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.

While the removal of all implant materials is thought to provide the greatest benefit, the degree of tissue or implant excision necessary for infection control is currently unknown. The inability to control infection in the setting of retained hardware is often thought to be due to residual bacteria. In many cases, the morbidity of removing implants or other hardware is considered too great, and, therefore, implants are retained. Evidence for this is supported in the practice of debridement with retention of components. Partial radical debridement has proven successful in a small case series where 17 of 19 patients remained infection free with retained cemented or uncemented femoral prostheses [8,9]. In addition to the retention of metal components, there are mixed results when considering cement retention. McDonald et al. reported that 3 of 7 patients with retained polymethyl methacrylate cement had a recurrence of infection, whereas only 8 of 75 patients in which the cement had been completely removed had recurrence of an infection ($p < 0.01$) [10]. There is evidence, however, that retaining cement that would otherwise be deleterious to remove is safe and effective in the setting of infection [11].

The retention of plates, hooks or cables will often occur in the periprosthetic fracture setting. Evidence exists for successful fracture union with retained hardware in the setting of infection [12–14]. Berkes et al. demonstrated that 71% (86 of 121) successful fracture unions with operative debridement, retention of hardware and culture-specific antibiotics and suppression [12]. The retention of an intramedullary device, however, was associated with higher failure rates ($p< 0.01$). Rightmire et al. demonstrated a 68% (47 of 69 cases) success rate for hardware retention and debridement in the treatment of infected fractures [13]. When considering these results, it is important to note the clinical differences between infected fractures and infected periprosthetic fractures that communicate with the joint space, which is typically a large effective space. In postoperative spine infections, Picada et al. reported on 24 of 26 fusions healing without removal of hardware, although they achieved these results most often with secondary closure [15].

When retaining components, rifampin should be considered as part of the antibiotic regimen, particularly for staphylococcus infections. Zimmerli et al. conducted a randomized, placebo-controlled, double-blind trial and demonstrated a 12 of 12 (100%) infection control rate in the ciprofloxacin-rifampin group compared to the ciprofloxacin-placebo group (7 of 12 - 58%) when implants were retained [5]. Additionally, Trebse et al. demonstrated improved success rates with the addition of rifampin [9].

The removal of all infected material, organic or inorganic, improves the ability to control PJIs by reducing bacterial bioburden and helping to eliminate biofilm. However, the removal of these materials must be balanced with the morbidity of their removal and considered carefully in surgical planning.

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QUESTION 3: Should all knee compartments be resected during resection of an infected unicondylar knee arthroplasty (UKA)?

RECOMMENDATION: Yes, during resection of an infected UKA, other compartments of the knee, including the fat pad, should also be resected.

LEVEL OF EVIDENCE: Consensus

DELEGATE VOTE: Agree: 80%, Disagree: 14%, Abstain: 6% (Super Majority, Strong Consensus)

RATIONALE

UKA has become increasingly popular among those affected by single-compartment osteoarthritis in that it preserves the integrity of the remaining knee compartments and ligaments, permitting the operated knee to be functionally and kinematically similar to the