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Minimally invasive flat foot Alingment short term results

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Abstract
Introduction: Medializing calcaneal osteotomy is one of the most common procedures in flat foot alignment. Recently it has been done percutaneously with several different techniques, most of them made in lateral position. Our paper aims to describe the minimally invasive calcaneal medializing osteotomy in ventral position and our initial results.
Methods: Between July 2019 and February 2020, 10 patients were operated using this technique. Patients in ventral position, sciatic nerve block, percutaneous Achilles lengthening, transcutaneous k-wire passage for drill cut control. Straight calcaneal cut, reduction in medial and plantar position and control both in lateral and axil views.
Results: Median age was 38, 92, median follow up time was 6, 95 months. Post operatory AOFAS score was 68, 09. 67% of patients felt better after surgery.
Discussion: This is a descriptive paper with technical tips for percutaneous flat foot correction in ventral position. Using these methods, the surgery becomes faster as patient position is the same for nerve block and for surgery, easier for distal calcaneal fragment in plantar and medial fashion, safer for drill use with the k-wire protection and easier for trans-operatively x-ray control. Immediate weight bearing didn't influence in bone healing, which occurred in 6 weeks.

Keywords: Flat foot, minimally invasive, hindfoot, medializing calcaneal, percutaneous

Introduction

Flat foot is a common condition of spectral presentation [1]. The indications for correction are evolving as many studies are showing the biomechanical implications and the association between bilateral flat foot and anterior knee pain, lumbar pain and hindfoot arthrosis [1, 2, 3]. It is important once, in a context were general population life expectations are growing and long longevity is needed for the muscle-skeletal system, flat foot correction may prevent latter knee or hindfoot arthrosis.

Calcaneal osteotomy is a well-established surgery for flexible flat foot [1, 4, 5]. Many methods are possible and one of the most used is the calcaneal medial translation popularized by Kouktsogiannis [1], commonly associated with tendon transfer and spring ligament reconstruction. [1, 6, 7, 8]

Calcaneal medialization was usually made to favor the tendon transferred once the initial understanding was that the progressive flat foot in adults was secondarily to a tibialis posterior insufficiency. As tibialis posterior was the initial cause of the disease, it's substitution by a healthy despite weaker tendon was necessary [1, 5, 6, 7, 8, 9, 10, 11, 12, 13].

Some recent evidence has shown that in many cases, the disease starts as a ligamental insufficiency and the healthy tibialis posterior reacts trying to compensate and in a later pathology moment degenerate [1, 7, 10, 14, 15].

This new understanding led to surgeries to address ligament reconstruction preserving tibialis posterior [1, 7, 8, 10, 16] or isolated calcaneal osteotomies to give a better leaver arm for the tendon function [17, 18, 19].

One common complication of open techniques is wound healing delay (5), as the incision is made on the lateral side of the foot and correction tractions lateral side skin. The more correction is made, more soft tissue suffering is expected, which is a limitation for the amount of correction. Minimally invasive calcaneal osteotomy is one possible technique for flat foot correction with many possible advantages: lesser lesion on lateral side skin, earlier weight bearing and earlier consolidation [17, 18, 19, 20].

Most descriptions about this technique are made with the patient in lateral position with a lateral approach in a similar fashion as open techniques [17, 18, 19]. This paper describes the minimally invasive technique made by one lateral or medial approach in a ventral position and our initial results.

Methods

Between July 2019 and February 2020, 10 patients were operated using this technique. Surgery is performed in ventral position under a sciatic nerve block. Consent was obtained and protocol was approved by local and national ethical committees. All patients have a percutaneous Achilles lengthening. One k-wire is inserted transcutaneously at the desired site for the osteotomy (figure 1B). Lateral incision of about 5 mm large is made at the center of calcaneus.

A percutaneous periosteal elevator is inserted and only the line for the burr passage is dissected to allow minimal soft tissue

disruption. The 2,5/20 mm Shannon burr is used. One dorsal to plantar direct and straight cut is made with the fluoroscopic visualization and the use of the k-wire as a guide for the cut. At this point an instrument can be inserted at the portal to leverage the fragment to in a plantar and medial direction or a Steinman 3.0 wire is passed near the Achilles insertion were a stronger bone is expected. (Figure 3).

Lateral and axial views are easily performed in this position to check the ideal position for calcaneus and screws (figure 1A).

Full weight bearing is permitted as pain is tolerated immediately. In 6 weeks strengthening exercises are initiated.

Results

Median age was 38, 92, median follow up time was 6, 95 months. Post operatory AOFAS* score was 68, 09. 67% of patients felt better after surgery. All patients were able to fully bear weight immediately or after 10 days. More swelling and pain was seen in the younger patients.

No cases of non-consolidation were observed, and consolidation occurred in all patients by 6 weeks, as pain reduced, and initial signs of calcification could be detected in x-ray. (Figure 2A).

No cases of infection, skin problems or vascular damage were detected. All patients reported some transitory paresthesia on the sural nerve territory.

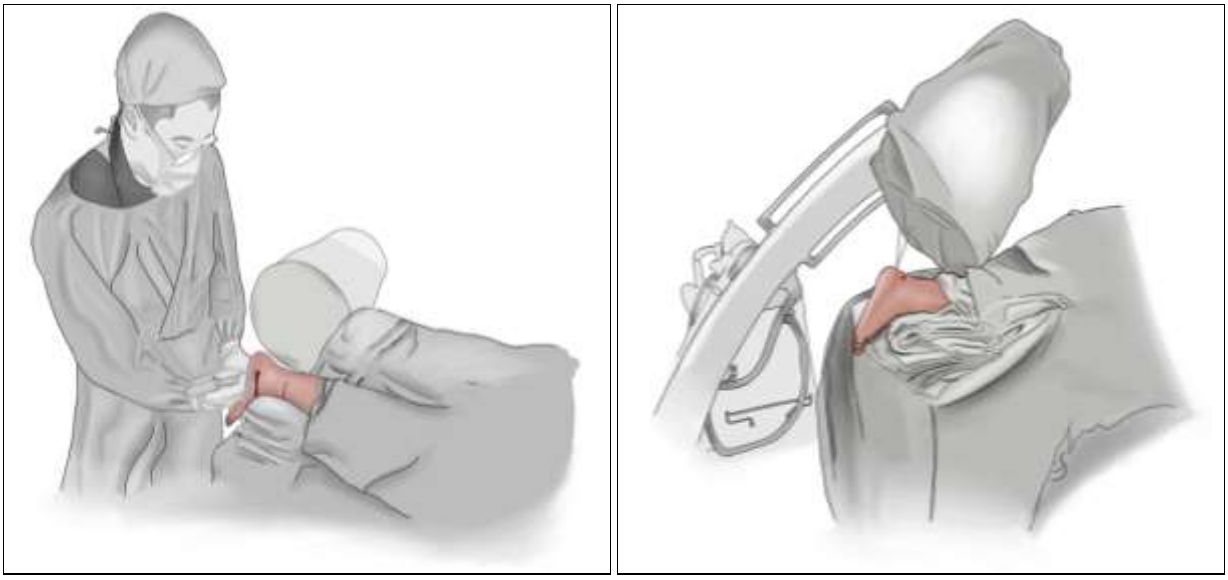

Fig 1A: Patient positioning, great view of the lateral and axial view of the calcaneus, also cuboid and first metatarsal can be assessed.

Fig 1B: K-wire positioning to guide the cut

Fig 2A: Improvement in talar first metatarsal angle, talar plantar flexion with isolated percutaneous medializing osteotomy

Fig 2B: Talar head covering and talar plantar flexion pre and post operatively with isolated calcaneus minimally invasive medializing osteotomy

Fig 3: Inserted at the portal to leverage the fragment to in a plantar and medial direction or a Steinman 3.0 wire is passed near the Achilles insertion were a stronger bone is expected.

Discussion

Painful flat foot is one of the most common orthopedics lesions in the elderly population, possibly because of progressive ligament insufficiency [10, 22]. Once a valgus deformity is formed, non-conservative treatment has proved to correct definitively [10, 22]. Bilateral flat foot has been associated with anterior knee pain, lumbar spine pain, besides hindfoot and ankle arthritis [23, 24].

Once the valgus alignment is present the deformity tends to evolve [3, 8, 22, 24, 25]. And as population goes older because of the longer life expectation, severe cases of flat foot alignment tend to grow. Hindfoot arthritis are the next stage for these patients. Performing the calcaneal medializing correction can avoid this evolution [2, 19, 24]. So, the best time to perform the procedure is after deformity but before arthritis, which means that the patient should be addressed in a moment of the lifetime when short recovery procedures are fundamental for early return to work, our understanding is that minimally invasive corrections will play a fundamental role in this new reality.

When doing the traditional technique for flat foot correction (Jonhson's type 2), after the medializing osteotomy and flexor digitalis longus to navicular or tibialis posterior transfer, our

group felt that in most cases a health tibialis posterior was found only with some degree of fat degeneration and synovitis (8,10). That impression went in the same direction of the recent literature, were the tibialis posterior insufficiency comes later after longer time of hindfoot progressive valgus alignment [22, 26]. Thus, bone correction when a not completely degenerated tibialis posterior is seen in MRI* is a possible and less aggressive choice [22].

Longer or more aggressive surgeries with longer rehabilitation protocols make many patients ineligibles. Minimally invasive surgery with only two punctual incisions, regional block and the possibility of immediate weight bearing make the procedure more acceptable for a large number of patients that can be operated in an early disease stage.

This paper is addressed to show the ventral position used in our group, which in our opinion makes the procedure easier. The nerve block is made already in the ventral position not needing to change patient position. Lateral and axial view of the calcaneus are made by only rotating the C-arm.

These are preliminary results made based on only 10 patients and only 6 months of median follow up. In our opinion that's the reason we had a relatively low AOFAS rate [27, 28]. Despite that, we felt that immediate weight bearing didn't influence the bone healing, which occurred in 6 weeks. The authors encourage isolated minimally invasive calcaneus osteotomy in early stages of painful flat foot. In our practice we are doing additional procedures like tibialis posterior re-tension our lateral column lengthening in patients with an important abduction component.

We consider important the Achilles tendon tenotomy before the osteotomy. It makes the reduction easier; some similar articles show cases were the fragment makes a proximal migration [17]. We consider the plantar positioning of the fragment to be essential for good correction (figure 2B). Thus, we observed less pain in patients submitted to the lengthening.

In this surgery, the greater risk is to injure the calcaneus branch of the tibial nerve, once it's the most posterior structure at medial side and it's important for plantar sensibility. Laterally several branches of the sural nerve are posterior, but they are responsible for a small not weight bearing area [29]. The k-wire passed transcutaneously helps prevent migrating to proximal as the surgeon make the cut [18].

We had a clear impression that older patients are easier to operate, as the bone cut is softer, and they reported less pain in post operatory rehabilitation. So, this technique became our choice for patients over 50 years old.

Conclusion

We described a new technique approach for minimally invasive flat foot correction in ventral position which seems easier, faster and more reliable for fluoroscopic control. Immediate weight bearing and the possibility to do the entire procedure with regional block amplify the range of patients electable for surgery.

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