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## QUESTION 4: Is there a role for preoperative open or arthroscopic tissue biopsy in the evaluation prior to initial revision shoulder arthroplasty?

**RECOMMENDATION:** Arthroscopic or open biopsy prior to initial revision shoulder arthroplasty can aid in the diagnosis of suspected shoulder periprosthetic joint infection (PJI).

**LEVEL OF EVIDENCE:** Limited

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

### RATIONALE

PubMed and Embase were searched from 1980 to January 2018 to identify studies evaluating preoperative open or arthroscopic tissue biopsy prior to revision shoulder arthroplasty. A secondary search of the references of included studies was also conducted. Three articles were selected for inclusion. Articles regarding hip and knee arthroplasty were excluded.

Morman et al. described one case in which arthroscopy was used in the evaluation of shoulder PJI prior to revision [1]. The patient presented with pain and glenoid loosening three years after total shoulder arthroplasty (TSA), underwent arthroscopic tissue biopsy that grew *C. acnes*, and went on to undergo successful two-stage revision for shoulder PJI.

Dilasio et al. reported on a series of 19 cases from a series of 350 painful shoulder arthroplasties who underwent arthroscopic biopsy prior to revision [2]. At revision shoulder arthroplasty, 41% had positive cultures, all for *C. acnes*. Arthroscopic biopsy prior to revision was exactly consistent with the final revision cultures with 100% sensitivity, specificity, positive predictive value and negative predictive value. The authors also reported that fluoroscopically guided glenohumeral aspiration prior to revision was inferior to arthroscopic biopsy with 16.7% sensitivity, 100% specificity, 100% positive predictive value and 58.3% negative predictive value. There are potential limitations including selection bias in this study without well-defined criteria by which the 19 patients out of 350 painful TSAs were selected to undergo arthroscopy. Thus, it is unclear what features of the presentation led the treating surgeon to continue to have a high index of suspicion for infection in these particular cases. Furthermore, cultures were held following revision surgery for only 7 days, whereas many authors advocate for longer incubation times (most frequently 14 days) for the fastidious and slow-growing *C. acnes*.

Tashjian et al. reported on a series of 77 patients who had revision TSA, and pre-revision biopsy was performed in 17 cases considered "at-risk" for infection [3]. Specifically, this included patients with abnormal erythrocyte sedimentation rate (ESR) and/or C-reactive protein (CRP) with no growth on shoulder aspiration, as well as patients with normal ESR/CRP and a dry aspirate. Patients that were grossly infected, those with positive aspiration culture, as well as those with normal ESR/CRP and negative aspiration culture were not biopsied. Open biopsy was performed for cases of known deficient rotator cuff via the proximal 3cm of the prior deltopectoral incision. Arthroscopic biopsy was performed with anatomic TSA with intact rotator cuff via a posterior viewing portal and anterior rotator interval portal for obtaining biopsy specimens. Two to three samples were obtained during biopsy and again at the time of revision TSA, and cultures were held for 14 days. Revision arthroplasty

was performed at least three weeks after biopsy. They found that the prerevision biopsy resulted in 75% sensitivity, 60% specificity, 82% positive predictive value and 50% negative predictive value for the prediction of positive culture at the time of revision TSA. For diagnosis of infection, sensitivity was 90%, specificity 85%, positive predictive value 90% and negative predictive value 86%. The study limitations include a mixture of open and arthroscopic biopsies prior to revision TSA, a small sample size, and the use of two biopsy samples in some patients and three in others. There was also no comparison between open and arthroscopic biopsy and no comparison to other diagnostic tests.

Overall, the limited available literature suggests that biopsy prior to revision TSA can improve the diagnosis of shoulder PJI in cases without obvious objective evidence of infection, where the clinician remains suspicious of occult infection. While not well studied, many clinicians have used this technique as a method to confirm an aseptic environment before implantation of a prosthetic in cases where there is a distant history of apparently fully treated infection after shoulder surgery. Future research must report which history, demographic, physical exam, radiographic or laboratory features can guide a clinician to continue to be suspicious of occult infection. There is no evidence for a role in cases that are obviously infected or cases without suspicion for infection (e.g., loosening after trauma or loosening after many years of successfully functioning shoulder arthroplasty where labs are normal and radiographs do not suggest infection). Specific indications for arthroscopic biopsy remain to be further defined due to the limited available literature at present. Perhaps the main advantage of pre-revision biopsy for culture is that if the cultures are positive one might make the definitive decision to perform two-stage revision and have a better understanding of appropriate antibiotic management. However, it also remains unclear if this would be the appropriate decision given the good track record of one-stage revision TSA in cases of unexpected positive cultures for *C. acnes*. In addition, the cost-effectiveness of adding an arthroscopic biopsy to the treatment algorithm for revision shoulder arthroplasty remains unknown.

### REFERENCES

- [1] Morman M, Fowler RL, Sanofsky B, Sanosky B, Higgins LD. Arthroscopic tissue biopsy for evaluation of infection before revision arthroplasty. *J Shoulder Elbow Surg.* 2011;20:e15–e22. doi:10.1016/j.jse.2010.11.015.
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