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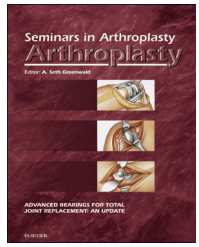

Managing the infected arthroplasty: Cleanout, 1-stage, or 2-stage

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ABSTRACT

The management options for infected shoulder arthroplasty can be divided into those in which an implant is ultimately retained or implanted (i.e., debridement and 1-stage or 2-stage reimplantation), and those in which an implant is no longer used (i.e., resection or arthrodesis). The options that allow the eventual use of an implant result in better shoulder function. Knowledge of their indications and outcomes can help guide the surgeon's decision.

1. Introduction

Management of the prosthetic shoulder infection (PSI) remains a challenging and complex problem. The incidence of infection in the literature has been reported to be as high as after 1.8% after primary arthroplasty and 15.4% after revision arthroplasty [1–4]. Low-grade infections may be more common than previously recognized, and are difficult to diagnose. The present article discusses the diagnosis of prosthetic shoulder infections and the various management strategies, with particular focus on debridement with component retention, 1-stage and 2-stage revision.

2. Patient evaluation

A thorough history is essential in the workup of any prosthetic joint infection. Some patients may recall having had superficial infection or drainage shortly after the index procedure. A history of post-operative hematoma has been correlated with infection as well [5]. However, unlike infected arthroplasty in the hip or knee, constitutional symptoms such as chills and fever rarely occur. Many patients will report persistent pain since the original procedure and pain at rest, which can be differentiated from wear-related pain that occurs during activity. Stiffness can often be present, with pain at the terminal range of motion [1,2].

Prior incisions should be noted, and a thorough neurovascular examination should be performed. The assessment of the deltoid includes evaluation of the anterior, middle, and posterior heads of the muscle, as well as rotator cuff atrophy. During the observation of active and passive motion in flexion, abduction, and internal and external rotation, the shoulder should be evaluated for any humeral head escape.

3. Investigative studies

Serum laboratory values should be obtained in all patients, including a complete blood cell count, C-reactive protein, and sedimentation rate, keeping in mind that elevated values post-operatively are nonspecific [6,7]. There has been recent

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interest in serum interleukin-6 (IL-6), IL-8, IL-1B, and alpha-defensin, though significant more study must be completed before their use is a matter of routine. Plain radiography must include anteroposterior and certainly axillary radiographs. Serial radiographs may reveal a change in radiolucent lines around one or both components, osteolysis, and new periosteal bone formation [8], with loosening of the humeral component within 5 years of the index procedure being suggestive of chronic infection [9]. Computed tomography (CT) can detect subtle signs of loosening or a change in component position. Ultrasonography and magnetic resonance imaging may reveal fluid collections, but nuclear studies have not been as useful for obtaining the diagnosis of infection in shoulder arthroplasty as compared to other periprosthetic infections [1,10,11]. Aspiration is also less reliable in the shoulder given that there is less severe inflammatory response resulting in less of an effusion. The rates of reportedly successful aspirations range from 39% to 56% [2]. The sensitivity of organism detection in culture can be increased by ultrasonification of the removed implant, with subsequent polymerase chain reaction (PCR) being used for detection [12].

4. Diagnosis

The diagnosis of infection remains a significant challenge in most patients. Topolski et al. [3] reported that in a series of 75 patients with intraoperative cultures at the time of revision arthroplasty, none of the patients had clinically obvious signs of infection, the ESR was negative in 86%, and the CRP was negative in 75%. Detection of *Propionibacterium acnes*, the usual organism responsible for PSI, may require culture of

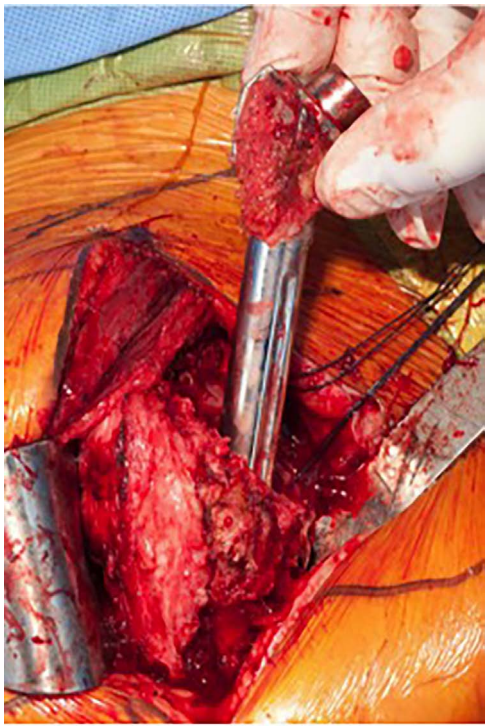

Figure 1 – The infected implant is removed with care taken to minimize the amount of bone loss.

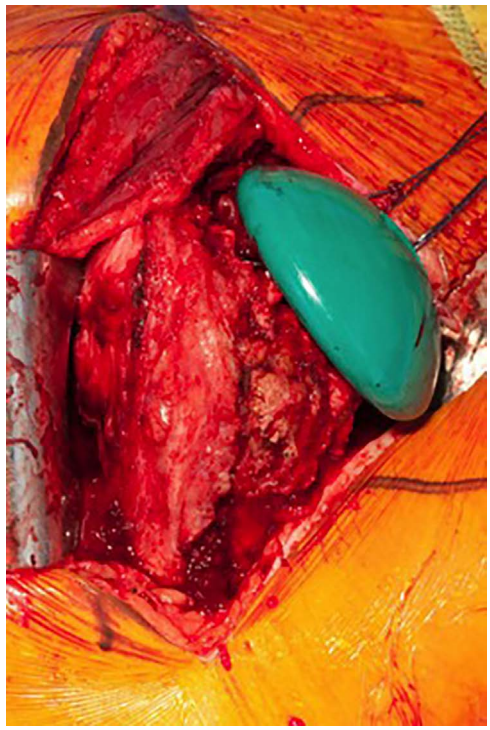

Figure 2 – A trial stem and head is used to determine the appropriate size of the spacer.

14–21 days [13,14], though there is evidence suggesting that in cases of probable infection, cultures will return positive before 11 days [15]. Pottinger et al. [16] determined that male sex, radiographic evidence of humeral component loosening, cloudy fluid, and the formation of a membrane were independent and significant predictors of *P. acnes*.

5. Classification

The Gustilo classification is predicated on the amount of time passed between the procedure and onset of infection, and is divided into 4 types—type 1, positive cultures at the time of surgery; type 2, acute infection within 30 days of the arthroplasty; type 3, acute hematogenous infection; and type 4, chronic infection [17].

6. Treatment

The following 5 management options are currently in place for PSI: (1) antibiotic suppression, (2) debridement with component retention, (3) 1- or 2-staged revision arthroplasty, (4) resection arthroplasty, and (5) arthrodesis. The present article will primarily focus on results of debridement and 1- versus 2-staged revision arthroplasty.

7. Cleanout

Debridement with component retention is typically considered for patients with acute presentations of PSI or with acute hematogenous infections, ideally less than 3 weeks. The