

Residual Clubfoot-Correction By Controlled Differential Fractional Distraction.

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Abstract:

Introduction; Treatment of club foot is still a clinical challenge. The literature on clubfoot as a general rule, that of unvarying success. The increased failure rates among conservative management has led to various surgical interventions. A recent study of clubfoot surgeries have come up with a high proportion of unsatisfactory results. The work of Illizarov showed encouraging results without the dreaded complication of infections. He believed that controlled mechanical stress lead to regeneration of soft tissues including skin, muscle, tendon, nerve.

Aims And Objectives; In this study, we aim to assess the result of residual clubfoot correction using Joshi's external stabilizing system at Jubilee Mission Medical College Hospital, Thrissur, Kerala.

METHODOLOGY, we have analysed 25 children with clubfoot deformity who had undergone correction by differential fractional distraction in Jubilee Mission Medical College in the year 2008 to 2010. They were followed up for two years, bi monthly. All had idiopathic club foot. There 15 male child and 10 female child aged between 6 to 10 years. All the patients had prior soft tissue releases at different age group. All these patients had discontinued their treatment for various reasons. We did Dr. B.B Joshi external frame on all these children. Pre operatively they were assessed with Carrolls criteria, radiological assessment was also done. Post operative period for correction of deformity varied from 4 weeks to 7 weeks. Once correction is obtained then the apparatus is locked in that position for 6 weeks. The results were analysed with Functional Rating System advocated by Lehman.

Results And Observations; 57.14 % had excellent functional outcome, 17.8% had good outcome, 17.8% had fair outcome. Only 7.14 % had poor outcome. 17.86 % obtained dorsiflexion beyond 0 degree, 75% obtained neutral foot. Adduction deformity of fore foot was corrected in 100% of the cases. The average talocalcaneal angle pre and post operative was 29.8 and 55 degree respectively. There were only minor complications in patients.

Conclusion; External fixation is a good method in management of residual deformity in congenital talipes equino varus. Cosmetic and functional results are satisfactory. Radiological correction is comparable with other methods. Ankle dorsiflexion is better when compared to other soft tissue procedures.

Keywords ; congenital talipes equino varus, controlled fractional distraction.

I. Introduction.

Congenital talipes equino varus has always been shrouded in controversy. Although many studies have been made over the years about its management, confusion and varying opinion still exists regarding etiology, pathogenesis, treatment and prognosis. This is one of the commonest condition in Orthopaedics, its incidence being 1-2/1000 live birth.

The treatment of clubfoot still remains an exciting clinical challenge. The literature on the treatment of clubfoot as a general rule, that of unvarying success. The increased incidence of failures by conservative means led to various surgical intervention for correction of clubfoot deformities. The last 2 decades have witnessed an emphasis on extensive surgical releases and new incisions. A recent study of three most commonly performed surgeries for the clubfoot deformity came up with a high proportion of unsatisfactory results. Long term follow-ups has revealed the same problems as seen with the older procedures.

Change is the way of life, and it is only a change for the better that can improve the system to perfect it. With the rejuvenation of the age old principle of tissue distraction a new vista appeared on the horizon on management of clubfoot. The work of Ilizarov believed that controlled mechanical tension stress led to regeneration of soft tissues including skin, muscles, blood-vessels and nerves. This gradual stretching of deformed foot also led to adaptation of the internal bony structure.

In this study we used the external fixator frame designed by Dr.B.B.Joshi which is suitable for correction of complex deformities in these small feet. This provides precisely controlled fractional distraction the foot is supple and pliable like a bag of bones and cartilage, in an envelop of soft tissues and is amenable to

precise moulding in a cast or external fixator. The correction of adduction deformity of forefoot is achieved simultaneously with the correction of hind foot equinus and varus deformities and yet there is individual control in the correction of each deformed element in sequence.

II. Aims & Objectives:

In this study, we aim to assess the result of residual clubfoot correction using Joshi's external stabilizing system at Jubilee Mission Medical College Hospital, Thrissur, Kerala, India. We would like to discuss details of various surgical procedures and finally draw conclusions of overall study.

III. Materials And Methods:

This study was conducted on 25 children with 28 residual clubfoot deformity who had undergone correction by controlled differential fractional distraction in Jubilee Mission Medical Hospital, Thrissur, Kerala, India, in the period 2008 to 2010. All had idiopathic variety of clubfoot. There were 15 male children and 10 female children. The age distribution was between 6 to 10 years. The left side was affected in 18 patients and right side in 7 patients. There were three patients with bilateral involvement. Of these 25 patients, 20 patients had postero medial release at different ages, 8 patients had postero medial release at 6 months, another 8 at 12 months, and 4 patients at 18 months of age. The details of the operative procedures done and the post operative regimes were not available. In the remaining 5 patients, 4 patients had posterior release at 6 months and 1 had at 12 months of age. All these patients had discontinued the treatment after 12 months due to various reasons. In 18 patients it was due to poor socio economic status in 5 patients due to poor understanding of the parents and in 2 patient it was due to religious customs and beliefs.

Clinical Assessment:

The pre operative assessment of these 25 patients were done using Carrolls¹ method. The features to be noted are,

1. Calf atrophy
2. Posterior displacement of the fibula.
3. Creases on the medial aspect or posterior aspect.
4. Curved lateral border of the foot.
5. Carvus deformity.
6. Fixed equinus.
7. Navicular fixed to medial malleolus.
8. Os-calcis fixed to fibula
9. No midtarsal mobility.
10. Fixed forefoot supination.

Each feature scores 1 point when present or no point when absent. Thus the foot having all the features would score 10 points showing a severe deformity and a normal foot would score 0 point. According to Carrolls criteria, in this series we had 20 feet with 7 points and 8 feet with 6 points.

Radiological Assessment:

This is done taking various measurement from the antero posterior and lateral view of the foot. The angles measured are,

- | | |
|--------------------------------------|-----------------------|
| 1. Talo calcaneal angle-AP view | 20 to 40 deg.(normal) |
| 2. Talo calcaneal angle-Lateral view | 25 to 50 deg.(normal) |
| 3. Talo calcaneal index | 40 deg.or more. |

Pre Operative Measurement:

Talo calcaneal angle	Range(degrees)	Average(degrees)
1. Ap View	10 to 20	14.6
2. Lateral view	15 to 21	15.2
3. Talo calcaneal index	-	29.8

IV. Follow Up And Results:

In this series we had 25 patients (28 feet) with residual CTEV for whom controlled differential fractional distraction using Joshi's external fixator was applied. The total duration of active treatment was three months and all patients attended the follow-up study. Follow up was 2 years. Assessments were carried out every month with special regards to deformity correction, range of movement of ankle and subtalar joints,

radiological assessment and analysis of gait, pain etc. This assessment was based on the Functional Rating system by Lehmen, Atar et al²

Post Operative measurement:

TC angle	Range(Deg.)	Average(Deg.)
AP view	25 to 35	27
Lateral view	25 to 40	28
TC index	-	55
Talo 1 st.metatarsal angle AP view	-	8

According to the functional rating system by Lehman,Atar et al²,in this series we had the following results.

Excellent	16 feet	57.14%
Good	5 feet	17.85%
Fair	5 feet	17.85%
Poor	2 feet	7.14%

V. Complications

In this series the following complications were noted:

1. Temporary oedema.

In all cases this problem was seen in the early stages. By elevating the foot the swelling came down and everything was cleared by three days. It was advised to withhold the distraction for 3 to 5 days if the swelling persists.

2. Superficial pin tract infection.

In 7 feet we had superficial pin tract infection and were controlled by dressings changed at three days interval. Use of the half wires and pre-stressing of transfixing wires or addition of a vertical wire in the tibia connected to the transverse bar between the limbs of Z rods prevents the rocking and loosening, thus averting pin tract infection.

3. Flexion contractures of the toes.

In 12 feet this problem was noted and considered to be due to the inelasticity of the flexor tendons during distraction phase. The foot plate and elastic band traction applied to the slings around the toes helps to prevent this eventuality.

4. Loosening of the linking joints.

In 6 feet we had this complication. This could be prevented by checking and tightening of all joints during every dressing.

VI. Discussion

Congenital talipes equinovarus is one of the commonest condition with much controversy regarding its etiology, pathogenesis, treatment and prognosis. The aim of treatment in clubfoot is to obtain a plantigrade, pliable and cosmetically acceptable foot either by non-operative/operative means. The correct treatment for correction of the deformities in residual clubfoot is still disputed. The controversy over conservative and operative treatment still remains. There are various arguments put forward by each group regarding the advantages and disadvantages of a particular method. The long term results of a revision surgery have never been studied extensively A recent study of 159 feet followed up for over 3 years by lehman, Atar et al² emphasized that even the best results cannot be regarded as giving normal looking foot.

All the patients in this series with residual clubfoot deformities initially had treatment with plaster cast. Kite³ reported that of the 387 patients treated with plastering,92(23%) had excellent result,246(63%) good and satisfactory in 25(14%).The average time required for the correction was 37.2 weeks. Mc Kay⁴ estimated only a success rate of 5% with the conservative treatment. Turco⁵ reported his long term end result study with non-operative treatment and obtained lasting correction in only 35%. Zimble⁶ followed 90 cases unto maturity and found only 10% cases responding to plaster treatment.

Even now it is not agreed at what age the soft tissue release procedures should take place. It has been observed by some authors that the age at operation does not affect the result. There is a view that the best results are obtained when the operation is done between 1-2 years.

Turco⁷ mentioned that the best results are in children operated on between the ages of 1-2 years. He noticed failures in children operated on when they are less than 1 year old, due to overcorrected flat foot deformities and recurrence. In Turcos study after 2 years of age the number of excellent results also diminished. He reported his result in 88 patients 1-2 years of age as excellent in 45(51.13%), good in 35(39.27%), fair in 6(6.81%), and failures in 2(2.27%). Carroll et al¹ recommended operating on the resistant clubfoot early, as young as 2 months. This early surgery permits the corrected foot to remodel the pliable, cartilaginous surfaces of the ankle, subtalar, and talonavicular joints. Mc Kay⁴ also recommended operating on clubfoot as young as 2 months to maximize the preservation of articular cartilage and promote growth of the talus. Simmons⁸ mentioned that the child should be under 4 years of age for the best result. The highest rate of satisfactory result occurred in patients under 1 year of age. After 4 years of age the advanced stage of bone and structural deformity reduces the probability of success.

It is mentioned that relapse of deformities does occur very commonly in CTEV even after a very early soft tissue procedures. The most common causes for relapse is the inadequate correction obtained at surgery. Turco⁷ mentioned that the loss of correction is due to wound necrosis, wound dehiscence, slipping of k-wires etc. The other causes mentioned are failure to maintain the correction in an orthosis, infection and scar formation at the operated site.

Magone, J.P.; et al⁹ reviewing the surgical treatment of idiopathic clubfoot by Turco's, Carrol, McKay's procedure mentioned that relapse of foot deformities occurred in all these procedures. Atar¹⁰ mentioned that the recurrence of the hind foot deformity is due to an iatrogenic talo calcaneal bar which he noticed in 22% of revision surgeries. Laaveg, S.J.; Ponseti, I.V¹¹ are of the opinion that the recurrence can occur within two years. The extensive soft tissue procedures by McKay's and Simmons technique leads to over correction which is becoming more common. Simmons⁸ noticed lateral over-correction which is becoming more common. Simmons noticed lateral over-correction in 72% and dorsal over-correction in 28% following the complete subtalar release operations in clubfoot deformities. The main aim in clubfoot surgery is to get a full and lasting correction.

The surgical technique used in this study is a simple and semi invasive one where we used an external fixator designed by Dr. B.B. Joshi for the correction of complex deformities of the foot in small feet. The principle behind this technique is the histiogenesis following tissue distraction by the law of Tension-Stress popularized by Ilizarov. The apparatus provides controlled fractional distraction to correct all aspects of deformity by gradual sequential stretching of the tissues. The correction of the adduction deformity of the foot is achieved simultaneously with the correction of hind foot equinus and varus deformities and yet there is individual control in the correction of each deformed elements in sequence.

It is believed that gradual distraction leads to histiogenesis of tissues. This gradual distraction procedures stresses on living tissues which will stimulate the regeneration and active growth of the living tissues. This histiogenesis following distraction on tissues is called the law of tension stress. It is also noticed that once a living tissue subjects to gradual distraction it becomes metabolically active. The histiogenesis following tension stress is studied quite extensively. The muscle growth is by myofibrillogenesis and the new muscle tissue seen as an increase in the number of muscle satellite cells. The neural tissues shows elongation of axons with partial covering of the Schwann cells cytoplasmic process. The skin shows activation of the basal layer of the epidermis as a result of this tissue distraction. The effect of distraction of tarsal bones is not very clear.

The total period required for getting correction in clubfoot depends on the severity of the deformity. Fernando de la Huerta¹², reported 5 to 8 months for correction of the neglected clubfoot by this method. Grill, F and Franke, J.¹³ reported a period of 4 to 10 weeks for connection. Cantin, M.A.¹⁴ has reported a period of 5 days and 5 months to a mean of 7 weeks for the correction. In this study the total time taken for the correction is from 4 to 7 weeks with an average of 6 weeks and 1 day. The period recommended for the static phase with the fixator also varies. Grill, F and Franke, J.¹³ recommends a period of 8 to 10 weeks for the maturation of stretched tissues and so to prevent a recurrence. Joshi, B.B.¹⁵ recommends a period of 3 to 6 weeks. In this series the total static phase with fixator was 6 weeks.

Series	excellent	good	fair	poor
1. Atar, Lehman, M.D; et al	38%	28%	28%	6%
2. Lehman, W.B; Atar, D; Grant, A.D	51%	24%	8%	7%
3. In this series	57.14%	17.85%	17.85%	7.14%

It is worth discussing some of the categories of this Functional Rating System.

Ankle Dorsi Flexion(Passive):

It is noticed that in this series 5 feet(17.86%) obtained passive dorsiflexion beyond neutral and 21feet(75%)obtained neutral and 2 feet(7.14%)less than neutral. W.B.Lehman,D.Atar² et al reported a passive ankle dorsiflexion of more than 0 degree in 76% and 0 degree movement in 24% in a follow up study of 45 patients.

Series	Ankle dorsi flexion(passive)		
	>0 deg.	0 deg.	<0 deg.
1.Lehman,.W.B;Atar,et al	76%	24%	-
2.In this series	17.86%	75%	7.14%

Fore Foot Appearance:

Adduction of the fore foot is one of the most frequent residual deformity following surgical correction of CTEV. This can give problems with fitting and wearing of shoes and in toeing gait is evident. A mild adduction of the fore foot does not need any operative interventions. J.P.Magone,et al¹⁴ reviewing the surgical treatment of CTEV by various procedures mentioned that the problem noticed is the residual forefoot supination and fore foot adductus. In this series the fore foot was neutral in all feet indicating correction of fore foot deformity.

Radiological Assessment:

There are very many radiological angles for measuring the deformity pre operatively and for assessing the deformity correction post operatively in CTEV. But some of these classic radiographic parameters have an unacceptably high rate of inter observer error Kite’s antero posterior talo calcaneal angle reflects the varus – valgus position of the heel. An angle of more than 40 degree indicate a valgus and angle of less than 20 indicates a hind foot varus.

One problem noticed here is the difficulty in drawing the Kite’s angle in skeletally immature foot ,since the talus and calcaneus appear as ossific nucleus which tends to be round. Drawing a line along the long axis of a round structure will create errors in measurement to be reliable at the 95% confidence level. The normal measurement is 25 to 50 degrees, an angle of less than 25 indicates a hind foot equinus. There is diversity of opinion as to acceptable normal range of some angles measured.For the AP talo calcaneal angle, Templeton et al¹⁵ advocated the range of 30 to 50 degrees for children under 5 years of age. In children over 5 years of age the range of 25 to 50 degrees as normal, Simons⁸ uses the range of 35 to 50 degrees. All authors agrees a value less than 25 degrees reflects inadequate correction of the hind foot.

In this study, we measured the talo 1st.metatarsal angle from an AP view for the assessment of forefoot adduction. In a normal foot the measurement varies from 5 to 15 degrees. In clubfoot it is 0 degree or negative. In this study the post operative mean talo 1st.metatarsal angle is 8 degrees.

It has been shown by arthrography that in clubfeet the nucleus of the talus exists eccentrically in talar neck, with medial deviation of the talar neck. The mean angle of the talar neck is found to be 139.9deg.in normal feet. The mean angle between the long axis of the talar body and the calcaneus ossific nucleus ossific nucleus is 7.3 degree in normal feet and -8.9 degree in CTEV. Thus this is considered to be most reliable in the assessment of the correction. Beatson and Pearson¹⁶ advocated assessment by the talo calcaneal index where the talo calcaneal angles in the AP and lateral projections are added together. They stated that the correction is inadequate if the talo calcaneal angle is under 40 degree.

VII. Conclusion

- External fixation is a good method in management of residual deformity in congenital talipus equino varus.
- Cosmetic and functional results are satisfactory.
- Radiological correction is comparable with other methods.
- Ankle dorsiflexion is better when compared to other soft tissue procedures.
- Good acceptance by the parents
- This method has the advantage of histiogenesis, absence of scar and maintenance of foot length.

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