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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.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

The incidence of deep infection after total elbow arthroplasty (TEA) has been reported to be 3–13.3% [1–4]. It has been widely accepted that elbow PJI is difficult to treat and has poor outcomes [1,2,5]. Compared to knee and hip arthroplasties, relatively high infection rates [2] and poor outcomes [6] have led to an assessment of the efficacy of different treatment procedures [2,5]. Treatment modalities include debridement with prosthetic retention, resection with subsequently staged reimplantation, staged reconstruction with composite allograft, permanent resection and arthrodesis [2–9].

Among the aforementioned treatment modalities, arthrodesis must be the last choice and should be regarded as a salvage procedure. Functional limitation after arthrodesis cannot be compensated by adjacent joints [8,10,11]. Small contact areas of the remaining bone stock and high moments generated by the long lever arm preclude obtaining solid bone fusion [8,11,12]. Even if fusion can be achieved, it has been reported that humerus fracture risk increases in longer follow-up [13]. Arthrodesis has been reported to be a successful treatment only if there is adequate bone stock, good soft tissue envelope and sufficient vascular supply [8,14,15]. However, in majority of patients with elbow PJI, there are bone defects due to the destructive effect of infection, removal of bone as part of treatment of infection, vascularity is impaired and soft tissue coverage may be insufficient secondary to recurrent surgical interventions [2,5,12–16].

Wolfe et al. described two patients treated with arthrodesis after elbow PJI [9]. The authors reported a painful fibrous union in one patient and a persistent infection in the other. In the limited literature evaluating the treatment of arthrodesis after elbow PJI, the largest series (by Otto et al.) consists of five patients [11]. The authors reported that no union was achieved in any of the patients, and there was asymptomatic fibrous union in only two patients (40%) at the last follow-up. In that study, high reoperation rates and high complication rates were emphasized, and arthrodesis was not recommended for the elbow PJI.

Severe bone loss in this patient group was seen as an important cause of treatment failure. Thus, Koller et al. described an arthrodesis technique using double fibular strut graft and reported favorable results in a patient at the 12-month follow-up [10]. The arthrodesis of the radius to the humerus described by Presnal et al. aimed to surpass nonunion caused by the massive bone loss in the ulna [8]. Nevertheless, according to widely accepted view, arthrodesis treatments for the elbow PJI have poor outcomes and high reoperation rates, and it is not recommended except in special conditions [4,9,14–18]. It might be considered in the case of a failure of resection arthroplasty due to instability [15,17], especially when control of sepsis due to the mobility of the articulation is not possible [14] and also in young patients who do heavy bodily work [18]. Because of the limited literature and small case series, the role of arthrodesis in the treatment of elbow PJI could be evaluated with a limited level of strength.

Treatment of elbow PJI has centered on antibiotics, surgical debridement and retention or staged reimplantation [1]. In some cases where the joint is extremely damaged or seems unsalvageable, arthrodesis may be a viable treatment choice to avoid amputation [1]. Traditionally arthrodesis of the elbow has only been used when all other motion-preserving interventions are declared not possible and studies have reported elbow arthrodesis results in more impairment than hip, knee or ankle joint arthrodesis [2,3]. Koch and Lipscomb report that arthrodesis should be considered only when there is sufficient tissue damage to prevent reimplantation following TEA PJI, and in these cases they reported a 15% delayed complication rate [13].

Literature examining the success of elbow arthrodesis for chronic PJI is limited. There have been no level I, II or III studies, and only two level IV studies have examined the use of arthrodesis for chronic elbow PJI related to tuberculosis [5,6]. A recent review article suggested that evidence to support the use of arthrodesis is

incomplete as a treatment modality for chronic elbow PJI [11]. One aspect that should be taken into account is the technique used during arthrodesis, as Sala et al. found this influences the functional outcome following elbow PJI [19]. Overall, due to the limited literature, we cannot recommend the use of elbow arthrodesis to treat chronic elbow PJI.

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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.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

Surgical management of an infected total elbow arthroplasty (TEA) is dependent on the chronicity of the infection and the infecting organism, as well as host factors. The majority of TEA components are placed in a cemented fashion. In cases where the humeral and ulnar components are removed, the cement mantle may or may not be easily extractable at the time of surgery. This discussion will focus on the literature which reports on patient outcomes following TEA component resection with retained foreign material.

A systematic review was performed using the search terms, "retained cement AND total elbow arthroplasty NOT shoulder." This search yielded zero results. Therefore, a broader search criterion was utilized. The second search evaluated "total elbow arthroplasty AND infection AND removal NOT shoulder." All 32 articles were reviewed. Of these, only one paper documented retained cement in the setting of removal of the humeral and ulnar components. Stoodley et al. [1] reported a single case series of a TEA performed for a distal humerus fracture nonunion. The patient underwent multiple staged operations including before and after the index TEA. Cultures remained negative until the seventh operation, when the authors noted a positive culture and documented that retained cement was removed at that time. However, the authors were unable to state if the retained cement was the cause of persistent infection, as the patient had not previously received targeted antibiotics that effectively addressed the infectious antimicrobial profile.

Given the lack of evidence available within the total elbow arthroplasty literature, information regarding the effect of retained cement must be taken from other orthopaedic literature. Early reports in the lower extremity arthroplasty literature raised concern about the correlation of retained cement and incomplete eradication of infection [2]. However, not all series have correlated retained cement with persistence of infection [3,4]. Petty et al. reported on 54 total hips treated for PJI. At the time of revision surgery, the presence of retained cement was not associated with positive intraoperative cultures.

Given the lack of data available in the elbow arthroplasty literature, we are unable to make a recommendation regarding the necessity to remove all cement or other foreign material in the treatment of periprosthetic TEA infections.

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