Predictors of Postoperative Complications of Ilizarov External Ring Fixators in the Foot and Ankle

Lee C. Rogers, DPM,[1] Nicholas J. Bevilacqua, DPM,[2] Robert G. Frykberg, DPM, MPH,[3] and David G. Armstrong, DPM, PhD[4]

Our objective was to determine factors associated with complications of Ilizarov external ring fixator surgery for foot and ankle disorders in persons with diabetes mellitus. We reviewed the records of patients who underwent Charcot foot reconstruction or soft tissue offloading surgery over 1 year at a single institution. We compared the association of serious pin tract infection, pin fracture, and surgical wound dehiscence with the patient age, weight, duration device was used, preoperative glucose, preoperative hemoglobin, tourniquet time, and total operating time. Fifteen patients (16 limbs) underwent reconstructive surgery. Younger age, elevated preoperative glucose, and lengthy tourniquet times were associated with complications (P = .03). These data demonstrate that 2 modifiable factors (preoperative hyperglycemia and tourniquet time) predict complications and should be mitigated to lower risk. (The Journal of Foot & Ankle Surgery 46(5):372–375, 2007)

Key words: ankle, Charcot's joint, foot, Ilizarov method, postoperative complications

External ring fixators are being used more frequently in foot and ankle surgery. There are advantages when using these devices for elective reconstructions and complicated cases. Several authors report successful use of these devices with ankle arthrodesis (1), ankle arthrodiastasis (2), tibial pilon fractures (3), calcaneal fractures (4, 5), subtalar joint arthrodesis (6), Lisfranc fractures (7), forefoot narrowing (8), surgical resection of osteomyelitis (9, 10), offloading plastic soft tissue surgery (11), and in the reconstruction of the Charcot foot (12, 13). In our patient population, we use this form of fixation for patients with Charcot foot deformity and for patients with chronic wounds that need complete pressure offloading or immobilization. These patients, a majority having diabetes, neuropathy, peripheral arterial disease, and immunopathy, are at increased risk for infections from the percutaneous pins (14), which may be in place for up to 12 weeks. Although there is an abundance of articles reviewing the uses of external ring fixation, few specifically address the complications of these devices (15–17). The aim of this retrospective investigation was to identify independent risk factors that were associated with complications in a series of persons with diabetes who underwent surgical reconstruction of the foot and ankle with external ring fixation.

Patients and Methods

All patients who underwent foot and ankle surgery involving external ring fixation over a 12-month period (April 2005 to April 2006) were identified. All surgeries were performed at a single institution, Saint Vincent Catholic Medical Centers, in New York, NY. Demographic data (ie, age, gender) and pertinent disease history (ie, duration and type of diabetes, renal insufficiency, other comorbidities) were documented. The operative report and technique, the type of fixator used (manufacturer), and the construct of the device (number of half rings, rings, foot plates) were recorded. Finally, a single investigator (L. C. R.) reviewed the case histories for complications (serious pin tract infections, pin fractures, wound dehiscence) that occurred during the period when the external fixator was in place and recorded specific preoperative data (described below). The

Address correspondence to: Lee C. Rogers, DPM, Amputation Prevention Center at Broadlawns Medical Center, 1801 Hickman Road, Des Moines, IA 50315. E-mail: Lee.C.Rogers@gmail.com.

[1]Director, Amputation Prevention Center at Broadlawns Medical Center, Des Moines, IA; Center for Lower Extremity Ambulatory Research (CLEAR), Dr. William M. Scholl College of Podiatric Medicine at Rosalind Franklin University of Medicine and Science, North Chicago, IL.

[2]Staff Surgeon, Foot and Ankle Center at Broadlawns Medical Center, Des Moines, IA and Center for Lower Extremity Ambulatory Research (CLEAR), Dr. William M. Scholl College of Podiatric Medicine at Rosalind Franklin University of Medicine and Science, North Chicago, IL.

[3]Chief of Podiatry, Carl T. Hayden VA Medical Center, Phoenix, AZ.

[4]Director, Center for Lower Extremity Ambulatory Research (CLEAR), Dr. William M. Scholl College of Podiatric Medicine at Rosalind Franklin University of Medicine and Science, North Chicago, IL.

L. C. R. and N. J. B. have previously received fellowship support from Small Bone Innovations (New York, NY). No device company was involved in the preparation of the article.

1067-2516/07/4605-0008$32.00/0
doi:10.1053/j.jfas.2007.06.004

weight of the devices was determined by measuring the fixator components with a Mettler PM2000 digital scale accurate from 0.01 to 2100 g (Mettler Instrument Corp., Hightstown, NJ). The weight of a particular patient's external fixation device was retrospectively ascertained from the operating report and determined by multiplying the standard weight of the major components (excluding rods, wires, and connecting elements) by the number of such components used for the particular device. Before surgery, all patients included in this study underwent extensive vascular and medical studies, and consults by a vascular surgeon and internal medicine specialist, to determine fitness for surgery. All patients received appropriate prophylactic antibiotics preoperatively, which consisted of either cefazolin, clindamycin, or vancomycin, depending on allergies and previous multi-drug-resistant organism history. Antibiotics were continued postoperatively only if patients had osteomyelitis, which was always resected during the operation. All surgeries were performed at a single institution, and all followed identical surgical and postoperative protocol. To limit hematoma formation and dehiscence, a drain under negative pressure was used in all patients and removed after 24 to 48 hours. Pin care was performed on a weekly basis and maintained until the skin healed around the transfixation wires. Pin care consisted of povidone-iodine–soaked 2 × 2" gauze with a pin slit cut into it. All patients included in the study participated in a vigorous Charcot arthropathy rehabilitation program and were kept nonweightbearing on the foot with the external fixator. Patients used either a wheelchair or a Roll-A-Bout (Roll-A-Bout Corporation, Frederica, DE) for ambulation. During rehabilitation, all patients received deep vein thrombosis prophylaxis with low molecular weight heparin. All of these interventions were uniformly applied to all patients and therefore were not considered as independent variable risk factors.

Serious pin tract infection was defined as an infection requiring hospitalization with intravenous antibiotics or pin removal or replacement. Pin tract infections and pin fractures were recorded by location as 1) proximal lateral tibial ring, 2) proximal medial tibial ring, 3) distal lateral tibial ring, 4) distal medial tibial ring, and 5) foot plate. Wound dehiscence was defined as a surgical incision that opened and required local wound care. Statistical analysis was done on a per-limb basis with SPSS 11.0 (SPSS Inc., Chicago, IL) and completed by the 2 independent investigators (R. G. F. and D. G. A.) in an effort to diminish bias. To assess the differences between dichotomous variables based on severe postoperative complications (severe pin tract infection, pin fracture, or surgical wound dehiscence), we used Fisher's exact test. To assess differences between continuous variables, we used the nonparametric Mann-Whitney *U* test. All variables were expressed as mean ± standard deviation unless otherwise stated, and an alpha of 5% (alpha = .05) was set for all analyses. This study received institutional review board approval from Saint Vincent Catholic Medical Centers.

TABLE 1 Patient characteristics (N = 15)

Patient characteristics	Mean ± standard deviation or n (%)
Age (y)	55.3 ± 11.9
Gender	
Male	9 (60)
Female	6 (40)
Diabetes	14 (87)
Charcot feet	15 (94)
Coronary artery disease	6 (40)
Nephropathy	6 (40)
MRSA*(history)	4(27)
Manufacturer of external fixator used	
Smith & Nephew	10 (63)
Small Bone innovations	6 (37)
Length of time external fixator used (d)	87.2 ± 8.6

*Methicillin-resistant *Staphylococcus aureus*.

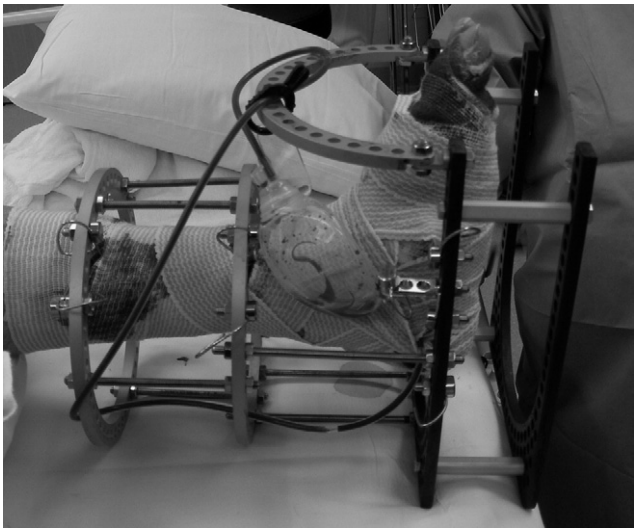

FIGURE 1 The standard configuration of external fixator in our series consisting of 2 tibial rings, 2 foot plates, and a half ring, which connects the distal ends of the foot plate.

Results

Fifteen patients (16 limbs) were identified, and their demographic and clinical characteristics are listed in Table 1. All patients, except for one who did not experience complications, were admitted to inpatient rehabilitation for the duration of the external fixator use. External fixation devices used in the first 10 patients were Smith and Nephew (S&N) circular fixation (Smith and Nephew, Memphis, TN), and, in the following 6 patients, Small Bone Innovations (SBi) RingFix (Small Bone Innovations, New York, NY) was used. The standard device construct con-