

Clinico-radiological study of congenital clubfoot in young children (up-to five years) undergoing percutaneous tenotomy: A prospective observational study

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Abstract

Clubfoot or congenital talipes equinus varus (CTEV) is a common problem in pediatric foot. Neglected clubfoot require extensive and lengthy procedures which is out of reach of most people especially in developing countries. Ponseti’s technique can be tried in young children to treat CTEV. Children between age of one to five years were enrolled and treated by Ponseti’s technique. Patients were followed up weekly for plaster revision till six weeks and correction and relapse was clinically assessed with Pirani score at each visit. Continuity of Achilles tendon was assessed ultrasonographically before tenotomy, immediately after tenotomy and at 3rd and 6th week of tendon healing. All the pretreatment and post treatment scores were compared. Out of 70 patients screened for inclusion in the study, final analysis can be done on 30 feet. Pirani score improved in all the components of clubfoot after treatment. Clinical continuity was seen in

all the tendons after 3rd week of treatment and radiological continuity was seen by 6th week post treatment. The lack of requirement of extensive surgery in this technique makes this procedure ideal for developing countries like ours where specialist care is out of reach of most people, hence by this technique basic health care workers can also manage young children with club foot.

Keywords: Clubfoot, CTEV, Ponseti, Young Children.

Introduction

Congenital talipes equinus varus (CTEV) or clubfoot is common congenital deformity complex occurring in otherwise normal child (primary CTEV) or as a part of other disorders such as poliomyelitis, cerebral palsy, arthrogryposis multiplex and muscular dystrophy (secondary CTEV)[1]. Incidence of CTEV in India is 0.9 per 1000 live births and prevalence is about 1.29 per 1000 live births with 2-2.5 males affected per female. Most cases are bilateral. In unilateral cases,

right foot is affected more than left[2]. Many children with club foot, especially in developing countries, are left untreated and develop neglected clubfoot. Treatment of neglected clubfoot ranges from extensive soft tissue release to complex correction using different types of external fixators, corrective osteotomy and triple arthrodesis. Not only these produce painful, stiff and scarred feet but are also long drawn and costly procedures, hence out of reach of majority of the population[3]. This warrants a simpler approach which may be carried out by health care workers other than specialists so that early and successful intervention can be done.

CTEV has four components: equinus, varus, adductus and cavus. The goal of treatment is to correct all components of deformity so that patient has a pain free plantigrade foot with good mobility, without the need to wear modified shoes[4]. Correction of CTEV after the age of six months had been mostly surgical. However, most experts now believe that initial treatment of clubfoot should be non-operative and initiated early to utilize favorable viscoelastic properties of connective tissue forming joint capsules, ligaments and tendons during first few years of life[5]. Microscopically, bundles of collagen fibers display a wavy appearance known as “crimp”. This crimp allows ligaments to be stretched. Gentle stretching of ligaments in infant causes no harm. Crimp reappears few days later, allowing for further stretching. Hence, manual correction of the deformity is feasible at younger age group[6].

Excessive collagen synthesis in ligaments, tendons and muscles persisting till three to four years of age might be cause of relapse of CTEV[7]. Ponseti’s technique has been used to treat arthrogryptic clubfeet without extensive surgery during infancy and early childhood.

Ponseti’s treatment of idiopathic clubfoot is effective between ages of one to six years[8]. However, it has been tried mostly in younger age group. Ponseti treatment’s success in other foot deformity led to its application to achieve correction of clubfeet recurring after posteromedial release[9]. Hence this study was planned to study the patient profile and complication and outcome of club foot undergoing Ponseti plaster technique using Pirani scoring and ultrasonography(USG) in wider range of age group[10].

Materials and methods

Institutional ethical committee clearance was obtained before starting the study. In this prospective observational study pediatric patients (newborn to five years of age) of idiopathic clubfoot attending orthopedics and pediatric out patient department in tertiary center in north India, were enrolled for one year. Patients with secondary clubfoot like neuropathic clubfoot, syndromic clubfoot, postural clubfoot and metatarsus adductus were excluded. Parents of the patients were explained the procedure in their language and their consent was taken before enrollment. A detailed history was taken regarding associated deformity, family history of similar deformity and history of previous treatment. General examination was done to detect any other congenital anomaly or non-idiopathic club foot. Clinical assessment of various components of clubfoot using Pirani score was done. Foot examination and corrective manipulations were done with baby resting on his mother’s lap with toys and soothing music to relax the baby. All the data collected was entered in Microsoft Excel sheet for further statistical analysis. Patients were treated as per following Ponseti treatment guidelines[11]:

- All components of club foot deformity were corrected simultaneously except equinus which was corrected last.
- Cavus is corrected as foot is abducted by supinating forefoot thereby placing it in alignment with midfoot.
- Adduction deformity was assessed by medial crease and lateral border curvature. While holding the whole foot in supination and flexion, it was gently abducted under talus and secured against rotation in ankle mortise by applying counter pressure with thumb against lateral aspect of head of talus.
- Varus deformity was assessed by lateral talar border head coverage and empty heel sign. Heel varus and foot supination were corrected when entire foot was fully abducted in maximum external rotation under talus. Care was taken to never evert the foot.

Soft roll and plaster cast were wrapped snugly over the foot and ankle and loosely over calf and thigh. Toes were covered by tips of thumb and index finger to prevent crowding of toes. Plaster was extended to below knee first. Heel prominence was emphasized by molding around it. Correction was maintained through molding, not pressure. Plaster cast is then extended to upper thigh with knee at 90 degrees of flexion and leg in slight external rotation.

Patients were followed up at weekly intervals and further manipulation was done at each visit. Improvements obtained by each manipulation were maintained by immobilizing the foot in molded plaster cast for five to seven days. Final manipulation was done after four or five casts when the entire foot was abducted between 50-60 degrees under talus and no

longer supinated. This was followed up by tenotomy after a week to correct equinus deformity.

Equinus deformity was assessed clinically by rigid equinus and posterior crease. For tenotomy, cleaning and draping the part was done and a small amount of local anesthetic was injected medial to the Achilles tendon. The knife was kept parallel, beneath and anterior to the tendon approximately one centimeter above its insertion into calcaneus. Sharp edge of the knife was turned towards the tendon and tenotomy was performed. After placing small piece of sterile gauze over the wound it was wrapped with sterile soft roll. Foot was then dorsiflexed. A well molded plaster cast was placed with foot in 20 degrees dorsiflexion and 70 degrees of abduction (with no eversion). This last cast was worn for three weeks. Foot abduction bar with distance from one shoe heel to other equal to the width of child's shoulders was applied. Shoes for the involved foot were externally rotated to 70 degrees and for normal foot was externally rotated to 30 degrees. The bar was bent to give approximately ten degrees of dorsiflexion.

The patient was advised to wear the shoes full time for three months. It was then worn at night until the child was three years old. Parents were instructed to reposition the foot in shoe when required.

Patients were followed up weekly for plaster revision till six weeks and correction and relapse was clinically assessed with Pirani score at each visit. Continuity of Achilles tendon was assessed ultrasonographically before tenotomy, immediately after tenotomy and at 3rd and 6th week of tendon healing.

All the pretreatment and post treatment scores were statistically compared to look for any significant changes.

Results and Discussion

Patients for the study were recruited as per the above defined protocol. Final analysis of 45 feet were done as per Figure 1. The baseline characteristics of the enrolled patients were comparable and are enumerated in Table I. Maximum number of patients presented within six months of age. There was equal distribution of unilateral and bilateral cases and male preponderance was observed. Fifteen patients had bilateral CTEV and 15 patients had unilateral involvement. None of the children had any sibling with similar condition and none had family history of CTEV. Only one patient had other congenital abnormality (umbilical hernia in the concerned case) apart from CTEV.

The changes in scores of various components of CTEV before and after treatment are compared in Table II. There was marked improvement in Pirani scores of treated feet after completion of treatment. Average number of casts required for correction of each component of clubfoot is enumerated in Table III. Cavus deformity was most easily corrected followed by adduction and varus. Equinus deformity was corrected after tenotomy.

Clinical and ultrasonographic finding before and immediately after tenotomy and at 3rd and 6th week after healing is summarized in Table IV. Clinically all the tendons were healed six weeks after treatment but ultrasonographically all the tendons showed continuity at the end of third week post treatment itself.

In this study, no patient developed complications due to cast such as cast sore, erythema and swelling of toes. No infection, skin necrosis or profuse bleeding post tenotomy were observed. Out of the whole cohort, in one foot, tenotomy was done twice to achieve correction and 14 casts were applied. This patient developed recurrence of equinus, cavus, adduction and

varus deformity after two months of treatment. Noncompliance to foot abduction brace was the reason responsible for recurrence of deformity. In this feet, Ponseti method was reapplied and patient is improving. Tenotomy was done in all the cases. Correction was obtained in all patients with an average of seven casts (range 7-10).

Due to slipping of cast in a few infants they required additional casts with short cast free periods in between. Some heterogeneity is expected in degree of deformity depending on age at presentation leading to varied degree of final correction achieved.

In a clinical study done between 1991 to 2001, Morcuende treated 256 clubfeet, 81% in patients younger than six months and 19% patients between age six months to two years. He achieved correction of all deformities in all patients except four(2.5%). Correction was obtained with one to seven casts (90% of the patients required five or more casts). Percutaneous tenotomy was done in 86% of cases[12]. John Herzenberg treated 27 patients (34 feet) by Ponseti method. All patients underwent serial casting beginning within first three months of life. Of the 34 feet, 31(91%) underwent successful percutaneous tenotomy[13]. In a series of 11 tendons in eight infants Barker reported that eight tendons were shown to be clinically intact and ten had ultrasonic evidence of continuity three weeks after tenotomy, similar to our study[14].

Achilles tenotomy is an established step in Ponseti technique for correction of idiopathic CTEV in most cases. In all age groups, tendons showed clinical evidence of intact tendons and ultrasonographic evidence of continuity by six weeks. Hence, we found Ponseti technique useful in all the age groups of our cohort.

Conclusion

The reduced requirement of extensive surgery makes this technique a simple alternative for clubfoot surgical correction, which can be carried out by basic health care workers hence making correction of clubfoot and achievement of functional, painless, flexible plantigrade foot accessible to wider population with minimal resources especially in developing countries.

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Legend Tables and Figures

Table 1: Baseline characteristics of the patients

Age group (months)	Number of patients	Percentage (%)
0-1	7	23.3
1-2	6	20
2-3	5	16.6
3-4	4	13.3
4-5	2	6.6
5-6	2	6.6
6-12	1	3.3
12-24	2	6.6
24-36	0	0
36-48	0	0
48-60	1	3.3
Laterality		
Bilateral	30	66.6
Right foot	11	24.4
Left foot	4	8.8
Gender		
Male	17	56.6
Female	13	43.3
Chronological order in family		
First born	18	60
Second born	10	33.3
Third born	2	6.6
Mode of delivery		
Vaginal	18	60
Cesarean	12	40

Table 2: Pirani score for various deformity

Equinus	Pretreatment		Post Treatment	
Score	number of feet	%	number of feet	%
0	0	0	45	100
0.5	15	3.3	0	0
1	30	6.6	0	0
posterior crease	pretreatment		post treatment	
Score	Number of feet	%	number of feet	%
0	0	0	45	100
0.5	12	6.7	0	0
1	28	2.2	0	0
Lateral talar head coverage	pretreatment		post treatment	
Score	number of feet	%	number of feet	%
0	0	0	36	0
0.5	32	1.1	9	0
1	13	8.8	0	0
empty heel	pretreatment		post treatment	
Score	number of feet	%	number of feet	%
0	0	0	28	2.2
0.5	15	3.3	17	7.7
1	30	6.6	0	0
medial crease	pretreatment		post treatment	
Score	number of feet	%	number of feet	%
0	0	0	45	100
0.5	31	8.8	0	0
1	14	31.1	0	0

lateral border curvature	pretreatment		post treatment	
	Number of feet	%	number of feet	%
0	0	0	28	62.2
0.5	36	80	17	37.7
1	9	20	0	0

Table 3: Average number of casts required for correction of each component of clubfoot

age group in months	cavus	adduction	varus	equines
0-1	1	1-2	1-2	1-2
1-2	1	2-3	2-3	2-3
2-3	1	2-3	2-3	3-4
3-4	2	3	2	3
4-5	2	3	3	3
5-6	2	3	3	4
6-12	2	3	3	4
12-24	2	4	4	4
24-36	1	0	0	0
36-48	1	0	0	0
48-60	2	4	4	4
Total	1-2	2-3	2-3	3-4

Table 4: Study of Achilles tendon

Stage	Number of tendons clinically intact	Number of tendons shown to have continuity by ultrasound
Pretenotomy	45	45
Immediately after tenotomy	0	0
Three weeks after tenotomy	40	45
Six weeks after tenotomy	45	45

Figure 1: Patient recruitment

