Florschütz et al. [8] also reported that patients undergoing primary total shoulder with history of previous non-arthroplasty surgery had a significantly higher (p = 0.016) rates of infection compared to patients with no previous surgery on the operative shoulder.

A few other studies not aimed directly at answering this question directly support this conclusion. Foruria et al. [9] studied 107 patients with unexpected positive cultures at revision shoulder arthroplasty and found that the number of previous surgeries was higher in patients deemed to have "true infections" compared to "contaminants" (p = 0.025) (it is unclear if these were arthroplasty or non-arthroplasty surgeries). Horneff et al. [10] found that patients undergoing revision arthroscopic surgery had a significantly higher rate of positive culture growth than those undergoing primary arthroscopic surgery (29.4% vs. 3.2%). Zavala et al. [11] reported on their experience with deep infection after reverse shoulder arthroplasty and found an overall infection rate of 6% and an infection rate of 12.9% for those who had previous failed cuff surgery.

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QUESTION 3: Does prior corticosteroid injection increase the risk of periprosthetic joint infection (PJI) after primary or revision shoulder arthroplasty?

RECOMMENDATION: An increased number of corticosteroid injections and a shorter interval between corticosteroid injection and shoulder arthroplasty may increase the risk for surgical site infection or shoulder PJI.

LEVEL OF EVIDENCE: Limited

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

RATIONALE

It is well-documented that usual skin preparation solutions do not adequately penetrate below the skin surface to eliminate bacteria, such as *Cutibacterium* [1,2]. Therefore, any instrument transecting the skin surface and sebaceous glands can theoretically inoculate the deep tissues [3].

To answer the question of whether corticosteroid injections increase the risk for surgical site infection/PJI, we performed a systematic review using the following search phrase: ("corticosteroid" OR "steroid" OR "cortisone") AND "shoulder" AND ("arthroplasty" OR "replacement"). Fifty-two results were filtered by title and abstract, and reference lists were reviewed for relevant studies. Studies were included for analysis if they were a study on primary or revision shoulder arthroplasty and studied preoperative injections as a risk factor.

A total of four studies have directly investigated the effect of previous steroid injection on the shoulder – one database study, one clinical study and two studies investigating deep cultures.

Werner et al. [4] performed a Medicare database study that compared three groups: arthroplasty within three months after injection, arthroplasty within three and 12 months after injection and a control group. Infection was defined by ICD-9 and CPT codes for both superficial and deep infection. The odds ratio for infection after arthroplasty was 2.0 at both three months (p = 0.007) and six months (p = 0.001) in patients who underwent injection within three months of arthroplasty and controls. No statistical difference was seen comparing those patients who underwent injection 3-12 months prior to arthroplasty and the control group. This study suggests that patients undergoing arthroplasty within three months after injection have a higher risk of infection.

Rashid et al. [5] performed a retrospective matched cohort study of 23 patients undergoing shoulder arthroplasty with history of preoperative intra-articular corticosteroid injection and 60 patients without a history of injection. None of the patients in either group had a superficial surgical site infection, and only one of the patients had a deep surgical site infection (defined as obvious purulence).

Two other studies have investigated the rate of positive deep cultures at the time of primary open shoulder surgery in patients that have and patients that have not had previous corticosteroid injections. Mook et al. [6] prospectively collected data on 104 patients undergoing open shoulder surgery at which time control

and pericapsular tissue samples were cultured. A history of two or more corticosteroid injections had a higher likelihood of bacterial growth than those with one or less injections ($p = 0.047$). Koh et al. [7] retrospectively analyzed 30 patients undergoing primary shoulder arthroplasty at which time superficial and deep wound swabs were taken. Steroid injection was not statistically significantly associated with positive deep cultures ($p = 0.14$), and the presence of hair in conjunction with previous steroid injection was not statistically significant ($p = 0.092$).

While the evidence in the hip arthroplasty literature is somewhat conflicting [8–10], multiple recent studies from the knee arthroplasty literature support the conclusion that corticosteroid injections before arthroplasty increase the risk for PJI [11,12].

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1.4. PREVENTION: SKIN PREPARATION

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QUESTION 1: Is there a role for preoperative skin scrub (home scrubs and washes) prior to primary or revision shoulder arthroplasty?

RECOMMENDATION: Chlorhexidine gluconate (CHG) showers or cleansing wipes with at least two applications decreases the incidence of positive skin cultures prior to shoulder surgery. Pending further research, this protocol may provide a benefit.

LEVEL OF EVIDENCE: Limited

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

RATIONALE

A systematic review of the published literature was performed on Scopus, PubMed and Cochrane databases that included any primary or secondary aims regarding preoperative skin prep for shoulder arthroplasty. A comprehensive review and list were accumulated and review was done to include all relevant studies that met these specific criteria.

Surgical site infections (SSIs) account for 14-16% of all nosocomial infections [1]. In an effort to reduce SSI's, protocols have incorporated whole body showering or bathing with CHG and other antiseptics. The aim is to cleanse the skin and reduce the cutaneous bacterial load prior to surgery. Previous studies have found reduced bacterial counts after use of chlorhexidine baths or washes with increased effect after multiple applications [2].

However, there has been much debate on this issue with various organizations expressing different views on the matter. The Centers for Disease Control and Prevention (CDC) has indicated that either soap or other antiseptic agents are equally efficacious as CHG. While the hospital infection control practice advisory committee – CDC recommend that patients shower at least one time with any kind antiseptic. Finally, the Institute for Healthcare Improvements – Project JOINTS recommends that patients should bathe or shower with CHG soap for at least three days prior to surgery [3].

Multiple interventional studies have investigated the use of preadmission CHG showers. Eiselt et al. focused on preoperative CHG cloths twice prior to total joint procedures and found that surgical site infections were significantly reduced from 3.19% to 2% when compared to a no wash group this was a significant reduction of 50.2% in SSIs [4]. Johnson et al. studied the use of at home chlorhexidine impregnated skin preparation cloth in decreasing the incidence of deep periprosthetic hip arthroplasty. Of the 1,134 studied, 157 complied with the preoperative chlorhexidine preparation protocol. There was no significant difference in the infection rates between the non-compliant and compliant groups (1.6% infection rate vs. 0% respectively; $p = 0.231$) [5]. Kapadia et al. evalu-