

## **Lateral Calcaneal Lengthening for Correction of Symptomatic Flexible Flat Foot in Children**

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### **Abstract**

The purpose of this study was to evaluate the clinical, functional and radiological outcome of lateral calcaneal lengthening osteotomy and medial soft tissue plication for correction of symptomatic flatfoot deformity in children. A prospective multicenter study on 22 feet of 20 patients who underwent lateral calcaneal lengthening for symptomatic flatfoot in children by Mosca technique in the period between December 2017 and February 2019. Inclusion criteria were symptomatic flexible flatfoot in children with failed non operative treatment. During the study period, 22 feet of 20 patients with symptomatic flatfoot underwent lateral calcaneal lengthening osteotomy. All patients met the inclusion criteria and were available for clinical and radiological follow-up. The percentage female were (55%)–male were (45%), The mean age at time of surgery was 10.33 years old (7 – 17 years old) and their mean follow up period was 15months.The mean functional American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score had improved from 68.9 (58-78) preoperatively to 96.09 (86-100) postoperatively at last follow up (P value < 0.001) using paired t-test as a significance test for evaluation of pre and post-operative AOFAS score.The results of this study support the combination of lateral column lengthening and soft tissue reconstruction for treatment of PesPlano-valgus foot deformity, The adopted technique revealed satisfactory result both in children and adolescents.

**Keywords:** Flatfoot, Symptomatic, Calcaneal lengthening, Surgery, children.

### **1.Introduction**

Approximately 20 percent of all musculoskeletal complaints are related to the foot and ankle, Flatfoot is the term used to describe a weight-bearing foot shape in which the hindfoot is in valgus alignment, the midfoot sags in a planter direction with reversal of the longitudinal arch, and the forefoot is supinated in relation to the hindfoot [1].

Pediatric flatfoot can be divided into flexible and rigid categories. Flexible flatfoot is characterized by a normal arch during non-weight bearing and a flattening of the arch on stance. The arch elevates spontaneously in most children during the first decade of life. Flexible flatfoot may be asymptomatic or symptomatic [2].

Symptomatic forms of flexible flatfoot produce subjective complaints, alter function, and produce significant objective findings. When all nonsurgical treatment options have been exhausted, surgical intervention can be considered [2].

Options for surgical treatment vary from simple soft tissue procedures to calcaneal osteotomy, subtalar extra-articular arthrodesis and triple arthrodesis [3].

The purpose of this study was to evaluate the short term results of lateral calcaneal lengthening osteotomy and medial soft tissue reconstruction in management of symptomatic flexible flatfoot.

### **2. Patients and methods**

A prospective multicenter study on 22 feet of 20 patients who underwent lateral calcaneal

lengthening for symptomatic flexible flatfoot in the period between December 2017 and February 2019. The mean age was 10.33 years old (7 – 17 years old) and their mean follow up period was 15 months. Inclusion criteria were painful, passively correctable pes planovalgus after failure of conservative treatment for atleast 6 months. Exclusion criteria include rigid flatfoot, arthritic changes, post traumatic, neuromuscular disorders, osteoporosis of the calcaneus, previous surgery regarding FFF and patients who didn't complete a minimum follow up of 9 months

Each patient in this study was carefully assessed radiologically and clinically by taking a detailed clinical history and examination and adequate information from the child or parent to determine whether the flat foot deformity is painful or pain free.

Demographic and clinical data were recorded as follows: gender, underlying pathology, age at time of surgery, side operated, details of surgical procedure and length of follow-up.

#### **2.1 Operative Procedure**

All procedures were performed under anesthesia, 14 patients were operated under spinal anaesthesia while the remaining 6 patients were operated under general anaesthesia. The patients operated supine on a radiolucent table, pneumatic thigh tourniquet was used. Percutaneous Tendon achillis lengthening was done as a first step Fig (1). A modified lateral oblique or curvilinear Ollier incision about 3 cm that extended 1 cm proximal to anterior calcaneal process was made over sinus tarsi,

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Calcaneocuboid joint was identified, the interval between middle and anterior facets of calcaneus was identified

A second longitudinal incision along the medial border of the foot was made. The tibialis posterior tendon was cut in a Z-manner. A talonavicular capsulotomy was made.

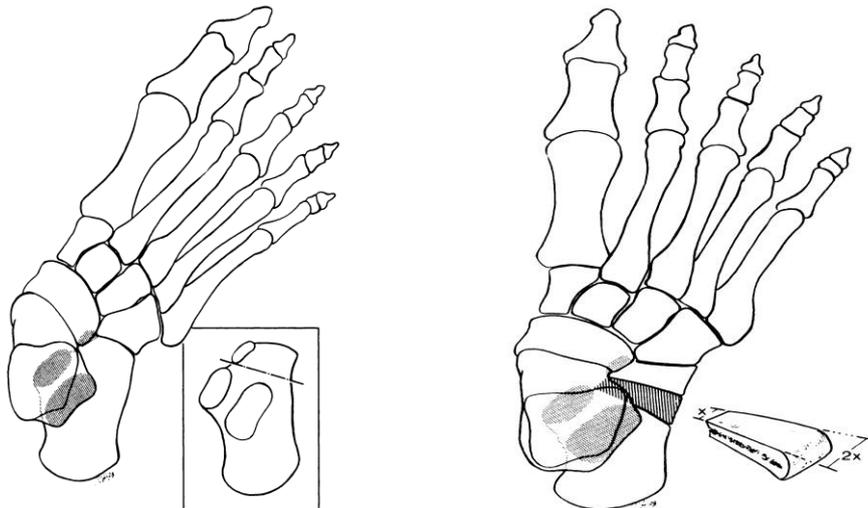
An oblique calcaneal osteotomy was done between the anterior and middle facets about 1.5 cm posterior to the calcaneocuboid joint Fig (2). A Kirschner wire was inserted from the cuboid distally across the calcaneocuboid joint to avoid its subluxation with osteotomy distraction and trapezoidal tricortical iliac crest bone graft

was placed through the opened osteotomy using lamina spreader then advancing the calcaneocuboid k-wire to fix the graft Fig (1).

Medial and plantar capsular imbrication of the talonavicular joint was performed. The proximal slip of the tibialis posterior was advanced about 5 to 7 mm through a slit in the distal stump of the tendon and repaired, Fixation of advanced dorsal slip of tibialis posterior by direct suturing of the dorsal slip to the periosteum of navicular bone combined with interosseous sutures. The incisions were closed, and a well-padded short-leg non-weight-bearing cast was applied Fig (1).



**Fig (1)** The operative procedure



**Fig (2)** left; Dorsal view of a flatfoot. There is abduction at the talonavicular joint. The oblique line of the osteotomy on the dorsal surface of the calcaneus. Right; Dorsal view showing correction of all components of the deformity with the trapezoid-shaped graft in place (1)

Antero-posterior and lateral X- rays for the operated foot was done on the same day of operation.

Non-weight bearing below knee cast in dorsiflexion for the 1st 6 weeks post-operatively had been done. Wound condition was assessed after 2 weeks with changing the below knee cast and stitches were removed. At 6th week pins and cast are removed, protective weight bearing cast as tolerated was done with the ankle in neutral position for another 2-4 weeks. Return to pre-operative function and activity as tolerated by the patients as early as possible to be tried.

From the 8th week to 6-month postoperative patients used medial longitudinal arch support.

At the final follow-up, the outcome was assessed clinically by the AOFAS ankle-hind foot scale, dogan scale and by radiographic parameters.

### 2.2 Statistical analysis

Data were statistically described in terms of mean standard deviation (SD), median and range. Comparison between pre- and post-operative values was done using paired *t* test. *p* values less than 0.05 was considered statistically significant. All statistical calculations were done using computer program IBM SPSS (Statistical Package for the Social Science) release22for Microsoft Windows.

### 3. Results

During the study period, 22 feet of 20 patients with symptomatic flexible flatfoot underwent lateral calcaneal lengthening osteotomy. all patients met the inclusion criteria and were

available for clinical and radiological follow-up (Table). The male-female percentage was (45, 55%). Mean age at time of surgery was (10.33 years). The average follow-up duration was 13 months (range 9 to 21 months).

The mean functional American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score improved from 68.9 (58-78) preoperatively to 96.09 (86-100) postoperatively at last follow up (*P* value < 0.001) using paired *t*-test as a significance test for evaluation of pre and post-operative AOFAS score.

### 3.1 Radiological results

Pre and post operative radiological and AOFAS scoring Table (1).

All bone grafts united with the calcaneus within an average of 2 months, complete incorporation and remodeling occurred within 6 months.

Post operative complications, one patient (5%) suffered wound dehiscence on lateral aspect after surgery, was in cast with window, and daily dressing till healthy granulation and wound healing without any surgical intervention. One patient (5%) showed superficial wound infection which improved on daily dressing. Another patient (5%) had mild sural neuritis that was improved dramatically by physiotherapy and local steroid injection. Five patients developed tibialis posterior tenosynovitis which was improved by physiotherapy (strengthening exercise and ultrasonic waves). In one patient (5%) the graft was minimally displaced after surgery, but then healed uneventfully.

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**Table (1)** Pre and post operative radiological assessment and AOFAS score.

Patient number	age	sex	Operated side	Side NU	AOFAS ankle hind foot score		Radiological assesment				complications
					pre	post	TNA		TMTA		
							Pre	Post	Pre	Post	
1	12	♀	R. t	1	70	100	15	1	34	0	
2	14	♀	Lt	2	76	96	25	2	23	0	
3	13	♀	Lt	3	64	96	20	1	22	1.5	
4	8	♀	Rt.	4	68	94	34	3	35	0	
5	11	♀	Rt	5	58	96	35	2	30	1	
6	7	♀	Rt	6	76	96	35	4	39	2	SWI
7	14	♀	Rt	7	62	100	34	3	18	0	
8	13	♀	Lt	8	74	96	15	1	30	1	
9	16	♀	Rt	9	58	90	12	5	26	2	WD
10	10	♀	Lt	10	72	94	20	4	20	2	
11	10	♀	Rt	11	70	100	35	1	35	0	
12	7	♀	Rt	12	78	100	20	1	39	1	
13	17	♀	Lt	13	60	86	35	5	35	2	GMD
14	10	♀	Rt	14	76	96	24	3	22	0	
			Lt	15	72	96	22	3	20	0	
15	13	♀	Lt	16	66	100	35	1	35	1	
16	12	♀	Lt	17	70	94	32	5	15	2	SN
17	13	♀	Rt	18	74	94	33	2	20	1	
18	7	♀	Lt	19	68	96	15	3	20	0	
			Rt	20	72	96	18	3	25	0	
19	10	♀	Lt	21	64	96	35	1	39	1	
20	11	♀	Rt	22	58	94	35	5	38	1.5	

#### Case (Female patient 15y old with bilateral flexible flatfoot)



**Fig (3)** Pre operative



Fig (4) Post operative

Table (2) Comparative analysis for the results with that of other studies.

	Our study	Baghdadi T et al (2018) (6)	Marengo et al (2017) (7)	Hintermann et.al(2003) (9)	Ahmed (2016) (10)	Kumar et al (2017) (8)
<b>Number of cases</b>	22	30	38	48	19	156 feet (7 studies)
<b>Average age</b>	10.33 years old (7 – 17 years old)	10.4 ± 0.9 years	13.3 ± 2.2 (range 7.8-17)	23-72 years	13.53	13.3 years (Range 5.7-42)
<b>mean follow up</b>	15 months (9 – 21 months)	23.1 ± 9.9 months			27.89 (range 18–44 months)	70.2 Months (Range 24.9-156)
<b>Pre AOFAS score</b>	68.9 (58-78)	37	49.9 ± 16 (range 23-75)	56.5 14	57.53 (range, 53-72)	58.85 (Range 34-78)
<b>Post AOFAS score</b>	96.5 (86-100)	88	89 ± 15.9 (range 34-100)	90.5 11	96.32 (range, 82-100)	92.25 (Range 73-100)
<b>Radiographic parameters</b>	Improved	Improved	improved	improved	improved	improved
<b>complications</b>	superficial wound infection , wound dehiscence,graft displacement and sural neuritis)	Distal segment displacement and hardware irritation			superficial wound infection and Delayed healing of the lateral incision.	nerve related, pseudo arthrosis, non-union and metal related complications

### 5.Conclusion

The results of this study support the combination of lateral column lengthening and soft tissue reconstruction for treatment of Plano-valgus foot deformity with the following advantages:

Correction of all components of the deformity in one sitting. The technique does not use arthrodesis, so the distribution of stresses in the different foot joints is not disturbed. The technique can be done safely in young children as there is no interference with

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the centers of ossification of the foot bones. Minimal complications. The adopted technique revealed satisfactory result both in children and adolescents.

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