poor outcomes (e.g., fungal or enterococcus PJIs) salvage procedures should be considered.

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QUESTION 3: What are surgical alternatives to hip disarticulation in patients with persistent joint infections?

RECOMMENDATION: Surgical alternatives to hip disarticulation include resection arthroplasty when reconstruction of the joint with the use of a megaprosthesis is not possible. Hip disarticulation should be reserved for patients with systemic sepsis and/or extreme soft tissue infections of the extremity, in whom the surgery is performed as part of a life-saving procedure.

LEVEL OF EVIDENCE: Limited

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

RATIONALE

Hip disarticulation is considered a last-resort option for non-neoplastic indications including necrotizing soft tissue infections, gas gangrene and life-threatening infections [1]. Fenelon et al. [2] reported on 11 cases of hip disarticulations performed as a result of failed arthroplasties due to severe infections of soft tissues and bones, bone stock losses or vascular injuries.

The extensive loss of bone stock from failed arthroplasty procedures and revisions is a major challenge with or without infection. Fountain et al. [3] identified 14 patients who had a total femoral arthroplasty as a limb salvage procedure after complications following revision arthroplasty surgery over a 25-year period. The indications for treatment included eradication of prosthetic joint infection (PJI), treatment of infected periprosthetic fractures, massive bone loss precluding the use of stemmed prosthesis, recurrent dislocation or a combination of these factors. Six patients had no complications. Three patients developed an infection and five patients sustained repeated postoperative dislocations. Eight patients had no pain, whereas eight other patients had persistent pain necessitating prolonged opioids. There was an overall improvement in function in all patients with four patients achieving a 75% improvement.

Parvizi et al. [4] reviewed 48 patients who received a modular megaprosthesis with or without bone grafting. There were good functional outcomes in 22 patients, fair results in 10 patients and poor results in 11 patients. Three patients had died before the minimum 2-year follow-up had elapsed. They concluded that for patients with severely compromised bone stock precluding the use of conventional prostheses due to inability to achieve adequate fixation, this might be a viable salvage procedure for these patients.

Smolders et al. [5] reviewed 25 patients in a retrospective study treated with the Modular Universal Tumor and Revision System (MUTARS®); Implantcast GmbH, Buxtehude, Germany). Harris Hip Scores improved from 28 points preoperatively to 81 points postoperatively, with 24% of patients developing complications.

Berend et al. [6] reported on 59 patients that had total femoral arthroplasties for salvage of end-stage prosthetic diseases. Indications for the procedure included numerous revision total hip or knee arthroplasties, failed periprosthetic femur fractures or recurrent infections treated with multiple radical debridement surgeries. Mean follow-up was 4.8 years. The average Harris Hip Pain Score was 34 out of 44 points. Good function was achieved with 98% able to ambulate and 43% using an assistive device or cane. There were 18 complications or subsequent surgeries (30.5%). Infection occurred in eight patients and dislocations in seven patients.

Shih et al. [7] evaluated 12 patients with massive proximal femoral deficiencies who received a proximal femoral megaprosthesis for failed total hip arthroplasty (THA). They had a mean follow-up of six years. Eight (67%) patients had satisfactory results, one had a fair result and three had poor results. The complication rates were high with dislocations in five (42%), deep infections in four (33%), ectopic ossifications in one (8%), one displacement of the greater trochanter and one case of aseptic loosening. Three patients had permanent resection arthroplasty procedures for recurrent infection.

Artiaco et al. [8] reported on five patients with severe femoral bone loss and infection using a megaprosthesis in the revision of infected THA. They compared their results to four studies using megaprosthesis for a severe femoral bone loss and infection. One of the studies was inadequate for data and three were used for comparison. Their results were four out of the five patients had eradication of their infection and Harris Hip Mean Score of 74 points compared to 20 cases from three literature studies of 75 points. The literature review group had 6 (33%) patients with recurrent infections and overall complications in 8 of 20 (40%). They stated that revision with a megaprosthesis in cases of infected total hip arthroplasties with severe femoral bone loss have a high risk of complications and should be carefully evaluated and used in selected patients when other surgical procedures are not feasible.

Friesecke et al. [9] evaluated the results of total femur prostheses implanted during revision arthroplasty in 100 consecutive patients without infections. The mean duration of follow-up was five years. Sixty-five patients (68%) had no complications. Deep infection occurred in 12 patients (12%), material failure in 3 and peroneal palsy in one (1%.). The mean Enneking hip function score was 1.25 points preoperatively and improved to 3.29 points postoperatively. The mean preoperative Enneking knee score was 2.09 points and 3.29 points postoperatively. They concluded that total femur arthroplasty (TFA) is a useful implant for patients with extensive bone losses at revision arthroplasty. Although the infection rate was high, the overall functional results were rated better than good by the Enneking classification for the hip and knee.

Gebart et al. [10] reported on 45 patients undergoing revision surgeries using the MUTARS® (Implantcast GmbH, Buxtehude, Germany). The average follow-up was 39 months. Complications occurred in eight patients (18%) with one dislocation, two aseptic loosenings and five reinfections. The Harris Hip Score was 3.0 presurgical and 78 postsurgical. Castellanos et al. [11] reported on the results of 78 patients at 5-year follow-up with infected hip arthroplasties who underwent resection arthroplasty procedures. A total of 86% of patients had infections controlled and satisfactory pain relief was achieved by 83% of patients.

Ganse et al. [12] reported on 18 hips with a mean follow-up of 52 months. Thirteen hips had two-stage revisions and five patients had an excisional arthroplasties. They reported no differences in the Harris Hip Scores between the two groups, with a mean score of 60 points. Cordero-Ampuero et al. [13] reviewed the results of resection arthroplasty procedures in the literature concluding that there was wide variability in satisfaction ranging from 13-83%. Resolution of infection occurred in anywhere from 80-100% of patients. Risk factors for failure included rheumatoid arthritis, methicillin-resistant *Staphylococcus aureus* (MRSA) and enterococcal infections and retention of cement. Pain was reported as severe in 16-33% of patients, moderate in 24 - 53%, and mild in 76%. Twenty-nine percent were able to walk independently, and 45% of geriatric patients were unable to walk. Harris Hip Scores ranged from 25 to 64 points.

Korim et al. [14], in a systemic review of proximal femoral arthroplasty (PFA) for non-neoplastic conditions, reported on 14 studies with an average of follow-up of 4 years (range 0-14 years) describing 356 PFAs. Complications most commonly occurring were dislocation (15.7%) and infection (7.6%). The mortality rate ranged from 0 to 40%.

In conclusion, several alternatives to hip disarticulation exist, including the resection arthroplasty and the implantation of megaprosthesis such as proximal and total femoral arthroplasties with or without allograft. However, the efficacy and indications of these procedures remains unclear due to low-level evidence and short-term follow-up. Further higher-level studies are required to better guide treatment in these complex clinical settings.

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5.9. TREATMENT: ANTIMICROBIALS

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QUESTION 1: What is the recommended duration of antibiotics after a single-stage exchange for periprosthetic joint infections (PJIs)?

RECOMMENDATION: In the setting of single-stage exchange arthroplasty, intravenous antibiotics should be administered for 10-14 days followed by oral antibiotics. Generally, the overall duration of antibiotics of 4-6 weeks is sufficient.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 73%, Disagree: 23%, Abstain: 4% (Super Majority, Strong Consensus)

RATIONALE

The two-stage exchange arthroplasty is the preferred method for treatment of chronic PJIs. However, the single-stage exchange procedure has been gaining popularity, demonstrates comparable outcomes regarding infection control and offers various benefits for