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A study on outcome of combined cuboid/cuneiform osteotomy for correction of residual forefoot adduction deformity in idiopathic clubfoot

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Abstract

Introduction: Recurrence is by definition the development of one or more of the original deformities (equinus, varus, adductus and cavus) after the full correction of the clubfoot is obtained. Adduction of the forefoot is the most common residual deformity in clubfoot associated with supination of the foot [Tarraf and Carroll]. Under correction at the time of initial surgery, medial displacement of the anterior part of calcaneum and navicular bones around the talus were considered to be some of the causative factors.

Aims & objectives: To analyse the effectiveness of the combined cuboid /cuneiform osteotomy for correction of residual forefoot adduction deformity in idiopathic clubfoot. To study the improvement in forefoot flexibility, gait and overall functional outcome. To study the advantage of this procedure over other techniques of osteotomy.

Materials and methods: 16 cases (feet) in 11 children, who presented to our institution (Government Rajaji Hospital, Madurai) between November 2010 and November 2012 with residual forefoot adduction deformity. Children were followed up for a period 2 years. Ethical committee approval was obtained for the procedure. The mean age at the time of surgery was 6.5 years (range 3- 10 years). There were 7 boys (10 feet), 4 girls (6 feet). The right foot in 9 children and left foot in 7.

Results: Results according to point scoring system: (modified Bensahel *et al.*) approved by the International clubfoot study group. Of the 16 feet treated, 8 feet (50%) had excellent results, 5 feet (32%) good, 2 feet (12%) fair and 1 foot (6%) poor results.

Conclusion: The combination of a shortening osteotomy of the cuboid and elongation of the cuneiform was first described by Mc hale and Lenhart. The combined osteotomy is a safe procedure and allows satisfactory correction of the residual forefoot adduction deformity and achieving a straight plantigrade foot.

Keywords: Clubfoot, cuboid, cuneiform, combined osteotomy, K- wire, forefoot adduction

Introduction

Recurrence is by definition the development of one or more of the original deformities (equinus, varus, adductus and cavus) after the full correction of the clubfoot is obtained. The cause of recurrence is unknown, but it is the same mechanism that initially caused the deformities to develop and is related to the rapid growth of the foot. Recurrence is rare after the age of 4- 5 years and almost never occurs after 7 years of age. Recurrence is often effectively and easily treatable when discovered at an early stage. Adduction of the forefoot is the most common residual deformity in clubfoot associated with supination of the foot. Undercorrection at the time of initial surgery, medial displacement of the anterior part of calcaneum and navicular bones around the talus were considered to be some of the causative factors.

The combination of a shortening osteotomy of the cuboid and elongation of the cuneiform was first described by Mc hale and Lenhart^[7]. It has the potential for correction of the deformity of the tarsal bones with minimal additional scarring. We report our experience with this double osteotomy.

Materials and methods

16 cases (feet) in 11 children, who presented to our institution between November 2010 and

November 2012 with residual forefoot adduction deformity. The parents complaints included in toeing gait and difficulty in wearing normal footwear in their children. All had undergone a full posteromedial soft tissue release using the Turco's incision with lengthening of tendoachilles for idiopathic clubfoot, and followed up for a period 2 years. Ethical committee approval was obtained for the procedure.

Inclusion Criteria

1. Rigid forefoot adduction deformities with associated cavus, equino varus deformities.
2. Age group between 3 – 10 years
3. Children with idiopathic clubfoot who have failed to respond to conservative treatment and soft tissue procedures.

Exclusion Criteria

1. Clubfoot secondary to arthrogryposis multiplexa, amniotic band syndrome, spasticity
2. Children < 3 years of age, > 11 years of age
3. Relapsed clubfeet for several times

The mean age at the time of surgery was 6.5 years (range 3-10 years). There were 7 boys (10 feet), 4 girls (6 feet). The right foot in 9 children and left foot in 7.

Pre operative clinical examination

Secondary causes of clubfoot was ruled by a through neurological examination. The gait evaluated along with the

presence of other associated deformities. The components of foot deformity, flexibility of the forefoot and skin condition assessed. The forefoot adduction deformity was assessed using Podograms. Associated deformities included equinus (9 feet), cavus (6 feet), varus (5 feet), supination (3 feet). two cases (4 feet) had thickened callous over the dorsolateral aspect of foot.

Pre-operative radiographic evaluation

Standing anteroposterior (AP) and lateral X Rays of ankles and feet taken for all patients. Podograms using ink were taken to measure forefoot hind foot angle. in the AP view the talo-calcaneal angle or Kites's angle for varus (normal 20- 40 degrees), talo – first metatarsal angle (0- -10 degrees, adduction positive) and calcaneo- first metatarsal angle (0 – 5 degrees) for forefoot adduction were measured. In the lateral view, the talo-calcaneal angle (normal 25- 50 degrees) and the talo- first metatarsal angle or Meary's angle for cavus (normal 0-5 degrees) were measured.

Operative procedure

Cuboid laterally based closing wedge

The cuboid was identified using image intensifier. Through a 6 cm incision over the lateral surface of cuboid, skin superficial fascia incised and the cuboid bone was exposed. A wedge of bone was removed from the cuboid with its base on the lateral surface using a sharp osteotome. The width of the wedge was approximately one third that of the cuboid on its lateral side. (FIG 1- 3)



Fig 1: Cuboid identified under fluoroscopy



Fig 2: Opening wedge osteotomy in cuboid



Fig 3: Wedge Graft harvested

Medial cuneiform opening wedge osteotomy

The medial cuneiform was identified using image intensifier. A medial incision is made over the cuneiform, skin superficial fascia incised, the abductor hallucis muscle was retracted inferiorly. A straight osteotomy of the medial cuneiform was made, the forefoot and midfoot are abducted to correct the adduction and supination deformity and to close the osteotomy site laterally. A lamina spreader or thin osteotome

is used to open the osteotomy site. The wedge of bone taken from the cuboid was inserted into the osteotomy site of the medial cuneiform with the base of the wedge facing along the medial surface. the foot is fixed in the corrected position with two smooth 1.2 mm K- wire, one from the medial cuneiform into the navicular bone and the other from the cuboid into the calcaneus. (FIG 4- 6)



Fig 4: Osteotomy and distraction of cuneiform



Fig 5: Closing of osteotomy site laterally



Fig 6: Graft fixed with K - wire

Complementary procedures

Tendoachilles lengthening by Z Plasty in 9 feet, plantar fasciotomy in 6 feet.

A well-padded above knee plaster of paris (POP) slab was applied in all feet, which was subsequently converted to cast after suture removal and maintained for 4 weeks. The above knee cast is converted to a below knee cast and maintained for two weeks. The K wires were removed at 6 weeks and a weight bearing is allowed with the cast till radiological bony union seen usually at 8 weeks. Plastic night splints used after cast removal and patient allowed weight bearing in custom made CTEV boots till 12 weeks later advised to wear normal shoes. All the feet were assessed clinically and radiographically and a scoring system (Bensahel *et al.*) supported by the International clubfoot society, a total score of 20 marks was used for the evaluation.

Results

Sex distribution: out of the 11 children 7(64%) were male and 4(36%) were female.

Sex	No. of cases	Percentage
Male	7	64%
Female	4	36%
TOTAL	11	100%

Side Affected

Results according to point scoring system used: (modified Bensahel *et al.*) approved by the International clubfoot study group. Of the 16 feet treated, 8 feet (50%) had excellent results, 5 feet (32%) good, 2 feet (12%) fair and 1 foot (6%) poor results.

Laterality	No. of cases	Percentage
Unilateral	6	55
Bilateral	5	45
TOTAL	11	100%

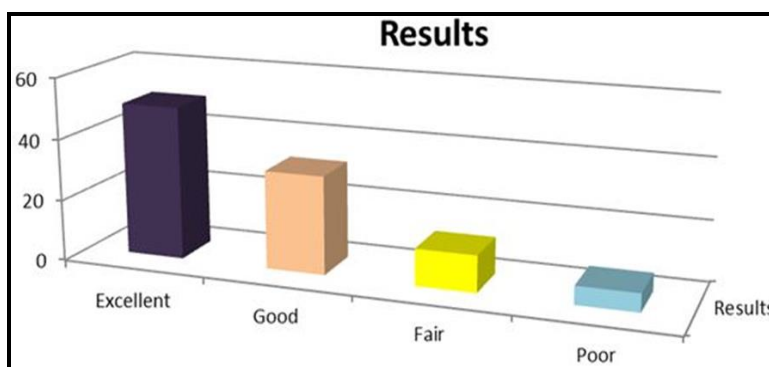


Fig 7:

Discussion

The principle of combined cuboid/cuneiform osteotomy was investigated in a cadaver study by Mc Hale and Lenhart [7]. They used metal wedges, to study the best position for the osteotomy, the influence of medial and lateral osteotomy and the need for additional soft – tissue releases. It was concluded that the combination of both the procedures gave the best correction compared with isolated osteotomies. The correction was reproducible and that additional soft tissue procedures were not necessary. The main drawback was that the experiment was carried out on normal cadaver feet lacking the soft tissue rigidity of club foot. The procedure was then undertaken in seven patients. Clinically all cases showed

satisfactory results except one which showed no correction following a mean follow up of 2 years. The authors concluded that every case should be treated individually, some feet over correction at the time of surgery and additional soft tissue releases may help in preventing subsequent relapse. In Schaefer *et al.* [7], study there were 27 feet with male predominance, age ranging from 2- 10 years, the follow up period was 5 years. All patients were able to wear normal shoes except one. The correction of adduction obtained was 9 degrees(mean) measured by talo-1 st metatarsal angle and 11 degrees by calcaneal – 2nd metatarsal angle. There was no incidence of non union and one case developed superficial infection.

In the study of Eugene and Patrick ^[41], concluded that cast application was best for flexible deformities, age less than 3 years. The problems with metatarsal base osteotomy was incomplete correction and the added difficulty in maintaining the correction. Of the 27 feet that were operated, 13 feet showed satisfactory correction.

In Muhamed and Tarek study ^[42], of the 32 feet operated upon which was boys predominantly, and bilateral predominance. All with a history of previous surgical release satisfactory results with an average correction of the adduction achieved being 17 degrees measured by the talo – 1 st metatarsal angle and 19 degrees for calcaneo- IV th metatarsal angle. The follow up period being 3 years and only one case showed complication of skin necrosis which was treated by medications.

Shoemaker *et al.* ^[25] operated on patients with metatarsus adductus with no history of previous surgery, with the same procedure and obtained satisfactory results.

Kose *et al.* ^[30] reported closing cuboid and opening cuneiform osteotomies in 10 feet with supination and adduction deformities and three patients with cavovarus deformities. Their results showed satisfactory correction of adduction and supination. Loza and Barbary *et al.* ^[43], operated on 20 feet with age between 3 to 7 years, predominantly male. The right foot being affected more than the left. 40% of the cases showed excellent results and the complications included superficial infection, slippage of graft, and K- wire migration.

Lourenco *et al.* ^[26], treated 39 feet with a closed wedge osteotomy of cuboid and open wedge osteotomy of the medial cuneiform. They were predominantly male unilateral in 19 and bilateral in 10. All cases underwent a prior surgery using the cincinnati incision. The average correction of adduction achieved was 15 degrees and no complications were reported. Gordon *et al.* ^[29] this procedure should be reserved for patients aged 5 years or older. The osteotomy in cuneiform is difficult since it was small and not fully ossified.

In our study, we did not carry out overcorrection in our cases as proposed by Mc Hale and Lenhart ^[7] and neither our data allow us to identify those patients at risk of recurrence and the long-term effect of overcorrection of a midfoot or forefoot deformity. Our aim was complete correction of the deformity by double osteotomy. In our study there was a predominance of males 7 (44%) and right sided in 9 feet (56%). Equinus deformity was seen in 12 feet and cavus in 5 feet which was corrected by tendoachilles lengthening by „Z“ plasty, plantar fasciectomy respectively. The correction in adduction achieved as measured by the Talo - 1 st metatarsal angle was on an average 11 degrees and calcaneo – 5 th metatarsal angle 14 degrees (average). The results were excellent in 50% of the cases (8 feet). None of the cases complained of pain prior to surgery and after surgery. One case had recurrence of deformity at 1 year follow up due to insufficient size of the graft wedge, 2 patients had a superficial infection which was treated and 2 cases had K- wire migration. All patients were satisfied with the operation, suggesting that the recurrence of the deformity does not necessarily influence the patients satisfaction with the results. This suggests that the ability to wear normal shoes and the absence of pain are more important than the prevention of recurrence. The limitations of the study were inadequate sample size and a follow up of 2 years, hence the long-term effects of the correction could not be assessed.

There is an increasing need for osteotomy as a part of revision surgery to correct forefoot adduction deformity. Tarraf and Carroll ⁵ noted an incidence of soft tissue operations of 46.5% compared with 4.4% of bony procedures at first

revision, 25% compared with 20% at second and 27.3% compared with 54.5% at third, the remainder being combinations of both. The increasing frequency of osteotomy was attributed to the presence of extensive soft tissue scarring, making soft tissue release more difficult. Scar tissue also promotes recurrence. Osteotomy also has the added advantage of correcting the deformities of the tarsal bones which undergo deformation during the growth phase in idiopathic club foot.

Conclusion

1. The most common deformity seen after surgical correction of idiopathic clubfoot is forefoot adduction.
2. The etiology is unknown, but the most probable cause being undercorrection at time of primary surgery and irregularity in wearing brace postoperatively.
3. The combined osteotomy is a safe procedure and allows satisfactory correction of the residual forefoot adduction deformity and achieving a straight plantigrade foot.
4. No modified foot wear or shoes were required to be worn for a long term after the correction was achieved unlike other procedures.
5. The operation is not suitable for non-idiopathic clubfoot, secondary clubfoot, and in those feet with repeated relapse and unsuitable skin condition.
6. The long-term morbidity must be evaluated by regular follow up to assess the functional outcome.

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