FOOT & ANKLE INTERNATIONAL

Bacterial Recolonization During Foot Surgery: A Prospective Randomized Study of Toe Preparation Techniques

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ABSTRACT

Fifty patients undergoing foot or ankle surgery were randomized into two groups for the purposes of toe preparation. Twenty-four patients underwent a standard preparation which included placing antiseptic between the toes while 26 were additionally cleaned by sliding a gauze swab soaked in topical antiseptic back and forth several times. Povidone iodine followed by chlorhexidine in alcohol was used in both groups. All toes were covered by a sterile glove during surgery unless the toes themselves were to be operated upon.
Bacteria were cultured from the toe clefts in 4% of all patients immediately following preoperative disinfection. Significantly fewer patients whose toes had been additionally scrubbed (group 1) showed bacterial recolonization at the end of surgery compared with those undergoing a standard prep (group 2) (7.7% vs 20.8%). We conclude that additional scrubbing of toe clefts prior to surgery reduces the incidence of recolonization of bacteria during the surgical procedure.

INTRODUCTION

Elimination of all bacteria from toe clefts prior to foot surgery is difficult. Limited space between the toes impairs access for application of antiseptic agents. A further reservoir of bacteria exists in the nail folds that may not be penetrated by topical agents.[8,13] In addition to standard preoperative disinfection with topical antiseptic agents, measures to reduce the risk of contamination during foot surgery may include formally scrubbing each toe cleft in turn and separately covering the forefoot in a sterile wrap. There is little evidence to suggest whether these additional techniques are effective in reducing the levels of bacteria on the skin during surgery.

Zacharias et al[16] found that 9 of 12 patients undergoing foot surgery had positive results from bacterial cultures prior to surgery even after a minimum of ten minutes of skin preparation with povidone iodine, while one of the three who were negative at the start of surgery showed positive cultures at the end of the procedure. They conclude that, unless the toes are to be operated upon, the forefoot should be covered in a separate sterile drape. However, sealing the toes in a warm moist environment might stimulate bacterial recolonization and therefore still contribute to the risk of infection.

The technique of toe preparation is also important; in many departments, this is undertaken by scrubbing the clefts with a gauze swab or sponge in addition to the standard preparation of the remainder of the foot. Scrubbing of this delicate area, however, may result in bacteria from deep in the skin being brought to the surface and so this technique may not be more effective than simple cleaning.

We have conducted a prospective randomized study in order to investigate the effect of scrubbing the toe clefts in addition to simple antiseptic cleansing on the incidence of bacterial colonization before and after foot surgery and whether it is affected by additional scrubbing of the toe clefts. We have also evaluated the influence of a separate sterile cover over the toes upon bacterial recolonization during surgery.

MATERIALS & METHODS

All patients undergoing surgery in which the foot was to be included in the operative field were considered for study. Patients were only excluded if there was evidence of pre-existing infection or if surgery was to be performed outside normal working hours such that the laboratory would be unable to process microbiology samples immediately. Surgery in each case was performed by two of the authors (RAB & WJR) or a senior podiatrist; when not acting as surgeon, one of the three was usually present as assistant and so the surgical

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team was similar in each case.

50 consecutive eligible patients were randomized by computer into two different groups for the purposes of toe disinfection; Group 1 (cleft scrub group) consisted of 26 patients (10 male, 16 female, age (mean ± SD) 47.7 ± 17.8). In this group, a gauze swab soaked in topical antiseptic was held between two towel clips which allowed the clefts between each toe to be gently scrubbed in turn (figure 1). Twenty four patients (9 male, 15 female, age 47.2 ± 21.0) were randomized to

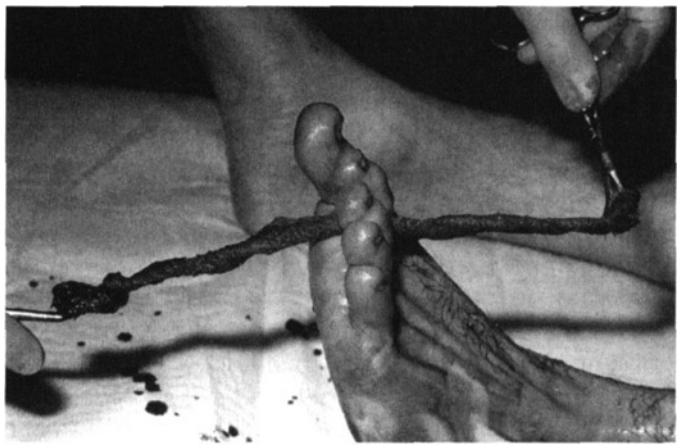

Fig. 1: Technique of cleaning toe clefts (Group 1).

group 2 (standard scrub group); in these patients, toes were cleaned using a gauze swab held on a sponge-holding forceps which was pushed into each cleft in turn; visual inspection confirmed that all skin in each cleft was covered in antiseptic solution, but the toe clefts were not scrubbed with the "to and fro" motion as in group 1. Two patients in group 1 and one patient in group 2 were diabetic, 1 patient from group 1 and three from group 2 had rheumatoid arthritis and one patient in group 2 was taking oral steroids.

According to our usual practice, toes in both groups were cleaned twice; initially with Povidone-Iodine USP 10% w/v in alcohol and then with Chlorhexidine Gluconate 0.5% w/v in 70% v/v industrial methylated spirit. The time spent in preparing the foot was the same in each group. Therefore the difference between the two groups that the study was designed to evaluate was that in group 1 the toe clefts underwent additional scrubbing with antiseptic solution while the toe clefts in group 2 were simply moistened with the same antiseptic agents over the same period.

Bacteriological toe swabs were taken from the third and fourth clefts and skin scrapings from the same sites were taken for fungal cultures. Three sets of cultures were taken for each patient; the first (pre-preparation) was taken immediately prior to toe disinfection, the second (post-preparation) at the start of surgery, after disinfection and the third (post-surgery) at the end of the procedure prior to application of dressings. The toes were separately covered during surgery with a glove according to our usual practice whenever surgery was not to be performed on the forefoot. Toes were therefore covered in 7 patients (27%) in group 1 and 8 patients (33%) in group 2. Antibiotic prophylaxis consisting of 1.5g cefuroxime was given prior to surgery in procedures which involved either bony resection or insertion of metalwork (61% group 1, 54% group 2). Note was taken of the length of the procedure and whether the patients subsequently developed infection, determined as evidence of local cellulitis, wound slough or discharge. Statistical analysis was performed using the Mann-Whitney Test for quantitative data and Chi-squared Test for categorical data.

RESULTS

Results of bacteriological and fungal cultures are summarized in Table 1. Thirty-nine patients underwent elective surgical procedures while 11 patients underwent surgery following trauma. For the purposes of analysis, culture results were considered to be positive if any bacteria, regardless of number of species, were isolated or negative if none was found.

Table 1: Summary of Bacterial and Fungal Results

		Group 1 (26) **(Cleft Scrub)**	**Group 2** (24) **(Standard Scrub)**	**p**
Antibiotic Prophylaxis (%)		16 (61.2)	13 (54.2)	0.197
Glove Over Toes (%)		7 (26.9)	8 (33.3)	0.215
Length of Surgery, mins. (median, range)		45 (10-235)	40 (15-210)	0.370
Positive Bacteriology - No. patients (%)	Pre-preparation	23 (88.5)	23 (95.8)	0.337
	Post-preparation	0	2 (8.3)	0.133
	Post-surgery	2 (7.7)	7 (29.2)	**0.048 (sig)**
	Intra-operative recolonization*	2 (7.7)	5 (20.8)	
Positive Fungal Culture - No. of patients (%)	Post-preparation	0	4 (16.7)	**0.030 (sig)**
	Post-preperation	1 (3.8)	3 (12.5)	0.259
		0	3 (12.5)	0.063

* Recolonization represents bacteria identified on post-surgery cultures that were not present on post-preparation cultures.

There was no difference between the two groups in the length of surgery, the proportion given antibiotic prophylaxis and in the use of a glove to cover the toes. Pre-preparation swabs cultured 87 organisms in the toe clefts of 46 of the 50 patients (92%) who made up the whole study group. The most common species was coagulase negative *Staphylococcus* (39 feet) followed by diptheroids (16 feet) and mixed anaerobes (15 feet). Skin preparation reduced the number of positive swabs to two organisms (coagulase negative *Staphylococcus* and diptheroids) in two feet, both in the standard scrub group (group 2), identified on post-preparation cultures. No organisms were cultured from the cleft scrub group (group 1) on post-preparation cultures, but this difference between groups was not significant. However, there was a significant difference in the incidence of positive toe cultures at the end of surgery (post-surgery cultures) in those whose toe clefts were additionally scrubbed (group 1) compared to those undergoing standard scrub (group 2) (7.7% vs 29.2%, p = 0.048) (see table 1). This represents recolonization, defined as the finding of bacteria on post-surgical swabs not present on post-preparation swabs, in 2 patients (7.7%) in the cleft scrub group (group 1) compared to 5 (20.9%) patients in the standard scrub group (group 2).

The frequency of recolonization was not dependant on the length of surgery; recolonization was seen in 16% of feet undergoing operations of less than 45 minutes compared to 21% of feet for which surgery was longer than 45 minutes (c2 = 0.66).

The effect of covering the toes with a glove is shown in Table 2. The proportion of feet showing positive cultures changed from one patient (6.7%) after preparation to two patients (13.3%) at the end of surgery in those feet covered by a glove. In those in whom a glove was not used, the incidence of positive cultures showed an increase from one patient (2.9%) after preparation to seven patients (20%) at the end of surgery. Recolonization therefore occurred in six patients (17.1 %) where toes were uncovered during the surgical procedure compared to one patient (6.7%) when toes were covered. This difference is not statistically significant.

A difference in the frequency of positive fungal culture results was observed between the groups on initial culture (table 1); this was not affected by skin preparation and neither was recolonization observed during surgery for either scrub group.

Three patients in our series developed a wound infection. Two patients were in the standard scrub group (group 2) and one was in the cleft scrub group (group 1). The infecting organism in two cases was Staphylococcus aureus and Klebsiella oxytoca in the third. In none of these three patients was the infecting organism identified in any of the three sets of cultures. These infections resolved rapidly; two patients were treated with oral antibiotics while the third received intravenous antibiotics and required removal of an underlying screw.

Table 2: Bacteriological Cultures in Covered vs. Uncovered Toes

		Toes Covered (15)	**Toes Uncovered** (35)	**p**
Length of Surgery, mins (median, range)		60 (10-235)	40 (15-210)	0.497
Positive Bacteriology No. of patients (%)	Pre-preparation	14 (93.3)	32 (91.4)	0.426
	Post-preparation	1 (6.7)	1 (2.9)	0.429
	Post-surgery	2 (13.3)	7 (20.0)	0.282

DISCUSSION

The technique of application of antiseptic agents is important. Bacteria in normal human skin reside deep in the follicles of the hair and sebaceous glands. Scrubbing the skin in order to reach these areas might seem likely to improve the efficacy of antiseptic agents, but this may cause damage to the epithelium and expose more bacteria that would otherwise have lain dormant in the deeper skin layers. Pre-operative hand scrubbing has not been shown to be more effective than washing alone[9] and it cannot therefore be assumed that scrubbing the toe clefts will reduce either infection or the finding of positive bacterial cultures. This study shows that scrubbing the toe clefts does not affect the immediate bactericidal rate, but it is associated with a lower incidence of recolonization during surgery.

In the knowledge that any skin, and particularly toe clefts, cannot be free from bacteria, barrier methods to limit spread are important. Placing a sterile glove over the toes, a technique that is widely practiced in the United Kingdom, is the simplest method of achieving this. Although we observed a lower incidence of bacterial recolonization when toes were covered during surgery, we have been unable to demonstrate statistical significance in a study of this size.

While this study demonstrates differences in the incidence of recolonization of bacteria during surgery which was dependent on scrub technique, correlation with a difference in infection is still required. Three of our patients developed a wound infection and in none of these could the infecting organisms be identified in

operative cultures. Published infection rates following foot surgery are 1-2%[3,4] and a study of several hundred patients in each group is therefore required to demonstrate a link between bacterial counts and infection. Conclusions must therefore be limited by the understanding that these observed differences have not yet been shown to have clinical significance, but this does not detract from the surgeon's aim, in preparing the foot for surgery, to minimise the opportunity for contamination of the surgical field by host bacteria. We therefore conclude that bacterial recolonization of toe clefts is reduced by scrubbing each toe cleft individually prior to foot surgery. Further study is required to determine the effect that this might have in limiting postoperative wound infection.

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