Substantial cultures of *Propionibacterium* can be found in apparently aseptic shoulders revised three years or more after the index arthroplasty

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**Background:** Revisions of apparently “aseptic” shoulder arthroplasties are not infrequently culture positive for *Propionibacterium*, organisms that may be introduced at the time of the index surgery when the dermal sebaceous glands are transected. This report seeks to answer the question, Do surgeons performing revision shoulder arthroplasty years after the index procedure need to be concerned about the persistence of *Propionibacterium*?

**Methods:** We reviewed the medical records of 148 revision arthroplasties performed between July 2008 and June 2013 to find those revisions performed at least 3 years after the index procedure and at which intraoperative cultures were strongly positive for *Propionibacterium*.

**Results:** We identified 14 cases of revision surgery performed 8 ± 4 years after the original arthroplasty for which deep cultures were strongly positive for *Propionibacterium*. A total of 109 specimens were obtained, 84 of which were positive. All 14 patients were male.

**Conclusion:** Shoulder arthroplasties revised for the mechanical problems of loosening or stiffness can be substantially culture positive for *Propionibacterium*, even if the revision is performed many years after the index procedure. Therefore, even in shoulder arthroplasties revised for mechanical problems years after the index procedures, surgeons should consider submitting multiple deep specimens for specific *Propionibacterium* culture. In the presence of persistent *Propionibacterium*, surgeons should consider the need for directed surgical and medical treatment in their management of a failed arthroplasty.

**Level of evidence:** Level IV, Case Series, Treatment Study.

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organisms such as *Propionibacterium*. There is evidence that these organisms are introduced at the time of the index surgery when the dermal sebaceous glands are transected. The question now to be answered is, Do surgeons performing revision shoulder arthroplasty years after the index procedure need to be concerned about the presence of *Propionibacterium*? This study sought evidence that substantial cultures of *Propionibacterium* can be recovered from deep specimens harvested at revision shoulder arthroplasty surgery performed years after the index shoulder arthroplasty.

**Materials and methods**

Between July 2008 and June 2013, we performed 148 revision arthroplasties on shoulders presenting with stiffness or component loosening without clinical suspicion of infection, that is, no wound erythema or drainage and normal white blood cell count, sedimentation rate, and C-reactive protein values. In each of these cases, we submitted multiple deep tissue and prosthesis explant specimens for culture; specimens were cultured in broth and on aerobic and anaerobic media and were observed for a minimum of 3 weeks. We retrospectively reviewed these 148 cases to identify those revised 3 years or more after the index arthroplasty and that had multiple positive cultures for *Propionibacterium*.

**Results**

Fourteen patients met our inclusion criteria; all were male. The average age of the patients at the time of revision surgery was 64 ± 8 years (range, 47-79 years). The index surgery was a total shoulder in 10, a reverse total shoulder in 1, and a humeral hemiarthroplasty in 3. The revisions were performed for stiffness or component loosening without clinical evidence of infection at an average of 8 ± 4 years (range, 3-14 years) after the index procedure. Ten patients had osteolysis, 6 humeral components were loose, and 9 of the 10 glenoid components were loose (Fig. 1). An average of 8 ± 3 cultures (range, 3-12) were submitted for each revision procedure. Of the 109 cultures, 79% (84) were positive for *Propionibacterium*; 18% (20) were positive for coagulase-negative staphylococcus. The number of cultures positive for *Propionibacterium* was correlated with the number of specimens submitted for culture ($R^2 = .73$) (Fig. 2). At 1 week, 53% of the cultures were positive; 74% were positive at 2 weeks, and 79% were positive at 3 weeks (Fig. 3).

**Discussion**

This is the first report of a substantial number of cases of revision arthroplasty performed years after the index procedure that were strongly positive for *Propionibacterium*. These cases are particularly remarkable in that the revisions were performed for mechanical rather than for inflammatory symptoms. Whereas there have been prior reports of *Propionibacterium* being cultured from deep specimens harvested at the time of revision shoulder arthroplasty, our series is important because of the long time between the index procedure and the revision at which positive culture specimens were obtained, which averaged 8 ± 4 years. Although some authors

![Figure 1](image1.png) Radiograph of a male patient with humeral and glenoid osteolysis and component loosening who had positive cultures for *Propionibacterium*.

![Figure 2](image2.png) The relationship of the number of cultures positive for *Propionibacterium* to the number of specimens submitted for culture.
have referred to such results as unexpectedly positive cultures,\textsuperscript{14,15} many of these cases have clinical findings that are now recognized as being associated with positive cultures for \textit{Propionibacterium}, such as male gender, radiographic evidence of component loosening and osteolysis, intraoperative finding of cloudy joint fluid, and a membrane around the humeral or glenoid component.\textsuperscript{24} The high percentages of the cultures positive for this organism indicate that \textit{Propionibacterium} was present in substantial numbers in these shoulders; thus, the results cannot be easily explained by accidental specimen contamination. On the other hand, the observation that some of the specimens from these shoulders did not grow out \textit{Propionibacterium} points to the necessity of submitting multiple samples for culture; apparently this organism is not distributed evenly across the tissues and implants of a failed arthroplasty. The dominance of males in this case series is consistent with the results from a recent study that found that male patients undergoing shoulder arthroplasty often had positive skin cultures for \textit{Propionibacterium}, whereas female patients did not.\textsuperscript{22}

There is increasing evidence of an association between the presence of \textit{Propionibacterium} and a painful, stiff shoulder after prior shoulder arthroplasty.\textsuperscript{20,23,28,29} Whereas our study does not prove that \textit{Propionibacterium} caused the mechanical problems of loosening or stiffness, it is possible that this slow-growing, biofilm-forming organism may cause bone resorption leading to the clinically apparent mechanical symptoms of component loosening, possibly related to chronic activation of osteoclastogenesis.\textsuperscript{2,6,26}

This report has the limitations of being a retrospective study of cases from the experience of an individual shoulder surgeon. Because most of these patients had their index surgery at centers other than our own, we were unable to determine the true incidence of revision surgery with positive cultures. Furthermore, this paper does not present robust evidence on how shoulders with positive cultures for \textit{Propionibacterium} should best be treated.

The findings of this study and the recent literature have informed our current protocol for patients having surgical revision of prior shoulder arthroplasties that have no overt preoperative evidence of clinical infection. Because a prior publication reported that 108 of 193 similar revision arthroplasties were associated with positive cultures and 70% of the positive cultures demonstrated growth of \textit{Propionibacterium} when these culture specimens were obtained before the administration of antibiotics,\textsuperscript{24} we withhold antibiotics until the culture specimens are obtained (whereas we routinely administer prophylactic antibiotics before surgery in our primary arthroplasties). Per the findings of this prior article, we are especially concerned about male patients with cloudy fluid, humeral loosening, glenoid wear, and membrane formation.

To avoid excessive expense from taking a large number of culture specimens, we harvest 4 or 5 different non-fluid specimens (tissue or explants); each of these specimens is cultured on aerobic, anaerobic, and broth media, and these cultures are observed for a minimum of 17 days as recommended in a recent publication.\textsuperscript{22} Patients with loose components have a thorough surgical débridement of the soft tissues, implants, cement, and membranes with single-stage reimplantation of a new humeral component fixed with impaction of cancellous allograft soaked in antibiotic solution. Because of the high rate of positive cultures, we avoid cement and do not reimplant a new glenoid component or graft the glenoid defect. Because of the previously reported high rate of positive cultures and because our revision surgery includes a vigorous surgical clean-out, we
References


Conclusions

The clinical importance of these observations is that even in shoulder arthroplasties revised for mechanical problems years after the index procedures, surgeons should consider submitting multiple deep specimens for Propionibacterium-specific culture. When there is concern for persistent Propionibacterium, surgeons should consider the need for directed surgical and medical treatment in their management of a failed arthroplasty.

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continue perioperative antibiotics until the results of the cultures become final at 17 days. If antibiotics were discontinued after 24 hours (as we do in primary arthroplasty), we would run the risk of inadequately treating an infection and allowing biofilm formation on the new implant. If the cultures become positive, a specific antibiotic regimen is prescribed by our infectious disease consultants.


