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" Evaluation of pain after lateral calcaneal lengthening for symptomatic flexible flat foot "

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Abstract

Background: Whether asymptomatic or symptomatic, flexible flatfoot (FFF) is defined by a flattening of the arch when stanched and a normal arch when not bearing weight. Even while flatfoot seldom results in disability, some kids have diminished lower limb function and experience lower limb pain.

Aim: to assess the outcomes of osteotomy for lateral calcaneal lengthening with tibialis posterior advancement in treatment of symptomatic flexible flatfoot deformity.

Patients and methods: This was a clinical study that involved patients visit pediatric orthopaedic unit in El Nasr specialized hospital in Port Said. The study was conducted on 20 patients. Ankle-hindfoot scores from the American Orthopaedic Foot & Ankle Society (AOFAS) and pre- and post-operative discomfort were compared.

Results: Preoperative mean AOFAS score was 55.8 ± 6.3; postoperative mean score was 91.1 ± 3.2 ($p < 0.001$). 60% of patients reported total pain alleviation at the final follow-up. while 40 % experienced only occasional discomfort

Conclusion: Clinically, the majority of patients reported complete relief or significant reduction in pain. These findings support the efficacy of this combined surgical approach as a reliable and efficient method of treating pediatric flexible flatfoot symptoms unresponsive to conservative management.

Key words: Flexible flat foot, Lateral calcaneal lengthening,

Introduction

In children, flexible flat foot is also referred to as planovalgus or pes planus. It consists of two parts: valgus heel and sagging of the medial longitudinal arch. A normal arch while not bearing weight and a flattening of the arch when standing are characteristics of flexible flatfoot (FFF), which can be either asymptomatic or symptomatic **(1).**

While it is uncommon for flatfoot to result in handicap, some kids suffer lower limb pain and have shown decreased function. It is generally thought to cause gait abnormalities later on**(2).**

Harris and Beath stated strict indications for surgery involving the failure of protracted nonsurgical measures to alleviate discomfort in the sinus tarsi and/or under the medial midfoot that interferes with daily activities. The surgery's goals are to reduce discomfort and avoid irreversible deformities and prophylaxis against anticipated pain and disability **(3,4).**

When the medial longitudinal arch decreases, the body weight shifts to the medial side of the foot when walking and standing. Because of this, it has been regarded as both a dynamic functional aberration of the lower extremities and a problematic static alignment of the foot and ankle bones. The knees, hips, and lower back are proximal regions that experience this overloading mechanism **(1).**

The purpose of surgery is to alter the foot's form, which need not cause issues. A careful operating plan is necessary for flexible flatfoot, particularly when it has a noticeable deformity, such as forefoot or hindfoot abnormalities. Complete repair can be achieved with osteotomies and soft tissue treatments to prevent the progression of deformities and the ensuing early degenerative alterations **(3).**

Forefoot abduction is a good procedure for correcting symptomatic flexible flat foot because it corrects all the components of the deformity in one sitting. Evans describes lateral calcaneal lengthening osteotomy and dynamic soft tissue reconstruction of the medial foot with regard to tibialis posterior tendon augmentation or advancement to elevate the collapse of the medial longitudinal arch on the weight bearing state and correct the deformity of heel valgus**(5).**

The purpose of our study was to assess the effectiveness of tibialis posterior advancement combined with lateral calcaneal lengthening osteotomy in treating symptomatic flexible flatfoot deformity.

Patients and methods

This was a clinical study that involved patients visit pediatric orthopaedic unit in El Nasr specialized hospital in Port Said. The study was conducted on 20 patients.

Inclusion criteria: Symptomatic idiopathic flexible flatfoot, patients who are skeletally immature and patients not respond to conservative treatment.

Exclusion criteria: Skeletally mature patients, rigid flatfoot (tarsal coalition) and spasmodic flatfoot, patients with neuromuscular disorders, pain-free flexible flat foot, children with flexible flatfeet complaining non localized, lower extremity pain associated with activities or at night and iatrogenic flatfoot resulted from

overcorrected clubfoot with valgus alignment of the hindfoot. However, The thigh-foot angle is neutral, and the talonavicular joint is in good alignment.

Sample size:

Convenience sample from patients visit pediatric orthopaedic unit in El Nasr specialized hospital in Port Said according to the collaboration protocol between university of Port Said, faculty of Medicine and insurance hospitals in Port Said and pediatric orthopaedic unit in Alexandria university hospital. As mean calcaneal pitch angle preoperative 14.9+/-5.2 compared to 21.1+/-4.3 postoperative. **Wen et al., (6).** So, sample size is 20. The sample size, which had an 80% power and a 95% confidence level, was calculated using Open Epi Software.

Methods

All patients were subjected to:

Complete history taking: Personal history, past medical and surgical history, history of drug sensitivity, complaint and its duration, and current history, **physical examinations:** general examination and local examination (medial arch posture, hindfoot and forefoot alignment and muscle power, gait, flexibility of flatfeet and triple joint complex, assessment of tendon Achilles' contracture and rotational profile of foot.) and **full Weight-Bearing Radiographs of the Foot:** Harris axial view (calcaneal axial view), anteroposterior (AP) view, the ankle's oblique, lateral, and anteroposterior (AP) views.

Surgical procedure

On the radiolucent table, the patient was positioned supine under the ipsilateral buttock, with a folded towel.

After applying a tourniquet and raising the patient, the patient was draped from the iliac crest to the toes. Starting over the dorsolateral part of the talonavicular joint, the Ollier incision extends obliquely inferoposteriorly and ends approximately 2.5 cm inferior to the lateral malleolus. The soft tissues overlying sinus tarsi was elevated with avoiding exposure or injury to the calcaneocuboid joint's capsule. The tendons of the peroneus longus and peroneus brevis were dislocated from their sheaths on the lateral aspect of the calcaneus. To stop the peroneus brevis tendon from opposing the lengthening of the lateral column, it was Z lengthened. The position for the calcaneal osteotomy was established by measuring the distance between the anterior and middle facets of the subtalar joint using a Freer elevator. A longitudinal incision was made along the medial border of the foot from a place slightly distal to the medial malleolus to the base of the first metatarsal. After being cut in a Z pattern and liberated from its sheath, the tibialis posterior tendon's dorsal half was separated from the navicular bone. The plantar half of the tendon fibers are found in the tendon stump that is still attached to the navicular bone. To ascertain whether an open or percutaneous Achilles tendon lengthening or an isolated gastrocnemius recession was required, the equinus contracture was assessed using the Silfverskiold test. Percutaneous 2 mm K wires from the dorsal surface of the forefoot should be used to stabilize the calcaneocuboid

joint in order to prevent subluxation. These wires should then pass through the cuboid bone, cross the anatomic center of the calcaneocuboid joint, and stop at the osteotomy site under fluoroscopic guidance. A sagittal saw or osteotome was used to conduct lateral calcaneal osteotomy in an oblique complete pattern. It started around 2 cm posterior to the calcaneocuboid joint and finished between the anterior and middle faces, running from posterolateral to anteromedial. Either a hinged smooth lamina spreader or manual forefoot adduction and the placement of 2mm Steinmann pins into the calcaneus's anterior process and anterior body were used to divert attention from the osteotomy site. Examine the hindfoot's deformity correction clinically and with fluoroscopy. The dimensions of the trapezoid-shaped iliac crest graft's lateral length were determined by measuring the separation between the calcaneal pieces' lateral cortical edges. The trapezoid's medial length should be between 20% and 30% of its lateral length. The graft's cancellous bone and the calcaneal fragments came into direct touch when it was implanted and struck with its cortical surfaces aligned along the long axis of the foot from anterior to posterior. The posterior calcaneal fragment and the graft were penetrated by the previously placed 2 mm k. wire. The tendon of the peroneus brevis muscle was lengthened by 5 to 7 mm and then sutured with an absorbable suture. The proximal slip of the tibialis posterior tendon was advanced 5 to 7 mm and threaded through a slit in the tendon's distal stump as a Pulver taft weave using an absorbable suture material. The wounds were sealed using absorbable sutures. To avoid swelling, a well-padded, short-leg, non-weight-bearing cast was put on and bivalved**(7,8).**

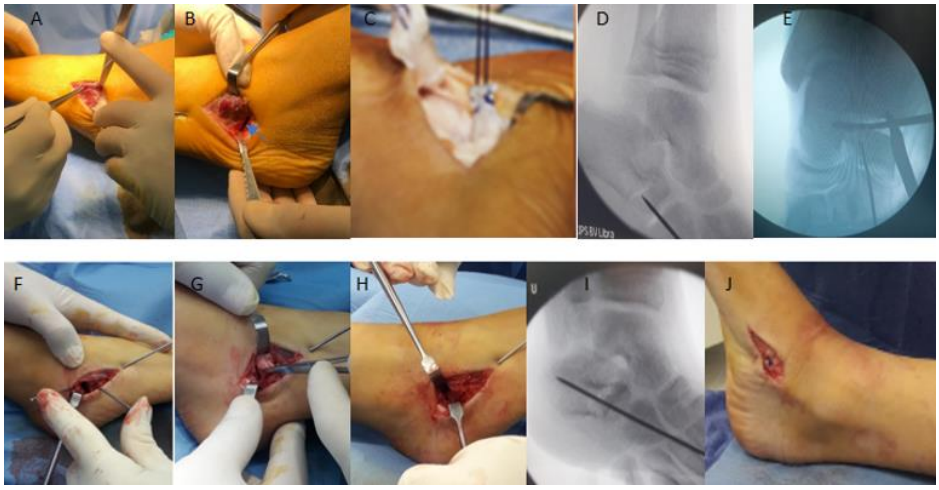

Figure 1: Illustrating steps of the surgical procedure; A) Through Ollier incision, elevation of extensor digitorum brevis to identify calcaneocuboid joint. B) calcaneocuboid joint (blue arrow). C) identification of tibialis posterior tendon through medial incision and splitting it into distal and proximal parts. D) C-arm image showing K-wire fixation of calcaneocuboid joint. E&F) Clinical and C-arm images for the osteotomy site and distraction of the osteotomy site. G) Trapezoid iliac crest bone graft insertion. H&I) Clinical and C-arm image for advancement of K-wire into the osteotomy site fixing the graft. J) advancement and suturing of tibialis posterior tendon

Outcome Measurements: Until bone healing was established, the patients were monitored clinically and radiologically every month. This included keeping an eye on the following: Medial longitudinal arch posture, hind foot alignment, osteotomy site for union and triple joint complex motion, lateral view foot (The distance between the medial cuneiform and the floor, the calcaneal inclination angle, the talo-calcaneal angle, the talo-first metatarsal angle, and the talo horizontal angle.) and anteroposterior view foot (Talonavicular coverage angle, talo-first metatarsal angle, and talo Calcaneal angle). Functional outcome can be assessed by AOFAS ankle and hindfoot scale **(9)**.

Follow-Up: For eight weeks, the operated side cannot bear any weight, and Below the knee, the foot is immobilized in a cast. At six weeks, the cast is taken off in order to remove the K wire and perform standing AP and lateral radiographs. Until the eighth week, a second non-weight-bearing cast is placed below the knee. Final standing AP and lateral radiographs are taken at 8 weeks after the cast is taken off. Rarely is physical therapy required.

Ethical Consideration

The information collected from participants is private. No report or publication about this study included the names of the study participants. The goal and nature of the trial, together with the risk-benefit analysis, were presented to the participants prior to their admission. Informed consent was acquired.

Statistical Analysis

Lateral calcaneal lengthening osteotomy with tibialis posterior tendon advancement was carried out on 20-foot patients who had idiopathic flexible flatfoot that did not respond to conservative measures. Radiographic indices and the AOFAS universal evaluation score scale were used to assess the patients. preoperative and postoperative with follow up over 6 months. Data from all patients was collected in a patient file, then transferred into master table and fed to the computer on SPSS-20.0 statistical program for statistical analysis. The different suitable statistical tests for data analyses were used.

Results

Table (1): Demographic data of the study group.

	Study group (n=20)
Age (years) Mean ± SD	9.6 ±1.6
Sex	
Male	12 (60%)
Female	8 (40%)
Side distribution	
Bilateral	22 (88%)
Unilateral	3 (12%)

SD: Standard Deviation

According to Table 1, the study group's average age was 9.6 ± 1.6 years. Males represented 60% (n = 12) of the participants, while females accounted for 40% (n = 8). Regarding the side affected, the majority of cases were bilateral (88%, n = 22), with a smaller proportion being unilateral (12%, n = 3).

Table (2): Comparison of Preoperative and Postoperative AOFAS Scores.

	Mean ± SD	**t test**	**P value**
AOFAS			
Preoperative	55.8 ± 6.3	22.3413	**< 0.001***
Postoperative	91.1 ±3.2		

P value >0.05: Not significant, P value <0.05 is statistically significant, p<0.001 is highly significant., SD: standard deviation.

The mean functional Ankle-Hindfoot score of the American Orthopaedic Foot and Ankle Society (AOFAS) improved from 55.8±6.3 preoperatively to 91.1±3.2 postoperatively at the last follow-up, as seen in Table 2. There was a statistically significant improvement (P < 0.001).

Table (3): Patient residual pain post-operative at last follows up.

	Study group (n=20)
Relief of pain	12 (60%)
Occasional pain	8 (40%)

Table 3 shows that, at the last follow-up, 60% of patients in the study group reported complete relief of pain following surgery, while 40% experienced occasional pain.

Discussion

According to our results, the study group's mean age was 9.6 ± 1.6 years. Males represented 60% (n = 12) of the participants, while females accounted for 40% (n = 8). Regarding the side affected, the majority of cases were bilateral (88%, n = 22), with a smaller proportion being unilateral (12%, n = 3).

In accordance with **Sakr et al., (10)** who evaluated the radiographic and functional outcomes of a single-stage restoration of a problematic, flexible fat foot using calcaneal lengthening osteotomy in conjunction with tibialis anterior rerouting. 16 people with 28 feet had an average age of 11.6±2.1 years (range: 9–14.5). There were eight (50%) male and eight (50%) female patients. In 12 cases (75%) the affected side was bilateral.

Also, **Nejib & Delpont (11)** who evaluated The medium-term consequences of calcaneus lengthening in children and adolescents with idiopathic valgus flat foot, they reported that the mean age of 13.9 years and a predominance of bilateral involvement in 20 symptomatic, idiopathic valgus flat feet.

Also, **Ahmed (12)** who evaluated the outcomes of calcaneal lengthening using Mosca's technique in adolescents with symptomatic flexible flatfoot. In the study, 14 patients with a mean age of 13.53 (range 11.5–16) years underwent bilateral surgery at intervals of 15.6 (range 12–21) months on average.

According to the current study, the mean functional American Orthopaedic Foot and Ankle Society's (AOFAS) ankle-foot score.

improved significantly from 55.8±6.3 before surgery to 91.1±3.2 after surgery at the final follow-up. The improvement was statistically substantial ($P < 0.001$).

In supporting with **Sakr et al., (10)** reported that at the final follow-up, the average AOFAS score rose from 51.6±5.5 (range: 42–61) preoperatively to 85.3±10.2 (range: 56–96) with a p-value < 0.001.

Also, agreed with **Oh et al., (13)** reported that At the latest follow-up, the average AOFAS score rose from 49.1 before surgery to 93.4.

As well, **Viegas (14)** found that, after Evans calcaneal osteotomy and medial split tibialis anterior tendon transfer, the average AOFAS score in 34 flexible planovalgus feet significantly improved from 68.59 preoperatively to 96.35 after an average follow-up of 24.9 months.

Accordance with **Suh et al., (15)** They evaluate the differences between lateral column lengthening (LCL) and arthroereisis (AR) in terms of radiographic correction, clinical results, complications, and re-operations when treating children with symptomatic flatfoot. They showed significant improvement in AOFAS scores as reported by **Kumar & Sonanis, (16)**.

This study reported that at the last follow-up, there was 60% of patients in the study group reported complete relief of pain following surgery, while 40% experienced occasional pain.

Thirteen (46.4%) feet indicated pain as their main complaint, followed by three (10.7%) who claimed cosmetic issues and twelve (42.9%) who reported both pain and cosmetic issues, according to **Sakr et al. (2010).**

Additionally, **Marengo et al. (17)** assessed the radiological, functional, and clinical results of calcaneal lengthening osteotomy in treating skeletally immature patients with symptomatic flatfoot deformity. They reported significant improvements in clinical outcomes, with 66.7% of patients experiencing complete relief of pain and 33.3% reporting occasional discomfort.

Conclusion

Pediatric idiopathic flexible flatfoot was successfully treated with a combination of tibialis posterior tendon advancement and lateral calcaneal lengthening osteotomy. Significant gains in radiological, functional, and clinical results were shown by the study. Postoperatively, patients showed a marked increase in the AOFAS Ankle-Hindfoot scores, indicating substantial functional improvement. Clinically, the majority of patients reported complete relief or significant reduction in pain. These findings support the efficacy of this combined surgical approach as a reliable and

effective treatment option for symptomatic pediatric flexible flatfoot unresponsive to conservative management.

Limitation

The lack of a control group and small sample size in this study may have limited how far the findings may be applied. The follow-up period was relatively short, and subjective measures like pain relief could introduce bias. Further research with larger cohorts and longer follow-up is recommended.

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