CHAPTER **21**

MULTIPLE APPLICATIONS OF THE MINIRAIL

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INTRODUCTION

The unilateral MiniRail External Fixation System is a device used in the treatment of bone conditions and deformities of the foot. In the last decade this application has evolved and become more popular with the development of systems that allow a greater understanding of this technique. External fixation is divided into two main categories: circular frames and unilateral rails (1, 2); however the use of Illizarov-type circular frames is reserved for more complex deformities in the foot and ankle as well as the distal leg. MiniRail external fixators have been described in the use of a variety of procedures, more commonly used in forefoot surgery (1, 3, 4).

In this paper we put together a total of nine different surgical procedures used to treat fifteen different foot conditions and deformities as well as trauma. All conditions were treated with a unilateral external fixation system with excellent results. These procedures include arthrodesis of the first metatarsocuneiform joint (with two revisions of this procedure not previously using a MiniRail), medial column fusion, open and closed reduction of Lisfranc fracture–dislocation injuries, metatarsal callus distraction, correction of first and fifth metatarsal fractures, sliding calcaneal osteotomy, first metatarsal-cuneiform fusion, and first metatarsophalangeal joint fusion.

External fixation systems have been shown to be advantageous over internal fixation for various reasons. Placement of an external fixator is done percutaneously thus eliminating any unnecessary incisions and risk of infection (1). Dehiscence and the need for wound care are thus prevented. Associated treatments, such as dressing changes, skin grafting, bone grafting, and irrigation are possible without disturbing the correction or fixation. Any post-operative condition that may arise such as ulcerations or pin-track infections may be easily accessed and cared for; a luxury not enjoyed by a plate or screw. External fixators can also be applied in the presence of a bone infection. The percutaneous placement of pins eliminates guesswork involved in deciding how to correct the deformity since the pins can be placed at a safe distance from the infection. External fixators can also be safely used in the presence of comorbidities such as diabetes mellitus, smokers, osteomyelitis, and avascular necrosis (1-3).

As with any external fixation system, early weight bearing is not only allowable but encouraged as this expedites bone healing. Immediate motion of the proximal and distal joints is also allowed aiding in the reduction of edema and preventing capsular fibrosis, joint stiffening, muscle atrophy, and osteoporosis. When it comes to multi-planar deformities, external fixators provide neutralization and stabilization with adjustable amounts of compression or distraction. This allows correction (compression or distraction) throughout the postoperative period through a minimally invasive procedure and a multifunctional correction (1, 2). Finally, once the desired correction has been achieved, the pins are removed and the patient is left with no internal hardware that may cause pain in the future.

Disadvantages of the unilateral MiniRail system are mainly due to the complexity of the system and difficulty in application and manipulation. This difficulty can be overcome, as with any technical and mechanical difficulty, through surgeon education, training, and experience. Another disadvantage of external fixator systems is the cost of the equipment, including the tools needed for application and removal. Although major incisions are avoided as well as placement of internal hardware, the risk of pin track infection and possible neurovascular damage continue to be realistic (1-3). As stated earlier however, most of these problems can be solved by early detection, quick action, and by surgeon education and experience.

MATERIALS AND METHODS

A total of 29 Orthofix MiniRail external fixators were placed on 26 patients with 15 different diagnoses who underwent 9 different surgical procedures. The patients ranged in age

from 23 to 79 years with 8 male (30%) and 18 female (70%). Each patient was educated at length about both internal and external fixation. All advantages and disadvantages including complications as well as recovery time and weight bearing status after surgery were discussed with the patients in detail. All patients who opted for the MiniRail external fixator received preoperative and postoperative instructions for careful management of the MiniRail. All patients received prophylactic intravenous antibiotic therapy 30 minutes preoperative and postoperative weekly pin care (cleansing and dressing changes).

In the study, compression-stabilization techniques were used in 26 of the 29 procedures, within these cases 20 were arthrodesis and 5 were fracture management techniques. One sliding osteotomy with fixation and 3 distraction-stabilization procedures were also performed (Table 1). All patients had weekly postoperative adjustments of the mini-rail except for the callus distraction patient who performed his own adjustments daily. Intra-operative radiographs were performed to confirm position and stabilization with follow-up radiographs performed at 3 weeks and 8 weeks postoperative. The average postoperative period with the MiniRail was 8 weeks with weightbearing beginning as early as one week postoperative with the aid of a surgical shoe and crutches.

Ten Lapidus fusions were performed with 4 pins placed perpendicular to the long axis of the bone: 2 in the medial cuneiform and 2 in the shaft of the first metatarsal. Prior to pin insertion, the first cuneiform-metatarsal joint was prepared under fluoroscopy with temporary fixation through the use of a 0.45 Kirshner wire. After placement of the Mini-Rail, compression was then achieved with an Allen wrench.

Two revisional Lapidus fusions were performed after failed procedures with internal fixation resulted in non-union. The screws were removed and the joint was prepared once again for the Lapidus procedure described above. Three medial column fusions were performed with a talo-navicular joint fusion involving the use of 2 pins in each bone and compression through the rail with early weight bearing after 1 week and postoperative adjustments made every other week (Table 1).

Three Lisfranc's fracture-dislocations, two fifth metatarsal fractures, and one first metatarsal fracture-dislocation were reduced with a total of 6 MiniRails with compression through the fracture defect. Five first metatarsophalangeal joint fusions were performed with 4 pin compression at the joint through the neck of the first of the metatarsal and the first proximal phalanx.

Two brachymetatarsia callus distraction procedures were performed with MiniRail placement along the metatarsal shaft. Daily adjustments of the MiniRail were performed for callus distraction by the patient at home. One sliding calcaneal osteotomy procedure was performed and a MiniRail external fixator was used for compression and stabilization of the osteotomy.

Table 1

	DIAGNOSIS	PROCEDURE	SURGERIES
1	Hallux Rigidus	1st MPJ Fusion	2
2	Hallux Varus	1st MPJ Fusion	1
3	Charcot Arthropathy	1st MPJ Fusion	1
4	Osteomyelitis	1st MPJ Fusion	1
5	HAV + Hypermobility	Lapidus	10
6	Non-Union Medial Column Fusion	Revision Lapidus	2
7	Avascular Necrosis Medial Cuneiform	Medial Column Fusion	1
8	Severe Pes Planus	Medial Column Fusion	1
9	Severe Osteoarthritis	Medial Column Fusion	1
10	Calcaneal Varus	Calcaneal Sliding Osteotomy	1
11	Brachymetarsia	Callus Distraction	2
12	5th Metatarsal Fracture	Repair 5th Met Fracture	1
13	Non-Union 5th Metatarsal Fracture	Repair 5th Met Fracture	1
14	First Ray Fracture Dislocation	Repair 1st Met Fracture/Dislocation	1
15	LisFranc's Fracture Dislocation	Repair LisFranc's Fracture/Dislocation	3

RESULTS

Of the 29 procedures, all patients went on to full recovery with no complications or recurrence. The average time of duration with the MiniRail external fixator was 8 weeks, with removal at that time +/- one week. After removal of the MiniRail external fixator, all patients had an average recovery period of approximately 3 weeks at which time patients were allowed to transition out of their post-operative shoes and into athletic shoes. By one month following removal, patients were cleared to return to all normal preoperative activity without restrictions. Physical therapy was highly recommended to all patients to regain muscle strength and balance and averaged 3 weekly physical therapy sessions for 3 weeks. Most patients were allowed to begin physical therapy a week after removal of the external fixator. To date there have been no recurrences and patient satisfaction has been overall positive with results. There was no need for further corrective procedures and all patients went on to full recovery.

DISCUSSION

The use of external fixation devices has been in practice for many years. Today the use of external fixators has become a popular methodology for treating a great variety of conditions with minimally invasive procedures. While the larger ring fixators are reserved for more complex conditions (ankle fractures, limb lengthening, Charcot reconstructions), MiniRail external fixators have been a staple for the minimally invasive surgical correction of various forefoot and midfoot conditions as well as some calcaneal and rear foot conditions.

In this study, 26 patients underwent a total of 9 different surgical procedures with application of 29 MiniRail external fixators to correct conditions in 15 different diagnostic categories. All patients received preoperative education and weekly postoperative adjustments and pin care with follow up radiographs at 3 and 8 weeks. The patient population ranged in age from 23-79 years of age with females outweighing males 18 to 8, respectively.

Since 2009 we have found MiniRail external fixators to be superior over internal fixation for the various reasons listed above. The success rate is exceptionally high with patients able to ambulate very early after surgery, and the ability to perform any necessary adjustments postoperatively make the MiniRail system a very useful device (4, 5). It should also be noted that satisfaction is overall very positive considering they are able to ambulate early on and they have the peace of mind knowing that any correction needed can be easily adjusted at any time. Patient complaints are minimal and are generally geared toward the bulky dressings and uncomfortable postoperative shoe gear however any complaints of pain or discomfort are virtually non-existent. Finally, it is of importance to note once again that this device can be safely and successfully used on patients with comorbidities that would otherwise lead to failure with internal fixation such as patients who are smokers, have bone infections, or have chronic illnesses such as diabetes mellitus (5, 6).

We will continue to use MiniRail external fixators for future cases and hope to broaden the scope of indication for the device. Although this study has a very small sample population, the degree of success we have experienced thus far will propel us to continue.

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Figure 1.

Figure 2.

Figure 3.

Figure 4.

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Figure 10.

Figure 11.

Figure 12.

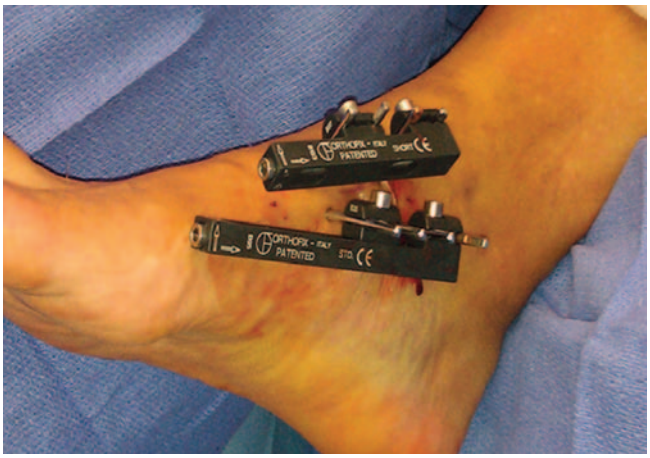

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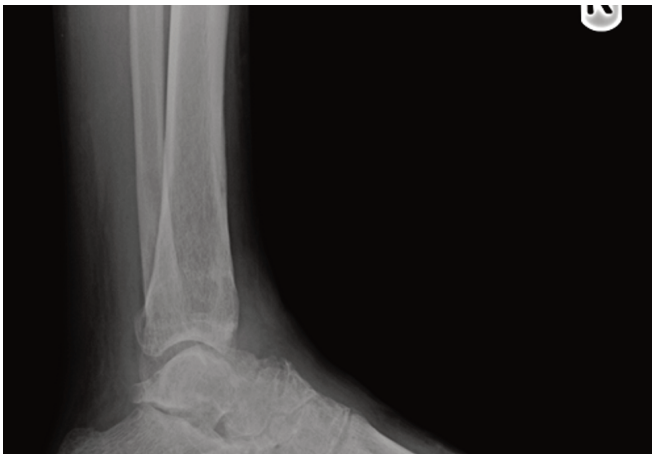
Figure 22.



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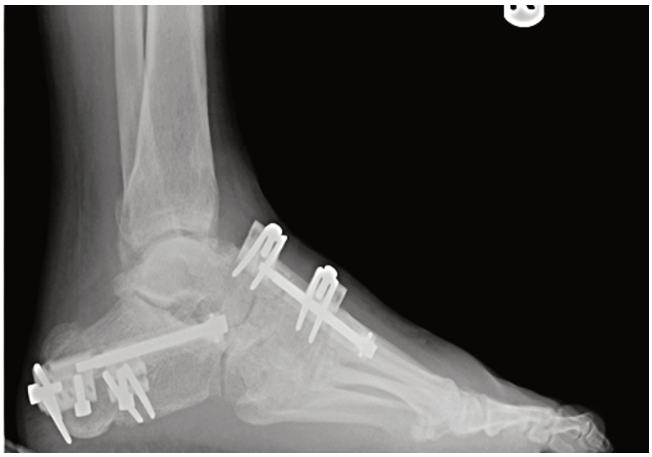

Figure 25.