる関節鏡視下手術を予定されている MRSA 保因者には、手術前にバンコマイシンまたはテイコプラニンが予防投与されるべきである。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：ACL再建術に使用する他家移植腱の滅菌方法として、手術後の感染発生率および移植腱の力学的強度低下を最小限にする方法はなにか？

著者：Sam Oussedik, Sachin Tapasvi, Domenico Ravier, Ilaria Morelli, Shantanu Patil, M.K. Balaji 翻訳者：稲垣有佐

推奨：手術後の感染発生率および移植腱の力学的強度低下を最小限にする、最も適切な ACL 再建術に使用する他家移植腱の滅菌法は放射線照射（可能であれば 1.8Mrad 未満）である。他家移植腱はできるだけ無菌的に採取され、新鮮凍結保存されたものであるべきである。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問5：ACL再建術時、自家あるいは他家移植腱は、その移植前に殺菌的あるいは抗菌的溶液に浸漬されるべきか？

著者：Jacek Kruczyński, Christopher Dodson, Pawel Chodór, Tomasz Andrzejewski, Christopher Hadley 翻訳者：稲垣有佐

推奨：ACL 再建術時、自家移植腱は、その移植前に抗菌的溶液に浸漬されるべきである。

エビデンスレベル：Moderate

投票結果：賛成 91%、反対 9%、棄権 0%（大多数、強いコンセンサス）

質問6：ACL再建術時、手術室の床に落下した ACL 移植腱の最も適切・効果的な殺菌法はなにか？ または、その移植腱は廃棄し、新たな移植腱を用いるべきか？

著者：Carl Haasper, Sommer Hammoud, Sage Vincent 翻訳者：稲垣有佐

推奨：ACL 移植腱が手術室の床に落下した際は、汚染された移植腱を 4% グルコン酸クロルヘキシジン溶液で洗浄することが、最も効果的な除染方法である。落下した ACL 移植腱をグルコン酸クロルヘキシジン溶液で除染した後の感染率は非常に低いため、その移植腱を廃棄する必要はないと考えられる。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 7：駆血帯の使用は、四肢関節に対する関節鏡視下手術後の SSI 発生率に影響するか？

著者：Matteo Romagnoli, Sandro Kohl, Alberto Grassi, Stefano Zaffagnini, Christopher Hadley 翻訳者：稲垣有佐

推奨：影響しない。駆血帯の使用と四肢関節に対する関節鏡視下手術後の SSI 発生率の直接的関連は証明されていない。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 8：感染歴のある関節に対して、人工関節置換術ではない関節再建手術を施行する際、感染再発率を最小化するためにはどのような方針がとられるべきか？

著者：Ramón Barredo, Roberto Rossi, Nirav K. Patel 翻訳者：稲垣有佐

推奨：過去あるいは最近の感染歴を有する感染に対しては、関節穿刺にて関節液を採取し、感染の有無を分析することを推奨する。予定関節再建術施行時、その対象関節に発赤・腫脹・熱感などのいかなる感染の臨床徴候があってはならない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 9：ACL 再建術後感染に対する外科的処置は緊急で行われるべきか？ その術前に患者の状態を最適化できるか？ そうであれば、何を最適化する必要があるか？

著者：Dragan Radoičić, Ramón Barredo, Eric Wicks 翻訳者：稲垣有佐

推奨：ほとんどの例において、ACL 再建術後感染は緊急の外科的処置は要さない。ACL 再建術後感染に関連した敗血症は緊急の治療を要する。ほとんどの外科医は、ACL 再建術後感染に対する、遅滞のない迅速な外科的処置に同意しており、感染の臨床徴候を認めた同日中に行うことが望ましい。高血糖、出血傾向、貧血、その他合併症といった（訳者 Rationale より引用）患者の状態は術前に最適化される必要がある。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

QUESTION 1: What perioperative antibiotic prophylaxis should be used in patients undergoing arthroscopic surgery without the use of implants or grafts? What about patients with non-anaphylactic or anaphylactic penicillin allergy?

RECOMMENDATION: The literature neither supports nor refutes the use of antibiotic prophylaxis for routine arthroscopic surgeries, without the use of implants or grafts. For non-compromised, non-implant arthroscopy, antibiotic prophylaxis is not required. Patients with comorbidities which have been shown to cause higher risk for infection may benefit from antibiotic prophylaxis. A first-generation (cefazolin) or a second-generation (cefuroxime) cephalosporin can be used as first line, including for those with a non-anaphylactic penicillin allergy. For patients with an anaphylactic penicillin allergy, other antibiotics such as vancomycin, clindamycin or teicoplanin can be used.

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QUESTION 2: Should routine methicillin-resistant *Staphylococcus aureus* (MRSA) screening be in place for patients undergoing elective sports procedures?

RECOMMENDATION: Routine MRSA screening is not warranted for patients undergoing elective sports procedures. Screening may be appropriate in higher-risk patients and patients undergoing more complex procedures.

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QUESTION 3: What perioperative antibiotic prophylaxis should be used in patients undergoing arthroscopic surgery who are methicillin-resistant *Staphylococcus aureus* (MRSA) carriers?

RECOMMENDATION: MRSA carriers should be administered vancomycin or teicoplanin as antibiotic prophylaxis prior to arthroscopic surgery involving an implant and/or a graft or for patients at higher risk of infection.

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QUESTION 4: What is the best method for anterior cruciate ligament (ACL) allograft sterilization to minimize the incidence of postoperative infections and mechanical weakening of the graft?

RECOMMENDATION: The best method for ACL allograft sterilization to minimize the incidence of postoperative infection and mechanical weakening of the graft is the use of irradiation (preferably less than 1.8 Mrad). Allografts should be harvested aseptically and fresh-frozen, whenever possible.

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QUESTION 5: Should autograft or allograft be soaked in an antiseptic or antibiotic solution prior to implantation during anterior cruciate ligament reconstruction (ACLR)?

RECOMMENDATION: Yes, autograft tissue should be soaked in an antibiotic solution prior to implantation during ACLR.

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QUESTION 6: What is the most appropriate/effective sterilization method of an anterior cruciate ligament (ACL) graft dropped on the operating room (OR) floor during ACL reconstruction (ACLR)? Should the tissue instead be disposed and alternate graft acquired?

RECOMMENDATION: Rinsing the contaminated graft in a 4% solution of chlorhexidine gluconate is the most effective decontamination method in the event that an ACL graft is dropped on the OR floor. When a chlorhexidine gluconate solution is used for decontamination of the dropped ACL graft, the subsequent rates of infection are very low, suggesting that there is no need to dispose of the ACL graft.

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QUESTION 7: Does the use of a tourniquet influence the incidence of surgical site infection (SSI) following arthroscopic surgery of extremity joints?

RECOMMENDATION: No. A direct relationship between use of a tourniquet for arthroscopic surgery of the extremity joints and the incidence of SSI has not been established.

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QUESTION 8: What strategies should be employed to minimize recurrent infection of a previously infected joint during subsequent joint reconstructive (non-arthroplasty) procedures?

RECOMMENDATION: We recommend that joints with remote or recent history of infection be aspirated and the synovial fluid analyzed for the presence of infection. The affected joint should not exhibit any clinical signs of infection such as erythema, swelling, warmth and others at the time of planned reconstruction.

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QUESTION 9: Is the surgical management of a patient with infection following anterior cruciate ligament reconstruction (ACLR) an emergency, or can the patient be optimized prior to surgical intervention? If so, what needs to be optimized?

RECOMMENDATION: Infection following ACLR is not a surgical emergency in most cases. Sepsis associated with infected anterior cruciate ligament (ACL) requires an emergency treatment. Most surgeons agree that surgical intervention should take place without delay, on a prompt basis, preferably on the same day as the clinical presentation of an ACLR infection. The patient's condition needs to be optimized prior to surgery.

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質問1：膝関節感染に対して関節鏡視下手術を行う際に、培養検体は採取するべきか？ その場合、検体はいくつ必要でどこから採取するべきか？

著者：Arnaldo Hernandez, Roberto Rossi 翻訳者：本田賢二

推奨：培養検体は採取するべきである。3つの検体をそれぞれ別の箇所から採取するべきである。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：ACL再建術後の感染を診断するためにはどのような診断アルゴリズムを用いるべきか？

著者：Sam Oussedik, Kevin Plancher, Ilaria Morelli, Domenico Ravier, Nimit Patel 翻訳者：本田賢二

推奨：ACL再建術後感染の診断アルゴリズムには、臨床所見や、CRPを含む血清学的検査の結果を含むべきである。

エビデンスレベル：Moderate

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

QUESTION 1: Should culture samples be taken during arthroscopic treatment of a knee joint infection? If so, how many and from which area in the joint?

RECOMMENDATION: Yes, culture samples should be taken during arthroscopic treatment of a knee joint infection. We recommend that at least three culture samples from different sites be taken.

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QUESTION 2: What diagnostic “algorithm” should be used to diagnose infection following anterior cruciate ligament reconstruction (ACLR)?

RECOMMENDATION: The “algorithm” to diagnose postoperative infection in patients with ACLR should include clinical presentation, serological tests including C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) and analysis of the synovial fluid aspirate including gram staining and culture.

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質問 1：関節鏡視下手術は非術後の急性膝関節感染の治療に行うことができるか？

著者：Robert van der Wal, James Murray, Clare Taylor 翻訳者：岡村建祐

推奨：関節鏡視下手術は非術後の急性膝関節感染の治療に行うことができる。**エビデンスレベル：**Moderate**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問 2：非術後の膝関節感染に対する関節鏡視下手術ではどのような灌流液が使用されるべきか？**

著者：Kevin Plancher, Roberto Rossi, Nirav K. Patel 翻訳者：岡村建祐

推奨：非術後の膝関節感染に対する関節鏡視下手術用灌流液として、抗菌薬を含まない大量の生理食塩水が推奨される。**エビデンスレベル：**Limited**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問 3：滑膜切除術は急性の ACL 再建術後感染に対する関節鏡視下手術時に必ず行われるべきか？**

著者：Carl Haasper, Christopher Hadley 翻訳者：岡村建祐

推奨：全てのあるいは部分的滑膜切除術は、重症例や慢性例に対して行われるべきである。**エビデンスレベル：**Limited**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問 4：急性の ACL 再建術後感染に対する治療時には、移植腱やすべての固定材料は抜去されるべきか？**著者：Alan Ivković, Jacek Kruczyński, Raul García-Bógalo, Barbara Kunovac, Tomasz Jopek, Katarzyna Grbowska, L. Horna-Castineira
翻訳者：岡村建祐**推奨：**ACL 再建術後感染に対する初期治療は、関節鏡視下手術による灌流、デブリドマン、移植腱と固定材料の温存、経静脈抗菌薬投与である。**エビデンスレベル：**Moderate**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問 5：ACL 再建術後感染治療において、移植腱や固定材料の抜去を検討する前に、何回の関節鏡視下手術が妥当であるか？**

著者：Alan Ivković, Rocco Papalia, Christopher Dodson, Barbara Kunovac, Christopher Hadley, Eric Wicks 翻訳者：岡村建祐

推奨：ACL 再建術後感染治療において、移植腱や固定材料の抜去を検討する前に、少なくとも 2 回の関節鏡視下手術が妥当である。さらなる関節鏡視下手術により、移植腱温存に成功したエビデンスがある。**エビデンスレベル：**Moderate**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問 6：ACL 再建術後感染治療において、関節切開術を検討する前に、何回の関節鏡視下手術が妥当であるか？**

著者：Jacek Kruczyński, Nirav K. Patel 翻訳者：岡村建祐

推奨：ACL 再建術後の感染膝関節に対する治療として、必要であれば、6 回までの関節鏡視下デブリドマンは妥当である。ACL 再建術後感染治療における関節切開術の適応は、明確に定義されていない。**エビデンスレベル：**Limited**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問 7：ACL 再建術後の感染に対する外科的デブリドマン後、どのくらいの抗菌薬治療期間が適切か？ 自家または他家移植腱の温存によってその期間は変わるか？**

著者：Rocco Papalia, Andy O. Miller, Christopher Hadley 翻訳者：岡村建祐

推奨：ACL 再建術後の感染に対する外科的デブリドマン後、4 週から 6 週間は抗菌薬を投与されるべきであるが、臨床所見の消失や検査値の正常化により、終了してもよい。渉猟しえた文献では、移植腱の抜去と温存による抗菌薬治療期間の区別は明らかではない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 8：ACL 再建術後の感染に対する外科的デブリドマン後、リハビリテーションプロトコルは変更されるべきか？もしそうであれば、可動域訓練や荷重はどのように変更されるべきか？

著者：Giuseppe Calafiore, James Murray, Clare Taylor, Nimit Patel 翻訳者：岡村建祐

推奨：ACL 再建術後の感染に対する外科的デブリドマン後、リハビリテーションプロトコルの大きな変更は推奨されない。授動あるいは介助下関節可動域運動を通して、関節拘縮の予防や、関節可動域の再獲得に尽力されるべきである。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問 9：ACL 再建術後感染に対する治療後、どの程度経てば、ACL 再々建術は安全に施行できるか？

著者：Arnaldo Hernandez, Sommer Hammoud, Christopher Hadley 翻訳者：岡村建祐

推奨：臨床的症状の消失や検査所見の正常化によって判断された ACL 再建術後感染に対する治療の完遂後は、ACL 再々建術は安全に施行できると考えられる。文獻的には、感染の鎮静化後、安全といえる特定の期間を示すことはできない。

エビデンスレベル：Consensus

投票結果：賛成 92%、反対 0%、棄権 8%（大多数、強いコンセンサス）

QUESTION 1: Can arthroscopy be used for management of patients with acute sepsis of the native knee joint?

RECOMMENDATION: Yes. Arthroscopy can be used for treatment of acute sepsis of the native knee joint.

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QUESTION 2: What type of lavage solution should be used in patients with a native knee infection being treated with arthroscopy?

RECOMMENDATION: We recommend that high volumes of saline without antibiotics should be used as the arthroscopic lavage solution for native knee infection.

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QUESTION 3: Should a synovectomy routinely be performed during arthroscopic treatment of an acute infection following anterior cruciate ligament reconstruction (ACLR)?

RECOMMENDATION: No. Total or partial synovectomy should be reserved for cases of severe or chronic infection.

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QUESTION 4: Should the graft and all hardware be removed in the treatment of patients with an acute infection following anterior cruciate ligament reconstruction (ACLR)?

RECOMMENDATION: The initial approach to an acute infection following ACLR should be arthroscopic irrigation and debridement, retention of a stable graft and hardware and intravenous antibiotic therapy.

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QUESTION 5: How many arthroscopic procedures are reasonable for the management of an infected anterior cruciate ligament reconstruction (ACLR) prior to considering graft and hardware removal?

RECOMMENDATION: Prior to considering stable graft and hardware removal, at least two arthroscopic procedures are reasonable for the management of an infected ACLR. There is evidence for successful treatment and graft retention with further arthroscopic procedures.

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QUESTION 6: How many arthroscopic procedures are reasonable for the management of an infected anterior cruciate ligament reconstruction (ACLR) prior to considering arthroscopy?

RECOMMENDATION: It is reasonable to treat acute infection of the knee following ACLR with arthroscopic debridement, repeating the arthroscopy up to six times, if necessary. The use of arthroscopy in the management of infected anterior cruciate ligament (ACL) cases is not well defined.

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QUESTION 7: What is the optimal duration of antibiotic treatment after surgical debridement of an infected anterior cruciate ligament reconstruction (ACLR)? Should this be altered when autograft or allograft is retained?

RECOMMENDATION: Following surgical debridement of an infected anterior cruciate ligament (ACL), antibiotic treatment should be administered for four to six weeks and can be discontinued upon resolution of clinical signs and normalization of laboratory parameters. The available literature does not differentiate between retention or removal of autograft or allograft.

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QUESTION 8: Should the rehabilitation protocol be modified after surgical debridement of an infected anterior cruciate ligament reconstruction (ACLR)? If yes, what changes should be made with regards to range of motion and weightbearing status?

RECOMMENDATION: We recommend that rehabilitative treatment after surgical debridement of an infected ACLR with graft retention should not differ substantially from primary reconstruction; it should be focused on preventing stiffness and regaining motion through passive and active-assisted range of motion exercises

before progressing.

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QUESTION 9: When can patients safely undergo revision anterior cruciate ligament reconstruction (ACLR) following treatment for prior infection?

RECOMMENDATION: It is considered safe to perform a revision ACLR following completion of successful treatment for infection and normalization of clinical and laboratory parameters upon resolution of the infection. The literature does not suggest a specific timeframe following resolution of the infection prior to performing revision ACLR.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

PART IX

ELBOW

SECTION 1: PREVENTION

SECTION 2: DIAGNOSIS

SECTION 3: TREATMENT

〈監訳者〉

松下和彦

質問 1：TEA を行う患者に対する予防投与として適切な抗菌薬は？

著者：Raul Barco Laakso, Samuel Antuña 翻訳者：松下和彦

推奨：初回に TEA を行う患者は、局所に存在するグラム陽性・陰性菌をカバーする抗菌薬を投与する。査読のある文献は、体重に基づいたセファゾリンの投与を支持している。MRSA を保菌している患者は、体重に基づいたグリコペプチド系薬を投与すべきで、セファゾリンとの併用が望ましい。真のアレルギー反応や副作用でセファゾリンを投与できない場合は、グリコペプチド系薬あるいはクリンダマイシンを投与する。

エビデンスレベル：Consensus**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問 2：初回 TEA あるいは TEA 再置換時の抗菌薬含有骨セメント (ALBC) 使用のエビデンスと推奨は？**

著者：Pierre Mansat, Bernard Morrey 翻訳者：松下和彦

推奨：初回 TEA あるいは再置換時における ALBC の使用を支持するエビデンスは不十分である。

エビデンスレベル：Consensus**投票結果：**賛成 96%、反対 0%、棄権 4%（満場一致、最も強いコンセンサス）**質問 3：既往手術（関節鏡、骨折の内固定、人工関節置換術以外の他の手術）は、TEA 後の PJI のリスクを増大させるか？**

著者：Raul Barco Laakso, Samuel Antuña 翻訳者：松下和彦

推奨：患側肘関節の既往手術は、感染率を明らかに増加させる。しかし、関連性は確固たるものではなく、さらなる検討が必要である。

エビデンスレベル：Limited**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**QUESTION 1: What are the optimal prophylactic perioperative antibiotics for patients undergoing total elbow arthroplasty (TEA)?**

RECOMMENDATION: Patients undergoing primary TEA should receive antibiotics that cover gram-positive and gram-negative organisms specific to the regionally encountered organisms. Peer-reviewed literature supports that cefazolin should be dosed based on body weight. Patients with methicillin-resistant *Staphylococcus aureus* (*S. aureus*) colonization should receive weight-based glycopeptide, preferably in combination with cefazolin. Patients with a true hypersensitivity reaction or adverse reaction that precludes the use of cefazolin should receive vancomycin or clindamycin.

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QUESTION 2: What is the evidence and recommendation for the use of antibiotic-laden bone cement (ALBC) in primary total elbow arthroplasty (TEA) or in revision TEA?

RECOMMENDATION: There is inadequate evidence to support the use of ALBC during primary or revision TEA.

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QUESTION 3: Does previous surgery (arthroscopic, fracture fixation, other non-arthroplasty) increase the risk of subsequent elbow periprosthetic joint infection (PJI) after total elbow arthroplasty (TEA)?

RECOMMENDATION: There is an apparent increase in the percentage of infections among patients with a previous operation in the affected elbow joint, though the association is not robust and needs to be further analyzed.

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質問1：TEA後の疼痛肘における関節穿刺はPJIの鑑別診断に有用か？

著者：Ilya Voloshin, Theodore Blaine 翻訳者：山本豪明、松下和彦

推奨：：感染が疑われる TEA 後の疼痛肘において、術前の関節穿刺は診断に役立つ。**エビデンスレベル：**Limited**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問2：人工肘関節のPJI評価におけるESR、CRPあるいは白血球(WBC)の意義は？**

著者：Mark Mighell, Mark Frankle 翻訳者：山本豪明、松下和彦

推奨：ESR、CRP および WBC は PJI のスクリーニングおよびモニタリングにおいて一定以上の役割を果たすが、現状では検査値の閾値のエビデンスは限られており、外科医の治療方針を導くには限定的と判断する。**エビデンスレベル：**Consensus**投票結果：**賛成 95%、反対 0%、棄権 5%（満場一致、最も強いコンセンサス）**質問3：人工肘関節のPJI診断において術中組織学的検査は有用か？**

著者：Guido Marra, Matthew Ramsey 翻訳者：山本豪明、松下和彦

推奨：術中組織学的検査単独では、肘関節 PJI の診断に十分とは言えない。**エビデンスレベル：**Limited**投票結果：**賛成 92%、反対 4%、棄権 4%（大多数、強いコンセンサス）**質問4：PJIを疑い抜去された肘関節のインプラントに対する超音波処理は有用か？**

著者：Michael McKee, Graham King 翻訳者：山本豪明、松下和彦

推奨：現時点で、肘 PJI で抜去されたインプラントにルーチンで超音波処理することで培養の精度や陽性率が向上するとの根拠はない。**エビデンスレベル：**Limited**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問5：肘PJIの診断で、分子マーカーは有用か？**

著者：Mark Morrey, Shawn O'Driscoll 翻訳者：山本豪明、松下和彦

推奨：人工股・膝関節の PJI の診断における分子マーカーのデータはあるが、TEA における分子マーカーの有用性は不明である。**エビデンスレベル：**Limited**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問6：肘PJIの診断基準は？（臨床基準、X線診断基準、術中所見、病理学、細菌培養および血清バイオマーカー）**

著者：Jonathan Barlow, Joaquin Sanchez-Sotelo 翻訳者：山本豪明、松下和彦

推奨：以下の3つのパラメーターをもって肘 PJI の確定診断とする

- ・人工関節と通じる瘻孔（推奨度：Strong）
- ・滅菌下で採取された2検体以上の検体（組織、関節液）から細菌の同定（推奨度：Strong）
- ・関節内の膿の存在（推奨度：Consensus）

感染に関する次の基準は、総合的に考慮して判断する（推奨度：Limited）

- ・肘の熱感、発赤、腫脹
- ・血清マーカー値（ESR、CRP）の上昇—炎症性関節疾患の症例を除く
- ・関節液中の白血球（WBC）数の増加
- ・関節液中の多形核好中球の割合の上昇
- ・1検体（組織または関節液）からの細菌の分離
- ・急性炎症の組織学的証明
- ・予期しなかった早期のインプラントのゆるみ
- ・骨皮質内側の侵食像（endosteal scalloping）や X 線像での急速な弛み

エビデンスレベル：Consensus**投票結果：**賛成 92%、反対 8%、棄権 0%（大多数、強いコンセンサス）

QUESTION 1: Is there a role for preoperative joint aspiration in the evaluation of the painful elbow arthroplasty for periprosthetic joint infection (PJI)?

RECOMMENDATION: Preoperative joint aspiration can play a role in the evaluation of the painful total elbow arthroplasty (TEA) suspected for infection.

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QUESTION 2: What is the role for serum erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) or white blood cell (WBC) count in the evaluation of an elbow arthroplasty for periprosthetic joint infection (PJI)?

RECOMMENDATION: ESR, CRP and WBC play a role in screening and monitoring for PJI, though evidence is limited regarding specific thresholds and strategies to guide the surgeon when interpreting these values.

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QUESTION 3: What is the role of intraoperative histology examination in the evaluation of an elbow arthroplasty for periprosthetic joint infection (PJI)?

RECOMMENDATION: Intraoperative histology for the evaluation of elbow PJI in isolation is not sufficient for the diagnosis of infection.

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QUESTION 4: Is there a role for sonication of retrieved implants from an elbow in the diagnosis of a possible periprosthetic joint infection (PJI)?

RECOMMENDATION: At present, there is no evidence to support the routine use of sonication of removed elbow implants to improve the diagnostic accuracy or yield of cultures in the diagnosis of elbow PJI.

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QUESTION 5: Do molecular markers have a role in the diagnosis of elbow periprosthetic joint infection (PJI)?

RECOMMENDATION: Despite the presence of data related to the use of molecular markers for the diagnosis of infection in hip and knee arthroplasty, the role of molecular markers in the diagnosis of total elbow arthroplasty (TEA) infection remains unknown.

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QUESTION 6: What are the diagnostic criteria for elbow periprosthetic joint infection (PJI)? (Clinical criteria, radiographic criteria, intraoperative findings, pathology, cultures and serum biomarkers.)

RECOMMENDATION: The following three parameters provide a definitive diagnosis of elbow PJI:

- A sinus tract that is communicating with the prosthesis (Strength: Strong)
- Isolation of identical pathogens from two or more separate cultures (tissue or articular fluid) obtained under sterile conditions (Strength: Strong)
- Presence of intra-articular pus (Strength: Consensus)

The following criteria are concerning for infection and should be considered in aggregate (Strength: Limited):

- Warmth, redness, swelling of the elbow
- Elevated serum inflammatory markers (erythrocyte sedimentation rate (ESR), C-reactive protein (CRP)) –except in cases of inflammatory arthropathies
- Elevated synovial white blood cell (WBC) count
- Elevated synovial polymorphonuclear percentage
- Isolation of organism from one sample (tissue or articular fluid)
- Histologic evidence of acute inflammation
- Early unexpected component loosening
- Endosteal scalloping, rapid progressive loosening on radiographs

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

質問1：急性の肘 PJI において、洗浄とデブリドマンによるインプラントの温存は有用か？ 交換可能なインプラントは交換すべきか？

著者：Mark Cohen, Robert N. Hotchkiss 翻訳者：松下和彦

推奨：急性の肘 PJI の治療で、DAIR は実行可能な選択肢である。交換可能なインプラントを交換することを考慮すべきである。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：急性あるいは慢性の肘 PJI において、一次的あるいは二次的再置換の適応は？

著者：Thomas Throckmorton, Thomas Duquin 翻訳者：松下和彦

推奨：二次的再置換は、慢性の肘 PJI に考慮されるべきである。感染した TEA に対する一次的再置換術の適応ははっきりしていない。しかし、瘻孔があったり、肘周囲の軟部組織の状態が悪い場合や敗血症を伴う場合は、二次的再置換術が推奨される。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：肘 PJI の治療において、二次的再置換術前の関節穿刺は有用か？

著者：Theodore Blaine, Ilya Voloshin 翻訳者：松下和彦

推奨：二次的再置換術前の関節穿刺は有用である。

エビデンスレベル：Consensus

投票結果：賛成 96%、反対 0%、棄権 4%（満場一致、最も強いコンセンサス）

質問4：慢性の肘 PJI の治療において、永久抜去術は有用か？

著者：Akin Cil, Vani Sabesan, Gokhan Karademir 翻訳者：松下和彦

推奨：永久抜去術は慢性 PJI に対する救済手術である。機能的には内顆と外顆を温存することを考慮すべきである。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問5：慢性の肘 PJI の治療において、関節固定術は有用か？

著者：Akin Cil, Vani Sabesan, Gokhan Karademir 翻訳者：松下和彦

推奨：感染した肘に対する関節固定術は、通常有痛性の偽関節を生じたり機能的転帰が不良であるため、有用性は限られている。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問6：感染肘に対する切除関節形成術で、すべての異物(セメントを含む)を除去すべきか？

著者：Bradley Schoch, Felix H. Savoie 翻訳者：松下和彦

推奨：肘 PJI を治療する時は、すべての異物を除去するよう努力すべきである。しかし、すべての異物を除去することのメリットと骨量を温存する困難さとのバランスで決めるべきである。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問7：肘 PJI の管理において、持続抗菌薬(抑制)療法は有用か？

著者：Bradley Schoch, Felix H. Savoie 翻訳者：松下和彦

推奨：肘 PJI の治療で、抗菌薬による長期間の抑制療法は行われることがある。抗菌薬による長期間の抑制療法を行うか判断する場合は、感染症の専門医に相談することを考慮する。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

QUESTION 1: Is there a role for irrigation and debridement with implant retention when treating acute elbow periprosthetic joint infection (PJI)? Should modular implant parts be exchanged?

RECOMMENDATION: Surgical debridement, antibiotic and implant retention (DAIR) is a viable option for management of acute elbow PJI. Modular implant exchange should be considered.

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QUESTION 2: What are the indications for one-stage and two-stage exchange arthroplasty when treating an acute or chronic elbow periprosthetic joint infection (PJI)?

RECOMMENDATION: Two-stage exchange arthroplasty should be considered for patients with chronic elbow PJI. There are no clear indications for one-stage exchange arthroplasty for infected total elbow arthroplasty (TEA), but two-stage exchange is preferred in patients with sinus tract and/or compromised soft tissues around the elbow or those with systemic sepsis.

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QUESTION 3: Is there a role for preoperative joint aspiration prior to second-stage revision after treatment of elbow periprosthetic joint infection (PJI)?

RECOMMENDATION: Preoperative joint aspiration may play a role in the evaluation of the elbow arthroplasty for PJI before second-stage revision.

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QUESTION 4: What is the role of permanent resection when treating a chronic elbow periprosthetic joint infection (PJI)?

RECOMMENDATION: Permanent resection is a salvage treatment for chronic elbow PJI. Preservation of medial and lateral condyles should be considered to improve functional outcomes.

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QUESTION 5: What is the role of arthrodesis when treating a chronic elbow periprosthetic joint infection (PJI)?

RECOMMENDATION: There is a very limited role for arthrodesis of an infected elbow, as this procedure usually results in painful nonunion and poor functional outcomes.

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QUESTION 6: Should all foreign material (including cement) be removed during resection arthroplasty of an infected elbow?

RECOMMENDATION: When treating elbow periprosthetic joint infection (PJI), attempts should be made to remove all foreign material. However, the benefit of removing all foreign material should be weighed against the effort to preserve bone stock.

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QUESTION 7: Is there a role for chronic antibiotic suppression in the management of elbow periprosthetic joint infection (PJI)?

RECOMMENDATION: Long-term suppressive antibiotics may be used in the treatment of PJI of the elbow. Consultation with an infectious disease specialist should be considered in the decision to use long-term suppressive antibiotics.

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PART X

PEDIATRICS

SECTION 1: PREVENTION

SECTION 2: DIAGNOSIS

SECTION 3: TREATMENT

〈監訳者〉

内原好信、崔賢民

質問 1：ステロイドを経口または経静脈で投与されている小児患者では、化膿性関節炎を発症するリスクが増加するか？

著者：Muhammad Amin Chinoy, Ambreen Rakhshinda, Sher Wali Khan 翻訳者：内原好信

推奨：不明である。小児患者における経口または経静脈のステロイドの使用と化膿性関節炎の発症との間に明らかな関連性はない。

エビデンスレベル：Limited

投票結果：賛成 86%、反対 5%、棄権 9%（大多数、強いコンセンサス）

QUESTION 1: Are pediatric patients on oral or intravenous steroids at an increased risk of developing septic arthritis?

RECOMMENDATION: Unknown. There is no definitive link between the use of oral or intravenous steroids and development of septic arthritis in pediatric patients.

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質問 1：感染性関節炎の小児患者において行うべき必須の検査は何か？

著者：Ali Parsa, Mahzad Javid 翻訳者：内原好信

推奨：必須の検査はCRP、ESR、白血球（WBC）数、血液培養、関節液検査、組織かつ/または関節液の培養である。さらに分子生物学的検査と白血球エステラーゼ試験も有用かもしれないが、さらなる研究が必要である。画像検査は股関節の超音波検査を含む。症状が1週間以上続く場合は単純X線撮影が必要である。MRIと骨シンチグラフィーは患者によっては診断の確証に有用かもしれない。

エビデンスレベル：Moderate**投票結果：**賛成 88%、反対 6%、棄権 6%（大多数、強いコンセンサス）**質問 2：小児骨軟部感染症の診断において、ESRやその他の血液検査の信頼性が低くなる条件はあるか？**

著者：Ali Parsa, Mohammad Hammad 翻訳者：内原好信

推奨：ある。ESR、CRP、白血球（WBC）数の絶対値を含む血清検査は、新生児、リウマチ性疾患患者、外傷後、手術後、ライム関節炎患者、免疫グロブリン静脈内投与の患者らにおける小児骨軟部感染症の診断において信頼性が低くなる可能性がある。

エビデンスレベル：Moderate**投票結果：**賛成 88%、反対 3%、棄権 9%（大多数、強いコンセンサス）**質問 3：化膿性関節炎が疑わしい小児患者において、臨床的な診断基準は不確定な臨床検査より優先されるべきか？**

著者：Muhammad Amin Chinoy, Syed Ahmed Hussain, Sher Wali Khan 翻訳者：内原好信

推奨：化膿性関節炎が疑わしい小児患者では、臨床的な診断基準は不確定な臨床検査より優先されるべきである。

エビデンスレベル：Moderate**投票結果：**賛成 91%、反対 2%、棄権 7%（大多数、強いコンセンサス）**質問 4：小児患者において、感染した関節への関節穿刺は有効か？**

著者：Ali Parsa, Mohammad Hammad 翻訳者：内原好信

推奨：有効である。感染した関節を穿刺することは、関節の減圧に効果的である。しかし、関節切開が必要な場合もある。

エビデンスレベル：Limited**投票結果：**賛成 83%、反対 11%、棄権 6%（大多数、強いコンセンサス）**質問 5：化膿性関節炎/骨髄炎の微生物学的診断において、経皮的骨採取(生検)は有効か？ 有効であれば、いつ実施すべきか？**

著者：Muhammad Amin Chinoy, Sher Wali Khan 翻訳者：内原好信

推奨：有効である。経皮的骨採取（生検）は非常に安全で費用対効果があり、X線透視下やCTガイド下であらゆる部位から採取可能である。骨採取は骨髄炎に対する微生物学的診断としての感度は低い、病理組織学検査を加えることでより精度を上げることができる。文献では、経験的抗菌薬治療を始める前に骨採取を施行するよう推奨している。

エビデンスレベル：Limited**投票結果：**賛成 88%、反対 7%、棄権 5%（大多数、強いコンセンサス）**質問 6：小児骨軟部感染症において、PCRや分子生物学的検査は有用か？**

著者：Ali Parsa, Irene Kalbian, Karan Goswami 翻訳者：内原好信

推奨：PCRは微生物培養単独に比べ、小児骨軟部感染の予備的診断を早める可能性があり、診断の補助として有効である。その上、微生物が不活性で捉えにくく培養が困難な症例においては、PCRが病原体の特定を可能とする。しかし、現状ではデータに乏しく、分子生物学的検査を標準化し、コンタミネーションを最小限にし、プライマーに左右されない新しい分子生物学的診断法を開発するには、さらなる研究が必要である。

エビデンスレベル：Limited**投票結果：**賛成 93%、反対 2%、棄権 5%（大多数、強いコンセンサス）

質問 7：鎌状赤血球症の急性増悪と化膿性関節炎／骨髄炎はどのように見分けるか？

著者：Mahzad Javid 翻訳者：内原好信

推奨：鎌状赤血球症の急性増悪と感染の鑑別には、臨床所見、検査所見、画像診断をすべて総合的に考慮する必要がある。関節や骨膜からの穿刺液で感染が陽性であれば、感染と確定する。一方、一連の超音波検査で骨膜下に液体貯留を認めない場合は、鎌状赤血球症の急性増悪を示唆する。発症後 24 時間以内の三相骨シンチグラフィーは血管閉塞症と急性感染の鑑別に有用である。造影 MRI は感染と梗塞とをかなり正確に鑑別することができる。

エビデンスレベル：Moderate

投票結果：賛成 87%、反対 0%、棄権 13%（大多数、強いコンセンサス）

QUESTION 1: What are the essential tests that need to be done in pediatric patients with joint infections?

RECOMMENDATION: Essential laboratory tests include serum C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), white blood cell (WBC) count, blood cultures, synovial fluid analysis and culture of tissue and/or synovial fluid. Further molecular testing and leucocyte esterase (LE) testing may have a role and warrant further research. Imaging studies include ultrasound in the hip joint. Symptoms lasting over a week warrant investigation with plain radiography. Magnetic resonance imaging (MRI) and bone scanning may have value in confirmation of the diagnosis in some patients.

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QUESTION 2: Are there conditions where the erythrocyte sedimentation rate (ESR) and other blood tests are unreliable for diagnosis of pediatric musculoskeletal infections?

RECOMMENDATION: Yes. Serum tests including ESR, C-reactive protein (CRP) and absolute white blood cell (WBC) count might be unreliable for diagnosis of pediatric musculoskeletal infections in neonates, patients with rheumatological disease, post-trauma, post-surgery, patients with Lyme arthritis and those receiving intravenous immunoglobulin (IVIG) administration.

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QUESTION 3: For pediatric patients with suspected septic arthritis (SA), does the clinical criteria override inconclusive laboratory tests?

RECOMMENDATION: For pediatric patients with suspected SA, the clinical criteria override inconclusive laboratory tests.

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QUESTION 4: Is there a role for arthrocentesis (joint puncture) of an infected joint in a pediatric patient?

RECOMMENDATION: Yes. Arthrocentesis of an infected joint is effective for decompression of the joint. However, some children need arthrotomy.

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QUESTION 5: Is there a role for percutaneous bone sampling (biopsy) for microbiological diagnosis of septic arthritis/osteomyelitis (OM)? If so, when should this be performed?

RECOMMENDATION: Yes. Percutaneous bone sampling (biopsy) is very safe and cost-effective and can be obtained from any site under the guidance of fluoroscopy or computed tomography (CT). It has a low sensitivity for microbiological diagnosis of OM that can be enhanced by the addition of histopathological examination. Literature suggests that bone sampling should be performed before initiating empirical antibiotic therapy.

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QUESTION 6: Is there any role for polymerase chain reaction (PCR) or molecular testing in pediatric musculoskeletal infection (PMSI)?

RECOMMENDATION: PCR may be a useful diagnostic adjunct with the potential to expedite a preliminary diagnosis of PMSI in comparison to the use of microbiological culture alone. Furthermore, PCR can enable pathogen identification in cases where the organism is indolent, fastidious or difficult to culture. However, data remains sparse and further research is needed to standardize molecular techniques, minimize contamination and explore emerging molecular methods that are primer-independent.

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QUESTION 7: How can we differentiate between sickle cell crisis and septic arthritis/osteomyelitis (OM)?

RECOMMENDATION: A combination of clinical, laboratory and imaging studies are all needed for differentiating between sickle cell crisis and infection. A positive aspiration for infection from the joint or periosteum confirms the presence of infection while sequential ultrasounds in the absence of sub-periosteal fluid collection favor sickle cell crisis. Tri-phasic bone scan in the first 24 hours can differentiate vaso-occlusive crisis (VOC) from acute infection. Contrast-enhanced magnetic resonance imaging (MRI) is fairly accurate in differentiating infection from infarction.

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質問 1：骨髄炎または化膿性関節炎の手術適応は？ 治療の効果と寛解はどのように評価すべきか？

著者：Ali Parsa, Alexander J. Shope 翻訳者：崔賢民、稲葉裕

推奨：化膿性関節炎は緊急性のある整形外科疾患であり迅速な手術治療を要する。最近の文献では、CRP の値の傾向によって疾患進行・治療効果・寛解をモニタリングするよう推奨している。**エビデンスレベル：**Limited**投票結果：**賛成 91%、反対 3%、棄権 6%（大多数、強いコンセンサス）**質問 2：骨髄炎または化膿性股関節炎において、手術はどれくらい徹底的に行われるべきか？**

著者：Mahzad Javid 翻訳者：崔賢民、稲葉裕

推奨：手術が必要となる小児の骨髄炎または化膿性股関節炎では、感染部位の積極的なデブリドマンと十分な洗浄が必須である。**エビデンスレベル：**Moderate**投票結果：**賛成 89%、反対 7%、棄権 4%（大多数、強いコンセンサス）**質問 3：小児の化膿性関節炎に対して、関節鏡を用いた洗浄は有用か？**

著者：Ali Parsa 翻訳者：崔賢民、稲葉裕

推奨：有用である。関節鏡は小児の化膿性関節炎に対して有用である。**エビデンスレベル：**Limited**投票結果：**賛成 83%、反対 10%、棄権 7%（大多数、強いコンセンサス）**質問 4：抗菌薬の使用期間は初発の化膿性関節炎と骨髄炎で異なるべきか？**

著者：Craig A. Aboltins, Brennan Collins, Parham Sendi, Ali Par 翻訳者：崔賢民、稲葉裕

推奨：小児患者において、初発の化膿性股関節炎より骨髄炎のほうが抗菌薬がより長期間使用される傾向にあるが、これは確実なエビデンスに基づくものではない。**エビデンスレベル：**Limited**投票結果：**賛成 93%、反対 2%、棄権 5%（大多数、強いコンセンサス）**質問 5：ステロイドは小児化膿性股関節炎において、軟骨保護作用を持つか？**

著者：Ali Parsa, Ashok Johari 翻訳者：崔賢民、稲葉裕

推奨：参照可能な前臨床試験および臨床試験によると、コルチコステロイドと抗菌薬の併用は、小児の化膿性股関節炎の治療において、保護的な作用を持つ。**エビデンスレベル：**Limited**投票結果：**賛成 58%、反対 20%、棄権 22%（多数、コンセンサスなし）**質問 6：MRSA による化膿性股関節炎または骨髄炎に対する適切な治療方法は？**

著者：Mahzad Javid 翻訳者：崔賢民、稲葉裕

推奨：MRSA 感染においては抗菌薬治療（バンコマイシンの静脈内投与の後にリネゾリドなど）が効果的である。小児患者における骨軟部 MRSA 感染では、高い確率で起こる合併症や遅発性の続発症を減らすためにも、発症早期から手術治療を考慮することや、注意深く経過観察を行うことが重要である。**エビデンスレベル：**Moderate**投票結果：**賛成 85%、反対 11%、棄権 4%（大多数、強いコンセンサス）**質問 7：小児の骨軟部組織における結核感染に対する最適な治療法は何か？**

著者：Ali Parsa, Parham Sendi, Ashok Johari, Ed McPherson 翻訳者：崔賢民、稲葉裕

推奨：結核菌による PJI の治療は、治療期間（最短 6 ヶ月から最長 2 年）や抗菌薬の種類（一般的には 4 剤の併用）が原因菌の薬剤耐性をもとに決定されることから、感染症のスペシャリストの協力が不可欠である。**エビデンスレベル：**Moderate**投票結果：**賛成 86%、反対 2%、棄権 12%（大多数、強いコンセンサス）

質問8：宿主遺伝子発現は小児の急性骨関節感染(特にMRSA感染)の重症度に関係するか？

著者：Ali Parsa, Irene Kalbian 翻訳者：崔賢民、稲葉裕

推奨：不明である。限られた文献において、体内の獲得免疫や自然免疫のバランスに関わる宿主遺伝子の転写の変化が、小児患者における重篤な骨関節感染症（特にMRSA感染）への易感染性を増強したと報告している。しかし、どのような遺伝子が最も有益であり、それらをどのように特定の患者における感染経過予測に役立てられるかについては、さらなる研究が必要である。

エビデンスレベル：Consensus**投票結果**：賛成 75%、反対 3%、棄権 22%（大多数、強いコンセンサス）

QUESTION 1: What are the indications for surgical intervention in cases of osteomyelitis/septic arthritis? How should treatment progress and resolution be monitored?

RECOMMENDATION: Septic arthritis is an orthopaedic emergency and needs prompt surgical treatment. Based on current evidence, there are no clear indications for the timing of surgical intervention in cases of osteomyelitis. The current literature does suggest monitoring disease progression, treatment efficacy and resolution by trending C-reactive protein (CRP) levels.

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QUESTION 2: How radical should surgery be for osteomyelitis/septic arthritis?

RECOMMENDATION: In pediatric patients with osteomyelitis/septic arthritis who require surgical intervention, aggressive debridement and copious irrigation of the infected joint is required.

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QUESTION 3: Is there a role for arthroscopic washout in children with septic arthritis?

RECOMMENDATION: Yes. Arthroscopy is a useful tool in the treatment of septic arthritis in children.

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QUESTION 4: Should the length of antibiotic usage be different for a primary septic arthritis (SA) versus osteomyelitis (OM)?

RECOMMENDATION: Although there is a tendency towards prescribing a longer course of antibiotics in pediatric patients with OM compared to primary SA, this practice is not based on conclusive evidence.

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QUESTION 5: Do steroids have a chondroprotective effect in children with septic arthritis (SA)?

RECOMMENDATION: Based on available pre-clinical and clinical studies it appears that the concurrent use of corticosteroids and antibiotics may have a protective role in the management of SA in the pediatric patient population.

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- nous septic arthritis in children. *Pediatr Infect Dis J*. 2003;22:883-888. doi:10.1097/01.inf.0000091293.32187.7b.
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QUESTION 6: What is the optimal management of septic arthritis/osteomyelitis (SA/OM) caused by methicillin-resistant *Staphylococcus aureus* (MRSA)?

RECOMMENDATION: Patients with MRSA infection should be started on an antibiotic regimen, such as vancomycin, intravenously followed by linezolid, which is effective against this organism. Early consideration for surgical treatment and close monitoring is essential in pediatric patients with musculoskeletal MRSA infection to reduce the high prevalence of complications and late sequelae that are often seen.

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QUESTION 7: What is the best management for *mycobacterium tuberculosis* (TB) of the musculoskeletal system in children?

RECOMMENDATION: *Mycobacterium TB* periprosthetic joint infection (PJI) must be treated in collaboration with an infectious disease specialist, noting that the duration of treatment (minimum six months and up to two years) and the type of antimicrobials (usually a combination of four drugs) is determined based on the resistance profile of the pathogen.

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QUESTION 8: What is the role of host gene expression and severity of acute osteoarticular infection in children, especially methicillin-resistant *Staphylococcus aureus* (*S. aureus*), or MRSA, infection?

RECOMMENDATION: Unknown. The limited literature available suggests altered host gene transcription related to the balance of the body's adaptive and innate immune responses may increase pediatric patients' susceptibility to severe osteoarticular infection, particularly in cases of MRSA. However, much more investigation is needed to determine which genes are most useful and how they can be utilized to help physicians anticipate the course of infection in a given patient.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

PART XI

BIOFILM

SECTION 1: FORMATION

SECTION 2: DISRUPTION

〈監訳者〉

井上大輔、崔賢民、土屋弘行

質問1：バイオフィルムのライフサイクルと成熟までのメカニズムは？

著者：Mark Smeltzer, Manjari Joshi, Mark Shirtliff, Daniel G. Meeker, Jeffrey B. Stambough, Janette M. Harro 翻訳者：崔賢民、稲葉裕

推奨：バイオフィルムは微生物からなる固着性の共同体で、何らかの基盤または境界面に付着し、微生物同士が細胞外高分子物質に組み込まれた状態で付着したものと定義され、成長や遺伝子発現、たんぱく産生に関するフェノタイプの変異を示すものとされる。バイオフィルム感染のライフサイクルは通常、付着（細菌とインプラントとの相互反応）、集簇（細菌同士の相互作用）、成熟（3次元構造の形成）、剥離と離散（バイオフィルムからの放出）の段階を経る。バイオフィルムのライフサイクルは、関与する菌種により異なる。バイオフィルム形成のライフサイクルには特徴があり、その中には、付着と増殖／集簇／成熟と放出が含まれる。バイオフィルムは表面に付着した状態または一塊として浮遊した状態で認められる。

エビデンスレベル：Strong**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問2：どのような材質の表面にバイオフィルムは形成し易いか？**

著者：Philip C Noble, Olga Pidgańska, Carla Renata Arciola, Zack Coffman, Sara Stephens, Sabir Ismaili, Ryan Blackwell, Davide Campoccia, Lucio Montanaro 翻訳者：崔賢民、稲葉裕

推奨：インプラントまたは生物学的な表面への細菌の付着は複雑な過程を経るが、まずはコンディショニングフィルムの形成から始まる。細菌の付着に影響を与える重要な要素は粗雑さ、疎水性／親水性、多孔性、気孔を有する形態や、その他の表面状態である。このように要因が多岐にわたるため、付随する要因を調べるのは困難であることから、細菌のインプラント表面への付着に関する研究のほとんどは、ある特定の表面状態に限定されている。様々な結論が基礎研究や動物実験を基に導き出されているが、ほとんどの結果は、以下のように説明できる。つまり、細菌はほぼ全ての人工物や生物学的な表面にバイオフィルムを形成することが可能である。なお、*in vivo* においてバイオフィルムの成長を妨げるような表面材質はこれまで発見されていないということで、コンセンサスグループの見解は一致している。

エビデンスレベル：Strong**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問3：In vivoにおいて、整形外科インプラントの表面に存在するバイオフィルムは好中球やマクロファージを透過することが出来るか？ それらの自然免疫細胞(全てのマクロファージや好中球)は、細菌の貪食、殺菌が可能か？**

著者：Edward Schwarz, Jamie Esteban, Hamidreza Yazdi, John-Jairo Aguilera-Correa 翻訳者：崔賢民、稲葉裕

推奨：成熟したバイオフィルムでは、好中球やマクロファージの透過性は限定される。もし透過できたとしても、バイオフィルム内の細菌に対して臨床的な殺菌効果を認めない。好中球やマクロファージは浮遊細菌の貪食や殺菌が可能であるが、バイオフィルム内の菌に対しては効果的な貪食や殺菌能力を持たない。

エビデンスレベル：Strong**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問4：バイオフィルム形成のタイムスケールは、細菌の菌種により異なるか？ 異なるとすれば、一般的な原因菌のタイムスケールはどのようなものか？**

著者：Claus Moser, Kordo Saeed 翻訳者：崔賢民、稲葉裕

推奨：バイオフィルム形成のタイムスケールが細菌の菌種により異なるか否かを報告した臨床研究は現状認めない。*In vitro* の研究では、バイオフィルムの形成は細菌の菌種や状態により大きく異なることが報告されている。動物実験では、迅速な（数分から数時間）バイオフィルムの形成が報告されている。このコンセンサスグループでは、バイオフィルム形成のタイムラインが感染の症状の発生とは相関しない可能性があることを付記する。

エビデンスレベル：Strong**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）**質問5：細菌は金属インプラントと同様、セメントスパーサーの表面にもバイオフィルムを形成するか？**

著者：Dustin Williams, Kenneth Urish 翻訳者：崔賢民、稲葉裕

推奨：形成する。ほとんどの研究は *in vitro* だが、大多数の細菌がセメントスパーサーの表面にもバイオフィルムを形成することが臨床的なエビデンスとして認められている。

エビデンスレベル：Strong**投票結果：**賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問6：結核菌はインプラント上にバイオフィルムを形成するか？

著者：Parham Sendi, Giorgio Burastero, Georgios Komnos 翻訳者：崔賢民、稲葉裕

推奨：実験的な *in vitro* と *in vivo* の研究や少数のケースレポートなどによると、結核菌はゆっくりとではあるが確かに金属表面にバイオフィルムを形成することが示唆されている。このコンセンサスグループでは、結核菌によるインプラント関連感染に対する治療は、その他のインプラント関連感染と原則的には同様の治療を行うことを推奨する。

エビデンスレベル：Strong

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問7：混合感染における細菌の共同作用が持つ役割とは何か？

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推奨：混合感染では、細菌同士が分子生物学的な相互作用を有する複雑な環境が形成される。科学的なエビデンスとして、細菌による共同体が存在し、それらが病毒性や薬剤耐性に関わる遺伝子を交換しつつ、お互いを抗菌的な作用から保護しあう作用を持つ事が証明されており、それが混合感染を伴うインプラント関連感染での成績不良に現れている。また混合感染は免疫機能や組織修復能の低下を認める患者において、より発生しやすい可能性がある。

エビデンスレベル：Strong

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問8：バイオフィルムの形成部位を特定のコンポーネントや解剖学的部位において同定することは、インプラント関連感染症の治療において重要な意味をもつか？

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推奨：現状では、バイオフィルムの形成部位の同定は研究室内でのみ可能であり臨床への応用は不可能である。そのため、インプラント関連感染の治療における重要性は不明である。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

QUESTION 1: What is the life cycle of biofilm and the mechanism of its maturation?

RESPONSE: A biofilm may be defined as a microbe-derived sessile community characterized by organisms that are attached to a substratum, interface or each other are embedded in a matrix of extracellular polymeric substance and exhibit an altered phenotype with respect to growth, gene expression and protein production. The biofilm infection life cycle generally follows the steps of attachment (interaction between bacteria and the implant), accumulation (interactions between bacterial cells), maturation (formation of a viable 3D structure) and dispersion/detachment (release from the biofilm). The life cycle of biofilm is variable depending on the organism involved. There are characteristics in the life cycle of biofilm formation. These include attachment, proliferation/accumulation/maturation and dispersal. Biofilm can either be found as adherent to a surface or as floating aggregates.

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QUESTION 2: What surface properties favor biofilm formation?

RESPONSE: The attachment of bacteria to implant and biological surfaces is a complex process, starting with the initial conditioning film. Roughness, hydrophobicity/hydrophilicity, porosity, pore topology and other surface conditions are the key factors for microbial adhesion. Because of the huge variety of these factors, most of the studies directed at bacterial attachment to the implant surface were limited to specific surface conditions since it is difficult to examine the plethora of parameters concomitantly. There are variable conclusions among the available basic science and animal studies relevant to this topic, many of which will be described in greater detail below. Bacteria can form biofilm on almost all prosthetic surfaces and biological surfaces. To date, this consensus group knows of no surface that is inimicable to the growth of biofilm *in vivo*.

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QUESTION 3: Is the biofilm on orthopaedic implant surfaces permeable to neutrophils and macrophages *in vivo*? Are these innate immune cells (meaning any macrophages or neutrophils) capable of engulfing and killing bacteria?

RESPONSE: A mature bacterial biofilm has limited permeability to neutrophils and macrophages. Those that get through are clinically ineffective at eradicating biofilm bacteria. While neutrophils and macrophages are capable of engulfing and killing planktonic bacteria, they are not innately capable of effectively engulfing and killing sessile bacteria in biofilm.

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QUESTION 4: Does the timescale of biofilm formation differ between bacterial species? If so, what is the timescale for common causative organisms?

RESPONSE: Currently, there is no clinical research available to answer whether the timescale in the development of biofilm formation differs between bacterial species. *In vitro* studies show high variability in biofilm formation based on bacterial strains and conditions. Animal studies have demonstrated rapid (minutes to hours) biofilm formation. The group notes that the timeline of biofilm formation may not correlate with the onset of infection symptoms.

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QUESTION 5: Do bacteria form biofilm on the surface of cement spacer in a similar fashion to a metallic implant?

RESPONSE: Yes. While the vast majority of studies have been *in vitro*, there is clinical evidence that majority of bacteria are able to form biofilm on the surface of cement spacer.

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QUESTION 6: Does *Mycobacterium tuberculosis* (*M. tuberculosis*) form a biofilm on implants?

RESPONSE/RECOMMENDATION: Few data from experimental *in vitro* and *in vivo* studies and a limited number of case reports indicate that *M. tuberculosis* has a slow, albeit significant, ability to form biofilm on metal surfaces. The group suggests that management of *M. tuberculosis* implant-related infections should be treated using the same principles as that of other implant-related infections.

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QUESTION 7: What is the role of the microbial synergy in polymicrobial infections?

RESPONSE: In polymicrobial infections, a complex environment may be formed in which microbiological interactions exist between microorganisms. Scientific evidence exists to show that combinations of bacterial species may exist whereby these can protect each other from antibiotic action via the exchange of virulence and antibiotic resistance genes, and this may be evident in adverse outcomes for polymicrobial orthopaedic implant-related infections. It is also probable that polymicrobial infections may be more likely in patients with poor immunity and tissue healing.

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QUESTION 8: Is the mapping of biofilm to a particular component or anatomical location an important consideration in management of implant related infections?

RESPONSE: At present, mapping of biofilms is only possible in the laboratory, not in the clinical setting. Therefore, it is of unknown clinical importance in relation to management of implant-related infections.

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GENERAL ASSEMBLY
HIP AND KNEE
SHOULDER
SPINE
TRAUMA
FOOT AND ANKLE
ONCOLOGY
SPORTS
ELBOW
PEDIATRICS
BIOFILM

質問1：クオラムセンシングを行う分子を阻害し、細菌間情報伝達を障害すると、*in vivo*におけるバイオフィーム形成を最小限に留められるというエビデンスは存在するか？

著者：Alex McLaren, Garth D. Ehrlich 翻訳者：井上大輔、土屋弘行

推奨：*In vivo*の動物実験において、いくつかの感染症ではクオラムセンシングを行う機構／分子を障害することでバイオフィーム形成を減少させることができたことと示されている。ブドウ球菌属においては、矛盾した結果が存在している。しかしながら、この現象を示した臨床研究は存在しない。

エビデンスレベル：Limited

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問2：生体材料の表面を改良することで、細菌の接着やバイオフィームの形成を阻害しうるか？ バイオフィームに対抗するためインプラント表面の改良をするにあたり、何が懸念されるか？

著者：Yixin Zhou, Matthew Kheir, Valentia Antoci, Luigi Zagra 翻訳者：井上大輔、土屋弘行

推奨：表面改良の目的は、周術期の細菌接着を減弱させることにより、バイオフィームの形成を阻害することである。これは *in vitro*の研究や *in vivo*の動物実験で示されてきており、表面を改良する方法は数多く存在している。そのような表面改良は、予測される骨親和性、物理的安定性、長期のインプラント生存の妨げとなるかもしれない。長期的な抗感染効果の持続期間は不明である。今までのところこれらの因子について、臨床的にプラスの効果を示した *in vitro*の結果は存在しない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問3：バイオフィームを介在した遅発性感染において、何が感染細菌の最小発育阻止濃度(MIC)と関係するか？

著者：Jeppe Lange, Matthew Scarborough, Robert Townsend 翻訳者：井上大輔、土屋弘行

推奨：MICの使用は、(1) 微生物が浮遊状態にあると考えられる際の抗菌薬の選択に限定され、バイオフィーム形成状態下での治療を行うために使用すべきではない、そして (2) 感染の根治が期待できず、長期における抗菌薬の抑制療法を選択する際に限定される。バイオフィーム関連感染症においては特に、代替となりうる有効な抗微生物的療法の開発と検証が望まれる。

エビデンスレベル：Strong

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問4：抗菌薬の最小バイオフィーム発育阻止濃度(MBEC)とは何か？

著者：Jan Geurts, Willem Berend Schreurs, Jean-Yves Jenny 翻訳者：井上大輔、土屋弘行

推奨：抗菌薬の最小バイオフィーム発育阻止濃度とは、*in vitro*の状態下でバイオフィームを形成する感染病原菌の感受性の尺度を指す。最小バイオフィーム発育阻止濃度は、表面、培地、そして感染病原菌への暴露時間に左右される。しかし、最小バイオフィーム発育阻止濃度の測定基準となるパラメーターは現状存在しない。最小バイオフィーム発育阻止濃度は現在のところ研究段階にあり、臨床的有用性についてのデータは不足している。我々グループとしては、臨床的に検証可能な最小バイオフィーム発育阻止濃度の分析試験の開発が有用であると考ええる。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

質問5：バクテリオファージは、多剤耐性PJIの治療に有効か？

著者：Tristan Ferry, Antonio Pellegrini, Sébastien Lustig, Frédéric Laurent, Gilles Leboucher, Claudio Legnani, Vittorio Macchi, Silvia Gianola
翻訳者：井上大輔、土屋弘行

推奨：不明である。骨関節感染症の治療に関するいくつかの前臨床試験や臨床試験では、バクテリオファージを使用した治療効果や良好な安全性が示されている。しかし、多剤耐性PJIを持つ患者に対するバクテリオファージ治療については、さらなる臨床研究が必要とされている。血清中ではバクテリオファージが無効化されてしまう点と、一連の細菌にはバクテリオファージに対抗するための Clustered Regularly Interspaced Short Palindromic Repeats - associated protein-9 nuclease (CRISPR/cas9) が含まれている点が、バクテリオファージ治療の障害となっていることが知られている。ファージは一般的に菌株に特異的なものである。したがって、バイオフィームを介在した感染を有効に治療するには、様々なバクテリオファージの系統を組み合わせることが必要となるのかもしれない。

エビデンスレベル：Consensus

投票結果：賛成 100%、反対 0%、棄権 0%（満場一致、最も強いコンセンサス）

QUESTION 1: Is there evidence that interference with bacterial communication by blocking quorum sensing molecules can minimize biofilm formation *in vivo*?

RESPONSE: *In vivo* animal studies have demonstrated that interference with quorum sensing signals/molecules in some infections leads to decreased biofilm formation. There are contradictory results in *Staphylococcus* species. However, there are no clinical studies demonstrating this phenomenon.

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QUESTION 2: Can a biomaterial surface be modified to dispel bacterial adherence and biofilms? What are the potential concerns in modifying implant surfaces to combat biofilms?

RESPONSE: The purpose of the surface modification is to decrease perioperative bacterial adherence and thus prevent biofilm formation. This has been shown in *in vitro* studies and *in vivo* animal models. There have been numerous strategies devised to alter surfaces. Such modified surfaces may interfere with the expected osseointegration, mechanical stability and long-term implant survivability. The duration of long-term anti-infective effects are unknown. To date, no positive *in vitro* effect has been translated into a clinical setting.

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QUESTION 3: What is the relevance of minimum inhibitory concentration (MIC) of infecting organisms in biofilm-mediated chronic infection?

RESPONSE: The use of MIC is limited to (1) defining antibiotics that the microorganism is susceptible to in its planktonic state but cannot be used to guide treatment of biofilm-based bacteria and (2) selecting long-term suppressive antibiotic regimens where eradication of infection is not anticipated. Alternative measures of antibiotic efficacy specifically in the context of biofilm-associated infection should be developed and validated.

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QUESTION 4: What is the minimum biofilm eradication concentration (MBEC) of anti-infective agents?

RESPONSE/RECOMMENDATION: The MBEC of antimicrobial agents is a measure of *in vitro* antibiotic susceptibility of biofilm producing infective organisms. It is dependent on the surface, medium and the exposure period to an antimicrobial agent. There are no standardized measurement parameters for MBEC. MBEC is currently a research laboratory value and lacks clinical availability. In the group's opinion, there is value in developing a clinically-validated MBEC assay.

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QUESTION 5: Do bacteriophages have a role in treating multidrug-resistant periprosthetic joint infection (PJI)?

RESPONSE: Unknown. Although some preclinical and clinical studies have demonstrated a good safety profile as well as promising therapeutic effects using bacteriophages for treating bone and joint infections, further clinical research using bacteriophage therapy in patients with multidrug-resistant PJI is required. HAI There are known obstacles to bacteriophage therapy, including the fact that bacteriophages are neutralized in serum and relevant pathogens contain Clustered Regularly Interspaced Short Palindromic Repeats - associated protein-9 nuclease (CRISPR/cas9) immunity against bacteriophage. Phages are usually bacterial strain specific; thus, a cocktail of different bacteriophage lineages may be necessary to effectively treat biofilm-mediated infections.

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