CHAPTER **47**

CONTAMINATION RATES AND ORGANISMS ASSOCIATED WITH DROPPED BONE FROM STERILE FIELD

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INTRODUCTION

Bone grafting has several specific functions including treatment of delayed unions, nonunions, pseudoarthroses, augmentation of defects, and reconstructive procedures. The use of bone grafts is a common practice in podiatric surgery. In using autogenous bone grafts, the graft must be transported from the donor to the recipient site. When the graft is in transit there is a risk for an accidental break in the sterile field. In addition, many surgeons, when performing a bunion procedure, impact the capital fragment onto the metatarsal shaft. There is a risk of overzealous impaction resulting in the loss of the metatarsal head from the sterile field to the operating room floor. Although the loss of a bone to the operating room floor is very rare, I believe most surgeons would admit knowing of such an occasion.

If a bone does fall to the operating room floor breaking the sterile field, the surgeon is faced with some difficult decisions. Possible treatments include discarding the bone, obtaining a new autogenous graft, replacing the bone with bone substitute or allograft replacement, autoclaving the graft, treating the graft with antibiotics, or using the fallen bone.

To help determine if sterilization is needed, a study was designed to show the percentage of contamination found when bone contacts the operation floor, determine the common organisms encountered, and to see what impact a sterile normal saline flush has on a dropped bone graft.

MATERIALS AND METHODS

Bone samples were collected from podiatric surgeries from October, 2000 to March, 2001 at Scripps Mercy Hospital in San Diego, California. Only bone that was to be discarded was used in the study. The specimens were obtained from arthroplasties and bunionectomies. Any patients with a known or suspected infection were excluded from the study. Exclusion criteria included constitutional symptoms such as chills, fever, nausea and vomiting, open ulcerations and ascending cellulitis. Patients given preoperative antibiotics were also excluded.

Three bone samples were taken for each procedure. The samples were shaped with bone forceps to an equal diameter, which was less than one centimeter to fit into thioglycolate tubes. The samples were placed on the sterile back table until completion of the procedure. Following completion of the surgery, the first sample was placed with sterile instrumentation into a sterile specimen container and labeled. This specimen was to be used as a control. The second sample was placed on the operating room floor within four feet of the operating table, where it was most likely to be dropped during a surgical procedure. This sample was left on the floor for one minute. The second sample was then placed into a sterile container, using sterile forceps. The third sample was placed on the floor for one minute in a similar fashion. This sample was retrieved with sterile instruments and flushed with 10 ml of normal saline from a 10 cc syringe. This sample was then placed into a sterile container and labeled.

All three samples were then placed into separate thioglycolate broth culture tubes under sterile conditions by the microbiology staff. The three tubes were then placed into the incubator at 35 degrees Celsius for four days. At the end of this time, the tubes were examined for turbidity. If no turbidity was noted the specimen was categorized as no growth. If turbidity was present the sample was streaked on blood agar, which can support both gram positive and gram negative bacteria, and isolated to bacteria type. The information was then organized and kept in a log. Susceptibilities were also taken using the Kirby - Bauer disk diffusion method.

No changes were made in the floor preparation. The floor was mopped with Heptagon disinfectant cleaner containing DISNFX – 125 from Microgen, Inc. between cases. The cleaning staff was not informed of the study. No changes to floor cleaning were made.

RESULTS

Fifty sets of cultures were taken with a total of 150 total samples. Samples dropped onto the operating room floor and not flushed with normal saline showed thirty (60%) no growths, seventeen (34%) coagulase negative staphylococcus, two (4%) staphylococcus aureus, and one (2%) streptococcus viridans. 11/17 that grew out coagulase negative staphylococcus and ½ that grew out staphylococcus aureus had positive cultures on all three samples from the same patients; the remaining 8 positive cultures had no growth on the other two samples from the same patients (Figure 1).

Samples which were dropped to the floor and were subsequently flushed with 10 ccs of normal saline demonstrated thirty-five (70%) no growths, fourteen (28%) coagulase negative staphylococcus, and one (2%) staphylococcus aureus. 12/14 that grew out coagulase negative staphylococcus had positive cultures on all three samples from the same patients; 2/14 had no growth on the other

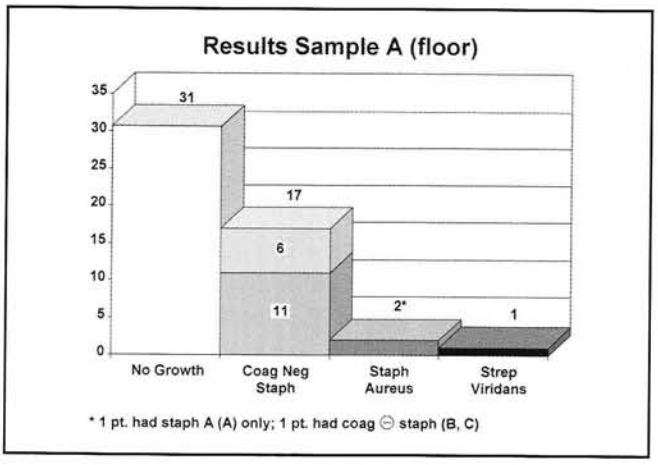

Figure 1. In samples dropped on the operating room floor that were not flushed with normal saline, 31 (62%) demonstrated no growth, 17 (34%) grew out coagulase negative staphylococcus, 2 (4%) staphylococcus aureus, and 1(2%)streptococcus viridans. 11/17 that grew out coagulase negative staphylococcus and ½ that grew out staphylococcus aureus had positive cultures on all three samples from the same patients; the remaining 8 positive cultures had no growth on the other two samples from the same patients.

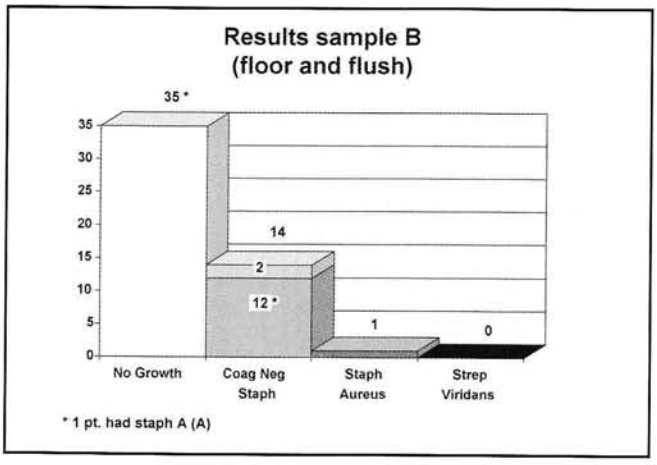

Figure 2. In samples taken from the floor and flushed with 10 ccs of normal saline, 35 (70%) demonstrated no growth, 14 (28%) grew out coagulase negative staphylococcus, 1 (2%) staphylococcus aureus. 12/14 that grew out coagulase negative staphylococcus had positive cultures on all three samples from the same patients; 2/14 had no growth on the other two samples from the same patients.

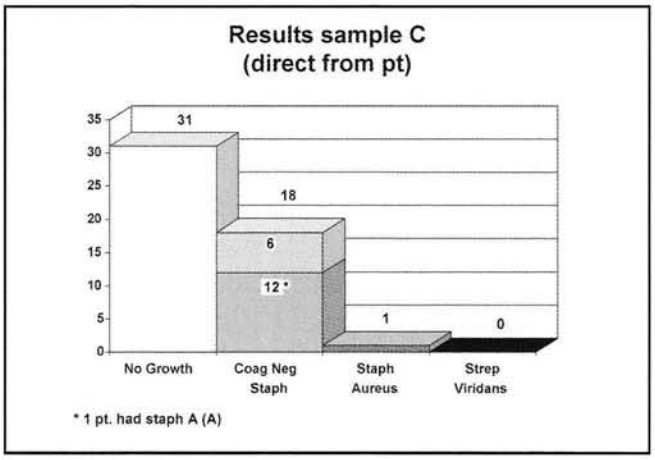

Figure 3. In samples taken directly from the patient, which did not break the sterile field, 31 (62%) demonstrated no growth, 18 (36%) grew out coagulase negative staphylococcus, and 1 (2%) showed staphylococcus aureus. 12/18 that grew out coagulase negative staphylococcus had positive cultures on all three samples from the same patients; 6/18 had no growth on the other two samples from the same patients.

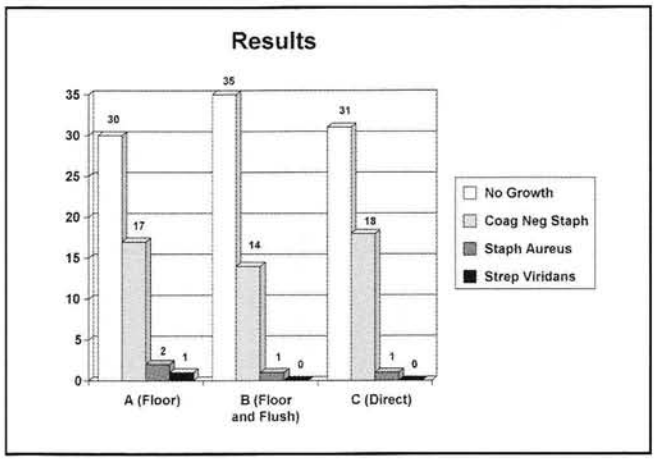

Figure 4. Each group (A, B, & C) resulted in no growth in approximately 2/3rds (60-70%) of their samples. Each group had approximately 1/3 (28-36%) of their cultures that grew out coagulase negative staphylococcus. Staphylococcus aureus grew out in 2-4% of each sample group. Streptococcus viridans grew out in one sample in the group A.

two samples from the same patients (Figure 2).

The samples taken directly from the patient, which did not break the sterile field, demonstrated thirty-one (62%) no growths, eighteen (36%) coagulase negative staphylococcus, and one (2%) staphylococcus aureus. 12/18 that grew out coagulase negative staphylococcus had positive cultures on all three samples from the same patients; 6/18 had no growth on the other two samples from the same patients (Figure 3).

From the 150 samples taken, 96 remained essentially sterile. There were 49 coagulase negative organisms. Four staphylococcus aureus organisms were isolated. The study showed one strepococcus viridans. (Table 1) Each group (A, B, & C) resulted in no growth in approximately 2/3's (60–70%) of their samples. Each group had approximately 1/3 (28–38%) of their cultures that grew out coagulase negative staphylococcus. Staphylococcus aureus grew out in 2-4% of each sample group. Only one other organism grew out in any of the samples. Streptococcus viridans grew out in one sample and that was in the group A that fell on the floor without being flushed with saline (Figure 4).

The Kirby – Bauer disk diffusion susceptibilities taken from samples produced various results (Figure 5). There was 100% sensitivity to cefazolin, chloramphenicol, gentamicin, tetracycline, and vancomycin. Most organisms were resistant to penicillin and erythromycin. Approximately 50% of organisms tested were resistant to clindamycin and septra.

DISCUSSION

Although a rare occurrence, a break in sterile field resulting in bone on the operating floor is possible with transport of bone graft from donor to recipient site. It is also possible to cause a similar situation with overzealous impaction of capital fragments during bunionectomies. If the bone was not essential, the lowest risk of infection to the patient would be to discard the graft, although these grafts are usually essential for good surgical outcomes. It may also be possible to obtain a new autogenous graft. This would cause more morbidity to the patient as you procure bone. Replacing the autogenous bone with an allograft is a possible alternative depending upon the purpose of the bone lost from the field. If the bone was to be used to add length to a metatarsal, for instance a brachymetatarsia repair, an allograft may be used. Replacing a metatarsal head with its complex shape and joint surfaces with allograft may not be an option if preservation of function is desired. Allografts also lack osteoinduction, have slower and less complete incorporation than autografts, and have possible antigenicity.

Table 1

THE RESULTS OF THE 150 CULTURES TAKEN ON 50 PATIENTS.

	A	B	C		A	B	C	
1	coag -	no	no	26	no	no	no	
2	coag -	no	no	27	no	no	no	
3	no	no	no	28	no	no	no	
4	no	no	no	29	no	no	no	
5	no	no	coag -	30	coag -	no	no	
6	no	no	no	31	coag -	no	no	
7	no	no	no	32	no	coag -	no	
8	coag -	no	no	33	Viridans	no	no	
9	coag -	coag -	coag -	34	coag -	coag -	coag -	
10	coag -	coag -	coag -	35	coag -	coag -	coag -	
11	no	no	no	36	coag -	coag -	coag -	
12	no	no	coag -	37	no	no	no	
13	coag -	coag -	coag -	38	no	no	no	
14	no	no	coag -	39	no	no	no	
15	no	coag -	no	40	no	no	no	
16	no	no	no	41	no	no	no	
17	no	no	no	42	no	no	no	
18	coag -	coag -	coag -	43	coag -	coag -	coag -	
19	S. aureus	no	no	44	no	no	coag -	
20	coag -	coag -	coag -	45	coag -	coag -	coag -	
21	no	S. aureus	S. aureus	46	no	no	no	
22	no	no	coag -	47	no	no	no	
23	no	no	coag -	48	no	no	no	
24	no	no	no	49	coag -	coag -	coag -	
25	coag -	no	no	50	S. aureus	coag -	coag -	

Autoclaving the bone has been attempted to sterilize the bone. This process is believed to denature the protein, thereby interfering with osteoblastic resorption and subsequent ingrowth by viable osteoblasts. The revascularization of these autoclaved grafts appear to occur much more slowly than with conventional autogenous grafts or even with allografts.

Antibiotics have also been used to treat bone in an attempt to avoid infection. In an experimental study with rats bone isografts dusted with chloramphenicol or methicillin power or with polybactrin spray before implantation produced little or no new bone over a period of two weeks whereas untreated, control grafts showed abundant osteogenesis, as did grafts pretreated with solutions of antibiotics. The conclusion of the study suggests that antibiotic solutions will not inhibit osteogenesis.

In a study by Copper, ten tendon grafts were dropped on the floor for three minutes and then cultured. Six of the ten grafts had a positive culture at ten days. To test the efficacy of an antibiotic solution, ten additional grafts were dropped on the floor for three minutes and soaked in a sterile saline solution containing bacitracin and polymyxin for fifteen minutes. This study used a mixture of

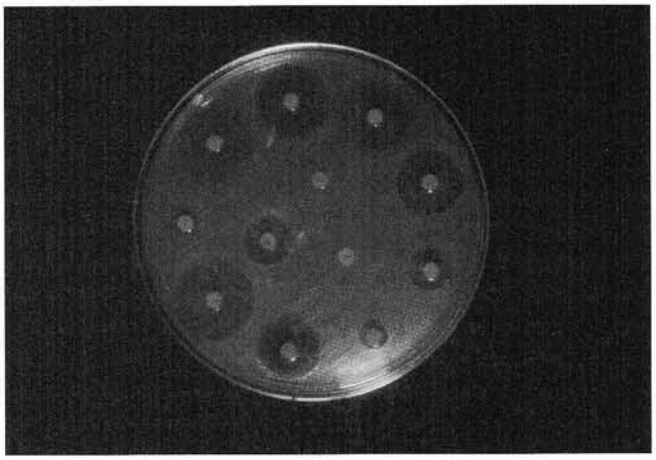

Figure 5. The Kirby – Bauer disk diffusion susceptibilities taken from samples produced various results (Fig. 2). There was 100% sensitivity to cefazolin, chloramphenicol, gentamicin, tetracycline, and vancomycin.

50,000 U of bacitracin and 500,000 U of polymyxin B in 1,500 ml of normal saline, yielding concentrations of 33 and 333 U/ml, respectively. Three of ten grafts cultured positive at ten days. Each bacteria was found to be sensitive to the antibiotic agents used. The conclusion of the study was that a fifteen minute exposure to a broad spectrum antibiotic solution may reduce the incidence of positive cultures, but there still remains a thirty percent incidence of contamination. Interesting to note was the fact that only sixty percent of the grafts dropped on the floor and not cleansed in the antibiotic solution grew positive cultures.

Bradley in 1992 took fifty bone specimens and dropped them onto the operating room floor for one minute and submitted the samples for culture.

No positive cultures were obtained. The study suggested that extensive sterilization of a dropped bone graft is not essential.

The current study has demonstrated that there is a low risk of contamination of bone that has been briefly dropped on the operating room floor. Sixty percent of the samples, which were dropped and cultured without flushing, showed no growth. The percentage of no growth was identical with 60% remaining essentially sterile when comparing samples taken directly from the patient to samples dropped and not flushed. A simple flush with 10 ml of normal saline had little impact on decreasing the number of contaminated samples. Similar types and percentage of organisms were noted between the three groups. Ninety-one percent of the organisms isolated were coagulase negative staphylococcus. These organisms are often considered to be contaminants when isolating potential infectious etiologies.

The source of contamination was examined by a study by Viagappam. In his study they concluded that the most important source of coagulase negative staphylococcus contamination was from the patientís own skin flora.

CONCLUSION

After reviewing results from previous literature and considering data collected from this study, the authors recommend retrieval of the bone lost from the sterile field. If necessity demands, use of the dropped bone graft. The authors also recommend flushing the sample with copious amounts of normal saline due to the fact that ten ml of saline had little impact on culture results.

Further studies should also be done to determine the effect of various antibiotic solutions in reducing the incidence of positive cultures. The clinician should realize that Copperís treatment with 50,000 U of bacitracin and 500,000 U of polymyxin B in 1,500 ml of normal saline still produced a thirty percent incidence of contamination. Further studies are needed to determine if contamination of bone grafts result in infection. This may alter our treatment protocols.

Due to the predominance of gram positive organisms, it is recommended that empiric therapy be directed toward these organisms. A prophylactic dose of ancef may be warranted, since organisms cultured in this study were sensitive to the antibiotic. A course of antibiotics directed toward gram positive organisms may be of benefit if there are any signs or symptoms of infection following surgery.