

Original Article

External column lengthening with peek cage and modified single approach

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Abstract

Objective: To show the results obtained with the treatment of stage 2B flatfoot according to Myerson classification (reducible and flexible), through external column lengthening with interposition of a peek cage filled with spongy graft taken from the same calcaneus, without osteosynthesis, combined with medial slide calcaneal osteotomy with step plate, both using the a single approach. Medial time was associated with latero-lateral transfer of common flexor tendon of toes to posterior tibial.

Methods: Sixteen patients were assessed from 2015 to 2018, of which 11 were women and 5 were men. In all cases, surgery was performed with a first lateral time for osteotomies and a second time for tendon repair. Mean patients' follow-up was 28 months.

Results: All patients achieved consolidation of both osteotomies at nearly 12 postoperative weeks. No patient presented signs of peek cage migration due to lack of stability or dorsal cutaneous nerve branch injuries resulting from this modified single approach. Two patients evolved with wound dehiscence and only one with calcaneocuboid pain so far. No patient required reoperation.

Conclusion: The modified single tuberosity approach for the two osteotomies has shown to be a simple procedure that prevents damages to dorsal cutaneous nerve branches described with dorsal approach.

Level of Evidence IV; Therapeutic Studies; Case Series.

Keywords: Flatfoot/surgery; Foot deformities, acquired; Osteotomy; Calcaneus/surgery; Bone Screws; Treatment outcome.

Introduction

Posterior tibial tendon is the primary dynamic stabilizer of the medial longitudinal plantar arch. Its function is to promote adduction and inversion of the hindfoot and plantar flexion of the tibiotalar joint. During gait, this tendon allow for the blockade of the internal column, thus providing a rigid lever for the transition from the intermediate phase of gait up to its propulsive phase⁽¹⁾. In adult-acquired flatfoot, posterior tibial tendon dysfunction leads to collapse of internal longitudinal arch. It has a multifactorial etiology related to age, obesity, diabetes mellitus, hypertension, rheumatoid arthritis, and other congenital seronegative and autoimmune inflammatory rheumatic diseases, as well as to steroid therapies.

In stage II B of Myerson classification, patients present with functional deficit of the posterior tibial tendon, product of

its elongation and/or rupture. The deformities we find in this group of patients are hindfoot valgus, Achilles tendon shortening, and forefoot abduction (Figure 1). All these deformities are reducible and flexible⁽²⁾.

The implication of the external column in such deformities is well known, and many patients present with dysplasia in this column⁽³⁾. Its lengthening is part of treatment and allows to correct scaphoid uncoverage with respect to the talus and improve the clinical aspect of fore and middle foot. The procedure consists of an additive osteotomy in the lateral surface of the anterior calcaneal tuberosity. It is important to previously evaluate uncoverage and plan the adequate enlargement so as to prevent over or undercorrection⁽⁴⁾.

The aim of this study is to present a surgical technique of external column enlargement for reducible flatfoot and its results.

Study performed at the Sanatorio de la Trinidad de Ramos Mejía, Ramos Mejía, Buenos Aires, Argentina.

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Methods

This study was approved by the Institutional Review Board and this project was conducted under the ethical rules that regulate investigation in humans, according to the national law of personal data protection No. 25326 (Habeas Data Law) and to the latest version of the Declaration of Helsinki.

The study was conducted by our team of specialists in the disease using specific selection criteria, predefined algorithms, and identical guidelines.

We operated 16 patients with flatfoot from 2015 to 2018, of which 11 were women (68.75%) and 5 were men (31.25%). All operated patients belonged to the subgroup 2B of Myerson classification⁽²⁾. Patients aged from 18 to 75 years were included, and all had symptoms of pain and altered gait related to the study disease. The study excluded all patients not belonging to this subgroup, as well as those who had another associated disease in the affected leg or foot. Patients with systemic diseases (rheumatoid arthritis, gout, etc.) and with several peripheral vascular disease were also excluded. Mean patients' follow-up was 28 months (22-33).

All surgeries were performed under spinal anesthesia and using a hemostatic cuff on the thigh. At a first moment, patients were placed in the lateral position for the lateral time and then, for medial time, they were let fall laterally until reaching the supine position.

Lateral time or osseous time: we performed a single approach starting with a proximal incision from behind the periteneal tendons through the tuberosity up to its lower point, a se-



Figure 1. Clinical and radiographic aspect of a flexible valgus flatfoot.

micurved dorsal incision was made distally, and then a 2-cm lengthening, on average, was achieved toward the central portion of the calcaneocuboid joint.

In all cases, the calcaneus was displaced 1-cm medially by calcaneal osteotomy and fixed using a step plate with 4 screws (Figure 2).

Subsequently, osteotomy for external column lengthening were performed by interposing a 0.5cm peek cage filled with graft from the same calcaneus (taken from residual tissue of medial slide calcaneal osteotomy) with no fixation by osteosynthesis and no need for iliac crest graft (Figure 3). Six patients



Figure 2. Radiographic view of the plate and of the achieved displacement.

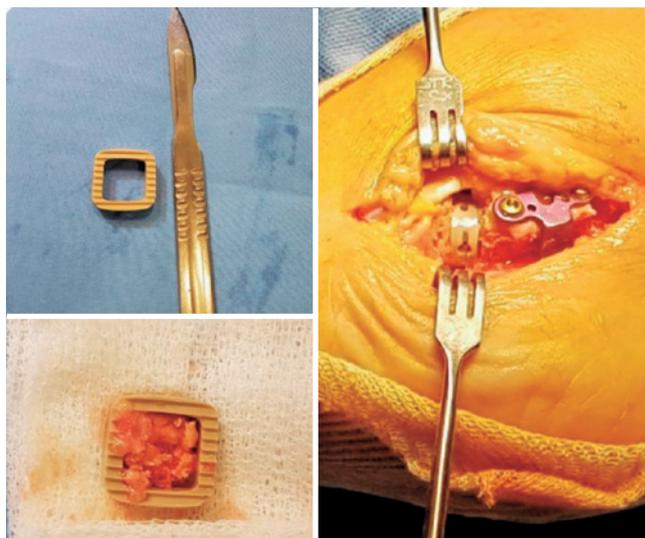


Figure 3. Peek cage filled with graft from the same calcaneus.

(37.5%) underwent Evans osteotomy, which is performed 1.5cm from the calcaneocuboid joint, and 10 patients underwent Hintermann osteotomy (62.5%), which is performed more proximally, at the heel level (Figure 4).

When performing the enlargement, we considered realign the facet joint to the medioplantar to correct flatfoot deformity⁽⁵⁾.

Medial time or tendinous time: in all cases, we performed a medial approach for exploration of the posterior tibial tendon and sinovectomy, always combined with latero-lateral transfer of the common flexor tendons of the toes.

RESULTS

All patients achieved complete consolidation of both calcaneal osteotomies after 12 weeks⁽⁶⁾ (Figure 5). There were no cases of peek cage migration due to lack of stability.

Two patients (12.5%) evolved with wound dehiscence, one was prescribed with antibiotics and a greater number of post-operative controls, and another patient required major follow-up, but no patient required surgical revision.

Only one patient (6.25%) persisted with pain on the lateral foot surface, resulting from irritation of the calcaneocuboid joint⁽⁷⁾. Up to date, she did not undergo reintervention.

No patient presented either with irritation or injury on peroneal tendons or with symptoms of dorsal cutaneous nerve branch injuries related to the surgical approach.

A VAS (visual analogue scale) was used, with a mean score of 9.125 (4-10). The patient who reported a VAS of 4 was the one with persistent calcaneocuboid pain, being actually the only patient who reported pain on the lateral foot surface in the long-term post-operative period.

Fifteen patients (93.75%) improved their activity and their quality of life soon after surgery. This included performing their daily and sports activities with no pain and no difficulties.

Only one patient (6.25%) was not able to take their feet off the ground after being operated; however, he reported a VAS of 10.

Finally, all patients reported achieving normal gait after surgery.

Discussion

There are many surgical treatments for adult-acquired flexible flatfoot that achieved good results, such as medializing calcaneal osteotomy, external column lengthening, double and triple arthrodesis⁽⁸⁾. There are also soft tissue techniques, such as posterior tibial plastic surgery and tightening, transfer of common flexor of the toes to the residual posterior tibial, or spring ligament suture. The latter procedures are hardly used alone, and it is currently discussed whether they should be associated with osseous time.

Many techniques of external column lengthening have been described in the treatment of flatfoot, either using the iliac crest bone, peek cage, or titanium Wedges⁽⁹⁾; and was also fixed with different implants, such as pins, screws, or screwed

plates⁽¹⁰⁾. Any implant in the lengthening region usually causes direct irritation on peroneal tendons, and a high percentage of patients undergo reoperation for the removal of surgical material, due intolerance or tendinous injury⁽¹¹⁾.



Figure 4. Hintermann osteotomy and calcaneal slide osteotomy consolidated in the correct position.

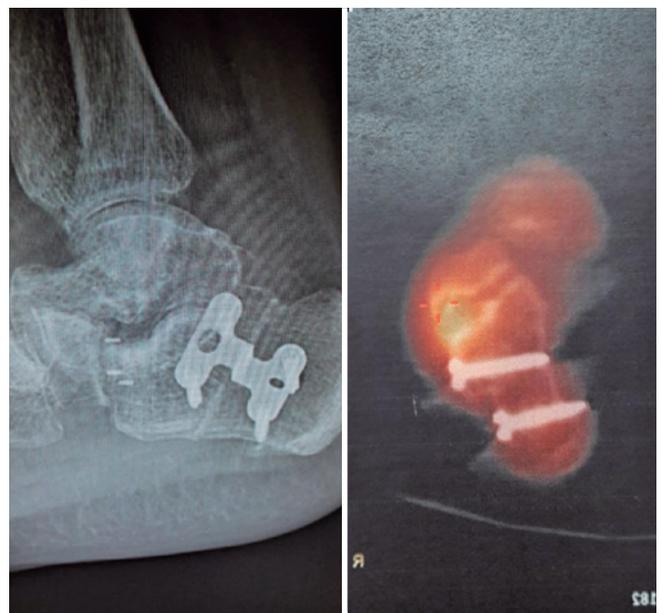


Figure 5. Left: image showing tuberosity after Evans osteotomy. Right: SPECT CT scan with hypercaptation at the calcaneocuboid joint.

Calcaneocuboid pain is frequent in patients who underwent external column lengthening. There is a discussion on where this procedure should be performed. In this study, Hintermann and Evans osteotomies were used. The first is performed on the heel, whereas the latter is performed 1.5cm from the calcaneocuboid joint. Studies comparing these two methods did not observe significant differences with regard to complications, although Hintermann osteotomy seemed to cause few degenerative injuries on the calcaneocuboid joint. The reported percentage of calcaneocuboid pain after Evans osteotomy is nearly 12%, and 36% of patients present with radiological degenerative changes on this joint⁽¹²⁾. Although study duration was not very long, only one patient (6.25%), who underwent Evans osteotomy, reported pain on this site during the study period, but the patient did not require surgical revision (Figure 5).

We proposed to interpose a peek cage in external column lengthening, which remains fixed and stable due to the toothed structure of its wall and to the pressure exerted on the edges of the lengthening osteotomy. This material achieves a high consolidation rate, as shown in a preliminary series published in 2012 by the Instituto Dupuytren⁽¹³⁾. It is not necessary to perform osteosynthesis when the external column is lengthened for the treatment of flexible flatfoot (Figure 6).

This type of discussion was not found in the literature, which only presents many studies with different fixation methods after external column lengthening was performed.

One of the limitation of the present study is its retrospective design and the fact that patients' follow-up was too short for achieving the expected results in treatment of any posterior tibial dysfunction. However, we believe that the time of presentation is appropriate for the technique presented here.



Figure 6. Postoperative image of peroneal tendons.

Conclusion

External column lengthening in flatfoot is a very important procedure that contributes for the improvement of clinical and radiographic results for this stage of the illness. We believe that use of only one lateral approach for both osteotomies, together with the use of a peek cage with a calcaneal graft, without osteosynthesis, has presented a high consolidation rate without leading to the complications described for this method with regard to osteosynthesis material resulting from peroneal tendon irritation and with no need for iliac crest graft.

Authors' contributions: Each author contributed individually and significantly to the development of this article: DY *(<https://orcid.org/0000-0002-9542-6914>) Conceived and planned the activity that led to the study, wrote the article, participated in the review process; IM *(<https://orcid.org/0000-0002-9452-0175>) data collection, bibliographic review; FA *(<https://orcid.org/0000-0001-6577-8911>) formatting of the article, bibliographic review; SS *(<https://orcid.org/0000-0003-0432-8102>) interpreted the results of the study, participated in the review process; JD *(<https://orcid.org/0000-0002-5733-6766>) performed the surgeries; data collection, statistical analysis. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID) 

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