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Original Article

Combined Cuboid-Cuneiform Osteotomy for Correction of Residual Forefoot Adduction Deformity in Idiopathic Clubfoot

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Abstract

Background: Residual forefoot adduction deformity refers to the persistent inward deviation of the forefoot in patients following corrective procedures for idiopathic clubfoot, with reported incidence rates varying up to 95%. The aim of this work was to evaluate the clinical and radiological results of combined cuboid-cuneiform osteotomy for correcting the residual forefoot adduction deformity of idiopathic clubfoot patients.

Methods: Eighteen cases (feet) in 13 children with residual forefoot adduction deformity were treated between October 2022 and September 2023 at the Orthopedic Department of Zagazig University Hospital in Egypt. The children were followed up for at least six months, and all cases underwent a combined cuboid-cuneiform osteotomy with soft tissue releases. Measurements including the anterior talocalcaneal angle (TCA1), anterior talo-first metatarsal angle (TFMA1), calcaneo-fifth metatarsal angle (CFMA), lateral talocalcaneal angle (TCA2), and lateral talo-first metatarsal angle (TFMA2) were taken pre-operatively and post-operatively.

Results: The residual forefoot adduction deformities were evaluated clinically and radiologically according to a scoring system modified by Bensahel et al. and supported by the International Clubfoot Society. Based on the total calculated score, the results were categorized into four levels: excellent, good, fair, and poor. Fifty percent of the treated feet had excellent results, 33% had good results, 11% had fair results, and 6% had poor results. Despite nonsignificant complications, 16 patients expressed satisfaction with the operation.

Conclusion: Combined cuboid-cuneiform osteotomy is a safe and effective option for correcting residual forefoot adduction deformity in idiopathic clubfoot. It surpasses other bone surgeries for adduction and rotational deformities, resulting in a straight plantigrade foot.

Keywords: clubfoot; osteotomy; K-wire; forefoot adduction; double column osteotomy.

INTRODUCTION

Residual forefoot adduction deformity refers to the persistent inward deviation of the forefoot in patients who have undergone corrective procedures for idiopathic clubfoot, either conservative or surgical [1, 2]. It is characterized by the deviation of the metatarsals and phalanges towards the midline of the foot, resulting in an abnormal foot posture and compromised function [2].

The literature varies regarding the incidence of residual forefoot adduction deformity following idiopathic clubfoot correction. Previous studies have reported rates up to 95%, highlighting the

persistent challenge of achieving complete deformity correction [3].

Residual forefoot adduction after clubfoot correction can result from incomplete release during surgery, failure to maintain bone position, avascular necrosis of the navicular bone, unreleased structures, uncorrected calcaneocuboid relation, and compensatory deformities [3].

The diagnosis of residual forefoot adduction deformity in idiopathic clubfoot is primarily clinical and radiographic. Clinical assessment involves evaluating the alignment and range of motion of the foot, assessing the position of the metatarsals and phalanges, and observing gait abnormalities. Radiographic evaluation includes standing anteroposterior and lateral foot X-rays to quantify the degree of deformity and assess the relationship between the metatarsals, cuneiforms, and cuboid bones [4].

Various treatment methods have been proposed to correct residual forefoot adduction deformity in idiopathic clubfoot. These include multiple metatarsal osteotomies, isolated tarsal bones osteotomy, and arthrodesis procedures [5]. However, the optimal approach remains debatable, and a comprehensive understanding of the advantages and disadvantages of each method is essential.

One approach that has gained attention in recent years is the combined cuboid-cuneiform osteotomy [5]. McHale and Lenhart were the first to describe the method of combining a shortening osteotomy of the cuboid and an elongation of the cuneiform. This is achieved through a closed wedge osteotomy for the cuboid bone, followed by an open wedge osteotomy for the medial cuneiform [5-7].

Advantages of this approach include the ability to correct multiplanar deformities, precise correction of the adduction angle, restoration of the normal alignment between the midfoot and forefoot, and the potential for better long-term outcomes without any growth disturbance [5, 6].

As with any surgical procedure, the combined cuboid-cuneiform osteotomy is not without risks and complications. Potential complications include incomplete correction, deformity recurrence, the need for additional soft tissue releases, superficial infections, kirschner wire migration, and graft slippage [6].

The aim of this study was to evaluate the clinical and radiological results of combined cuboid-cuneiform osteotomy for correction of residual forefoot adduction deformity of idiopathic clubfoot patients.

METHODS

At the Orthopedic Department of Zagazig University Hospital in Egypt, eighteen cases (feet) in 13 children were treated for residual forefoot adduction deformity between October 2022 and September 2023. The children were followed up for at least six months. The average age of the children was 6.78 years, with a standard deviation of 2.49. Out of the thirteen children, 46.15% were boys and 53.85% were girls.

Inclusion Criteria

Children with idiopathic clubfoot who have residual rigid forefoot adduction deformity with or without associated cavus, supination, and varus deformities and have failed to respond to conservative treatment and soft tissue release procedures, children between three and twelve years of age, and medically and surgically fit children.

Exclusion Criteria

Clubfoot secondary to arthrogryposis multiplexa, amniotic band syndrome, and spasticity, children who have not previously undergone conservative treatment for clubfoot, flexible (correctable) foot deformity, children with severe medical co-morbidities or contraindications for surgical intervention, children with active infections or open wounds in the foot region, primary (congenital) Metatarsus Adductus, children younger than three years of age, or older than twelve years of age.

Pre-operative clinical evaluation

A thorough neurological examination was performed to rule out any non-idiopathic causes of clubfoot. The assessment analyzed gait, muscle tone, sensation, motor power, and reflex activity.

In addition, an orthopedic examination was conducted to evaluate the gait, presence of deformities beyond the foot, components of the foot deformity, range of motion, and skin condition. The Bleck method was used to assess forefoot adduction deformity by determining the position of the forefoot in relation to the mid-line axis of the hindfoot. This deformity was severe and present in all cases.

Furthermore, Coleman's block test was utilized to evaluate cavovarus deformity and its flexibility. The alignment of the hindfoot while bearing weight was also assessed. All cases demonstrated severe rigid inward deviation of the foot, indicating forefoot adduction deformity.

Moreover, associated hindfoot varus deformity was evident in 11 cases, dynamic supination deformity in 3 cases, and cavus deformity in 8 cases. Two cases reported persistent foot pain, while 7 cases had mild pain. Two cases also had thickened callouses and a large bursa over the dorsolateral aspect of the foot.

Pre-operative radiographic evaluation

For all patients, X-rays were taken of their ankles and feet, including weight-bearing anteroposterior and lateral views. To determine the axis of the talus, the bisector of its head and neck was used, not necessarily the body. The axis of the calcaneus was determined by the line that connected most of its plantar points from the tuberosity to the most distal point, the calcaneocuboid joint. The bisectors of the first and fifth metatarsals were used to determine their axes. The anteroposterior view of the foot measured several angles, including the anterior talocalcaneal angle TCA1 or Kite's angle for varus, the anterior talo-first metatarsal angle TFMA1, and the calcaneo-fifth metatarsal angle CFMA, which are typically between 0-10º, 20-40º, and 0-5º, respectively. In the lateral view of the foot, the lateral talocalcaneal angle TCA2 and the lateral talo-first metatarsal angle or Meary's angle TFMA2 for cavus were measured, normally between 25-50º and 0-5º, respectively [8, 9].

The range of measures of these radiographic angles was recorded, and the mean was calculated. Before the operation, the average anterior talo-first metatarsal angle TFMA1 measure was 20º (range, 2-44º), the average calcaneo-fifth metatarsal angle CFMA measure was 27º (range, 4.4-68º). The average lateral talofirst metatarsal angle TFMA2 measure was 24º (range, 1-60º).

Operations

All feet underwent combined cuboid-cuneiform osteotomy associated with soft tissue releases (Achilles tendon lengthening, plantar fasciotomy, or posteromedial release).

Operative techniques

***Lateral closing wedge osteotomy*:**

The cuboid is located using an image intensifier. A 6 cm incision is made over the lateral surface of the cuboid, and the skin and superficial fascia are incised to expose the cuboid bone (Fig. 1-A). A wedge of bone is then removed from the cuboid, with its base on the lateral surface, using a sharp osteotome (Fig. 1-B). The width of the wedge is approximately one-third that of the cuboid on its lateral side (Fig. 1-C).

Medial opening wedge osteotomy:

The medial cuneiform was located using an image intensifier. A medial incision was made over the cuneiform, and the skin and superficial fascia were incised. The abductor hallucis muscle was then retracted inferiorly (Fig. 1-D).

A straight osteotomy of the medial cuneiform was performed, and the forefoot and midfoot were abducted to correct the adduction and supination deformity and to close the osteotomy site laterally. A lamina spreader or thin osteotome was used to open the osteotomy site (Fig. 1-E).

The wedge of bone taken from the cuboid was inserted into the medial cuneiform osteotomy site with the wedge's base facing along the medial surface. The foot was fixed in the corrected position with two smooth 1.2 mm K-wires, one from the medial cuneiform into the navicular bone and the other from the cuboid into the calcaneus (Fig. 1-F).

Postoperative care

A well-padded, non-weight-bearing below-knee plaster of Paris (POP) splint is applied, and

splitting the cast immediately after surgery is recommended to prevent swelling.

After two weeks, the wounds are checked, sutures are removed, and a more form-fitting, non-weight-bearing below-knee cast is applied. The K-wires are removed after six weeks, and a weight-bearing cast is then applied. This cast is worn until the bony union is evident on X-ray, typically at eight weeks. Plastic night splints are used after cast removal. Patients are allowed to bear weight in custom-made CTEV boots for up to 12 weeks, after which they are advised to wear regular shoes.

Postoperative evaluation

All the treated residual forefoot adduction deformities were evaluated clinically and radiologically according to a scoring system (modified by Bensahel et al.) supported by the International Clubfoot Society; a total score of 20 marks was used for evaluation after the sixth month postoperatively [10]. (Table 1)

The evaluation was conducted through clinical and radiographic means, with a total score of 20 marks being utilized for assessment after the sixth-month post-operation. The clinical evaluation involved examining the presence or absence of pain, forefoot adduction, varus heel, supination, cavus, tolerability to orthosis, and patient/parent satisfaction. The radiographic evaluation involved comparing the postoperative angle measures with those of the pre-operative, measuring the anterior talo-calcaneal angle (TCA1), anterior talo-first metatarsal angle (TFMA1), calcaneo-fifth metatarsal angle (CFMA), lateral talocalcaneal angle (TCA2), and lateral talo-first metatarsal angle (TFMA2). The resulting scores categorized the feet into four groups: excellent (19-20), good (16-18), fair (10-15), and poor (<10).

Case presentation

A 7-year-old girl with a complaint of persistent inward deviation of the right forefoot. She had previously undergone Ponseti casting and posteromedial release. Clinical examination revealed a rigid, severe forefoot adduction deformity. Preoperative X-rays indicated a right severe rigid residual forefoot adduction deformity in idiopathic clubfoot, with significant angles noted. The treatment approach involved combined cuboid-cuneiform osteotomy with tendoachilles lengthening. Postoperative evaluation at six months showed mild post-operative pain but no adduction, hindfoot varus, supination, or cavus deformity. While there was only a slight improvement in orthosis tolerability compared to pre-operative levels, the parents expressed satisfaction with the overall outcome. Postoperative X-rays demonstrated notable improvements in angles, indicating a successful intervention. The total score was 18 out of 20, indicating a good result (Fig. 2)

Ethical Approval

Written informed consent was obtained from all participants, the study was approved by the Institutional Review Board [IRB# 10994-1-8-2023] and the local ethical committee of the Faculty of Medicine, Zagazig University. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis

Data was fed to the computer and analyzed using IBM SPSS software package version 20.0 (Armonk, NY: IBM Corp). Qualitative data were described using numbers and percentages. The Shapiro-Wilk test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, standard deviation, median, and interquartile range (IQR). The significance of the obtained results was judged at the 5% level.

RESULTS

The thirteen children (18 feet) were followed up for a mean period of nine months. Of the eighteen feet examined, fourteen experienced a complete disappearance of pain during the postoperative gait training and physiotherapy.

Only four feet experienced mild pain. Non-mechanical pain at the site of sutures or K-wires was short-term, disappeared spontaneously, and was therefore not considered significant. The degree of forefoot adduction totally improved in ten feet, while eight feet had residual adduction of less than 5º at the last follow-up, which was

deemed acceptable. Hindfoot varus was corrected in all cases except five cases. Supination and cavus deformities improved in all cases (Table 2).

Tolerability to footwear/orthoses improved in all cases except two cases where intolerant to footwear or brace, while there was better tolerance in four cases. In 16 feet, the patient and/or the parent were satisfied due to the disappearance of preoperative pain or discomfort, the correction of the foot deformity, better footwear, and the overall gait improvement. Only in two feet were the patient and/or the parents dissatisfied because of mild pain and/or residual forefoot adduction < 5º.

On average, the adduction correction assessed by the anterior talo-first metatarsal angle was 14 degrees, the lateral talo-first metatarsal angle was 12 degrees, and the calcaneo-fifth metatarsal angle was corrected by 15 degrees. There was no major complication. Superficial skin infection occurred in two feet, and K-wire migration occurred in one foot. Three feet had flat-topped talus and one talar avascular necrosis (Table 3).

Using the Modified Bensahel et al. score for evaluation, nine feet (50%) had excellent, six (33%) good, two (11%) fair, and one (6%) poor outcome (Fig. 3).

Table 1: Modified Bensahel et al. Score.

A) Clinical Evaluation	B) Radiological Evaluation
1. Pain: Absent (2) Mild (1) Persistent (0) **2. Adduction:** Absent (2) Adduction < 5° (1) Adduction > 5° (0) **3. Hindfoot Varus** Absent (1) Present (0) **4. Supination** Absent (1) Present (0) **5. Cavus** Absent (1) Present (0) **6. Tolerability to Orthosis:** Optimum (2) Better than before surgery (1) Intolerant (0) **7. Patient/Parents satisfaction:** Satisfied (1) Unsatisfied (0)	**1. Anterior talo-calcaneal angle (TCA1):** 20° to 40° (2) 10° to 19° (1) <10° (0) **2. Anterior talo-first metatarsal angle (TFMA1):** <10° (2) 10° to 20° (1) >20° (0) **3. Calcaneo- fifth metatarsal angle (CFMA):** <10° (2) 10° to 20° (1) >20° (0) **4. Lateral talo-calcaneal angle (TCA2):** 25° to 50° (2) 10° to 24° (1) <10° (0) **5. Lateral talo-first metatarsal angle (TFMA2):** <10° (2) 10° to 20° (1) >20° (0)

C) Interpretation of the score	
Score	**Result**
19-20	Excellent
16-18	Good
10-15	Fair

Table 2: Comparison between Pre- and post-operative according to clinical evaluation (n=18)

Clinical Evaluation	Preoperative		Postoperative		P
	No.	%	No.	%	
Pain					
Persistent	2	11.1	0	0.0	**0.020***

Clinical Evaluation	Preoperative		Postoperative		
	No.	%	No.	%	
Mild	7	38.9	4	22.2	
Absent	9	50.0	14	77.8	
Adduction					
> 5°	18	100.0	0	0.0	**<0.001***
< 5°	0	0.0	8	44.4	
Absent	0	0.0	10	55.6	
Hindfoot Varus					
Present	11	61.1	5	27.8	**0.070**
Absent	7	38.9	13	72.2	
Supination					
Present	3	16.7	0	0.0	**0.250**
Absent	15	83.3	18	100.0	
Cavus					
Present	8	44.4	0	0.0	**0.008***
Absent	10	55.6	18	100.0	

p: p-value for comparing between **pre-and post-operative.**
***: Statistically significant at p ≤ 0.05**

Table 3: Comparison between Pre- and post-operative according to radiological measures (n=18)

Radiological Measures	Preoperative	Postoperative	p
Anterior Talo-Calcaneal Angle (TCA1)			
Min. – Max.	18.60 – 72.70	20.40 – 39.50	0.576
Mean ± SD.	36.46 ± 13.72	34.67 ± 5.05	
Median (IQR)	38.70 (23.40 – 42.20)	36.35 (32.60 – 38.10)	
Anterior Talo-First Metatarsal Angle (TFMA1)			
Min. – Max.	2.0 – 43.50	0.40 – 17.10	<0.001*
Mean ± SD.	19.64 ± 12.78	5.59 ± 4.34	
Median (IQR)	17.0 (11.90 – 24.50)	4.75 (2.20 – 8.30)	
Calcaneo- Fifth Metatarsal Angle (CFMA)			
Min. – Max.	4.40 – 68.30	0.30 – 23.40	0.001*
Mean ± SD.	26.63 ± 17.21	11.44 ± 6.23	
Median (IQR)	23.90 (13.40 – 35.60)	9.75 (8.60 – 16.40)	
Lateral Talo-Calcaneal Angle (TCA2)			
Min. – Max.	0.20 – 40.90	12.30 – 45.30	0.001*
Mean ± SD.	17.89 ± 11.74	30.17 ± 8.43	
Median (IQR)	14.30 (8.60 – 26.40)	28.10 (25.40 – 37.80)	
Lateral Talo-First Metatarsal Angle (TFMA2)			

Min. – Max.	0.60 – 60.30	1.90 – 38.60	0.018*
Mean ± SD.	24.41 ± 16.13	11.98 ± 10.05	
Median (IQR)	20.10 (11.80 – 35.50)	8.60 (5.50 – 15.10)	

IQR: Inter quartile range SD: Standard deviation p: p-value for comparing between pre-and post-operative.
*: Statistically significant at $p \leq 0.05$

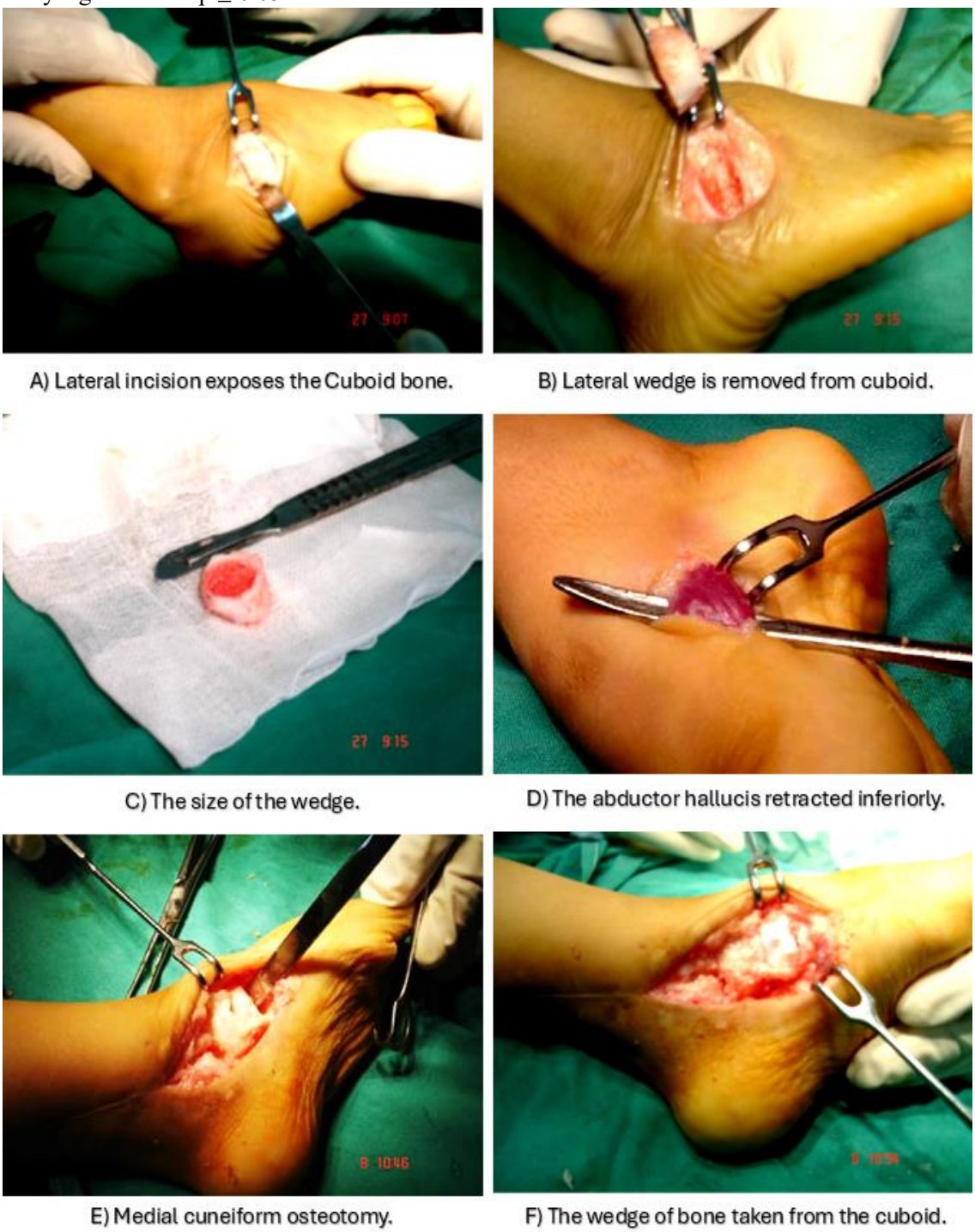

Figure 1: Combined Lateral Column Shortening and Medial Column Lengthening

Figure 2-A: Preoperative clinical evaluation revealed right severe rigid residual forefoot adduction deformity in a previously treated idiopathic clubfoot.

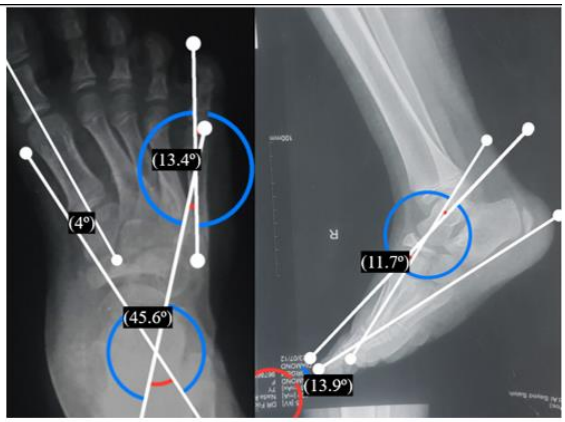

Figure 2-B: Preoperative angle measures:
A.P.: TCA1 (45.6°), TFMA1 (4°), CFMA (13.4°)
Lateral: TCA2 (13.9°), TFMA2 (11.7°)

Figure 2-C: Six months postoperative clinical evaluation shows full correction of the right foot and a scar of tendoachilles release.

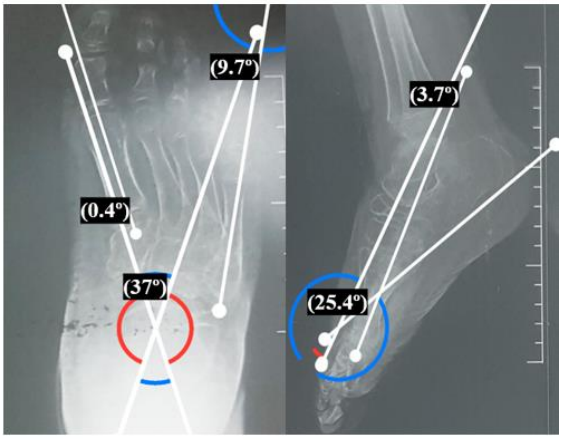

Figure 2-D: Six months postoperative angle measures:
A.P.: TCA1 (37°), TFMA1 (0.4°), CFMA (9.7°)
Lateral: TCA2 (25.4°), TFMA2 (3.7°)

Figure 2: Case study.

Figure 3: Pie chart showing the results of the studied cases according to Modified Bensahel et al. Score.

DISCUSSION

Our prospective study focused on the clinical and radiological evaluation of the correction of residual forefoot adduction in idiopathic clubfoot through a combined cuboid-cuneiform osteotomy.

Our patient population ranged from 3.5 to 12 years old, with a mean age of 6.8 years. Females made up the majority of the patients at 54%, and there was a predominance of left-sided deformities in 10 feet (56%). Varus deformity was present in 11 feet, supination in 3 feet, and cavus in 8 feet.

All feet were corrected through a double-column osteotomy, combined with tendoachilles lengthening utilizing the "Z" plasty technique, plantar fasciectomy, or posteromedial release as a supplementary procedure. On average, the adduction correction assessed by the anterior talo-first metatarsal angle was 14 degrees, the lateral talo-first metatarsal angle was 12 degrees, and the calcaneo-fifth metatarsal angle was corrected by 15 degrees.

The results using the Modified Bensahel et al. Score were excellent in 50% of the cases (9 feet), good in 33% of cases (5 feet), fair in 11% of cases (2 cases), and poor in 6% (1 case). Four cases complained of mild pain after surgery. Additionally, four cases reported mild pain after surgery. At the same time, two patients experienced a superficial infection that was successfully treated, and one case had K-wire migration. Despite these complications, 16 patients reported satisfaction with the operation, indicating that the recurrence of deformity did not necessarily impact their overall satisfaction. This suggests that the ability to wear regular shoes and the absence of pain are more critical factors than preventing recurrence.

McHale and Lenhart were the first to suggest a combination of lateral cuboid closing wedge osteotomy and medial cuneiform opening wedge osteotomy, incorporating both techniques to address forefoot adduction in cadavers. They noted that while a cuboid closing wedge osteotomy alone corrects the midfoot area, the combined cuboid-medial cuneiform osteotomy aids in correcting foot forefoot adduction [7]. In a subsequent study, they reported successful surgeries on six patients aged 4-10 years using an open wedge medial cuneiform and a closed wedge cuboid osteotomy. This technique effectively corrected midfoot supination and forefoot adduction without the need for extensive soft tissue dissection [11].

Schaefer et al. followed 27 male patients with residual adductus deformity in idiopathic and secondary clubfeet corrected with combined cuboid-cuneiform osteotomy between the ages of 2 and 10 for five years. Apart from a sole patient, all patients were able to wear standard shoes. The average correction of adduction was 9 degrees as assessed by the talo-1st metatarsal angle and 11 degrees by the calcaneal-2nd metatarsal angle. There were no instances of nonunion, and only one case of mild surface infection was recorded [12].

Lourenco et al. conducted a study involving 29 patients with residual adduction deformity in clubfoot, treating 39 feet through a combination of procedures: closed wedge osteotomy of the cuboid and open wedge osteotomy of the medial cuneiform. Predominantly male, with 19 receiving unilateral and 10 bilateral treatments, all cases had undergone prior surgery with the Cincinnati incision. Over an average follow-up of 4.8 years, clinical and radiological enhancements were observed in all cases, with an average correction of 15 degrees for adduction and no reported complications [13].

Gordon et al. suggested in their study on severe forefoot adductus that performing the cuneiform osteotomy should be considered for patients aged five years or older, highlighting the challenge posed by its small size and incomplete ossification [14].

Loza and Barbary et al. performed surgeries on 20 feet in fifteen residual adduction deformity children, primarily in male patients aged 3 to 7, where the right foot was more commonly affected than the left. They found that double-column osteotomy outperformed alternative surgical techniques in correcting various deformities. Follow-up assessments over an average period of 2.3 years revealed a distribution of results regarding modified Bensahel et al. score: 40% excellent, 40% good, 15% fair, and 5% poor, with no significant complications reported [15].

In 2014, A. Elgeidi et al. in their study on correcting the ‘‘bean-shaped’’ foot using combined double tarsal wedge osteotomy and trans-cuneiform osteotomy, stated that the patients showed a mean improvement of 21 degrees in the Talo-first metatarsal angle in clearance radiography, 14 degrees in the Calcaneo fifth metatarsal angle in clearance radiography, and 10 degrees in the Calcaneo first metatarsal angle in lateral radiography. Additionally, forefoot condition showed improvement in all patients [16].

In a study examining 16 cases of idiopathic clubfoot-resistant forefoot adduction deformity, Naidu et al. found that cuboid-cuneiform osteotomy outperformed alternative surgical interventions in rectifying forefoot adduction, cavus, and rotational deformities. The average age of the patients was 6.5 years, predominantly comprising males. The outcomes using modified Bensahel et al. score revealed 8 feet (50%) achieving excellent results, 5 feet (32%) with good outcomes, 2 feet (12%) exhibiting fair results, and 1 foot (6%) showing poor outcomes. Notably, no significant complications were reported [6].

Salama et al. conducted a study involving 17 adducted forefeet using the combined cuboid-cuneiform osteotomy technique in their correction, predominantly in male patients aged 4 to 12, with a higher prevalence of left-sided involvement. The follow-up evaluations demonstrated outcomes using modified Bensahel et al. score as follows: 12 feet (70%) showed excellent results, 3 feet (18%) exhibited good outcomes, and 2 feet (12%) displayed moderate results without any notable complications reported [17].

Mar'ei et al. found that double-column osteotomy is a more effective method for correcting adduction, cavus, and rotational deformities in cases of idiopathic clubfoot compared to other bone surgeries. The study examined 20 cases involving 25 feet of patients aged between 3 and 7 years. The results showed that 44% of the feet had excellent outcomes, 40% had good outcomes, 12% had fair outcomes, and 4% had poor outcomes, with no significant complications reported [18].

In a study by Gholipour et al., a comparison was made between cuboid-cuneiform and cuneiform-metatarsal 2-5 in correcting metatarsus adductus deformity. The analysis included 22 patients (30 feet) aged 5 to 14 years with idiopathic clubfoot who underwent corrective osteotomy. Both osteotomy methods effectively corrected the adductus deformity, with cuboid-cuneiform osteotomy as a viable option for correcting residual forefoot adduction deformity in idiopathic clubfoot, with comparable effectiveness to cuneiform-metatarsal 2-5 osteotomy [19].

Our decision to proceed with this procedure was primarily based on the clinical presentation of the foot. However, a radiographic study prior to surgery is essential. The outcomes, both in terms of function and appearance, were satisfactory. It is recommended to wait until the child is at least four years old before performing surgery unless the deformity is causing significant functional issues. It is crucial to ensure that the medial cuneiform ossification center is fully developed, which typically occurs after the age of three.

While the debate over the treatment of forefoot adduction continues with external fixators and other types of tarsal osteotomies being suggested, the combined cuboid-cuneiform osteotomy is an effective method for treating residual forefoot adduction deformity in idiopathic clubfoot

CONCLUSION

Combined cuboid-cuneiform osteotomy is a safe and effective option for correcting residual forefoot adduction deformity in idiopathic clubfoot, resulting in a straight plantigrade foot.

RECOMMENDATIONS

We recommend the use of the combined cuboid-cuneiform osteotomy technique in the management of residual forefoot adduction deformity in idiopathic clubfoot. It is a safe procedure that effectively corrects the residual forefoot adduction deformity, resulting in a straight plantigrade foot. However, the limitations of this study were an inadequate sample size and a short follow-up time, with an average follow-up of 9 months. Hence, the long-term effects of the correction could not be assessed.

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