Staged Correction of Congenital Ankle Valgus and Flatfoot Deformity in Pediatric Patient

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INTRODUCTION

Supramalleolar osteotomies for congenital growth plate arrest in the pediatric patient are infrequently described in literature, but are an effective option in correction of distal lower extremity deformity. Conservative measures should always be attempted before surgical intervention, but effectiveness becomes limited as the deformity progresses and arthritic changes develop. Many surgical options are available to the foot and ankle surgeon, and the correct procedure should be chosen for each patient based on thorough patient evaluation.

The primary goal of these procedures are to restore the weight-bearing alignment of the leg, tibiotalar articulating joint surfaces, and physiologic range of motion.

The supramalleolor osteotomy is a commonly used surgical procedure to correct congenital or acquired deformities of the distal tibia, ankle, or foot. In children, this osteotomy can be used to correct malunion of fractures, physeal growth arrest, tibial torsion, paralytic deformities and sequealae of club foot. Supramalleolar osteotomies for congenital growth plate arrest in the pediatric patient are infrequently described in literature, but are an effective option in correction of distal lower extremity deformity. The primary goal of these procedures are to restore the weight-bearing alignment of the leg, tibiotalar articulating joint surfaces, redistribute the loads on the ankle joint and physiologic range of motion, thus improving the biomechanics of the lower extremity. (1) This case study achieved those goals with a staged procedure by utilizing the principles of CORA to normalize force vectors and the weight bearing axis, thereby creating a functional and pain free limb.*

LITERATURE REVIEW

Pediatric flatfoot deformity in conjunction with distal tibial valgus deformity is a rare occurrence, and there are limited case presentations. Normal physiology of the ankle has the mechanical axis extending through the center of the ankle joint, measuring approximately 93 degrees on AP ankle radiographs, and 80 degrees on lateral ankle radiographs. Normal heel bisection is 5-10 mm lateral to the tibial mid-diaphyseal line. (2,3) Paley has written that 30 degrees of ankle valgus and 15 degrees of ankle varus can be compensated with a normal motion at the subtalar joint. The goal of any supramalleolar osteotomy is to restore normal values, and minimize osteoarthritic changes, thus avoiding joint destructive procedures. However, proper patient selection becomes the key to success when choosing the ideal patients' procedure. Paley has published extensively on correction of lower limb deformity and the importance of identifying the apex of the deformity prior to surgical intervention. This is done by identifying the mechanical axis of both proximal and distal segments of the planned osteotomy. Most literature focuses on single aspects of lower limb deformity, without detailing subsequent procedures that may be necessary to correct the foot and ankle deformity. (4) However, literature does address correcting distal tibial deformities with malleolar osteotomies. (5) One such example is Gessmann et al, who utilized taylor spatial frame external fixators for correction of complex supramalleolar deformities, with acceptable results and limited complications. Another study by Horn et al (2011) detailed the successes of circular external fixation frames for supramalleolar osteotomies. The case being presented, is one such example of a multiplanar correction of the weight bearing axis utilizing circular external fixation and subsequent flatfoot reconstruction to correct the remaining pedal deformity.

CASE STUDY

Patient is a 15 year old male who initially presented with chief complaint of chronic ingrowing toenails, bunion and painful fallen arches, right foot with worse pain than left. Patient had past medical history of brain injury at birth from asphyxia, and subsequent expressive language delay and progressive sensorimotor hearing loss. Patient has had progressively worsening pain over the past year, without relief from conservative treatment options which include orthoses, high topped shoes, and physical therapy. Patient is unable to participate in athletic activities and cannot stand for extended periods of time without significant pain in his feet and knees. Patient has never had pedal surgery in the past.

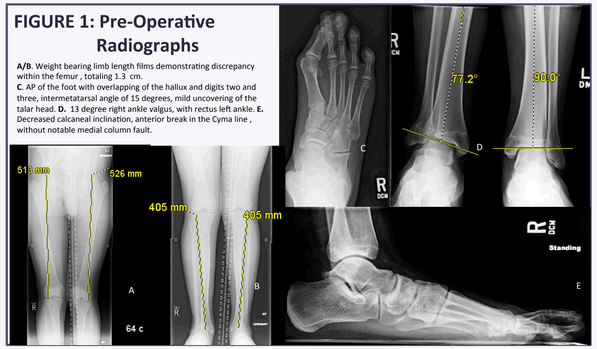
Physical examination demonstrated intact neurovascular status, normal dermatologic findings, severe calcaneal valgus bilaterally (right worse than left), severe right sided hallux abducto valgus, mild left sided hallux abducto valgus, instability of the midfoot, and significant pronation with weight bearing and ambulation. Patient had 5/5 muscle strength, with strong abduction of the right foot on mid-stance to push-off phases of gait.

Radiographic examination of the lower extremities was then performed which demonstrated an overall limb length discrepancy of 1.3 cm (left longer than right) valgus rotation of the right ankle to 13 degrees, and acquire hallux abductus deformity, overlapping digits two and three with intermetatarsal angle to 15 degrees.

Determination was made to proceed with staged correction of ankle and pedal deformity.

FIGURE 1: Pre-Operative Radiographs

A/B. Weight bearing limb length films demonstrating discrepancy within the femur , totaling 1.3 cm.
C. AP of the foot with overlapping of the hallux and digits two and three, intermetatarsal angle of 15 degrees, mild uncovering of the talar head. **D**. 13 degree right ankle valgus, with rectus left ankle. **E**. Decreased calcaneal inclination, anterior break in the Cyma line , without notable medial column fault.



Stage 1 Correction

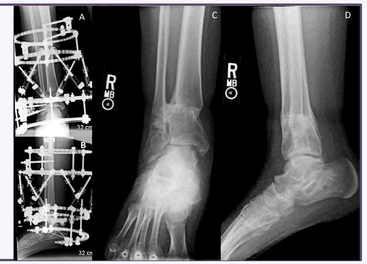
Given the patient's limb length discrepancy, determination was made to not perform a closing wedge osteotomy, and distract the tibia and fibula to reduce the ankle valgus deformity. Utilizing the principles of CORA, a supramalleolar osteotomy with multiplanar external fixation was planned. An external fixator frame was first applied. Distal tibial osteotomy was performed 30 mm proximal to the level of the ankle, and to the fibula approximately 10 mm proximal to the ankle joint. The frame was loosened to ensure complete freedom of both osteotomies, and again tightened in appropriate position to provide compression. Gradual deformity correction with distraction of the external fixator was performed until completed, and frame was left intact to allow for callus consolidation. Patient did develop a superficial pin tract infection, for which he was placed on a 10 day course of Augment n, and infection resolved. At six weeks post-operatively, the patient was admitted to the hospital in a catatonic state, which resolved with inpatient therapies. At 14 weeks he was again admitted to the hospital with depression, was discharged and at 16 weeks developed agitation with the frame.

At approximately 18 weeks the external fixator frame was removed.
Patient was admitted to subacute rehab center, and underwent aggressive range of motion and strengthening exercises with physical therapy. Patient improved to having no ankle pain and being able to ambulate without assistance, but continued to have pain associated with the arch of his foot, calcaneal valgus and hallux abducto valgus deformity.

FIGURE 2: Distal Tibial Correction

A/B. Anterior and lateral ankle views with application of external fixator frame.

C/D. Anterior and lateral ankle views immediately after frame removal.



Stage 2 Correction

At seven months from the original procedure, determination was made to proceed with correction of the flatfoot deformity. In a step wise manner, he underwent: Endoscopic gastrocnemius recession, medial calcaneal slide osteotomy, Evans calcaneal osteotomy, first tarso-metatarsal joint fusion, bunionectomy with first metatarsal osteotomy, capsulotomies of the second, third, and fourth metatarsal phalangeal joints.

FIGURE 3: Final Radiographic Results

A. Anterior view of the right ankle, demonstrating reduced valgus deformity and healing of callus distraction.
B. Lateral view of the right foot and ankle showing adequate placement of the ankle, retained decreased calcaneal inclination angle, healing of posterior calcaneal osteotomy, staple fixation of Evans calcaneal osteotomy with mild inferior displacement of anterior fragment and graft, healing metatarsal cuneiform joint fusion and first metatarsal osteotomy. Dorsal spurring noted of the talonavicular joint.
C. AP view of the foot with reduction of hallux abducto valgus deformity, and healing of fusion and osteotomy sites of the first ray. Callus formation of the Evans calcaneal graft site.

RESULTS

The patient underwent successful correction of ankle valgus and limb length with use of multi-planar external fixator. The patient did experience pin tract infection to the distal tibial pin, and agitation with the cage, causing it to be removed earlier than anticipated. Patient progressed to weight bearing with aggressive physical therapy prior to flatfoot reconstruction. Patient had successful flatfoot reconstruction, with improved pain, and advanced to all activities without restriction within one year from the original procedure.

At 13 months post-operatively the patient was discharged from physical therapy with all goals met, but with progressively decreased strength when climbing stairs.

Now 33 months from surgery, patient has not returned with pedal complaints, and maintains activities of daily living without difficulty. Patient remains limited by mental health issues related to schizophrenia, and attention deficit disorder.

ANALYSIS AND DISCUSSION

This case details an extensive staged lower extremity reconstruction for a pediatric congenital ankle valgus with flatfoot deformity. Our surgical techniques and principles are presented, with the goal of the procedures to lengthen the lower limb, realign valgus deformity of the ankle, and to correct flatfoot deformity with notable mid-foot instability, in an effort to decrease pain and improve the patient's function and activities of daily living. The patient did develop superficial pin site infections, which resolved with a 10 day course of Augmentin. More notably in the post-operative course, was the development of mental health issues and agitation with the external fixator, which did have an impact on the patient's post-operative course and rehabilitation. Careful evaluation of a patient's propensity to develop agitation with application of an external fixator or "cage rage" should be evaluated pre-operatively. Careful review of the radiographic views demonstrated successful ankle valgus rotation, consistent with previous literature demonstrating utility of supramalleolar osteotomies. (9,10)

Although pedal pain was resolved post-operatively, the patient had radiographic evidence of persistent flatfoot deformity, and development of talonavicular spurring. Ideally there would have been recreation of the arch in the sagittal plane, this may have been limited by the calcaneal osteotomies and choice of fixation for the anterior calcaneal osteotomy.

Overall the choice of procedures were successful in addressing the patient's complaints and resolving the symptomatic pedal deformities.

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