5.6. TREATMENT: SURGICAL TECHNIQUE

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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.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 93%, Disagree: 6%, Abstain: 1% (Super Majority, Strong Consensus)

RATIONALE

Principles of managing PJIs include removal of infected soft tissue, bone and biofilm containing implants. Advocates of debridement and implant retention, typically for acute infection, rely on sensitive antibiotics to the causative organism and its biofilm. In open debridement, antibiotic and implant retention (DAIR), modular components are typically exchanged to improve access for thorough debridement and to reduce the biofilm volume.

Although arthroscopic surgery is attractive as a less invasive procedure than open debridement for the treatment of PJIs, it can be technically challenging to access all compartments of the joint to perform a proper debridement, risking partial surgical treatment. Partial surgical treatment risks failure to eradicate infection, side-effects from long-term antibiotic use and possible emergence of antibiotic resistance. Outcomes of staged-revision following failed partial surgical treatment are worse [1,2]. The evidence for arthroscopic washout and debridement is predominantly small, non-comparative studies [3–10]. Comparative studies of DAIR comment that successful control of infection was lower if managed arthroscopically [1].

Success is typically viewed as long-term eradication of infection off antibiotics, but function must be maintained. Poor function can be caused by infection or from pain due to loose components, inflamed soft tissues and wound-management issues caused by sinus tract formation. Aggressive surgical management involving the excision of bone, soft tissue restraints and removing well-fixed implants can challenge functional outcomes. Each individual PJI requires consideration of surgical aggressiveness to eradicate infection relative to maintaining function.

Arthroscopy in Total Knee Arthroplasty (TKA) PJI

Arthroscopic treatment of TKA PJI has variable success from 38-100%. Flood and Kolarik were the first to describe successful arthroscopic treatment of two patients with a late acutely infected TKA [3]. Waldman et al. reported that 6 of 16 patients (38%) with infected TKA who presented with less than 7 days of symptoms and who were treated with arthroscopic surgery retained their prostheses at a mean follow-up of 64 months [4]. Dixonet al. reported that 9 of 15 patients (60%) with late acute infections of TKA retained their prostheses after a mean follow-up of 50 months [5]. Chung et al. reported that 10 of 16 patients (62.5%) with late acutely infected TKA who were treated with arthroscopic surgery within 72 hours of onset of symptoms retained their prostheses at a mean follow-up of 47 months [6]. The six patients who failed arthroscopic debridement underwent successful infection eradication with open debridement with polyethylene insert exchange.

Ilahi et al. reported 5 patients with late acute TKA infections who were treated with arthroscopic surgery within 7 days of symptom onset; all patients retained their prostheses after a mean follow-up interval of 41 months [8]. Liu et al. reported on 17 patients who had late TKA infections who were treated with arthroscopic debridement combined with a close continuous irrigation-suction system; at a mean follow-up 27.5 months, 15 (88%) retained their prostheses [7].

Byren et al. [11] compared arthroscopic treament with open debridement in a retrospective review of 112 cases, 51 of which were of hips and 52 of which were of knees, to assess outcomes of patients treated for PJIs. The group found that the 15 patients with PJIs who were treated with arthroscopic washout had a significantly lower rate of success (47%) than the 97 treated with open debridement (88%) (hazard ration (HR) = 4.2, 95% confidence interval (CI), 1.5–12.5, p = 0.008). Compared to the other series, the majority of the organisms were staphylococci and 77% were early postoperative within 90 days of the implantation.

Combining these papers results in 86 infected primary TKA treated with arthroscopic debridement. In total, 54 patients (63%) were successfully treated. The success rate was affected by the infecting organism which was available in only 71 cases. The organism results were: Streptococcus 12/14 (86%), *Staphylococcus epidermidis* 11/16 (69%), *Staphylococcus aureus* 14/26 (54%), gram-negative bacilli 3/6 (50%), Mycoplasma 1/2 (50%), no growth 5/6 (83%) and polymicrobial 0/1 (0%).

The time between implantation and infection was described in 60 patients. There were eight (13%) postoperative infections using six weeks as a cut-off. Arthroscopic washout and debridement was successful in four (50%) cases. The remaining 52 cases were described as late-acute PJI with success in 36 (69%) cases.

Arthroscopy in Total Hip Arthroplasty (THA) PJI

Only two studies investigated arthroscopy in THA PJIs [9,10].In a prospective study, Hyman et al. reported eight consecutive patients who had late acute PJIs after primary THA andwere treated with arthroscopic surgery [10]. Seven infections were caused by Streptococci and one by coagulase-negative Staphylococcus. After a mean follow-up of 70 months (range, 29-104 months), there were no recurrent infections. The authors concluded that arthroscopic irrigation and debridement could benefit well-selected patients with late-acute periprosthetic hip infections.

Another study included two patients with infected THA who were successfully treated with arthroscopic debridement followed by intravenous therapy; the report did not provide additional details [9].

Arthroscopy in Chronic Late Infections

The inclusion criteria for most of the studies mention a short duration between the presentation of symptoms and time of

arthroscopic debridement and therefore there is no clear evidence exploring the role of arthroscopy in chronic late infections. The 112 PJI series treated by DAIR included 35% that were over 90 days from onset of symptoms to debridement, but this was a mixed series of predominantly open debridement with only 15 performed arthroscopically [11]. There was no sub-group analysis of the arthroscopic group available to make conclusions regarding timing or utility in treating chroniclate infections.

There is a practical role of arthroscopy as part of the management of PJIs in chronic-late infections. Arthroscopy can be part of the diagnostic workup of a painful arthroplasty allowing dynamic inspection of the components for instability and wear, ruling out non-infective causes, visualization of the synovium and obtaining multiple samples for microbiology and histology. In patients who are not well due to sepsis, particularly where delaying surgery while waiting for appropriate equipment or surgical expertise risks further health deterioration, arthroscopically obtaining microbiological samples prior to commencing antibiotics and joint washout to reduce the bacterial load can allow time for appropriate preoperative planning for definitive surgical management of the PJI.

In conclusion, the studies describing arthroscopic management of PJIs generally analyze few patients and have very specific inclusion criteria, making the data difficult to generalize. Combining the available studies, the success from acute late infection is approximately 60%. The only comparative series available concluded that arthroscopic debridement has a significantly lower success rate than open debridement. Future work could investigate specific bacterial infections that lack an ability to form a biofilm and are sensitive to long-term oral antibiotics that may be susceptible to more conservative surgical management. Overall, based on the current literature, we recommend against the routine use of arthroscopic surgery for the management of PJIs.

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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 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.

LEVEL OF EVIDENCE: Consensus

DELEGATE VOTE: Agree: 97%, Disagree: 3%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

The treatment of PJIs involves the surgical removal of infected tissue and hardware in order to decrease the potential infectious bioburden. Many infecting organisms are capable of forming biofilms on foreign material surfaces. Therefore, all foreign material, including bone cement and hardware, should be removed to better treat or control PJIs.

Retained hardware prior to total knee arthroplasty (TKA) is a known risk factor for PJIs. In vitro studies demonstrate the ability of bacterial biofilms to adhere to orthopaedic implants [1–3], and the presence of extravascular foreign bodies in animal models increases the threshold for infection 100,000-fold due to a hypothesized granulocyte defect around implants [4,5]. Manrique et al. demonstrated a trend toward increasing rates of PJIs with partial or complete retention of hardware, but there was no statistical significance when compared to controls [6]. There are limited reports highlighting the need to remove hardware from around the hip or knee in the setting of PJIs. Suzuki et al. reported on their institutional experience of 2,022 TKAs. Seventeen infections were identified with a prior history of an open reduction internal fixation and the presence of retained internal fixation material was correlated with postoperative infections [7]. However, the mere presence of prior fixation material cannot fully be separated from the increased risk of PJIs in a multiply-operated joint.