[16] Shojania KG, Duncan BW, McDonald KM, Wachter RM, Markowitz a J. Making health care safer: a critical analysis of patient safety practices. Evid Rep Technol Assess (Summ). 2001;i–x.
[17] Magill SS, Edwards JR, Bamberg W, Beldavs ZG, Dumyati G, Kainer MA, et al. Multistate point-prevalence survey of health care–associated infections. New Eng J Med. 2014;370:1198–1208. doi:10.1056/NEJMoa1306801.
[18] Awad SS. Adherence to surgical care improvement project measures and post-operative surgical site infections. Surg Infect (Larchmt). 2012;13:234-237.
[19] Schweizer ML, Cullen JJ, Perencevich EN, Vaughan Sarrazin MS. Costs associated with surgical site infections in Veterans Affairs hospitals. JAMA Surg. 2014;149:575–581. doi:10.1001/jamasurg.2013.4663.
[20] Shepard J, Ward W, Milstone A, Carlson T, Frederick J, Hadhazy E, et al. Financial impact of surgical site infections on hospitals: the hospital management perspective. JAMA Surg. 2013;148:907–914. doi:10.1001/jamasurg.2013.2246.
[21] Cruse P. Wound infection surveillance. Rev of Infect Dis. 1981;3:734–737.
[22] Hawn MT, Vick CC, Richman J, Holman W, Deierhoi RJ, Graham LA, et al. Surgical site infection prevention: Time to move beyond the surgical care improvement program. Ann Surg. 2011;254:494-499.
[23] Rasouli MR, Maltenfort MG, Ross D, Hozack WJ, Memtsoudis SG, Parvizi J. Perioperative morbidity and mortality following bilateral total hip arthroplasty. J Arthroplasty. 2014;29:142–148. doi:10.1016/j.arth.2013.04.001.
[24] Peak EL, Hozack WJ, Sharkey PF, Parvizi J, Rothman RH. One-stage bilateral total joint arthroplasty: a prospective, comparative study of total hip and total knee replacement. Orthopedics. 2008;31:131.
[25] Vulcano E, Memtsoudis S, Della Valle AG. Bilateral total knee arthroplasty guidelines: are we there yet? J Knee Surg. 2013 Aug;26:273–279.
[26] Huotari K, Lyytikäinen O, Seitsalo S. Patient outcomes after simultaneous bilateral total hip and knee joint replacements. J Hosp Infect. 2007 Mar;65:219–225.
[27] Triantafyllopoulos GK, Memtsoudis SG, Zhang W, Ma Y, Sculco TP, Poultsides LA. Same-day surgery does not increase deep infection risk in bilateral total hip arthroplasty patients. J Arthroplasty. 2016;31:237–241. doi:http://dx.doi.org/10.1016/j.arth.2016.01.069.
[28] Della Valle AG, Walter WL, Peterson MGE, Pellicci PM, Sculco TP, Salvati EA. Prevalence of infection in bilateral total hip arthroplasty: a comparison of single-stage 565 bilateral procedures performed with 1 or 2 sets of instruments. J Arthroplasty. 2006;21:157–160. doi:10.1016/j.arth.2005.06.010.
[29] Dimitris CN, Taylor BC, Mowbray JG, Steensen RN, Gaines ST. Perioperative morbidity and mortality of 2-team simultaneous bilateral total knee arthroplasty. Orthopedics. 2011;34:e841–e846.
[30] Leonard L, Williamson DM, Ivory JP, Jennison C. An evaluation of the safety and efficacy of simultaneous bilateral total knee arthroplasty. J Arthroplasty. 2003;18:972–978. doi:10.1016/S0993-5403(03)00282-1.
[31] Luscombe JC, Theivendran K, Abudu A, Carter SR. The relative safety of one-stage bilateral total knee arthroplasty. Int Orthop. 2009;33:101–104. doi:10.1007/s00264-007-0447-1.

Authors: Marie-Jacque Reisener, Adrian van der Rijt, Jorge Manrique

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.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 90%, Disagree: 7%, Abstain: 3% (Super Majority, Strong Consensus)

RATIONALE

There are no specific studies that have addressed the levels of contamination of instruments in infected revision surgeries. Different studies have addressed surgical instrument contamination in orthopaedics and other specialties with no definite recommendations. Some have shown a level of surgical instrument contamination in contaminated and infected operations, implying the instruments will be contaminated by the surgery itself [1,2]. Furthermore, studies have shown that instruments also become contaminated during what are considered to be clean procedures [3].

Pinto et al. showed that in clean orthopaedic surgeries, 47% of the instruments were contaminated. In the same study, an even higher rate of 70% had positive cultures in contaminated surgeries and up to 80% in infected cases [4]. They concluded that there was a significant difference in microbial growth between the clean and contaminated surgeries and between the clean and infected surgeries. In a different study, Evangelista dos Santos et al. evaluated patients undergoing gastrointestinal surgery and found that the surgical wound classification significantly affected the microbial load recovered on instruments [5]. Microbial loads were higher on instruments used for contaminated procedures.

Not all studies share the same results. There is a contradictory report from Nystrom which found that regardless of the classification of orthopaedic operations as clean, contaminated or infected, similar contamination rates were observed in splash basins (75%, 80% and 71% respectively) [6]. They concluded that the data did demonstrate a relatively higher correlation between splash basin contamination and contaminated and infected cases but this was not significant.

When evaluating correlation between contaminated instruments and infection risk, only one study was identified. Dancera et al. showed post sterilization contamination of surgical instruments was linked with an increased rate of deep SSIs in orthopaedic and ophthalmological patients [2]. This seems to link contamination of surgical instruments to increased risk of infection.

In joint arthroplasty surgery literature, Davis et al. showed that in 100 consecutive primary hip and knee arthroplasty operations under laminar flow, instruments get contaminated. 11.4% of suction tips, 14.5% of light handles, 9.4% of skin blades and 3.2% of deep blades were seen to have positive cultures [7]. In conclusion, 63% of operations showed contamination in the field of operation. In a different study evaluating electrocautery tips, Shahi et al. found in 100 consecutive primary total hip arthroplasties (THAs) and aseptic revision THAs that up to 6% of tips were contaminated [3]. None of these patients continued to have a PJI/SSI. Robinson et al. also found that 41% of suction tips had evidence of bacterial colonization in THA surgery undertaken in ultraclean air operating rooms [8]. Furthermore, few studies have focused on elements of the surgical field other than the instruments. Beldame et al. found a surgical

glove perforation rate of 3.5% and glove contamination rate of 6% during total hip reduction (THR) and an overall glove contamination rate of 3.38% in elective THA [9].

Literature suggests that instrument contamination even occurs during primary and clean arthroplasty surgery. This contamination does not seem to translate into an increased risk of SSI/PJI. Although some studies do show that contamination is higher in contaminated and infected surgeries, conflicting evidence exists in whether it translates into clinical infection. Non-arthroplasty literature seems to support that contaminated instruments translate to active infection but few low evidence studies have been identified.

We consider that with these findings, although limited evidence is available, especially related to infected arthroplasty surgery, the routine use of a new set of surgical instruments and equipment following debridement and before reimplantation in infected revision arthroplasty surgery should be considered. This could potentially reduce the risk of having contaminated instruments and therefore reduce the risk of contamination overall in the surgical field, potentially reducing the risk of SSI/PJI.

REFERENCES

[1] Rutala WA, Gergen MF, Jones JF, Weber DJ. Levels of microbial contamination on surgical instruments. Am J Infect Control. 1998;26:143–145.
[2] Dancer SJ, Stewart M, Coulombe C, Gregori A, Virdi M. Surgical site infections linked to contaminated surgical instruments. J Hosp Infect. 2012;81:231–238. doi:10.1016/j.jhin.2012.04.023.
[3] Shahi A, Chen AF, McKenna PB, Roberts AL, Manrique J, Belden KA, et al. Bacterial contamination in tips of electrocautery devices during total hip arthroplasty. J Arthroplasty. 2015;30:1410–1413. doi:10.1016/j.arth.2015.03.011.
[4] Pinto FMG, de Souza RQ, da Silva CB, Mimica LMJ, Graziano KU. Analysis of the microbial load in instruments used in orthopedic surgeries. Am J Infect Control. 2010;38:229–233. doi:10.1016/j.ajic.2009.06.017.
[5] Evangelista S de S, dos Santos SG, de Resende Stoianoff MA, de Oliveira AC. Analysis of microbial load on surgical instruments after clinical use and following manual and automated cleaning. Am J Infect Control. 2015;43:522–527. doi:10.1016/j.ajic.2014.12.018.
[6] Baird RA, Nickel FR, Thrupp LD, Rucker S, Hawkins B. Splash basin contamination in orthopaedic surgery. Clin Orthop Relat Res. 1984;129–133.
[7] Davis N, Curry A, Gambhir AK, Panigrahi H, Walker CR, Wilkins EG, et al. Intraoperative bacterial contamination in operations for joint replacement. J Bone Joint Surg Br. 1999;81:886–889.
[8] Robinson AH, Drew S, Anderson J, Bentley G, Ridgway GL. Suction tip contamination in the ultraclean-air operating theatre. Ann R Coll Surg Engl. 1993;75:254–256.
[9] Beldame J, Lagrave B, Lievain L, Lefebvre B, Frebourg N, Dujardin F. Surgical glove bacterial contamination and perforation during total hip arthroplasty implantation: when gloves should be changed. Orthop Traumatol Surg Res. 2012;98:432–440. doi:10.1016/j.otsr.2011.10.015.

Authors: Greg Stocks, Abtin Alvand, Carlos Meheux; Robert Middleton

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.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 97%, Disagree: 2%, Abstain: 1% (Unanimous, Strongest Consensus)

RATIONALE

Several studies have shown that high-speed cutters in primary hip arthroplasty and spinal surgery can produce aerosols [1–3]. These aerosols, possibly contaminated with bacterial, fungal or viral agents, are spread over the operating room (OR) and contaminate the environment and all personnel present during the surgical procedure. In revision hip or knee arthroplasty, different tools and high-speed cutters are used for removal of cement from the bony cavities. Some of these tools, particularly ultrasound devices, can vibrate at a high frequency leading to a dissemination of cement particles throughout the operating room [4,5]. In some instances, other instruments such as chisels and osteotomes, used for cement extraction, can propel particles into the ceiling, OR lights or body parts of surgeons or assistants participating in the surgery. The particles that come in contact with an unsterile surface such as the ceiling, facial mask or lights, have the potential to fall back into the wound thereby acting as a vehicle for the transport of infectious organisms into this sterile area.

There are no studies in the literature evaluating the effect of debris that come in contact with an unsterile surface and fall back into the wound. Any assumptions must therefore be based on literature highlighting the role of airborne particles in the OR and their correlation with the risk of surgical site injection/periprosthesic joint infection (SSI/PJI). Airborne particles are a source of bacterial inoculation of the wound and can result in postoperative SSI/PJI [6–8]. Therefore, significant efforts are made to reduce the airborne particulate load. Studies suggest that particles larger than 10µm are large enough to carry viable bacteria [9]. Furthermore, as studies suggest that air turbulence and shedding of bacteria by OR traffic can result in an increase in bacterial counts in the sterile fields [10–12], it may be plausible to assume that larger debris may cause similar disruptions in airflow and increase the bioburden. Additionally, existing literature suggests that splash basins used in the OR are often contaminated with bacteria [13,14]. Non-sterile wound debris falling into such basins may be contributing to their contamination, but no study has demonstrated this theoretical possibility.

In summary, despite the absence of any specific studies demonstrating a contamination risk of the sterile operating field from "splash-back" of wound debris, we recommend that surgeons make every effort to mitigate this problem. Rachha et al. reported a technique for cement extraction that will likely prevent this problem. This was a transparent pulsed lavage shield made with plastic material that does not hinder the dexterity or vision of the surgeon. Non-