J Shoulder Elbow Surg (2015) 24, 995-1004

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Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

SHOULDER

Efficacy of topical benzoyl peroxide on the reduction of *Propionibacterium acnes* during shoulder surgery

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Background: *Propionibacterium acnes* infection is a significant problem after shoulder surgery. Residual *P. acnes* is found on the skin up to 29% of the time immediately after surgical skin preparation and in 70% of dermal biopsy specimens. These residual bacteria may be a source for infection. Identifying more ideal skin preparation may help reduce the risk of infection. The purpose of this study was to evaluate the effect that topical benzoyl peroxide (BPO), with chlorhexidine skin preparation, would have on the presence of *P. acnes* cultured at the time of shoulder surgery. We hypothesized that adding topical BPO to our skin preparation would reduce the number of positive *P. acnes* cultures identified during surgery.

Methods: Fifty patients undergoing first-time shoulder surgery were treated with topical 5% BPO cream 48 hours before surgery. After skin preparation, 13 samples per subject were obtained. Cultures were held for 14 days.

Results: Fifty patients underwent arthroscopic shoulder surgery; 650 culture specimens were obtained. The skin was positive at the initiation of surgery in 6% of cases. Tissue samples were positive in 6%. The skin was positive in 10% at the end of surgery. None of these rates of positive culture were different from the 4% rate observed with a control swab.

Conclusion: Application of BPO is an effective way to reduce *P. acnes* on skin at the beginning and, importantly, at the end of a surgical procedure. This may result in a lower risk for postoperative infection.

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

Keywords: Shoulder; infection; *P. acnes*; culture; arthroscopy; aspiration

Propionibacterium acnes is a significant pathogen in patients undergoing shoulder surgery.[3-5] Infection after shoulder surgery has a serious impact on patient outcome, costs, and value associated with care. Numerous methods for reducing surgical site infection (SSI) have been studied, with a particular interest in chlorhexidine as the most ideal skin preparation.[2,9,12,16,20,21]

The Greenwich Hospital Institutional Review Board approved this study: No. 2014001.

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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.2015.04.003

Chlorhexidine gluconate combined with isopropyl alcohol (ChloraPrep; Care Fusion Corp., San Diego, CA, USA) has been suggested to be the most effective surgical skin preparation for shoulder surgery, but this effect is not specific for *P. acnes*.[12,20,21] *P. acnes* may persist on the skin from 7% to 29% of the time immediately after skin preparation.[10,17,21] The chance of finding these bacteria at the end of the surgical procedure may increase to 41% to 63%.[22] Furthermore, *P. acnes* was identified in 70% of subjects undergoing a dermal biopsy after skin preparation with ChloraPrep.[12] These residual bacteria may be present because current skin preparations do not sufficiently penetrate the dermal layer of skin, whereas *P. acnes* resides in the sebaceous glands.[16] Alternatively, *P. acnes* may reside in the joint of the normal shoulder and may even be a precursor pathologic organism to development of arthritis.[13]

The high rate of residual bacteria left on the epidermis and dermis after surgical skin preparation may be the source of infection in susceptible patients, particularly those having procedures with a surgical implant.[12,16,20,21] These studies suggest a need for a more ideal surgical skin preparation to address the residual bacteria and potentially to reduce the risk for SSI.

Benzoyl peroxide (BPO) has been an important component of topical therapy for acne vulgaris for more than 5 decades because of its ability to markedly reduce *P. acnes*.[1,6,7,14,15] This study used dermatologic principles of reducing *P. acnes* as part of the surgical skin preparation.

The purpose of this study was to evaluate the effect that topical BPO, when used in addition to chlorhexidine skin preparation, would have on the presence of *P. acnes* cultured at the time of shoulder surgery. Our hypothesis was that treatment with BPO would reduce the proportion of subjects with positive *P. acnes* cultures.

Material and methods

A consecutive 54 patients indicated for first-time arthroscopic shoulder surgery were identified. Our inclusion criterion for participation was patients indicated for primary arthroscopic shoulder surgery. Subjects were excluded if they had previous shoulder surgery or if they had taken any antibiotics 2 months before surgery. Two subjects did not want to participate.

All patients were consented to participate in this study. Patients were asked to apply the provided 5% BPO gel starting 2 mornings before their surgery. After a wash, rinse, and dry of the area, patients were asked to apply a half-dollar-size dollop of BPO to the entire shoulder and armpit area. This application was repeated at night, the following morning and night, and the morning of surgery, for a total of 5 applications. Patients were asked to record the times and dates of application on a provided data sheet.

A total of 12 samples were obtained from each subject; 8 sterile skin swabs, an aspirated joint fluid sample, and 3 tissue samples were collected from 50 patients undergoing shoulder arthroscopy without any previous shoulder surgery. A thirteenth control swab was exposed to the air and sent for culture for each subject. Demographic data, visual analog scale score for pain, medical comorbidities, history of cortisone injection, antibiotics used during surgery, and duration of the surgery were also collected.

At the time of surgery, patients were given preoperative antibiotics. Preoperatively, 2 g of cefazolin was routinely administered, or 900 mg of clindamycin was given if cephalosporin allergy was present. At this time, 4 skin swabs were taken: the anterior deltoid of the surgical arm, the axilla of the surgical arm, the anterior deltoid of the nonsurgical arm, and the axilla of the nonsurgical arm. After this, patients were draped and prepared by scrubbing the arm, shoulder, and axilla with a scrub brush and 3.3% chloroxylenol cleansing solution. The skin was then patted dry with a sterile towel. The surgical site was prepared with 3 applications of 2% chlorhexidine gluconate (ChloraPrep). This is the routine for all patients undergoing shoulder surgery at our institution. After preparations and draping, the skin of the anterior deltoid and the axilla were each swabbed with a skin swab. A cotton swab of the air was taken at this time as a control. Each swab was placed into an individual charcoal medium.

After incision for trocar placement, the glenohumeral joint was aspirated. If no fluid was available, the glenohumeral joint was flushed with 5 mL of saline, which was then collected in a sterile specimen container. Three samples of débrided tissue were collected through a cannula. The first tissue sample was collected from the middle glenohumeral ligament. If the patient was having a rotator cuff repair, the second tissue sample came from the rotator interval and the third from the bursa. For a patient undergoing a labral repair, the second tissue sample was collected from the high rotator interval and the third from the low rotator interval. Each sample was placed into an individual specimen container.

Before skin closure, 2 final skin swabs of the anterior deltoid and axilla were taken and placed into a charcoal medium. The skin swabs were placed into individual charcoal mediums.

All samples for each patient were placed into individual transport bags and delivered to the Greenwich Hospital microbiology laboratory within 1 hour, where they were placed in a fume hood that had been sterilized with 1.4% hydrogen peroxide spray for 1 minute. Medical technicians, following sterile procedure, processed all samples. Each sample was plated on a blood agar plate (BAP) to facilitate the growth of any organism, a MacConkey agar plate to select for gram-negative rods, a colistin and nalidixic acid plate to identify gram-positive organisms, and a CDC blood agar plate kept in anaerobic conditions with a gentamicin disk (ANA CDC) to select for anaerobic organisms.

Each control and skin swabs were removed from their transport bag and streaked across a microscope slide to check immediately for contaminating organisms with a Gram stain. The swabs were next streaked across the first quadrant of each agar plate. The swabs were then placed in a test tube of thioglycollate broth to encourage the growth of any organisms present. Individual, disposable sterile loops were used to streak the remaining quadrants of each plate.

One drop of the joint fluid aspirate was transferred to each agar plate as well as a microscope slide for immediate analysis. Four or 5 drops of joint fluid were transferred to thioglycollate broth test tubes. Each drop of joint fluid was streaked across the agar plates with individual, disposable sterile loops.

Each tissue sample was combined with 1 mL of thioglycollate broth in a sterile tissue grinder (Precision disposable tissue grinder; Covidien, Dublin, Ireland) and ground for 1 minute or until homogenized. One drop of the dissolved tissue sample was