

## Residual Bacterial Contamination After Surgical Preparation of the Foot or Ankle With or Without Alcohol

Kurtis R. Hort, M.D.; James K. DeOrto, M.D.  
Jacksonville, FL

### ABSTRACT

To investigate the usefulness of a standard surgical preparation in prevention of surgical site contamination, 49 consecutive patients undergoing foot or ankle surgery were randomly assigned to standard preparation with chlorhexidine gluconate home scrubs and preoperative povidone-iodine or to standard preparation plus preoperative preparation with 70% alcohol.

Results were available for all 49 patients. Cultures were positive for normal aerobic bacteria from the toes of nine of 26 patients (35%) receiving standard surgical preparation and from the toes of 13 of 23 patients (57%) receiving standard preparation plus alcohol ( $P=0.12$ ). No patient had a positive culture for anaerobic organisms or clinical evidence of infection or wound problems.

Standard surgical preparation did not provide a completely sterile field, and the inclusion of alcohol added no benefit.

**Key Words:** Alcohol; Chlorhexidine; Povidone-Iodine; Preoperative Disinfectants; Prevention; Surgical Site Infection

### INTRODUCTION

Surgical infection is a devastating postoperative complication for a surgical patient. The antiseptic principles originally outlined by Joseph Lister for limiting the occurrence of infection have been almost universally accepted and have continued to evolve. Nevertheless, it is still estimated that between 1% and 4% of all clean surgical sites become infected.<sup>1</sup> In orthopedics, surgical

infections are often costly and difficult to treat, partly because of the frequent use of foreign implants and the challenge of eradicating infection from bone.

The toes can be a source of bacterial contamination during orthopedic surgical procedures. During total joint surgical procedures, routine sterile wrapping of the foot and toes is commonly performed. Zacharias et al.<sup>8</sup> found positive evidence of aerobic bacteria in 75% of cultures from surgically prepared toes and concluded that sterile wrapping of the toes was warranted. During operations on the foot, however, the toes often cannot be covered. Thus, better antiseptic techniques could potentially be useful to decrease the rate of infection. We investigated the effects of rigorous preoperative preparation with and without alcohol on the sterility of the operative field.

### MATERIALS AND METHODS

Forty-nine consecutive patients undergoing surgical procedures on the foot or ankle (excluding total ankle arthroplasties) in a distinct foot and ankle protocol were randomly assigned to receive either standard surgical preparation or standard surgical preparation plus alcohol. In the group receiving the standard surgical regimen, each patient was given two chlorhexidine gluconate scrub brushes, with directions to perform two separate self-scrubs several hours apart before retiring to bed the night before the operation. In the operating room, a 10-minute scrub with povidone-iodine cleansing solution (US Pharmacopeia, USP) was followed by painting of the foot with povidone-iodine topical solution (USP). In the group receiving the standard regimen plus alcohol, the standard surgical regimen was supplemented with the addition of a 3-minute preoperative preparation of the area with 70% alcohol. If a patient underwent bilateral procedures, both feet were assigned to the same group.

Immediately after preparation and draping of each patient, a surgeon who was blinded with respect to the patient's assigned group obtained skin cultures by swabbing between all toes and along the periphery of all nails.

---

From the Department of Orthopedic Surgery, Mayo Clinic, Jacksonville, Florida

Corresponding Author:  
James K. DeOrto, M.D.  
Mayo Clinic  
4500 San Pablo Road  
Jacksonville, FL 32224  
E-mail: DeOrto.James@mayo.edu

The cultures were then analyzed for aerobic and anaerobic bacteria. All patients were given one dose of a broad-spectrum antibiotic preoperatively and were monitored clinically for wound infections or healing problems.

## RESULTS

Data were available for all 49 patients. The group receiving standard preparation consisted of 26 patients, six of whom had bilateral procedures (total feet studied, 32). The group receiving supplemental alcohol preparation consisted of 23 patients, two of whom had bilateral procedures (total feet studied, 25). No patient in either group showed clinical signs of wound infection, and all wounds healed uneventfully. Analysis of the tissue cultures showed that no patient in either group had a positive result for anaerobic bacteria.

The results of tissue cultures for aerobic bacteria are given in Table 1. Cultures were positive in 22 of the total 49 patients (45%; confidence interval [CI], 31% to 60%). The proportion of patients with positive cultures was higher in the group receiving standard preparation plus alcohol (57%; CI, 34% to 77%) than in the group receiving standard preparation alone (35%; CI, 17%-56%). However,  $\chi^2$  analysis showed no significant difference between the two groups ( $P=0.12$ ).

In the group with standard preparation, multiple bacteria were observed in one culture, and multiple strains of one bacterium were observed in three cultures. The cultures from seven feet were positive for *Staphylococcus*, four for *Bacillus*, and one for *Pseudomonas*. In the group receiving standard preparation plus alcohol, multiple bacteria were observed in one culture, and multiple strains of one bacterium were observed in seven cultures. The cultures for 12 feet were positive for *Staphylococcus*, one for *Bacillus*, and one for *Corynebacterium*.

## DISCUSSION

The percentages of positive results in our cultures compared favorably with the 75% reported by Zacharias et al.<sup>9</sup> after a povidone-iodine scrub and preparation. In our study, cultures were positive for bacteria in 35% of patients without alcohol preparation and in 57% of patients with standard preparation plus alcohol. The home scrub with chlorhexidine in our regimen may be a factor in the overall lower rate of positive cultures in our study. Chlorhexidine showers have been shown to be more effective in lowering skin bacterial counts than povidone-iodine or soap and water.<sup>1</sup> The effect of chlorhexidine is also known to last for up to six hours.<sup>4,7</sup>

**Table 1:** Effect of alcohol preparation on number of patients with aerobic bacteria in toes after surgical procedures on the foot or ankle.

	Positive		Negative		Total	
	n	%	n	%	n	%
Without alcohol	9	35	17	65	26	100
With alcohol	13	57	10	43	23	100
Total	22	45	27	55	49	100

For these reasons, we think it is an ideal agent for the home scrub.

However, the standard surgical preparation did not provide a completely sterile field, and the addition of a 3-minute alcohol scrub to our routine preoperative procedures for cleaning the surgical site did not diminish the presence of bacteria on the skin surface of the toes. This is surprising, because a 1-minute alcohol scrub has been shown to be as effective as a 4- to 7-minute surgical scrub with other antiseptics.<sup>2,6</sup> We hoped that the 70% alcohol would significantly decrease the number of positive culture results, and we chose alcohol because of its effectiveness against normal skin flora,<sup>4</sup> ease of application, and low cost.

The increased incidence of positive cultures in the group receiving standard preparation plus alcohol may have been a result of the defatting nature of alcohol and its damage to mucosal cells, which may have resulted in the liberation of bacteria that were then capable of being cultured. However, the small size of our sample does not warrant a conclusion that alcohol increases the rate of positive bacterial cultures. Additional in vitro studies are certainly warranted.

Despite the occurrence of positive cultures in our study, no wound infections were seen. This may be due to several factors. First, the overall percentage of wound infections at clean surgical sites is so small that infections may have been observed only in a much larger study. Second, we also irrigate the wound frequently during surgery with an antibiotic solution during surgical procedures. A sterile spray bottle containing this solution is kept at hand, and all members of the surgical team are encouraged to irrigate periodically. We consider this to be an especially important practice, because the overall eradication of skin flora is probably impossible for any antiseptic.<sup>3,5</sup> Third, before tourniquet application, all patients receive a preoperative broad-spectrum intravenous antibiotic, usually cefazolin.

Several conclusions may be drawn from this study. In spite of a rigorous surgical preparation, bacterial contamination of the surgical field is quite likely. It appears that the addition of an alcohol preparation to the preoperative cleaning regimen does not diminish

the presence of bacteria on or between the toes. Therefore, we agree with Zacharias et al.<sup>8</sup> that the toes should be covered when possible, especially during midfoot and hindfoot procedures. This is an important concept, now that total ankle replacements are being performed with greater frequency and by surgeons who infrequently perform arthroplasties elsewhere. Fortunately, it appears that even when some bacteria can be cultured from the skin after surgical preparation, the overall incidence of clinical infection can be small. Finally, a regimen of preoperative home scrubs with chlorhexidine, frequent irrigation during the procedure, and the administration of preoperative antibiotics may be the most practical way to avoid infection.

#### ACKNOWLEDGMENTS

The authors would like to express their appreciation to Mr. Dirk Larson at Mayo Clinic, Rochester, MN, for his statistical review.

#### REFERENCES

1. **Garibaldi, RA; Skolnick, D; Lerer, T; Poirot, A; Graham, J; Krisuinan, E; Lyons, R:** The impact of preoperative skin disinfection on preventing intraoperative wound contamination. *Infect Control Hosp Epidemiol*, **9**:109-113, 1988.
2. **Geelhoed, GW; Sharpe, K; Simon, GL:** A comparative study of surgical skin preparation methods. *Surg Gynecol Obstet*, **157**:265-268, 1983.
3. **Hartmann, AA:** The influence of various factors on the human resident skin flora. *Semin Dermatol*, **9**:305-308, 1990.
4. **Larson, E:** Guideline for use of topical antimicrobial agents. *Am J Infect Control*, **16**:253-266, 1988.
5. **Lilly, HA; Lowbury, EJ; Wilkins, MD:** Limits to progressive reduction of resident skin bacteria by disinfection. *J Clin Pathol*, **32**:382-385, 1979.
6. **Morton, HE:** Alcohols. In: Block, SS (ed). *Disinfection, Sterilization, and Preservation*. 3rd Ed. Philadelphia, Lea & Febiger, 1983, pp. 225-239.
7. **Tanzer, M; Miller, J; Richards, GK:** Preoperative assessment of skin colonization and antibiotic effectiveness in total knee arthroplasty. *Clin Orthop*, **299**:163-168, 1994.
8. **Zacharias, J; Largent, PS; Crosby, LA:** Results of preprocedure and postprocedure toe cultures in orthopaedic surgery. *Foot Ankle Int*, **19**:166-168, 1998.