Double calcaneal osteotomies for the pediatric flatfoot: A case series

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Statement of Purpose

Retrospective review of the clinical outcomes of pediatric patients with flatfeet deformities who underwent double calcaneal osteotomies for surgical reconstructions.

Introduction

Flatfoot deformity in the pediatric population typically exists as either an isolated pathology or as part of a wider clinical entity that may include generalized ligamentous laxity, neurologic and muscular abnormalities, genetic conditions and syndromes, and collaged disorders (1). Pediatric flatfoot is characterized by a collapsed medial longitudinal arch, heel valgus, forefoot abduction, heel cord tightness, and forefoot supinatus or varus. The deformity is also further classified into flexible and rigid categories. The flexible flatfoot has a normal arch during non-weight bearing and collapse of the arch on stance, but is reducible. Those patients may be asymptomatic. Rigid deformities are non-reducible and are typically associated with other clinical entities (2).

The surgical management of the juvenile flatfoot is contingent on a full understanding of the primary plane of deformity, resultant biomechanical compensation, and radiographic measurements that identify the deformity (3). There are many surgical procedures to correct the symptomatic deformity, however, no single technique is universally acceptable or capable of correcting the entire foot (4). Typically, surgical options include a combination of either tendon transfer or lengthening, osteotomies, arthroeresis, and arthrodesis procedures (5). Isolated arthrodesis procedures have yielded poor outcomes in the past. Seymour reported 50% poor results of naviculocuneiform fusions after a 15 year follow-up (6). Similarly, Butte et al. reported 50% poor results in their series of 76 feet (7). In contrast, calcaneal osteotomies offer more predictable correction and thus better results as noted by Phillips et al. in their series reporting 90% good to excellent results with a follow-up of 13 years (4). Sangeorzan reported radiographic improvements in seven symptomatic flatfeet operated on using the Evans procedure (8).

The Evans procedure offers a powerful triplanar correction in lengthening the lateral column and correcting forefoot abduction and heel valgus. However, the procedure does not address problems of the medial column including forefoot varus/supinatus. Thus, medial column procedures are appropriately combined with the Evans osteotomy (10).

Patients and Methods

We retrospectively reviewed 21 pediatric patients between 11 and 17 years of age and an average follow-up of 10.8 months (6-18 months). All patients underwent double calcaneal osteotomies utilizing either internal or percutaneous Kirschner wire fixation depending on the growth plate. Tricortical cancellous graft was utilized for the Evans osteotomy and a percutaneous calcaneal slide osteotomy was employed. All patients had ancillary procedures of posterior muscle group lengthening via endoscopic or open Gastrocnemius muscle recession. In addition, the patients also underwent medial column procedures of either naviculocuneiform joint arthrodesis or cotton opening base wedge osteotomy.

All patients presented with primary flexible flatfoot deformity and 8 presented with juvenile hallux abductovalgus. None of the patients in this study presented with osseous tarsal coalition.

Preoperative lateral radiograph of a pediatric flatfoot. Note medial column instability and sagittal plane collapse

Postoperative radiograph of the same patient s/p DCO, Cotton osteotomy, and Endoscopic Gastroc recession.

Postoperative WB clinical photograph. Note plantar distribution on the surgically corrected right foot

Surgical technique of the calcaneal osteotomies

Percutaneous medial slide osteotomy:

Stab incisions were made at the medial, lateral, inferior, and superior aspects of the calcaneaus. They were specifically located posterior to the sural and peroneal nerves, as well as the medial neurovascular structures. The incisions were deepened in the same plane and subfascial dissection was performed down to the bone. All four locations were connected from inferomedial to superomedial, superomedial to superolateral, and finally from superolateral to inferolateral. A small Gigli saw was then inserted around the subfascially dissected area and the osteotomy was then performed. Fixation was secured using 0.062 K-wires or cannulated 7.3 mm screws depending on whether or not the growth plate was still open

Evans osteotomy:

An oblique incision was made at the anterior process of the calcaneaus. Peroneal tendons were then inferiorly reflected and an osteotomy was made 1.5 cm proximal to the calcaneal cuboid joint. A 1.2 cm tricortical cancellous bone graft was then inserted. Fixation was again secured with either 0.062 K-wires or cannulated 7.3 mm screws depending on whether or not the growth plate was still open.

Postoperative protocol

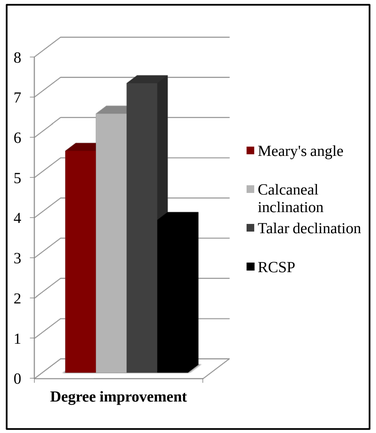
All patients were non-weight bearing for a period of 8-10 weeks in below the knee casts and then transitioned to CAM boots for another 4 weeks with physical therapy before transitioning into full weight bearing in regular shoe gear.

Patients with percutaneous K-wire fixation had the wires removed at the 8-10 week mark once radiographic evidence of osseous consolidation was established.

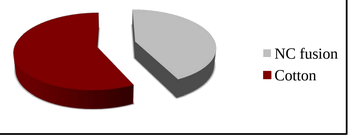
Results

Average BMI for the patients was 16.95. No reported cases of nonunion/delayed union were observed. Average postoperative follow-up was 10.8 months. Average time to transition into regular shoe gear with full function was 9.2 weeks. Average time to radiographic consolidation was 8.4 weeks. All patients had an average VAS score at their 3 and 6 months follow-up of less than 2. In addition, 12 patients underwent ancillary cotton osteotomy at the medial column while 9 patients underwent navicular-cuneiform arthrodesis.

Radiographic analysis



Ancillary medial column procedure



Discussion

Surgical management of the pediatric flatfoot is contingent on a number of factors including plane of deformity, biomechanical alterations, rigidity, and axis of deformity. Surgical procedures can be categorized as tendon transfer or lengthening, osteotomy, or arthrodesis. However, many authors suggest that a combination of procedures appears to be most efficient in correcting the flatfoot in all cardinal planes. (10).

Lateral column lengthening as described by Evans (11) in 1975 is a very powerful procedure that reduces forefoot abduction, midfoot pronation and hindfoot valgus. Retrospective analysis by Evans (11), Phillips (4), and Anderson et al. (12) reveal long-term success of the osteotomy. In addition, Anderson and Fowler have also demonstrated some success in reduction of the navicular-cuneiform sags.

Furthermore, the Koutsogiannis osteotomy has been shown to medialize the Achilles tendon insertion with respect to the STJ axis. Therefore, the position has a net supinatory effect on the subtalar joint during midstance. The osteotomy has also been shown to have radiographic improvement in the talo-first metatarsal angle and TN uncovering as noted by Catanzariti et al. (13) and Myerson et al (14).

The authors have found that the combination of double calcaneal osteotomy with the percutaneous Koutsogiannis and Evans lateral column lengthening help achieve a more predictable correction of the deformity. In addition, the primary author prefers to incorporate a medial column procedure of either Navicular-cuneiform arthrodesis or opening base wedge osteotomy of the medial column for added predictable stability. All patients also underwent heel cord lengthening via endoscopic or open Gastrocnemius recession.

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