

# Correction of a Severe Poliomyelitic Equinocavovarus Foot Using an Adjustable External Fixation Frame

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We treated the deformity with gradual correction using a Taylor spatial frame, followed by ankle arthrodesis. At the most recent postoperative evaluation, 20 months after the initial surgery, the patient was pain-free and ambulating on the sole of her right foot.

Level of Clinical Evidence: 4

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**Abstract**

One-stage surgical correction of severe equinovarus deformity can result in complications ranging from skin necrosis to tibial nerve palsy. Fewer complications have been reported when severe deformities were treated by gradual correction using external frames such as the Ilizarov external fixator or the Taylor spatial frame. We describe a case of a 64-year-old woman with severe poliomyelitic equinovarus whose deformity required her to ambulate using the dorsum of her right foot as a weight-bearing surface. We treated the deformity with gradual correction using a Taylor spatial frame, followed by ankle arthrodesis. At the most recent postoperative evaluation, 20 months after the initial surgery, the patient was pain-free and ambulating on the sole of her right foot.

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Equinovarus foot deformity is a common sequela of poliomyelitis infection. A variety of operative methods have been used to correct the deformity in adults, including

tendon transfer, wedge resection of the midfoot, triple arthrodesis, talar excision, and calcaneal osteotomy (1-4). However, one-stage surgical correction of severe deformities, especially in adult patients, may result in complications such as tibial nerve palsy and skin necrosis. Fewer complications have been reported when severe deformities were treated with gradual correction using external frames such as the Ilizarov external fixator or the Taylor Spatial Frame™ (TSF) (Smith & Nephew, Inc., Andover, Massachusetts) (1,2). The TSF is a ring-type external fixator that allows simultaneous correction of multifaceted deformities. Unlike the Ilizarov external fixator, the TSF does not require the use of multiple hinges (5). In addition, the TSF's simple correction techniques facilitate a short learning curve. Although the use of TSF has rapidly increased in recent years, its use in correction of severe ankle and foot deformities is not yet standard. We describe the case of an adult patient with severe equinovarus foot secondary to childhood poliomyelitis who was successfully treated by gradual correction through the use of a TSF, followed by arthrodesis.

## **Case Report**

A 64-year-old woman presented to our clinic with a chief complaint of abnormal gait and a non-healing wound on the dorsum of her right foot. Her medical history was significant for poliomyelitis at age four, with subsequent development of equinovarus deformity of the right foot at approximately seven years of age, causing her to walk on the dorsum of her foot. At age 40, she developed an ulcer on the dorsal aspect of the affected foot for which she received treatment at a local hospital, including orthotic therapy. The

wound failed to heal, however, and she was referred to our clinic for evaluation and treatment.

Initial evaluation of the affected extremity revealed a severe equinus deformity of the right foot that could not be reduced by manual manipulation. The deformity required the patient to weight bear on the dorsolateral aspect of the foot and a 7-cm ulcer had developed in that location (Fig. 1). Manual muscle testing (MMT) revealed grade 4 weakness in the iliopsoas, quadriceps, and right hamstring muscles, and grades 0-1 weakness in the anterior tibial, extensor hallucis longus, peroneal flexor, and flexor hallucis longus muscles. Culture specimens taken from the ulcer grew gram-negative bacilli. Standard radiographs showed 20-mm shortening of the right leg and a  $152^{\circ}$  right tibiocalcaneal angle. The metatarsotalo-bimalleolar angle (MTB) was  $68^{\circ}$ , indicating forefoot adduction, and the Hibbs angle was  $106^{\circ}$ , indicating pes cavus. Radiographs also showed end-stage osteoarthritic changes of the ankle. Computerized tomography (CT) imaging showed severe fatty degeneration in the muscles of the right lower extremity. Needle electromyography revealed fasciculation potentials and giant potentials in the affected muscles, characteristic of poliomyelitis. There were no signal changes on the magnetic resonance images (MRI) suggestive of osteomyelitis.

The patient was diagnosed as having severe equinocavovarus foot secondary to poliomyelitis and reconstructive surgery was planned. We opted to use the TSF for gentle mobilization in order to lower the risk for dermopathy and neuropathy. In the initial surgery, a full ring was applied to the tibia, a second full ring was applied to the calcaneus, and a half ring was applied to the forefoot (Fig. 3). Beginning on the first postoperative day, gradual correction of the equinus deformity was initiated at a rate of 1 mm per day. The

ring applied to the forefoot was retracted proximally using the natural hinge method (2) to correct pes cavus simultaneously. Slings were used on the toes to apply force in the direction of extension to prevent flexion deformity. A corrected position was achieved in 84 days. Secondary surgery was performed 105 days after the initial surgery and consisted of ankle arthrodesis, iliac crest bone graft and release of the flexor digitorum longus tendon. Bony union was achieved approximately 5 months after arthrodesis, at which time the TSF pins were removed. The duration of treatment with the external fixator was 259 days. Evaluation of postoperative radiographs revealed a tibiocalcaneal angle of  $77^\circ$ , MTB angle of  $95^\circ$ , and Hibbs angle of  $53^\circ$ , indicating a satisfactory deformity correction. [AQ1] The lateral radiograph showed calcaneal boney spur formation, which was not present before treatment (Fig. 4). With continued treatment, the ulcer on the dorsum of the foot gradually decreased in size and was fully healed by approximately 4 months after the initial hospitalization. At the most recent postoperative evaluation, 20 months after the initial surgery, the patient had no pain and was walking on the sole of her right foot (Fig. 5).

## Discussion

Our patient had a severe equinovarus foot deformity involving weight bearing on the dorsum of the orthotic-supported foot. Because of the patient's age and the long-standing nature of the deformity, gradual correction with the TSF and a rotating hinge was used. The ring was applied to the forefoot, and simultaneous correction of pes cavus was performed using the natural hinge method (2) to raise the forefoot into normal anatomic position. Conventionally, a prolonged period of limited weight bearing is required after

ankle arthrodesis. However, when the TSF is used as a fixation device after ankle arthrodesis as in our case, weight bearing can be initiated immediately after surgery and bone atrophy can be minimized. Patients should be closely monitored for the development of complications. Careful inspection of the wire insertion site may reveal wire displacement, requiring adjustment of the rate of correction. Other complications that can occur during correction include ankle dislocation and talar collapse. It is important to monitor bone healing with radiographs and to change the corrective program as needed to prevent complications. There is also a risk for posterior nerve palsy during correction (7), although such a risk is greater in one-stage correction. If symptoms develop, tarsal tunnel release should be considered. Finally, long-term application of external fixators is associated with a high incidence of infection at the pin insertion site. We used antibacterial iodine-supported titanium pins and wires developed by Tsuchiya et al (8). In our case, pins were also used in the area of ulceration on the dorsum to correct the foot deformity. The patient did not develop any infections in either location.

Recurrence of deformity is another risk in reconstruction of the paralytic equinovagovarus foot. We were concerned about the risk of recurrence of pes cavus and have the patient on an ongoing physical therapy regimen. There has been no recurrence to date.

We have reported on our experience treating a severe, long-standing equinovagovarus foot with gradual correction and ankle arthrodesis using a Taylor spatial frame. The successful outcome demonstrates that a minimally invasive correction procedure can be effective and should be considered for correction of equinovagovarus deformity.

## **Acknowledgment**

Written informed consent was obtained from the patient for publication of this case report.

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## Figure Legends

Figure 1. Photograph showing (A) dorsum of the right foot in contact with the ground, and (B) dorsal foot ulcer at the time of initial examination.

Figure 2. Preoperative radiographs. (A) Anterior view. (B) Lateral view.

Figure 3. In the initial surgery, a full ring was applied to the tibia, another full ring was applied to the calcaneus, and a half ring was applied to the forefoot

Figure 4. Radiographs taken at **XX?** months postoperative. **[AQ2]**

Figure 5. Clinical photograph of right leg at **XX?** months postoperative. (A) Weight bearing; (B) Non-weight bearing, lateral view **[AQ2]**

### **Author Queries (to be addressed when the Proof is reviewed)**

**AQ1: When were these radiographs taken? Please specify.**

AQ2: Please specify the timing (duration of time postoperative) of the photographs in this figure.

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