Pediatric Pes Planovalgus Reconstruction: A Multi-Center Study of Radiographic and Functional Outcomes

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Purpose & Literature Review

The aim of this study was to investigate the radiographic and functional outcomes after surgical reconstruction of pediatric pes planovalgus deformity, and to assess the maintenance or loss of correction over time.

A recent systematic review of the literature pertaining to pediatric pes planovalgus noted a lack of consensus on the effectiveness of conservative or surgical treatment of this deformity.[1] The same study also noted the paucity of literature in regards to medium to long-term, multi-center studies.[1] Several studies have analyzed the outcomes after pediatric pes palnovalgus correction, but most focus on one procedure or have short term follow up.[1-6] In addition, the classic techniques described by Evans and Cotton have come under recent scrutiny due to perceived graft subsidence and loss of initial correction.[7] The proposed remedy includes supplementation of the classic techniques with use of costly metal and titanium implants.[7] These studies bring into question the long term effectiveness of the classic procedures for correction of pediatric pes planovalgus as they were originally described.[8,9]

Methodology & Procedures

A multi-center, retrospective review of patients with symptomatic, flexible pediatric pes planovalgus deformity who underwent surgical correction with an Evan's osteotomy, Cotton osteotomy, and gastrocnemius recession or tendo-achilles lengthening (TAL) was performed. IRB approval was obtained prior to commencement.

Patients under the age of 18 at the time of surgery with a flexible pes planovalgus deformity were included in this study. In addition, the last follow up radiographs must have been performed at least 6 months from the date of surgery. Patients over the age of 18, those with history of prior surgery, systemic or neurologic etiologies of the deformity, or rigid deformities were excluded.

Preoperative and postoperative weightbearing radiographs were analyzed independently by the two principal authors at the first weight bearing and latest follow up visits. The following radiographic angles and signs were measured as previously described; talo-calcaneal (Kite's), cuboid abduction (CAb), calcaneal inclination (CIA), talar declination (TDA), talar first metatarsal angle (Meary's) and talar head uncovering.[10]

Pain and functional outcomes were evaluated using the subjective portion of the AOFAS hindfoot/ankle outcomes measure as previously described.[11] The scores were obtained from the patients and legal guardian, in person or over the phone after obtaining consent for inclusion into this study. The paired t-test was utilized to assess for statistical significance (p-value < 0.05).

Surgery was considered in patients who failed exhaustive conservative treatment (orthoses, stretching, PT, etc.) with continued pain and restriction of daily activities. Surgical procedures included the Evans calcaneal osteotomy and Cotton medial cuneiform osteotomy performed with insertion of a bone allograft, and no supplemental fixation or metallic grafts. Various previously described methods were utilized to perform a gastrocnemius recession or TAL based upon surgeon preference. All patients were directed to be non-weight bearing in a splint and/or cast for at least 6-8 weeks for graft incorporation. Lastly, any complications or revision surgeries were noted.

Results

A total of 21 patients (27 feet) met the inclusion criteria for this study, 9 females and 12 males. The mean age at time of surgery was 14.9 years old (10-17 years old) and mean BMI was 23 (Range 14.7-42). The mean graft sizes used in performing the Evans calcaneal osteotomy and Cotton cuneiform osteotomy were 10 mm and 8 mm respectively. The mean time to first WB follow up was 1.5 months (range 1.25-1.75 months), and final follow up was 27.4 months (Range 6-136 months).

Radiographic results revealed statistically significant improvements in calcaneal inclination, talar declination, Meary's, cuboid abduction angles and talar head uncovering (p-value < 0.05) from pre-operative values to first post-operative follow up (Table 1). In addition, although there was a slight loss of correction in these angles from the first to the last post-operative follow up, the changes were not statistically significant. (Table 2, p-value > 0.05). The Kite's angle did not significantly change after surgery or at either follow up.

Subjective AOFAS hindfoot/ankle scores, which are taken out of a possible total score of 60, significantly improved from mean 22.4 (range 11-31) preoperatively to mean 55.4 (range 48-60) postoperatively (Table 3, p-value < 0.05). There were two complications out of the 27 procedures. One case of dorsal translocation of the anterior calcaneus after an Evans which healed and was not symptomatic, and one nonunion and subsequent loss of correction after an Evans which was symptomatic and required revision. The complication rate was, therefore, 7.4% and rate of revision surgery was 3.7%.

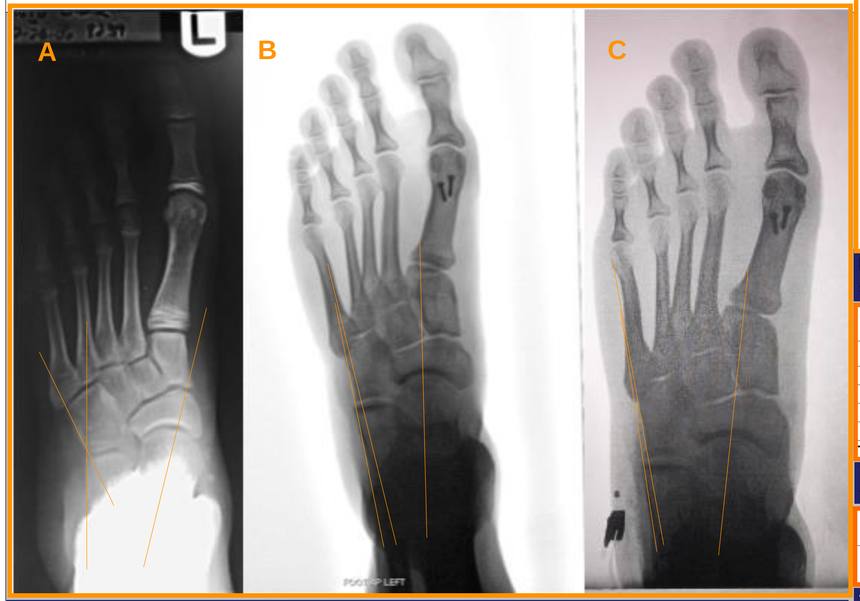

Figure 1: Weightbearing A-P Radiographs A) Pre-op B) 8 year Post-op C) 11 year Post-op.

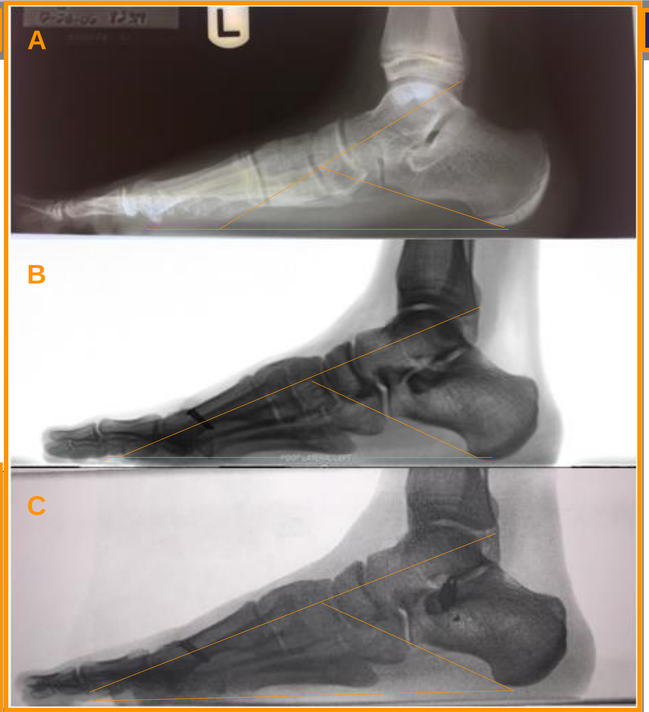

Figure 2: Weightbearing Lateral Radiographs A) Pre-op B) 8 year Post-op C) 11 year Post-op.

Angles	Pre-op	1st Post-op (mean 1.5mo)	p-value
CIA	11.9	21.81	0.0001
TDA	30.56	21.25	0.0001
Meary's	-16.38	5.88	0.0001
CAb	26.81	3.81	0.0001
Kite's	16.33	11.93	0.0874
Talar Un.	33.75	6.88	0.0001

Table 1: Mean Radiographic Angles: Pre-op vs. 1st Post-op (mean 1.5 mo).

Angles	1st Post-op (mean 1.5mo)	Last Post-op (mean 27.4mo)	p-value
CIA	21.81	19.81	0.2189
TDA	21.25	19.63	0.2676
Meary's	5.88	2.81	0.0582
CAb	3.81	5.69	0.1587
Kite's	11.93	11.67	0.8713
Talar Un.	6.88	8.75	0.4963

Table 2: Mean Radiographic Angles: 1st Post-op (1.5 mo) vs. Final Post-op (27.4 mo).

	Pre-op	Last Post-op (mean 27.4mo)	p-value
AOFAS (60 total points)	22.4	55.4	0.0001

Table 3: AOFAS Hindfoot/Ankle Subjective Scores: Pre-op vs. Last Post-op (mean 27.4 mo).

Discussion

The present multi-center, retrospective study demonstrated that the Evans and Cotton osteotomies when used in concert with a gastrocnemius recession or TAL provided significant radiographic correction and functional improvement in patients with flexible pediatric pes planovalgus deformities.

Although there was a slight loss of radiographic correction from initial weight bearing to final follow up at a mean 27.4 months, the changes were not statistically significant. This reveals that these procedures not only provided significant initial correction, but stood the test of time. This is highlighted in Figures 1 and 2, showing a patient followed for 11 years (136 months) from the time of surgery.

Perhaps most importantly, functional outcomes and pain at last follow up also improved significantly compared to pre-operative levels, with only one patient experiencing limitations in activities post-operatively. This patient was one of the two that experienced a complication, and the overall complication rate was 7.4%. The same patient required a revision Evans procedure to correct non-union, graft subsidence and loss of correction. Of note, the patient did not follow NWB protocol post-operatively, and was WB in a regular shoe AMA at 2 weeks after the surgery. Nevertheless, the low non-union rate of this study is similar to the rate of 1.4% reported by a recent systematic review focusing on the Evans osteotomy without supplemental fixation.[12]

Limitations of the current study include the retrospective nature and wide variation of follow-up period (range 6-136 months). As previously noted, further long term prospective, randomized controlled studies are still needed to elucidate the long term outcomes of surgical reconstruction of pediatric pes planovalgus deformities.[1] Despite recent varying results in the literature, this study shows that the standard techniques for pediatric pes planovalgus correction still have their merits, and provide reliable correction without the need for supplementation with metal and titanium implants.

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