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Research Article

Correction of Rigid Congenital Talipes Equiano Varus (CTEV) in Mature or Near Maturity Foot by Ilizarov External Fixator, Our Experience of 16 Cases

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Abstract

Overview: Neglected club foot deformity is common in our part of the world due to underdeveloped health facilities in a far flung areas. As the age progresses, the deformity becomes very rigid and with thick large callosity over lateral plantar arch of the foot. Foot remains rigidly supinated, forefoot in adduction, heel in varus and equinus position. Neglected congenital Talipes Equiano Varus has severe deformity. Correction of rigid foot deformity with Ilizarov is beneficial as it corrects all deformities of TEV foot.

Materials and Methods: Prospective study conducted in Rawalpindi Medical University Hospital from 2008-2017. Cases selected were mature foot or near maturity. Frame was kept for 6 weeks after full correction, casts were replaced every 6 weeks, for a total of 12 weeks. Patient weight bearing, comfort was noted in a pre and postoperative scoring table.

Results: A total of 10 patients, 16 feet were included in this study. Mean age was 17.5 years (SD ± 9.45) with range of 8 to 40 years. Deformity severity score was built with maximum score of 12 and least deformity score as 0.

Discussion: Treatment of neglected CTEV is adults is a great challenge, till the age of 20 if not treated has been considered as candidate for amputation and prosthesis. Extensive soft tissue release, bony wedge resections, excision of talus with triple or pantalar arthrodesis has been reported in literature. Use of Ilizarov became a popular success provided correct frame application is done. Notable complications included neuromuscular compromise, skin stretch and cut from wire, infection, subluxation of tarsal bone.

Keywords: *Congenital Talipes Equiano Varus; Club Foot Deformity; Mature Foot Correction; Ilizarov Fixator*

Introduction

Neglected club foot deformity is common in this part of the world [1] due to underdeveloped health facilities in a far flung areas, poverty and illiteracy are other reasons. Improvement in casting technique has reduced the number of surgeries. Extensive soft tissue release is being replaced by percutaneous tenotomy and serial casting [2-5].

Children with neglected CTEV, even if remain untreated, at some age they are able to start walking on the lateral aspect of the foot. This further worsens the deformity as the age progresses, the deformity becomes very rigid and with thick large callosity over lateral plantar arch of the foot.

Foot remains rigidly supinated, forefoot in adduction, heel in varus and equinus position [5]. Triple- arthrodesis has been practiced for such patients, which makes foot in plantigrade but foot becomes even more smaller, which is already smaller than normal [6,7]. Lot of talus is needed to be excised for correction of varus of hind foot which hinders the ankle movements as well. Correction of rigid foot deformity with ilizarov is very challenging but being practice in literature with favorable results [7-10].

Advantage of Ilizarov frame is that it can correct all rigid deformities of foot in adult with TEV patients. Extensive incisions and further bone excision is avoided, hence avoid further shortening of foot [11]. Complications like wound infection, neurovascular compromise is also decreased [4,12-19].

Ilizarov frame for CTEV deformity has 2 components, the leg and foot component. Both components are not in the same plane. In foot component the use of C ring, plate and distraction compression rod has to be placed intelligently according to the deformity.

Sequence of correction is important [20]. Supination of the foot and forefoot adduction followed by the cavus correction it also corrects the disproportionate medial and lateral column. Hind foot and equinus correction done simultaneously. Patient has good cosmetic outcome. Severe deformity is corrected if further procedure require, triple arthrodesis will need much smaller resections of bones [10,21].

The acceptability of the procedure relate to the cosmetic outlook, patient's convenience when he starts weight bearing. We have introduced the scoring system on the basis of severity of deformity and acceptability of the procedure by patients in terms of frame tolerance and comfortability on weight bearing. As the joint moment generally remain poor after correction of CTEV in adult foot so we have excluded the range of movements of the involved joints of foot We have modified scoring scale which can be very easily employed even in the busiest of clinic.

Aim of the Study

Our study aims to find the correction of the rigid TEV with Ilizarov apparatus and the acceptability of this procedure in our set up. We are presenting 16 cases with per cutaneous tendo-achilis lengthening and release of planter fascia followed by a gradual correction with an ilizarov apparatus.

Material and Methods

It is a prospective study conducted in Rawalpindi Medical University Hospitals from 2008 - 2017, sixteen feet were selected with neglected or recurrent congenital talipes equinovarus. Cases selected are mature foot or near maturity. Cases having previous extensive surgery, neuromuscular disorder and patients having infection of the foot were excluded as their clinical behavior and outcome may have been different. Bilateral cases were operated in two stages, once correction is achieved in patient with below leg cast and they are sufficiently adoptable to put weight on foot with cast only then second foot was consider eligible for surgery.

There are two components of frame. Leg component has two rings of appropriate size; distal leg ring should have sufficient distance from heel so that sufficient leaver arm is there for rods and hinges to correct heel varus and equinus of heel. For posterior foot we used, multi-hole Carbon U-ring for heel, in case if not available we used two rings overlapped and slide over each other to make U-ring suitable to heel size of patient. Holes of two C ring may not exactly align with each other which make assembly very difficult. Usually, we pass two beaded Kirschner wires 1.8 mm parallel to the sole of heel from medial to lateral, to avoid damage to neurovascular bundle. Sometimes three wires were used if deformity was very rigid. A Schanz screw in posterior heel is useful to make construct stable but it is very painful for the patient while deformity is correcting. Two K-wires 1.8 mm and 1.5 mm were passed according to the size of foot parallel to sole

of foot at mid-tarsal level and distal metatarsals. These wires were mounted with 4 to 5 holes plate or post. One C-vertical ring was tired with this plate. We used two rods with universal hinge from distal ring to distal foot C vertical ring in compression and distraction mode to correct supination and adduction. Cavus and medial lateral arch disproportionate were corrected with two distraction rods from heel appliance to distal plate.

Manipulations of feet were done prior to surgery by physiotherapy or exercise techniques done at home. During frame application optimum possible correction is achieved without stretching neurovascular bundle and skin. When patient became comfortable a few days after surgery they were given task of gradual distraction of one or two components. If the patient did not belong to remote or far-flung area they were easily discharged and followed up frequently in outpatient department to make sure deformity correction is going smooth and appropriately. Patients may require change of rods, post and even occasionally K-wire which was done under popliteal block or spinal anesthesia. This helped us to further augment the correction. Weight bearing with frame was at times not possible due to hardware not allowing sole to touch ground. When deformity was completed or is near its completion frame was made simpler to allow the weight bearing of the foot. Adequate measures were taken to make sure deformity is not over corrected. Frame was kept for 6 weeks after full correction and then it was replaced with below knee synthetic cast with full weight bearing was allowed. Cast was repeated and replaced every 6 weeks making a total of 12 weeks in cast. Patients weight bearing, comfortability and capability were noted.

Patients' questionnaires were made with pre- and post-operative scoring table. Patients' satisfaction in terms of frame acceptance and comfortability of weight bearing were scored.

Results

A total of 10 patients, 16 feet were included in this study, out of these 8 were male (80%) and 2 were female (20%). Mean age was 17.5 years (SD ± 9.45) with range of 8 to 40 years. Left (n = 8) and right (n = 8) were equal in frequency. Deformity severity score was built with maximum score of 12 and least deformity score as 0 (Table 1-3, figure 1-15).

Discussion and Conclusion

The treatment aim for congenital talipes equinovarus (CTEV) is to obtain full correction, a normal looking foot and having joint mobility at maturity of foot [22]. A stiff normal looking foot is considered far inferior in performance compared to a mobile foot [23]. When treatment remain ineffective or neglected patients attain maturity with rigid deformity of foot. These cases are not very rare to be seen

Variable	Pre- operative (mean)/(Range)	Post-operative (mean) - (Range)
Supination (0-3)	2.13/(1 - 3)	0.00/(0 - 0)
Adduction FF (0-3)	2.63/(2 - 3)	0.06/(0 - 1)
Hind Foot Varus (0-3)	2.75/(2 - 3)	0.13/(0 - 1)
Equinus (0-3)	2.75/(2 - 3)	0.44/(0 - 1)
Total Deformity Score (Mean)	10.25/(7 - 12)	0.63/(0 - 2)

Table 1: *Pre and post-operative deformity severity score.*

Deformity severity score:

0 = Normal looking.

1 = Mild, Deformity can be corrected to neutral passively.

2 = Moderate, Deformity can be passively correctly less than neutral.

3 = Severe, Rigid deformity.

Variable	Mean	Range
Patient Satisfaction	0.875	0 - 2
Weight bearing	1.125	0 - 2
No. of corrections	2.875	1 - 5

Table 2: *Patients satisfaction in the form of frame acceptance and weight bearing.*

Patient satisfaction includes: Frame acceptance and weight bearing capability.

0 = Frame acceptance with no complain.

1 = Painful and willing to go for same surgery.

2 = Painful and willing to undergo surgery but wants to borrow time.

3 = Painful and not willing for any further surgery.

Weight bearing capability:

0 = Pain free/no difficulty.

1 = Weight bearing with difficulty.

2 = Weight bearing with pain.

3 = Worse than before surgery.

Variable	Mean (Weeks)	Range (Weeks)
Duration of Frame	10.75	8 - 16
Duration of POP cast	9.75	6 - 12
AFO (Brace)	31	16 - 50

Table 3: *Duration of frame and splintage, in weeks, after correction of foot deformity.*

Figure 1-6*: 40 years male with corrected and deformed foot CT scan to show orientation of tarsal bones.*

Figure 7-12: *Figure 7: 10 years male before correction. Figure 8 and 9: Ilizarov frame from medial and lateral view of right foot. Figure 10 and 11: After correction of right foot. Figure 12: Left foot after correction.*

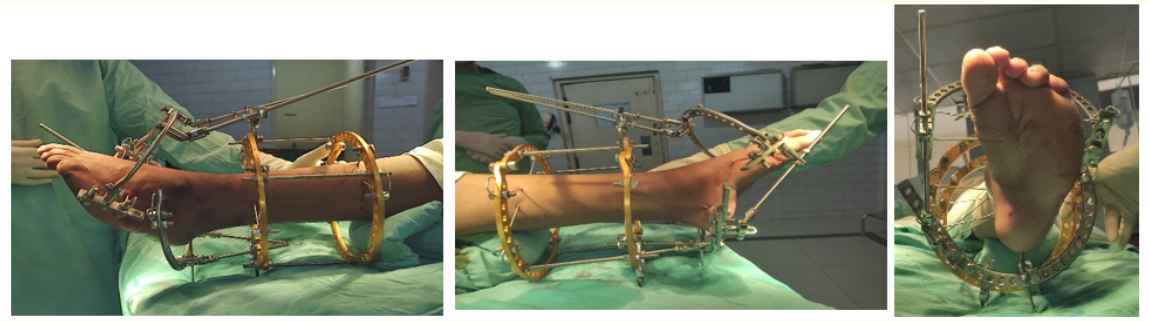

Figure 13-15: *Per-operatively taken pictures of ilizarov frame application from medial, lateral and plantar view of left foot correction.*

in our outpatient department. These patients are usually residing in far flung areas with poor medical services. Some adult Patients near sixth decade of life refuse any treatment or surgical intervention as they are well adopted. Patients of younger age, working class, near marriage or school going children face pain or embarrassment by peers or society are compelled to seek treatment.

When treatment remains neglected although the child starts walking on lateral aspect of foot, which further worsen the deformity, but patient and their family members are more satisfied on walking as the dependency has decreased thus further resulting in delay to seek treatment. As the age proceeds the deformity becomes rigid, callosity at lateral dorsum gets thickened and on occasion ulcers may also form. Infections make the scenario worst to an already ugly looking painful foot.

Treatment of neglected CTEV is adults is a great challenge, till the age of 20 if not treated has been considered as candidate for amputation and prosthesis [14,15] Extensive soft tissue release, bony wedge resections, excision of talus with triple or pantalar arthrodesis has been reported in literature [24].

Initially the use of the Ilizarov external fixator for correction of deformities of foot was not encouraging [4] but later it became popular for treatment of CTEV but this needs an understanding of the deformity and intelligent knowledge regarding frame application is essential [17,25-29]. Individual component of deformity of foot needs to be addressed, older the age more rigid is the deformity. Hence level of difficulty to correct deformity increases and acceptability or adoptability of patient to change in weight bearing axis as well as bones and sole of foot which are not yet adapted to load bearing. Sequence of the component correction and making it tolerable for patient without compromising neuromuscular status, skin stretching, cut out of skin with wire, pin tract infection, loosening, sub luxation of tarsal bones are noticeable complication of this procedure. Choi., *et al*. [30] has recommended the hind foot, mid foot and forefoot deformity correction simultaneously, while our study of 16 feet in 10 patients supination corrected simultaneously with hind foot, varus and equinus. Cavus deformity is addressed in later part of the correction which is different from Ponseti principal [3,4]. But the Ponseti excluded children more than 6 years due to soft tissue contracture and altered tarsal bone shape. For assessment of the club foot deformity severity different scoring systems are in clinical use, these scoring system not only determine severity of the problem but monitor the progress and treatment outcome. Pirani scoring system is reliable [31] and can predict the treatment duration as well [32].

Dimeglo has 20 points and four basic parameters for evaluation of foot deformities. Both of these scoring systems believed to be insufficient to predict the course and result of treatment [33]. Choi., *et al*. studied the arthrogrypotic foot, 12 relapse cases used the classification of AOFAS scores [34]. While Dimeglio score, Levaag and Ponseti functional score, Lamm., *et al*. [4,25], Reinker and carpenter scale [25].

All these scoring system are either based on evaluation of children and adults combined or they are a bit complicated in a sense of the outcome with the range of moment.

We have modified scoring system as already practicing scoring system are for the children while in adult foot which is very rigid with no bony remodeling capability. Our target is to achieve plantigrade foot which is cosmetically acceptable for patient and ultimately comfortable enough for weight bearing. There is significant improvement in the gait of patient which is extremely encouraging for treating physician. If we add range of motion at hind foot and mid foot level it severely compromises the results.

We have not done any corticotomy or osteotomy in correction of deformity. De La Huersta in 1994 reported results of 12 cases, while Ferresia reported 38 feet corrected with distraction histogenesis [34]. He has larger series compared to our 16 feet but we exclusively included all adult feet with more rigid deformity. We did not report any neurovascular complication.

Ponsetaylor technique has been used by Lamim., *et al*. [4] he used hexapod external fixator to correct the deformity by ponseti principals using olive wire but this was used on children while Fiyaad., *et al*. 2019 [24] has a case study neglected club foot by ponseti-hex assisted triple arthrodesis. We have not done triple arthrodesis in any case but it may be required in future for reoccurrence of deformity or for pain control. A plantigrade foot will not require to excise lot of bone wedges.

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