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Case series

Calcaneal lengthening osteotomy in the management of idiopathic flatfoot in children: cCase series of twenty-one feet

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ABSTRACT

Introduction: Flatfoot is a frequent reason for consultation in pediatric orthopedics. The calcaneal lengthening osteotomy according to the EVANS technique is a therapeutic alternative. The objective of this work was to evaluate the short and medium term clinical and radiological results of calcaneal lengthening osteotomy in children with idiopathic flat foot valgus.

Methods: This study concerned 12 children and 15 ft treated surgically by calcaneal lengthening osteotomy by an orthopedic surgeon in a pediatric orthopedic surgery center. The evaluation of the results was clinical according AOFAS score and radiological.

Results: The deformity was reducible in all of our patients. The mean preoperative AOFAS score was 61, postoperatively 90. The overall result was excellent in 11 cases (11 ft) and good in 4 cases. The postoperative radiological result was close to normal values.

Conclusion: Calcaneal lengthening osteotomy is a reliable and recommended technique for the correction of symptomatic idiopathic flatfoot.

Level of evidence: IV, Case series.

1. Introduction

Flatfoot is frequent in pediatric orthopedics. It is characterized by the reduction, effacement or even inversion of the internal longitudinal arch of the foot when standing. In the idiopathic form, the deformity appears on the loaded foot and disappears completely on the unloaded foot. It is a complex three-dimensional deformity involving several joints. The calcaneal lengthening osteotomy (CLO) according to the EVANS technique revisited by Mosca is a therapeutic alternative to treat idiopathic flat foot valgus (IFFV) in older children and adolescents.

The objective of this work was to evaluate clinical and radiological results of CLO in children with IFFV, at short and medium follow-up.

The work has been reported in line with the PROCESS 2020 [1] Agha RA, Sohrabi C, Mathew G, Franchi T, Kerwan A, O'Neill N pour le groupe PROCESS. The PROCESS 2020 Guideline: Updating Consensus Preferred Reporting Of CasE Series in Surgery (PROCESS) Guidelines, International Journal of Surgery 2020;84:231–235.

2. Methods

Our study does not pose any ethical problem and does not comply with the criteria in accordance with the declaration of Helsinki. This is a retrospective non-consecutive case series, descriptive single-center study, which concerned 15 flat feet operated on in 12 children who had a CLO (Fig. 1) during a period of 3 years (January 2016–December 18) in a university pediatric orthopedic center, with a minimum follow-up of a year. The inclusion criteria were idiopathic flatfoot and children who had elongated calcaneus according to Evans. The exclusion criteria were secondary flat feet and children treated with another surgical method. A data collection sheet was developed to collect all the elements necessary to meet the objectives of our study. The clinical data were the morphology of the foot, the quality of the support, the mobility of the ankle. The load distribution is evaluated by the podoscope and classified into three degrees. We used the American Orthopedic Foot and Ankle Score (AOFAS) [2] for the outcome assessment. Different angles were measured on the radiograph of the frontal and lateral foot, both under load and Meary's circled incidence. Thus, we calculated the talo-

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calcaneal divergence, the talonavicular coverage angle, the Méary angle, the pitch angle, the calcaneus-5th metatarsal angle and the valgus of the hindfoot. All the children had the same surgical technique: CLO using the Evans technique. A cortical bone graft taken from the fibular diaphysis was used to fill the site of the osteotomy (Fig. 2). All the children were operated on by a senior surgeon, using the same surgical technique. The use of a pneumatic tourniquet was systematic to minimize bleeding.

3. Results

The average age of the children at the time of surgery was 12 years with extremes ranging from 10 to 16 years. Our series was divided into 7 boys and 5 girls with a sex ratio of 1.4. The left side in 5 cases was involved, the right side in 4 cases and bilateral in 3 cases. For bilateral cases, only one foot was operated on at a time with an interval of one year. In all cases, there was a valgus of the hind foot, abduction of the forefoot and disappearance of the medial arch of the foot. Dorsiflexion of the ankle averaged 18° with extremes ranging from 15° to 22°. The mean plantar flexion was 32° with extremes ranging from 25 to 40°. Deformity was reducible in all of our patients. Preoperatively, the mean AOFAS score was 61 with extremes ranging from 49 to 65. Radiologically, the mean talo-calcaneal divergence was 33° with extremes of 29 to 42°. The calcaneus-5th metatarsal angle averaged 30°. The mean talonavicular coverage angle was 39° with extremes ranging from 15 to 53°. The Pitch was on average 2° with extremes ranging from 0 to 13°. Meary's angle averaged 21° with extremes ranging from 9 to 32°. The calcaneus-M5 angle averaged 178° with extremes ranging from 150 to 180°. For the flatfoot type, ten feet were type 2 and five were type 3. After surgery, the mean follow-up was 18 months with extremes ranging from 12 to 36 months. We noted a total disappearance of pain in 11 cases and occasional pain in 3 cases. An improvement in the quality of the footwear and returned to sport activity was noted in all patients. We observed a reappearance of the medial arch. We noted an improvement in the quality of the downforce confirmed by the planar footprint with better load distribution. The postoperative AOFAS score was on average 90 with extremes between 79 and 95. Healing of the bone osteotomy is obtained at two months. On post-operative radiographs, we noted a decrease in talo-calcaneal divergence with an average angle of 22° (Fig. 3), the talus-M5 angle decreased with an average angle of 2°, the talonavicular coverage is improved with an average angle of 5° (Fig. 4), the pitch increased with an average angle of 16° postoperatively, the average Méary angle was 8° and an increase in the Calcaneus-M5 angle with an average angle of 161°. We noted 2 cases of superficial sepsis at the operative site next to the calcaneal osteotomy and 3 cases of inflammatory skin granuloma around the spindle which progressed well in ten days under local care. For the overall result at the last follow-up, eleven feet have evolved well with a very good result: plantigrade feet, normo-centered in load, without pain, nor difficulty in walking, no limitation of physical activities, AOFAS score between 90 and 93 with quasi normalization of the radiological angles. Four feet with a good result: plantigrade foot, slight valgus of the hindfoot, occasional pain, with normal walking without assistance, no limitation of physical activities, AOFAS score between 79 and 85 and almost normalization of radiological angles.

4. Discussion

The prevalence of idiopathic flatfoot varies by age, sex, weight and ethnicity [3]. In our series as well as for several authors, the mean age at the time of surgery was 10.4 to 13 years with extremes ranging from 10 to 16 years. Indeed, by the age of 10, 4 % of children have flat feet, and only 10 % of these children require surgical treatment. Nonsurgical correction of IFFV in children before the age of 10 is possible. The patient should also be of sufficient bone maturity for osteotomy and graft interposition. Hence the majority of authors do not recommend surgery before the age of 10 years. Surgical indications are rare and only affect 4 to 5 % of flat feet. Most of these surgically sanctioned feet are clinically

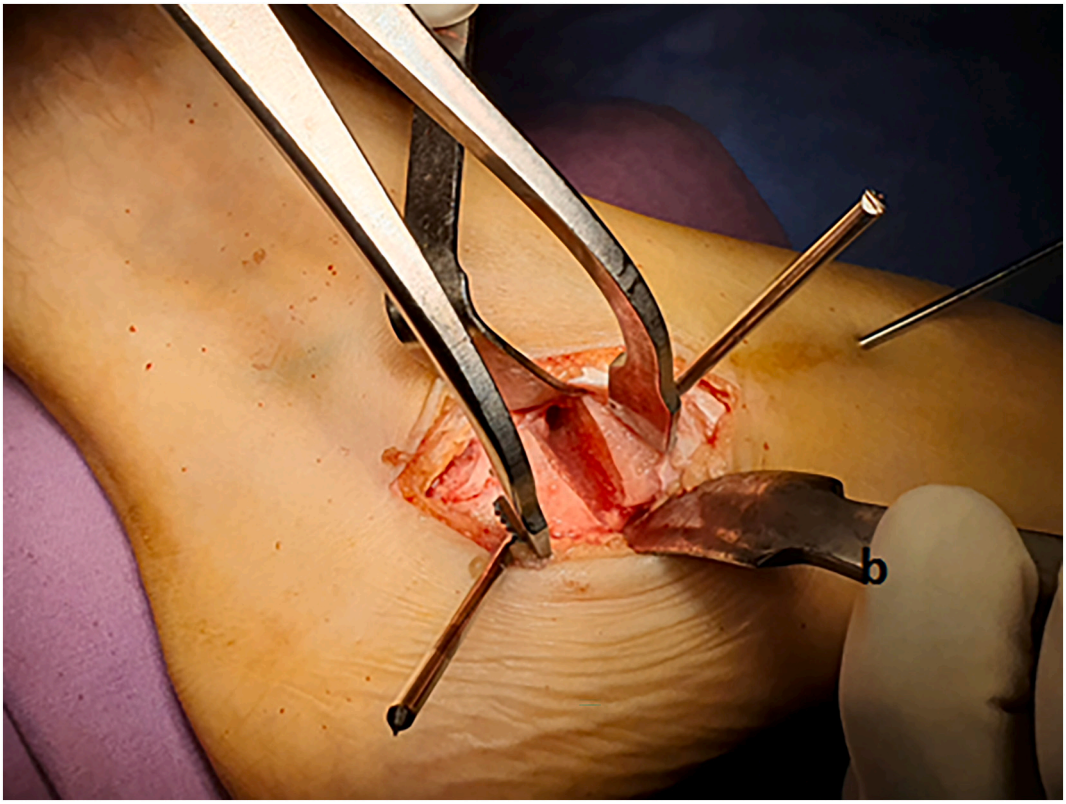

Fig. 1. Calcaneal lengthening osteotomy and distraction testing.

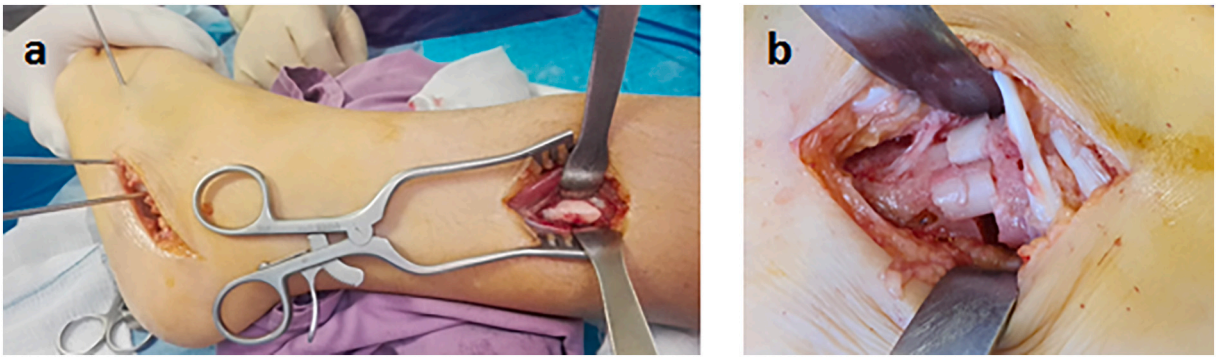

Fig. 2. Calcaneal lengthening osteotomy: a- removal of the fibular graft b- interposition of the bone graft.

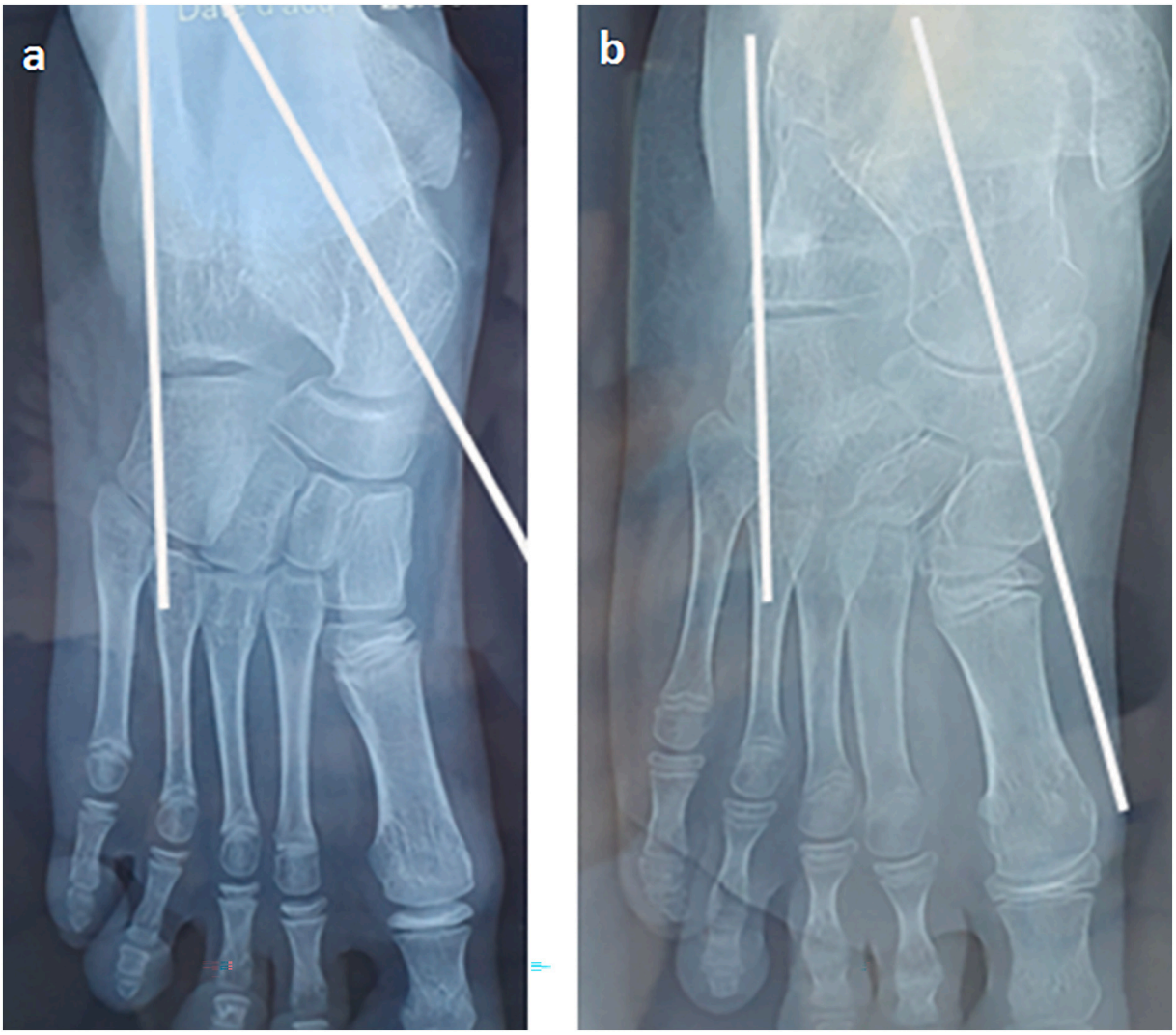

Fig. 3. Talo-calcaneal divergence: a- pre-operative b- post-operative.

symptomatic, presenting as large, flat, early onset feet, with extensive internal collapse. Radiographs can help, by demonstrating the extent of talocalcaneal divergence, incongruence of the talus head and horizontalization of the calcaneus [4]. The radiological assessment performed in charge load is the gold standard in the diagnosis of flat foot valgus [5,6]. On the x-ray of the front ankle standing with heel strapping, we assess the valgus of the hindfoot in load and the orientation of the tibial-talar space because sometimes the valgus is not sub-talar but tibial epiphyseal with ascension of the fibular malleolus. In De Luna's series [7] as well as ours, the angles measured were within the range of normal values after surgery. In the different series studied, the satisfaction and the quality of the postoperative result were judged according to the AOFAS score. In De Luna's series [7], the AOFAS score went from 69.03 (59–79) preoperative to 95.26 (88–100) postoperatively. Our results were similar to those in the literature with a postoperative AOFOS score between 79 and 93. CLO is a reliable and recommended technique for the correction of

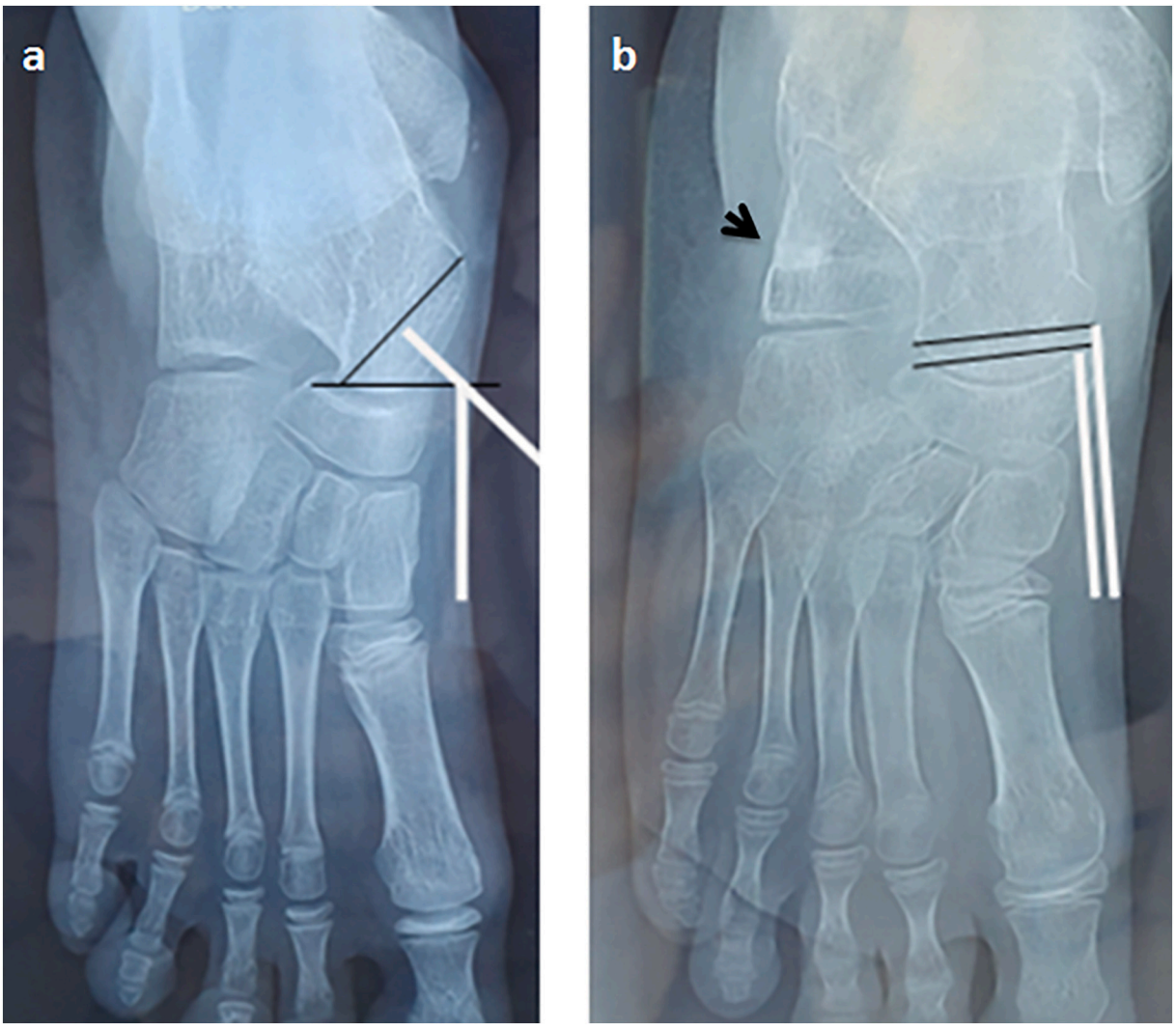

Fig. 4. Talonavicular coverage: a- pre-operative b- post-operative. Black arrow: consolidation of the osteotomy site.

symptomatic idiopathic flatfoot [8]. In Kim's series, 3-dimensional deformities of the flexible flatfoot were corrected by CLO, based on the morphological assessment using radiologic imaging. The correction was well maintained during gait at 1 year after the operation [9]. Some authors recommend osteotomy in combination with soft tissue procedures for better radiographic and functional results [10]. Evans and Hell concluded that the indication for surgery is rare in children with idiopathic flat feet [11]. Surgery is indicated if the patient is symptomatic and after having tried orthopedic means [12]. The CLO corrects the length disharmony between the lateral and medial columns by lengthening the lateral column, which allows all components of the deformity to disappear.

This intervention alters the articular relationships within the subtalar articular complex. The main preoperative indication for the EVANS technique is the reducibility of the deformity: flexible flat foot.

Strengths of our study were the homogeneity of the population studied and the use of the same operating technique. It only concerned surgery for idiopathic flat feet. Limitations were the size of the population studied and the long-term hindsight to have the future of operated feet in adulthood.

5. Conclusion

Surgical treatment is reserved for symptomatic flat feet, with major painful deformities that have not responded to symptomatic measures. Calcaneal lengthening osteotomy is a reliable and recommended technique for the correction of symptomatic idiopathic flatfoot.

Data availability

All data is available to readers.

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Color should be used for all figures in print.

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Consent

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Research registration (for case reports detailing a new surgical technique or new equipment/technology)

N/a.

Guarantor

Mohamed Zairi

CRediT authorship contribution statement

Authors	Contribution
Mohamed Zairi	Writing drafting the article
Rim Boussetta	revising it critically for important intellectual content
Ahmed Msakni	conception and design, revising it critically for important intellectual content
Ahmed Amin Mohseni	revising it critically
Mohamed Nabil Nessib	final approval of the version to be published
Ameur Othmen	Conception and Design
Kacem Mensia	Revising it critically for important intellectual content
Walid Saied	Revising it critically for important intellectual content
Sami Bouchoucha	Supervision

Declaration of competing interest

None.

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