J Shoulder Elbow Surg (2015) 24, 838-843

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Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Propionibacterium acnes infection in shoulder arthroscopy patients with postoperative pain

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Background: Recent studies have identified *Propionibacterium acnes* as the causal organism in an increasing number of postoperative shoulder infections. Most reports have found a high rate of *P acnes* infection after open surgery, particularly shoulder arthroplasty. However, there are limited data regarding *P acnes* infections after shoulder arthroscopy.

Materials and methods: We prospectively collected data on all shoulder arthroscopies performed by the senior author from January 1, 2009, until April 1, 2013. Cultures were taken in all revision shoulder arthroscopy cases performed for pain, stiffness, or weakness. In addition, 2 cultures were taken from each of a cohort of 32 primary shoulder arthroscopy cases without concern for infection to determine the false-positive rate.

Results: A total of 1,591 shoulder arthroscopies were performed during this period, 68 (4.3%) of which were revision procedures performed for pain, stiffness, or weakness. A total of 20 revision arthroscopies (29.4%) had positive culture findings, and 16 (23.5%) were positive for *P acnes*. In the control group, 1 patient (3.2%) had *P acnes* growth.

Conclusions: The rate of *P acnes* infection in patients undergoing revision shoulder arthroscopy is higher than previously published and should be considered in cases characterized by refractory postoperative pain and stiffness.

Level of evidence: Level II, Case-Control Design, Prognosis Study.

Keywords: *Propionibacterium acnes*; arthroscopic surgery; infection; revision surgery; synovitis; complications; pain; stiffness

Propionibacterium acnes is a non–spore-forming, gram-positive anaerobic bacillus that is part of the normal superficial skin flora, living deep in the hair follicles and sebaceous pores of the skin rather than on the surface.[1,11,12,24] The face, scalp, chest, and back possess an increased number of these glands and follicles compared with other regions of the body; this leads to an increased load of *P acnes* around the shoulder compared with other anatomic regions common undergoing orthopaedic surgery such as the hip or knee.[2,3,12] As a pathogen, *P acnes* has been implicated in chronic inflammatory conditions in various parts of the body such

Institutional review board approval was obtained for this study (University of Pennsylvania Institutional Review Board No. 7, protocol No. 817978).

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1058-2746/$ - see front matter © 2015 Journal of Shoulder and Elbow Surgery Board of Trustees.
http://dx.doi.org/10.1016/j.jse.2015.03.008

as the cardiac, urologic, ophthalmologic, and neurologic systems.[2-5,8,9]

In recent years, *P acnes* has been implicated as the causal organism associated with failures after shoulder surgery. Studies have shown that standard surgical prophylaxis use on the skin is ineffective in reaching *P acnes* that is sheltered deep in the skin in the pilosebaceous glands.[14,20,23] Instruments used around superficial tissues may be contaminated with *P acnes* below the skin, and these organisms can be introduced into the deep joint tissues. In a study of 193 shoulder arthroplasty revisions, Pottinger et al[21] found that 70% of 108 cases associated with positive cultures were positive for *P acnes*. Subsequent studies have shown that *P acnes* may be associated with indolent infections that are particularly difficult to diagnose.[10,12,18,19]

Patients with *P acnes* infection typically do not present with typical features of infection such as fever, erythema, or wound drainage. Furthermore, levels of inflammatory markers such as the erythrocyte sedimentation rate and C-reactive protein level are routinely normal in patients with these infections.[12,15,19,22,26] Diagnosis is further complicated by the difficulties in isolating *P acnes* in the laboratory—multiple studies have shown that confirmation of this bacterium may require up to 3 weeks based on culture-based methods.[7,10,17] Given the low virulence of this bacterium, the diagnosis is often overlooked, and the true prevalence of these infections after shoulder surgery is likely under-reported.

Although the evidence of and published data for such infections occurring after shoulder arthroplasty have continued to expand over recent years, there are limited data regarding *P acnes* infection after arthroscopic shoulder surgery. Similar to its association with shoulder arthroplasty failure, *P acnes* may be associated with unexplained pain and stiffness after shoulder arthroscopy. Therefore, the primary objectives of our study were to identify the prevalence of *P acnes* infection after arthroscopic shoulder surgery and to determine identifiable risk factors associated with *P acnes* infection in patients undergoing revision shoulder arthroscopy. To this end, we performed a specificity analysis of *P acnes* cultures by comparing the prevalence of positive *P acnes* cultures in revision arthroscopic shoulder surgery cases with the prevalence of positive cultures in a control group of patients undergoing an initial arthroscopic shoulder surgical procedure.

Materials and methods

We studied a prospective cohort of all consecutive shoulder arthroscopies performed by a single surgeon (G.R.H.) between January 2009 and March 2013. During this period, 1,591 arthroscopic shoulder surgery cases were prospectively entered into our database. From this cohort, we identified and analyzed a concurrent cohort of 68 consecutive patients undergoing revision shoulder arthroscopy because of failed surgery or for the treatment of refractory postoperative pain or stiffness. None of these patients exhibited overt clinical signs of infection such as fever or wound drainage. Although all of the patients had pain and complained of stiffness, none showed significant range-of-motion limitations characteristic of the diagnosis of adhesive capsulitis. For all patients, 2 intraoperative specimens were prospectively collected, submitted for culture, and held for a minimum of 14 days by the hospital microbiology laboratory. In all cases, tissue cultures were obtained from the synovium of the rotator interval, with additional cultures obtained from other focal areas of synovitis, from retained sutures or implants, and from the subacromial space. All cultures were kept as solid tissue, and the tissue was immediately placed in a culture swab container to ensure increased yield and to minimize contamination by eliminating any need for subsequent tissue transfer during the microbiology preparation.

Demographic variables including age, sex, medical comorbidities, tobacco use, and body mass index were extracted from the database. Other variables including type of index surgical procedure, duration between index and revision surgery, and history of shoulder injections were recorded. Microbiological data including history of positive bacterial cultures, number of cultures taken, and gram stain and culture results were also obtained. None of the revision surgery patients had positive cultures previously.

During the study period, it was decided that a baseline positive *P acnes* rate should be established in our laboratory. To establish this baseline rate, cultures were prospectively obtained from a control group of 32 patients undergoing primary shoulder arthroscopy between August and November 2012 in the exact same fashion as ongoing and prior cultures from revision arthroscopy patients obtained for this study. Two cultures were obtained from each control patient. In all controls, the first culture was obtained from synovial tissue in the rotator interval. Depending on the particular shoulder condition, synovial tissue or bursal tissue (or both) was also obtained. Procurement of solid tissue was performed after saline solution infusion into the shoulder, with immediate placement of specimens into tissue culture swab containers. The same demographic variables were collected in the control group as in the study group.

Patients in both the revision group and the control group were not given any specific directions to clean or shave the operative area before the day of surgery. On the day of surgery, patients underwent preparation in the standard fashion at our institution. The skin was cleaned with Hibiclens 4% chlorhexidine solution (Mölnlycke Health Care, Norcross, GA, USA) and finally prepared with two 26-mL ChloraPrep (CareFusion, San Diego, CA, USA) skin preparation applicators. The solution was allowed to air dry for 3 minutes, and then the standard sterile drapes were applied. In both groups, patients were given preoperative intravenous antibiotics within 1 hour of surgical incision because there were no cases of clinically suspected infection. This administration of antibiotics followed our institution's standard of care. The antibiotics included 1 to 2 g of cefazolin or 600 mg of clindamycin (or both) or, in cases in which there was a contraindication to cephalosporins, vancomycin (dosed according to patient weight and renal function) or 600 mg of clindamycin (or both). Tissue specimens were collected after saline solution infusion into the shoulder. Prior shoulder aspirations had not provided any positive cultures before surgery, and it was decided that infusing saline solution into the joint would not affect any synovial tissue samples taken for culture. All patients and results included in this study were cross-checked with a separate database maintained by the