

Utilization of Constrained External Fixation for Gradual Correction of Post-Traumatic Fixed Equinus Contracture: A Case Study

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STATEMENT OF PURPOSE

Constrained external fixation constructs can assist in gradual correction of fixed equinus contractures by manipulating the device to rotate around the ankle joint axis. Scant literature is currently available on this topic. We present a case and describe the technique for utilizing a constrained external fixator to correct post-traumatic equinus.

LITERATURE REVIEW

Equinus deformity is a well-known pathology. Patients with equinus deformities have insufficient ankle joint dorsiflexion for normal gait.¹ Congenital, traumatic, neurological, or pathological etiologies may occur.²⁻⁵ Posttraumatic equinus deformities often have scar contracture and neurological damage, which creates a challenge for the treating surgeon.^{3,6}

A multitude of nonoperative and operative treatment options have been described, especially for more subtle forms. Nonoperative treatment including a rigorous stretching regimen, dynamic splinting, and serial casting.⁷ Additionally, a gastrocnemius recession or Achilles tendon lengthening procedure can be successful in mild deformities.⁸ However, more severe equinus deformities caused by trauma, burns, or neurological deficits are often not amenable to traditional surgical methods.⁷

Multiple authors have described utilization of external fixation for the gradual correction of severe equinus contractures.^{5-7,9-13} Similar to our case study, Jeong et al¹⁰ was able to obtain correction of rigid equinus deformities in 10 patients with use of Ilizarov external fixation alone, without the need for any adjunctive soft tissue procedures. They recommended this approach for any high-risk patients who have poor soft tissue envelopes. They had a mean correction of equinus of -49° to a plantigrade foot. Ahmad et al¹³ reported on their experience utilizing external fixation for gradual correction of rigid equinus deformities in 30 patients with improvement from -32° of rigid equinus to a mean of 15° and 31° of dorsiflexion and plantarflexion, respectively. They found excellent to good results in 93% of patients.

CASE STUDY

A 30-year-old female sustained an open calcaneal fracture, talar neck fracture, and medial malleolus fracture following a motor vehicle accident. She underwent urgent open reduction internal fixation, as well as tarsal tunnel release. She subsequently underwent a peroneal artery perforator flap for soft tissue coverage. Following split thickness skin grafting and local wound care, the soft tissue envelope healed appropriately.

She presented 1-year postoperatively to our facility with a severe residual equinus contracture. At the time of presentation, she had a 20-degree plantarflexory contracture at the ankle joint (Figure 1). There was dysesthesia to the plantar midfoot. Vascular status was intact. A surgical cicatrix was noted, but the skin envelope and flap were well-healed. Preoperative radiographs revealed congruent articular surfaces of the tibiotalar, talonavicular, and subtalar joints with stable orthopedic hardware and no avascular necrosis or significant arthritic changes.

CASE STUDY CONTINUED

She underwent gradual equinus correction with a constrained external fixator frame. All 5 digits were pinned in a retrograde fashion across the metatarsophalangeal joints with K-wires. The external fixator consisted of 2 full tibial rings for the tibial block, a half ring for the foot, a footplate, and an adjustable strut anteriorly. The hinge was placed at the ankle joint. The ankle joint was distracted 5mm intraoperatively utilizing the external fixator (Figure 2). Patient immediately began 4 quarter turns with 1mm of correction per day. At 5 weeks postoperatively, a smaller adjustable strut was exchanged for additional correction. At 9 weeks postoperatively, final equinus correction was obtained. The ankle was held in the corrected position for an additional 6 weeks. Serial radiographs were obtained to monitor progression of the correction (Figure 3). At 15 weeks postoperatively, the external fixator was removed. Postoperative clinical photographs and radiographs revealed resolution of the equinus deformity, with the ankle joint aligned 90° to the leg (Figure 4). At 15 months postoperatively, the patient maintained a plantigrade foot with adequate ankle joint range of motion.

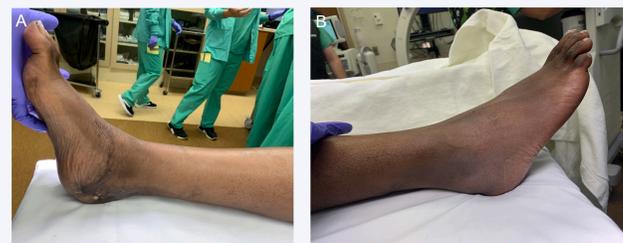


Figure 1: Clinical photographs of initial presentation. A) Maximum forced dorsiflexion with a 20-degree plantarflexory contracture. B) Lateral to medial clinical view in resting equinus position.

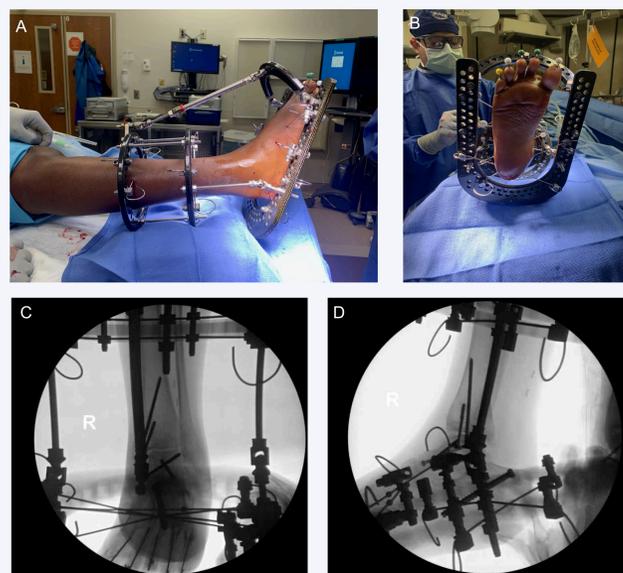


Figure 2: Intraoperative clinical and fluoroscopic images displaying placement of a constrained external fixator frame. A) Lateral clinical view. B) Caudal to cephalad clinical view. C) AP ankle fluoroscopic view. D) Lateral fluoroscopic view.

CASE STUDY CONTINUED

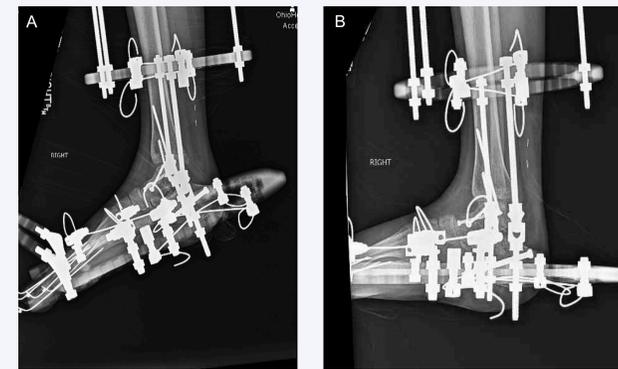


Figure 3: Serial postoperative radiographic progression. Note the significant improvement in dorsiflexion at the ankle. A) 6-week postoperative lateral radiograph. B) 13-week postoperative lateral radiograph.



Figure 4: Clinical and radiographic images following removal of external fixator. A) Medial to lateral clinical photograph showing maximum dorsiflexion and resolution of equinus contracture. B) Lateral to medial clinical photograph with maximum dorsiflexion. C) Lateral radiograph at final follow-up showing maintenance of a plantigrade foot.

ANALYSIS AND DISCUSSION

Severe equinus deformities can be treated acutely or through gradual correction. Complications with neurovascular structures, infection and the soft tissue envelope often raise concern for acute reduction.¹⁴ Progressive correction with a minimal approach limits the complications seen with acute correction.¹² External fixators can be utilized as constrained or unconstrained hinge systems. Constrained systems place the hinges at the center of rotation of a joint, allowing the external fixator to be manipulated around the joint axis. Unconstrained systems utilize a distraction technique to rotate around the center of the joint.⁶ We utilized a constrained external fixator in our case to rotate around the ankle joint axis.

One of the main concerns with gradual correction is potential recurrence. This can be limited by overcorrecting the deformity, maintaining the correction for an extended period, and utilization of bracing following external fixator removal.⁶ In general, external fixation should be maintained for twice the amount of time it takes to correct the deformity or at least a minimum of 6 additional weeks when treating contracture deformities.^{6,14,15} We left the external fixator intact for 6 weeks after obtaining a corrected position.

Other potential complications include toe clawing and tarsal tunnel syndrome. Claw toes following correction of equinus deformity has an incidence up to 50-78%.^{11,16} This can be prevented with prophylactic flexor tenotomies and retrograde pinning of the digits.¹² Although some authors recommend prophylactic tarsal tunnel release in severe deformity correction, the risk is more associated with acute correction rather than gradual.^{11,17} Nonetheless, it is important to monitor for posterior tibial nerve compression symptoms and adjustments to the rate of correction, or secondary surgical decompression, should be considered.¹⁷ We performed prophylactic retrograde pinning of the digits across the metatarsophalangeal joints, as well as closely monitored for any neurological deficits in the postoperative period.

CONCLUSION

Rigid post-traumatic lower extremity deformities present a challenge to clinicians. Consideration should be taken for utilization of a hinged constrained external fixator device in patients with fixed post-traumatic equinus deformities, with congruent ankle joints and a uniplanar deformity.

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