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ORIGINAL ARTICLE

Benzoyl peroxide and clindamycin topical skin preparation decreases *Propionibacterium acnes* colonization in shoulder arthroscopy

Hailey H. Dizay, DO*, Diana G. Lau, MD, Wesley M. Nottage, MD

The Sports Clinic Orthopaedic Medical Associates, Laguna Hills, CA, USA

Background: *Propionibacterium acnes* is a gram-positive anaerobe that can lead to devastating postoperative shoulder infections. The objective of this study was to investigate whether a benzoyl peroxide and clindamycin preoperative skin preparation reduces the incidence of *P. acnes* colonization during shoulder arthroscopy.

Methods: Sixty-five shoulder arthroscopy patients were prospectively enrolled. A skin culture specimen was taken at the preoperative visit from standard arthroscopic portal sites. Topical benzoyl peroxide 5% and clindamycin 1.2% (BPO/C) gel was applied to the shoulder every night before surgery. Skin culture was repeated in the operating room before preparation with chlorhexidine gluconate. Shoulder arthroscopy proceeded, with final culture specimens obtained from within the shoulder.

Results: *P. acnes* skin colonization remained similar to prior studies at 47.7% (31 of 65 patients.) With >1 application, BPO/C was 78.9% (15 of 19 patients) effective in eliminating *P. acnes* superficial colonization. With 1 application, it was 66.7% (8 of 12 patients) effective in eliminating superficial colonization. Deep colonization was reduced to 3.1% (2 of 65 patients) compared with previous studies of 15% to 20% ($P = .006$). BPO/C was 100% effective at decreasing deep colonization with >1 application.

Conclusions: *P. acnes* skin colonization is high at arthroscopic shoulder portals, especially in men. Despite standard skin preparation and prophylactic antibiotics, the rate of joint inoculation is much higher than the rate of infection reported in the literature. BPO/C effectively reduces *P. acnes* colonization in shoulder arthroscopy. It should be considered for use before shoulder procedures with a time-related trend of >1 application.

Level of evidence: Level II; Prospective Cohort Design; Treatment Study

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Keywords: *Propionibacterium acnes*; *P. acnes*; infection; shoulder; surgery; arthroscopy; benzoyl peroxide; clindamycin

This study received approval from Memorial Health Services Institutional Review Board: No. 158-12.

*Reprint requests: Hailey H. Dizay, DO, 23961 Calle de la Magdalena, Suite 229, Laguna Hills, CA 92653, USA.

E-mail address: haileydizay@gmail.com (H.H. Dizay).

Propionibacterium acnes is a commensal, gram-positive anaerobic bacillus that resides in pilosebaceous glands deep in the dermal layer of the skin.^{1,8,10} Because of the larger number of hair follicles and sebaceous glands found in the skin of the face, scalp, axilla, chest, and back, there is an increased presence of *P. acnes* in the normal flora of these regions.^{3,8} It is a common organism in acne and in cerebral,

ocular, shoulder, and spinal infections.⁴ Shoulder arthroscopy is one of the most common orthopedic procedures performed. *P. acnes* has been described as the primary pathogen of infections of the shoulder after surgical intervention because of the increased load of the bacterium at the shoulder, ranging from 50% to 86%.^{10,15,18,20}

Similar to its association with shoulder arthroplasty failure, *P. acnes* may be associated with unexplained pain and stiffness after shoulder arthroscopy.²⁴ The literature shows that the outcomes after treatment of *P. acnes* infections are poor. Athwal et al found that following surgical and antibiotic treatment of *P. acnes* infections after rotator cuff repair, 38% of patients reported unsatisfactory results at a mean of 8 years.³ Superficial skin colonization with *P. acnes* is high, reported in 72.5% of primary cases and 76.7% of revisions.^{5,19} Higher incidence is found in men, probably because of increased testosterone and sebum production.

Current accepted theory is that the shoulder joint is inoculated during skin incision secondary to *P. acnes* colonization of the dermal layer. Incision through the pilosebaceous glands of the shoulder skin is thought to inoculate the surgical wound with the pathogen. Standard surgical skin prophylaxis does not seem to decrease the bacterial load, most likely because the preparation does not penetrate to the deeper layer of the dermis.^{2,15} Intravenous antimicrobial prophylaxis before surgical incision has also been shown to be ineffective at eliminating *P. acnes* from the surgical field.²⁰ Despite standard skin preparation and prophylactic antibiotics, the rate of deep tissue inoculation with *P. acnes* during shoulder arthroscopy is high, reported at 19.6%.⁵

The low virulence of *P. acnes* and unconventional microbiologic tests required for identification have led to underreporting of colonization. In addition, clinical features of “infection” include variable onset, minimal pyrexia, normal inflammatory markers, and mild local tissue inflammation. Patients may present with only increased pain or stiffness. Microbiology involves culturing the samples on chocolate agar medium in an anaerobic environment for 14 to 21 days. Without the clinical acumen to look specifically for this organism, infection can remain unidentified.

Dermatology literature demonstrates effective reduction of *P. acnes* colonization on the skin with use of a combination benzoyl peroxide 5% and clindamycin phosphate 1.2% (BPO/C) topical gel.^{18,27} The combination of these medications makes it a powerful topical antimicrobial agent, allows penetration to the deep dermal layer, and inhibits the development of antibiotic resistance.¹⁷

In the first part of our series, we reported on the prevalence of deep colonization of *P. acnes* in patients undergoing shoulder arthroscopy. We found a 72.5% superficial culture rate and 19.6% deep inoculation rate.⁵ All positive deep cultures demonstrated positive superficial skin cultures, demonstrating the ability of swab cultures to be adequate for detection of *P. acnes* as well as supporting the theory that the bacterium is inoculated into the surgical site during skin incision.

P. acnes is more popularly associated with the dermatologic condition of acne vulgaris, and there is much support in the literature for the use of benzoyl peroxide in the topical treatment of this condition because of its direct bactericidal effects and excellent safety profile.^{6,7,9,12,13,16} In the second part of our prospective study (unpublished data), we reported on the ineffectiveness of a single application of benzoyl peroxide 10% wash as a preoperative surgical skin preparation to decrease the bacterial load of *P. acnes* at the shoulder, despite its documented topical bactericidal effect, probably because of the short duration of application.

The objective of this study was to investigate whether a topical BPO/C preoperative surgical skin preparation reduces the incidence of *P. acnes* inoculation of the shoulder joint during arthroscopy. A second objective was to determine the time-related effects of the topical medication on *P. acnes* colonization. Our hypothesis was that the antibiotic skin preparation would decrease shoulder inoculation with *P. acnes*.

Methods

Sixty-five patients indicated for an arthroscopic shoulder procedure were prospectively enrolled to participate in this Institutional Review Board–approved prospective cohort study. Exclusion criteria were patients with dermatologic disorders about the shoulder and patients with clinical signs of shoulder infection. The first culture specimen was taken at the patient’s preoperative office visit by swabbing the skin at 3 standard arthroscopic portal sites: posterior, anterior superior, and anterolateral. A topical BPO/C gel was then applied to the operative shoulder at that time, with instructions given to the patient to apply it every night before the day of surgery (Fig. 1). Patients were randomized to the number of applications of the topical



Figure 1 Patients were instructed to apply the clindamycin phosphate/benzoyl peroxide gel 1.2%/5% to the operative shoulder every night before the date of surgery. (A) Depiction of medication application to the shoulder from the instruction sheet given to the patients. (B) Container of the gel and dosing applicator given to patients.

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