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QUESTION 5: How many arthroscopic procedures are reasonable for the management of an infected anterior cruciate ligament reconstruction (ACLR) prior to considering graft and hardware removal?

RECOMMENDATION: Prior to considering stable graft and hardware removal, at least two arthroscopic procedures are reasonable for the management of an infected ACLR. There is evidence for successful treatment and graft retention with further arthroscopic procedures.

LEVEL OF EVIDENCE: Moderate

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

RATIONALE

Septic arthritis after arthroscopic ACLR is rare with an overall frequency to be around 1% [1–4]. However, when it does occur, it is a potentially serious event with possible sequelae of osteomyelitis, arthrofibrosis and damage to the articular cartilage leading to osteoarthritis [5–7]. Although a rare occurrence, surgeons who routinely perform this procedure are likely to encounter this complication during their career [8].

Repeated arthroscopic lavage is part of the algorithm to treat infection after ACLR [4]. The number of arthroscopic procedures necessary is guided by clinical and laboratory progression as well as organism virulence and patient-related factors such as age and pre-existent comorbidities [3,9]. In a study by Bostrom Windhamre et al., patients suffering from septic arthritis after ACLR underwent a mean of 3.7 interventions (range 1 to 11) [10]. Arthroscopic lavage was repeated if the patient had persistent fever, swelling and a C-reactive protein level greater than 50 mg/L. In a study of 90 cases of septic arthritis after ACLR conducted by Saper et al., arthroscopic irrigation and debridement was performed in 95.5% (86/90) of cases with an average of 1.51 procedures [2].

According to Abdel-Aziz et al., a median of three (range 1 to 6) repeated arthroscopic debridement and synovectomy procedures were required to eradicate infection [3]. In another study by Schulz et al., irrigation and debridement successfully treated the infection with a mean of 2.2 procedures with no recurrences of septic arthritis or bone infection [11]. Kim et al. presented 146 patients producing 111 (78.1%) positive intraoperative cultures. *Staphylococcus epidermidis* was identified in 46 knees (41.4%) with *Staphylococcus aureus* found as the second most common organism and presented in 38 knees (34.2%) with infection after ACLR [12]. This report differs from the previous general consensus that *Staphylococcus aureus* was the most commonly reported organism in ACLR infection [9].

In their study of 147 patients with infections of the knee, Wang et al. noted that coagulase-negative *Staphylococcus* (CNS) was the most common pathogen and represented 45.6% of the infections. *Staphylococcus aureus* was second most common and was reported to cause 23.8% of the infections [7]. The virulence of the infective organisms can affect the course of treatment, but the age of the patient appears to have some bearing on the outcome and the number of arthroscopic procedures required to control the infection. Mouzopoulos et al. reported that patients over the age of 25 years required,

on average, 1.12 more procedures to control infection compared to patients under the age of 25 [9].

Immediate arthroscopic lavage and debridement should be followed by six to eight weeks of intravenous antibiotic therapy, and then two to four weeks of oral antibiotics. In cases of persistent infection, repeat arthroscopy is recommended, but serious consideration for graft removal should be considered [9]. In patients with a retained graft, McAllister et al. reported that an average of 2.75 procedures were needed to sterilize the knee joint [5]. Graft retention is important, as 30% of patients with the graft retained following surgery experienced knee instability compared to 65% of patients who had their graft removed [11,13]. Early diagnosis of infection is critical, as the literature has reported that infection diagnosed within seven days post-ACL reconstruction has a higher rate of graft salvage than those infections diagnosed beyond seven days post-op [7]. Furthermore, graft retention following infection after ACLR is a viable procedure with a reported overall success rate of 85% [14].

Upon reviewing the literature, it was found that at least two arthroscopic treatments are needed to control infection after ACLR and prior to graft and hardware removal. Despite the lack of randomized clinical trials, several retrospective studies have reported that arthroscopic lavage and debridement for infection following ACLR is an effective therapeutic intervention to minimize the severity of sequelae, including osteoarthritis, osteomyelitis and arthrofibrosis [5].

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QUESTION 6: How many arthroscopic procedures are reasonable for the management of an infected anterior cruciate ligament reconstruction (ACLR) prior to considering arthrotomy?

RECOMMENDATION: It is reasonable to treat acute infection of the knee following ACLR with arthroscopic debridement, repeating the arthroscopy up to six times, if necessary. The use of arthrotomy in the management of infected anterior cruciate ligament (ACL) cases is not well defined.

LEVEL OF EVIDENCE: Limited

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

RATIONALE

Infection following ACLR is rare but can be a potentially devastating complication. However, if early appropriate surgical intervention is performed, the functional outcome may be comparable to non-infected cases of ACLR [1].

Historically, septic arthritis of the native knee was treated with open debridement and varying degrees of synovectomy, as described by Ballard et al. [2]. More recently, Riel et al. demonstrated arthroscopic irrigation and debridement with good results and since then, they have become a routine treatment option for an infected ACLR [3]. Several subsequent studies have described arthroscopic debridement as the initial treatment of choice for the management of septic arthritis of the knee [4].

Makhni et al. conducted a systematic review on functional outcomes following surgical treatment of the infected knee following ACLR. The studies included in the analysis demonstrated that up to six arthroscopic procedures were performed for the resolution of infection and symptoms [4].

Böstrom et al. examined outcomes following infected ACLRs. They described a standard treatment protocol of repeated arthroscopic debridements, with a mean of 3.7 procedures per patient, although the range was wide (1 to 11 procedures) in all patients [5]. Another systematic review by Saper et al. concluded that arthroscopic debridement with graft retention is an effective treatment of infection following ACLR. The mean number of arthroscopic procedures per patient in these studies was 1.5 (range, 1 to 4) [6].

Interestingly, Petersen et al. used a treatment approach according to the Gaechter classification system. In their study, they reported complete resolution of infection following ACLR in all patients without arthrotomy. For Gaechter stage I and II patients, the mean number of arthroscopic debridement's was 2.5, while in stage III patients it was 3.4. There were no stage IV patients reported [7]. Similarly, Gille et al. utilized a treatment algorithm based on the stage of infection according to Gaechter [8]. In patients with stage III or IV infections, medial and lateral

arthrotomy with near total synovectomy was performed after initial arthroscopy.

Torres-Claramunt et al. reported mean of 1.3 (standard deviation = 0.6) arthroscopic debridements in their study, and one patient required three procedures. The authors recommended repeated arthroscopic debridement, usually after 48 to 72 hours, if clinical and laboratory parameters do not improve [9]. Abdel Aziz et al. examined 24 patients with an infected ACLR, who required between 1 and 6 arthroscopic debridements before achieving complete resolution of infection [10].

The literature on the number of arthroscopic procedures needed prior to arthrotomy for an infected ACLR is sparse. Nevertheless, studies have shown that repeated arthroscopic procedures can give good results, although the number of procedures required varies. As a consequence, there may be no need to treat an infected ACLR with arthrotomy in most cases. However, in more severe and neglected cases (Gaechter stage IV), arthrotomy should be considered after initial arthroscopic evaluation of the joint.

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