RATIONALE

Antibiotic-impregnated cement spacers are used after resection arthroplasty, as part of a two-stage exchange procedure. The rationale for the use of spacers is to allow for delivery of local antibiotics, while managing the dead space that is left behind after resection of the components. Spacers also may facilitate subsequent joint exposure during second-stage reimplantation and, depending on their configuration, may improve function during the resection interval. Spacers can be classified as either static or articulating. There are numerous problems that can occur with the use of spacers and relative to the type of spacer used (Table 1).

Knee

In a study by Struelens et al. [1], 57% of patients experienced issues related to the use of articulating spacers in the knee. Of these, 45% were minor problems such as spacer tilting and medio-lateral translation. In their cohort, 12% of spacers had dislocated, fractured or subluxed. Possible reasons for subluxation or dislocation of spacers are inadequate soft-tissue tension and/or incorrect positioning of the spacer. In addition, pre-fabricated articulating spacers typically come in a limited number of sizes and have inadequate morphology offering minimal inherent stability. Articulating spacers rely mainly on soft-tissue tension around the joint for stability and function and soft tissues often have some compromise in this setting.

Soft tissues are not always to blame for instability associated with spacers. Even when proper tension is restored during surgery, later bone loss may cause further motion and subsidence of the spacer, leading to instability and dislocation. A study by Lau et al. [2] reported that sagittal subluxation was associated with bone defects on the tibial side. The same study found that coronal subluxation tended to be correlated with larger bone defects on the femoral side although this finding did not reach statistical significance. Lanting et al. [3] found that subluxed knees, more than one standard deviation from the mean in the sagittal plane, had lower early- to mid-term Knee Society Function Scores, but did not show any significance in other patient-reported scores like Medical Outcomes Study Short Form-12 (SF-12), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Coronal subluxation did not affect any of these scores.

Hip

There are fewer reports related to complications of spacers in the hip. A study by Jung et al. [4] reported a total complication rate with hip spacers of 40.8% (i.e., 17% dislocations, 10.2% fractures of the spacer, 13.6% femoral fractures). These numbers were not confirmed by Faschingbauer et al. [5] who had an overall mechanical complication rate of 19.6 % (i.e., fracture of the spacer 8.7 %, dislocation 8.7 %, femoral fracture 0.7 %, protrusion into the pelvis 0.7 %, dislocation and spacer fracture 0.7 %). According to Faschingbauer et al., 50% of the patients with a spacer fracture remained asymptomatic (the spacer fracture occurred at the stem area of the spacer) and showed a stable condition, while the other half underwent spacer revision. A fracture of the proximal femur occurred in one of the study patients (0.7 %), which was managed operatively. Closed reduction and stable retention was possible in only 4 of 12 dislocations. All other patients with a spacer dislocation underwent a subsequent operation with spacer revision. There was no comparison in these studies between the functional and morbidity outcomes between the revised and the nonrevised spacers with respect to associated complications.

REFERENCES

[1] Struelens B, Claes S, Bellemans J. Spacer-related problems in two-stage revision knee arthroplasty. Acta Orthop Belg. 2013;79:422-426.

[2] Lau AC, Howard JL, Macdonald SJ, Teeter MG, Lanting BA. The effect of subluxation of articulating antibiotic spacers on bone defects and degree of constraint in revision knee arthroplasty. J Arthroplasty. 2016;31:199-203.

[3] Lanting BA, Lau A, Teeter MG, Howard JL. Outcome following subluxation of mobile articulating spacers in two-stage revision total knee arthroplasty. Arch Orthop Trauma Surg. 2017;137:3753-80.

[4] Jung J, Schmid NV, Kelm J, Schmitt E, Anagnostakos K. Complications after spacer implantation in the treatment of hip joint infections. Int JMed Sci. 2009;6:265-273.

[5] Faschingbauer M, Reichel H, Bieger R, Kappe T. Mechanical complications with one hundred and thirty eight (antibiotic-laden) cement spacers in the treatment of periprosthetic infection after total hip arthroplasty. Int Orthop. 2015;39:989-994.

5.5. TREATMENT: TWO-STAGE EXCHANGE

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QUESTION 1: What is the optimal timing for reimplantation of a two-stage exchange arthroplasty of the hip and knee?

RECOMMENDATION: The optimal timing for reimplantation of a two-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.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 93%, Disagree: 4%, Abstain: 3% (Super Majority, Strong Consensus)

RATIONALE

There is no conclusive evidence for defining the optimal timing between resection arthroplasty and reimplantation in a two-stage revision arthroplasty for periprosthetic joint infections (PJIs). Multiple studies have reported time to reimplantation ranging from a few weeks to several months or even years [1–11]. Literature has utilized various definitions for PJI two-stage treatment success or failure as well as different variables influencing the timing of reimplantation. Due to this heterogeneity, they have failed to answer this

question. Success of treatment with a two-stage arthroplasty varies between <70 to 100%, with no direct correlation to the spacer time interval [1,2,6,7,9,11].

Several studies have reported on time to reimplantation and its influence on success or failure. Haddad et al. reported no increase inreinfection rates by reducing the interval to three weeks [5]. Sabry et al. found that an increased duration between resection and reimplantation was associated with higher rates of infection recurrence in a cohort of 314 infected total knee arthroplasties (TKAs) treated with two-stage exchange [7]. Their median interval between stages was 103 days (range, 2 to 470 days). A study by Kubista et al. [8] also found that a longer time period between spacer insertion and reimplantation was associated with increased PJI recurrence. In contrast, Babis et al. obtained a 100% success rate when using a long interval—mean 9 months (range, 8 to 12 months)—in a group of patients with a high percentage of multiresistant bacteria [9].

One common belief is that a delayed second-stage or reimplantation will result in a higher rate of treatment success. However, this is not based on strong evidence and may lead to an unnecessarily long inter-stage interval with its associated morbidity. Aali-Rezaie et al. [10], in a recent, large retrospective cohort study evaluating patients with two-stage exchange arthroplasty, did not detect a clear association between time to reimplantation and treatment failure. Furthermore, they found that delaying the time to reimplantation did not significantly improve treatment success of two-stage exchange arthroplasty. In addition, Vielgut et al. found, in a study of 76 hip infections, that patients who had their reimplantation between 4 and 11 weeks had a significantly higher success rate when compared to less than 4 and greater than 11 weeks [6].

When deciding on the optimal timing for reimplantation, most surgeons prefer to rely on a combination of clinical evaluations, such as a completely healed wound, no pain and serologic tests trending downwards after a period of antibiotic therapy [11]. Various studies recommend a complete workup with normalized laboratory and clinical variables to assure infection control prior to reimplantation.

REFERENCES

[1] Lange J, Troelsen A, Søballe K. Chronic periprosthetic hip joint infection. A retrospective, observational study on the treatment strategy and prognosis in 130 non-selected patients. PLoS ONE. 2016;11:e0163457. doi:10.1371/journal.pone.0163457.

[2] Sakellariou VI, Poultsides LA, Vasilakakos T, Sculco P, Ma Y, Sculco TP. Risk factors for recurrence of periprosthetic knee infection. J Arthroplasty. 2015;30:1618–1622. doi:10.1016/j.arth.2015.04.005.

[3] Mortazavi SMJ, Vegari D, Ho A, Zmistowski B, Parvizi J. Two-stage exchange arthroplasty for infected total knee arthroplasty: predictors of failure. Clin Orthop Relat Res. 2011;469:3049–3054. doi:10.1007/s11999-011-2030-8.

[4] Wimmer MD, Randau TM, Petersdorf S, Pagenstert GI, Weißkopf M, Wirtz DC, et al. Evaluation of an interdisciplinary therapy algorithm in patients with prosthetic joint infections. Int Orthop. 2013;37:2271–2278. doi:10.1007/s00264-013-1995-1.

[5] Haddad FS, Muirhead-Allwood SK, Manktelow ARJ, Bacarese-Hamilton I. Two-stage uncemented revision hip arthroplasty for infection. BoneJoint J. 2000;82-B:689–694.

[6] Vielgut I, Sadoghi P, Wolf M, Holzer L, Leithner A, Schwantzer G, et al. Two-stage revision of prosthetic hip joint infections using antibiotic-loaded cement spacers: when is the best time to perform the second stage? Int Orthop. 2015;39:1731–1736. doi:10.1007/s00264-015-2751-5.

[7] Sabry FY, Buller L, Ahmed S, Klika AK, Barsoum WK. Preoperative prediction of failure following two-stage revision for knee prosthetic joint infections. J Arthroplasty. 2014;29:115–121. doi:10.1016/j.arth.2013.04.016.

[8] Kubista B, Hartzler RU, Wood CM, Osmon DR, Hanssen AD, Lewallen DG. Reinfection after two-stage revision for periprosthetic infection of total knee arthroplasty. Int Orthop. 2012;36:65–71. doi:10.1007/s00264-011-1267-x.

[9] Babis GC, Sakellariou VI, Pantos PG, Sasalos GG, Stavropoulos NA. Two-stage revision protocol in multidrug resistant periprosthetic infection following total hip arthroplasty using a long interval between stages. J Arthroplasty. 2015;30:1602–1606.

[10] Aalirezaie A, Goswami K, Shohat N, Tokarski A, White A, Parvizi J. Time to reimplantation: waiting longer confers no added benefit. J Arthroplasty. 2018. doi:10.1016/j.arth.2018.01.073.

[11] Triantafyllopoulos GK, Memtsoudis SG, Zhang W, Ma Y, Sculco TP, Poultsides LA. Periprosthetic infection recurrence after 2-stage exchange arthroplasty: failure or fate? J Arthroplasty. 2017;32:526–351. doi:10.1016/j.arth.2016.08.002.

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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 PJIs. Limited data suggests 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.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 63%, Disagree: 29%, Abstain: 8% (Super Majority, Weak Consensus)

RATIONALE

Historically, resection arthroplasty for PJIs involved removal of all the foreign material including cement, as these materials can act as a nidus for biofilm and persistence of infection [1–5]. However, removal of the cement mantle increases operative time and causes increased morbidity through bone loss and fractures. The in-cement revision technique is a useful, well-described technique utilized in aseptic conditions to avoid the tedious task of cement removal and therefore avoid complications associated with cement extraction [6–10]. Retention of an intact cement mantle in cases of resection arthroplasty for PJI would be preferable to avoid the morbidity associated with its removal and would make subsequent reimplantation technically easier.

The concern for retaining cement in the setting of PJI has been supported by in vitrostudies. Kendall et al. examined microbial growth of staphylococcal species on the surface of antibiotic-loaded cement discs incubated in broth. While the broth itself was sterilized by the discs after 96 hours, growth was consistently seen on the surface of the cement discs themselves. The cement, therefore, seemed to be a habitable surface for continued growth of bacteria, despite elution of antibiotics [11]. Mariconda et al. demonstrated that fluid around antibiotic-loaded cement that is sonicated can yield positive cultures, even if aspiration fluid was culture-negative, indicating that biofilms can persist on antibiotic-loaded cement [12]. Tunney et al. and Minelli et al. showed that biofilm could form even