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Original research article

Analysis of Ponseti Method in Congenital Talipes Equinovarus (CTEV)

Dr. Rahul[1], Dr. Mukul Jain[2], Dr. Naveen.S [3], Dr. Harish Kumar Jain [4], Dr. Shantilal Chobisa[5]

[1]Postgraduate Resident, Department of Orthopaedics, Jhalawar Medical College, Jhalawar

[2]Assistant Professor, Department of Orthopaedics, Jhalawar Medical College, Jhalawar

[3]Senior Resident, Department of Orthopaedics, Jhalawar Medical College, Jhalawar

[4]Senior Professor and Head of Department, Department of Orthopaedics, Jhalawar Medical College, Jhalawar

[5]Postgraduate Resident, Department of Orthopaedics, Jhalawar Medical College, Jhalawar

Corresponding Author: Dr. Naveen.S

Abstract

Introduction: Congenital talipes equinovarus (CTEV) is the most common congenital foot disorder, commonly known as congenital clubfoot. Ponseti method of manipulation and serial plaster casting is the gold standard treatment for idiopathic congenital clubfoot. The purpose of this study is to analyse the efficacy of correction of Congenital Talipes Equinovarus deformity (CTEV) using ponseti method.

Materials and Methods: This analysis was carried out at the Jhalawar Medical College Hospital's Orthopaedics Department, including 30 children with idiopathic CTEV of age less than 2 years, among which 13 unilateral and 17 bilateral CTEV, total 47 feet, willing for treatment. Patients were followed up weekly for corrective casting till tenotomy and corrective cast was applied for three weeks after final correction or percutaneous tendo-achilles tenotomy.

Results: Assessment of results using Pirani severity scoring[6,7] at the end of treatment and on regular follow-ups. The most common age group was 0-1 months with 24(80%) cases.Among 30 cases ,there were 22 males(73.30%) & 8 females(26.70%). 17 cases were bilateral(56.67%) and 13 cases(43.33%) were unilateral. Post casting treatment , percutaneous tenotomy was done in 14 cases (46.67%) in which 12 cases(54%) were male and 2 cases(16%) were female. No patient has undergone extensive surgery like postero-medial soft tissue release or bony procedures to correct the deformity. Only two recurrence were recorded which was due to non compliance due to occurrence of pandemic COVID-19 Lockdown. They were treated with manipulation and pop cast followed D-B splint.

Conclusion: Ponseti method is an excellent conservative method of treatment of Congenital Talipes Equino varus. Treatment must start at the earliest possible for better outcome. Long term follow up till 4 years age would be better to assess the relapse rate.

Keywords: Congenital talipes equinovarus (CTEV); Casting; Pirani severity scoring; Ponseti Method

Introduction

Congenital talipes equinovarus (CTEV) is the most common congenital foot disorder, commonly known as congenital clubfoot. Incidence is approximately 1 in 1000 live births[1]. Bilateral deformities occurs in 50% of patients[2]."Talipes" is derived from Latin word talus meaning ankle and "pes" meaning foot. It contains four identifiable components that are easily remembered using the acronym CAVE (cavus, adductus, varus and equinus).Congenital talipes equinovarus may also present with conditions like neuromuscular diseases, such as arthrogryposis syndrome, spina-bifida, larsen syndrome, among all idiopathic congenital talipes equinovarus is the most common presentation. In 1948, Dr. Ignacio Ponseti began manipulating CTEV cases through serial casting, completely correcting the deformity[3].Ponseti method of manipulation and serial plaster casting is the gold standard treatment for idiopathic congenital clubfoot[4,5]. Ponseti method provides a lower complication rate, less pain and better function as the patient ages as compared to operative treatment. The ponseti method consists of two phases: treatment and maintenance.The treatment phase should begin as early as possible, optimally within the first two weeks of life; however older children also can be treated non-operatively using Ponseti's principles. Gentle manipulation and casting are done weekly.The order of correction by serial manipulation and casting should be as follows: first-correction of forefoot cavus and adduction; next- correction of heel varus; and finally-correction of hindfoot equinus. Correction should be pursued in this order so that a rocker-bottom deformity is prevented by dorsiflexing the foot through the ankle joint rather than at midfoot. Each cast hold the foot in the corrected position, allowing it to reshape gradually.Generally five to six casts are required to correct the alignment of foot and ankle fully. Before application of the final cast, most infants require percutaneous Achilles tenotomy to gain adequate lengthening of the Achilles tendon and prevent a rocker-bottom deformity. Approximately 95% cases of CTEV require percutaneous Achilles tenotomy for correction of equinus deformity.In the maintenance phase of Ponseti method; after removal of final cast, the infant is placed in a brace that maintains the foot in its corrected position (abducted and dorsiflexed). The brace (foot abduction orthosis) consists of shoes mounted to a bar in a position of 70 degree of external rotation and 15 degree of dorsiflexion. The distance between the shoes is set at about 1 inch wider than the width of the infant's shoulders.The brace is worn 23 hours each day for the first 3 months after casting and then while sleeping for 3 to 4 years. Brace wear compliance is of utmost importance in maintaining correction and preventing recurrence. Successful correction of CTEV deformity generally is reported in more than 90% of children (2 years and younger) treated with ponseti casting even after previous unsuccessful non-operative treatment.

Aims and Objective:

The purpose of this study is to analyse the efficacy of correction of Congenital Talipes Equinovarus deformity (CTEV) using ponseti method. To correct all the components of the deformity in congenital CTEV simultaneously except equinus (which generally requires percutaneous tenotomy) and to achieve pain free, functional, plantigrade supple foot with good mobility.

Methods and Materials:

This prospective study including 30 children with idiopathic CTEV of age less than 2 years registered at SRG Hospital JMC Jhalawar, willing for treatment and with following inclusion and exclusion criteria.

Inclusion criteria:
- All idiopathic CTEV cases.
- Age less than 2 years.
- Previously untreated clubfoot.

Exclusion criteria:
- Syndromic clubfoot.
- Relapsed clubfoot.
- Postural clubfoot.
- Neurological clubfoot.

Pirani's method of clubfoot evaluation[6,7]

Dr. Shafique Pirani had identified 6 well described clinical signs of clubfoot. Three of these signs indicate primarily hind foot contracture (HFC) and three signs indicate primarily midfoot contracture (MFC).

The abnormal area on the involved foot is compared to the same area on the normal foot (if the deformity is not bilateral) and scored:-
- 0 = no deformity
- 0.5= moderate deformity
- 1.0= severe deformity

Hind foot contracture (HFC)
- Posterior crease (PC)
- Empty heel (EH)
- Rigid equinus (RE)
- Possible HFCS between 0 – 3

Mid foot contracture (MFC)
- Curvature of lateral border of foot (CLB)
- Medial crease (MC)
- Lateral part of head of talus (LHT)
- Possible MFCS between 0 – 3

Method:
The foot is evaluated every week during serial cast treatment. The infant is kept supine and is examined while feeding & relaxed.

Look:
- LB (Curved lateral border)
- MC (Medial Crease)
- PC (Posterior Crease)

Feel:
- HT (Lateral Head of Talus)
- EH (Emptiness of Heel)

Move:
- RE (Rigidity of Equinus)

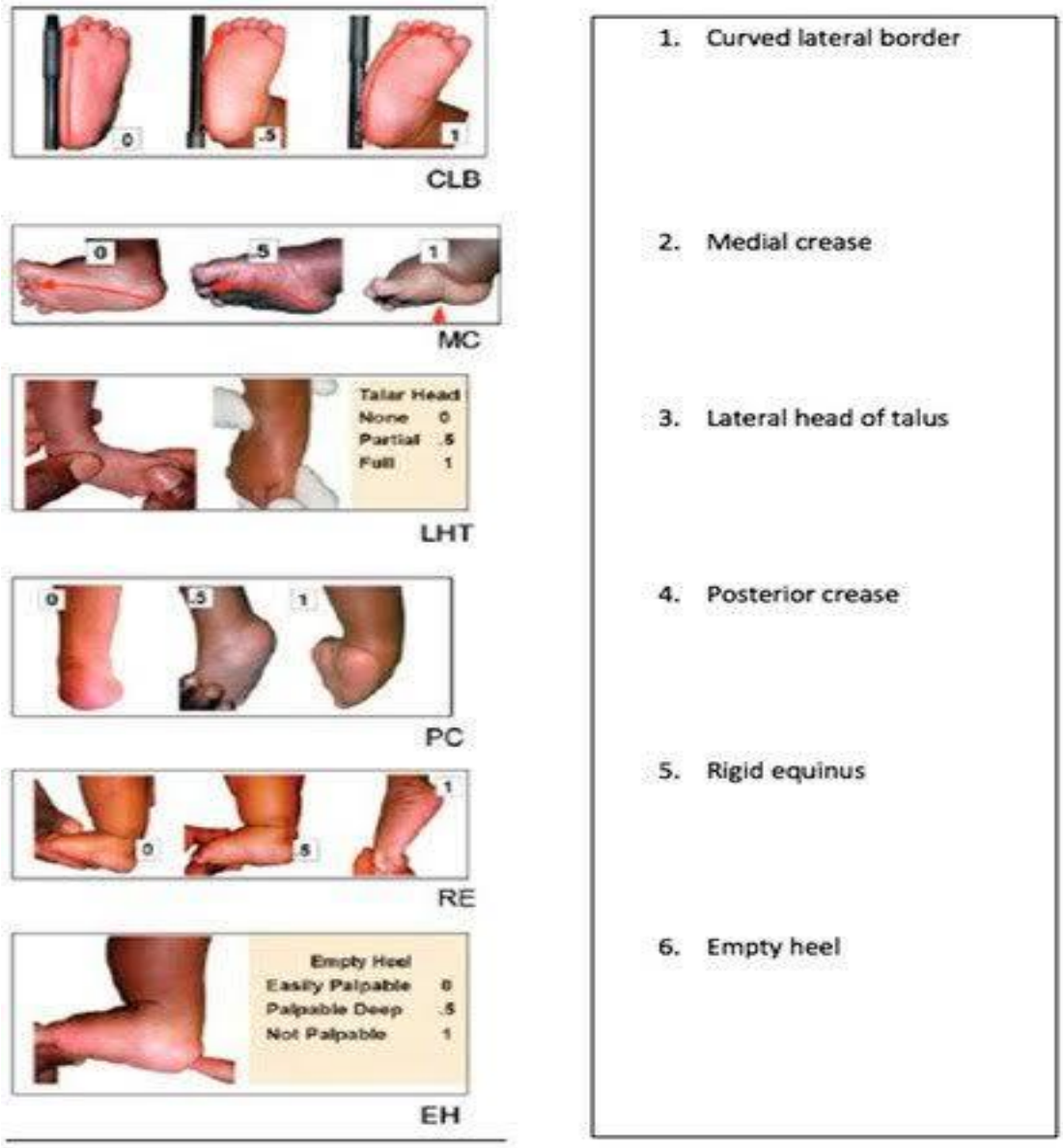


Fig.1: PIRANI SEVERITY SCORING

Ponseti method of correction:

Initially a layer of cast padding was applied from toe to groin and the surgeon hold the foot in corrected position. The CTEV cast was applied in two stages: first, a short leg cast to just below the knee, then extension above the knee when the plaster sets.

During this, the knee was held in 90 degree flexion. After application of the cast the child was observed for about 30 minutes for any signs of limb ischemia. The parents were educated about possible complications like cyanosis, swelling, excess cry and the contact number in case of emergency were provided. They were then advised to report for the next cast after 7 days.

The first cast was aimed at correcting the cavus deformity by supinating the forefoot there by bringing the forefoot in alignment with the hind foot.

Fig.2: Cavus corrected by dorsiflexing inner part of forefoot

In the second and subsequent casts, the foot in supination was abducted while the surgeon applied counter-pressure on the head of the talus.

The calcaneus abducts by rotating and sliding under the talus. Simultaneously it extends and everts there by correcting the heel varus.

Fig.3: Manipulation

After correction of the above deformities, passive dorsiflexion of the foot to 15 degree above neutral, a final cast was applied in the final corrected dorsiflexed position for three weeks.

If dorsiflexion more than 15degrees was not possible, a percutaneous tenotomy of the tendo-achilles was done under general anaesthesia. After this tenotomy, the foot was placed in the final corrected dorsiflexed position for three weeks.

Fig.4: Percutaneous tenotomy

Fig.5: Post tenotomy cast application

After the last cast was removed, correction was maintained by using Dennis Browne splint. The brace was worn 23 hours each day for the first 3 months after casting and then while sleeping for 3 to 4 years.

The patients were reviewed at 14 days after application of Dennis-Brown splint to assess the compliance of the parents. In subsequent visits patients were reviewed once in three months. The parents were given contact numbers and were advised to contact us regarding the maintenance of Dennis-Brown splint.

Fig.6:Application of DB-splint

Fig.7: No heel CTEV shoe

Fig.8: Outer raise border CTEV shoe

Fig.9: Straight inner border CTEV shoe

Result:

In this prospective study, total 47 Feet (30 patients) of CTEV deformity were treated by Ponseti method and end point of casting treatment is taken as ten casts. 13 unilateral and 17 bilateral cases among 30 cases. Post casting treatment, heel cord tenotomy was done if needed and started on bracing protocol.

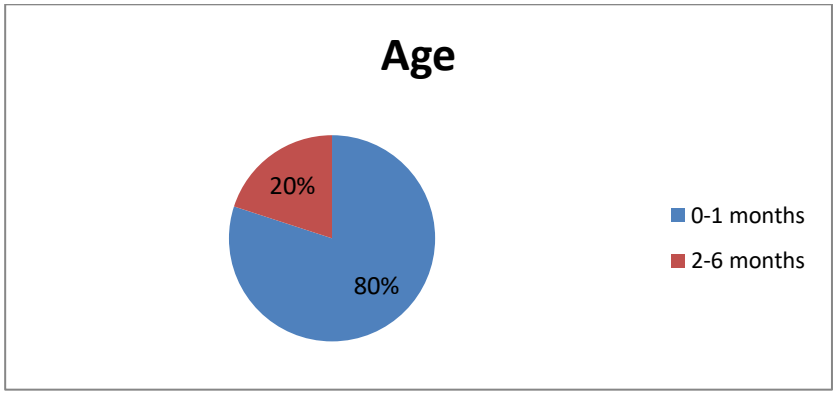
The mean initial Pirani severity score for 47 feet was 4.52. After correction by ponseti technique, the final mean score at follow up was found to be 0.00 and the mean change in score was found to be 4.52.

This was analysed by the paired t test and the p value was <0.0005 which is significant.

Table No.1: Age Incidence

AGE	FREQUENCY	PERCENT
0–1months	24	80
1 - 6 months	6	20
> 6 months	0	0
Total	30	100

The most common age group was 0-1 months with 24 (80%) patients.



Graph No:1

Table No.2: Details of age of subjects in days

	Age in days
Mean	31
Median	30
Minimum	1
Maximum	150

The minimum age -1 day.
The maximum age - 150 days (5 months).
Range (1 day - 150 days).

Table No.3: Details of surgical interventions done

	Number of Feet	Percent
Percutaneous tenotomy	16	66.67
Z-plasty	8	33.33

Surgical interventions needed in 24 feet out of 47 feet. Percutaneous tenotomy of tendo-achilles was done in 2/3rd cases (16 out of 24 feet) & Z-Plasty in1/3rd cases (8 out of 24 feet).

Table No.4: Correlation between Percutaneous tenotomy/Z-plasty and Gender

Tenotomy/ Z-plasty	Gender		Total
	Male	Female	
Done	20	4	24
Not done	15	8	23
Total	35	12	47

54.14% of male cases and 33.33% of female cases needed surgical intervention to correct equinus deformity.

Table No.5: Correlation between side and Gender

	BILATERAL	UNILATERAL	
		Right	Left
Male	13	5	4
Female	4	1	3

Table No.6: Number of Cast

No. of casts	No. of patients
4	4
5	12
6	15
7	10
8	6
Total	47

No patient has undergone extensive surgery like postero-medial soft tissue release or bony procedures to correct the deformity. Only two recurrence is recorded which was due to noncompliance due to occurrence of pandemic COVID-19 Lockdown. They were treated with manipulation and pop cast followed D-B splint.

Discussion:

Treatment of idiopathic clubfoot is either conservative or surgical. Despite long term experience in many centres, there still are outcome controversies surrounding both types of management. Controversies persist because of lack of standards for evaluating functional outcomes, rendering comparisons between treatment groups problematic and longterm follow-up studies showing results.**Lloyd-Roberts[9]** wrote "clubfoot will doubtless continue to challenge the skill and ingenuity of orthopaedic surgeons.**Prof. Ignacio ponseti[8]** devised his method of conservative treatment of congenital talipes equino varus which starts from day one of age and is based on the fundamentals of kinematics and pathoanatomy of the deformity. This method successfully realigns clubfoot in infants without extensive and major surgeries.This method has correct biomechanical basis for realigning deformed ankle and foot joints and corrects deformity due to favourable fibro elastic properties of the connective tissue and ligaments.so this method does not aim at anatomical and radiological correction and can be evaluated critically on the basis of clinical correction**[8].**The longest published follow-up is the 30year follow-up of 45 patients treated with the **ponseti method of manipulation and casting** at the university of Iowa hospital and clinics between 1950 and 1967[10].

Gender incidence:

There were 22 male and 8 female in our series with a male to female ratio of 2.7:1. The male:female ratio in Kite's[12] series was 2.07:1 and in series of **Wyne Davis[11]** was 2.17:1. In **Jose A. Morcuendeet.al[13]** series male to female ratio was 2.02:1. In P.**Harnett et.al[14]** series male to female ratio was 1:1, this study has smaller study population when compared to other studies. The ratio obtained from our study is quite different from the literature in age distribution. This difference may be due smaller study population.

Laterality:

As regards laterality, the ratio of bilateral to unilateral clubfoot is 1.3:1. 30 (56.67% bilateral and 43.33 % unilateral) which is in concordance with other series presented by workers like **Wyne Davis[11] (**44% bilateral and 56% unilateral**),** in Mckay (1983) series an incidence of unilateral to bilateral ratio 1:1.7, **P.Harnettet.al[14](** 52.5% bilateral and 47.5% unilateral**) , Jose A. Morcuende et.al[13] (** 38 % bilateral and 62 % unilateral**).**

Age:

When the feet were divided on the basis of the age at first presentation, it was seen that a large proportion of patients seen were less than one month old and among them child less than a week old are more. The youngest patient included in this study was 1day old and the eldest was 4 months and 28 days old.

Pirani Scores Vs Number of Cast Required:

If we categorize the feet on the basis of initial Pirani score , we find that those feet which had lower initial score 4 to 5 were more amenable to correction and responded relatively early when compared to those with higher initial score 5.5 to 6 (i.e., more severe and more rigid deformity).

The average number of cast application required to achieve full correction of the deformity in patients with Pirani score of 4.5 to 6.0 was 6.85 and the average number of casts required to achieve full correction of deformity in patients with Pirani score less than 4.5 are 5.7.

Tenotomy:

In our study14 patients required percutaneous tenotomy or z plasy of tendo Achilles, usually by literature 80% of the clubfoot treated by ponseti method requires percutaneous tenotomy ,but the difference in our study may be due to early presentation of patients (< week) and faster change of casts. However due to smaller number of study population we are not able to conclude on it.We performed the percutaneous tenotomy or z plasty of TA under general anaesthesia using strict aseptic precautions. There are reports of excessive bleeding with the procedure but we found no such complications in our series.

Complications of cast treatment:

The cast application in infants and neonates has to be done with utmost care and delicacy. This form of treatment can nonetheless give rise to following complications;

Too tight cast:

This is potentially most dangerous complication if not identified early and followed by prompt removal of the cast. In our series, no such complication is observed .

This complication needs proper patient counseling for early identification. All efforts were taken to ensure that the parents of each and every patient who leaves the CTEV clinic after application of cast are explained thoroughly using layman language about this complication. They were taught to observe the colour of the toes and compare it with the other side, to look for swelling of toes and to bring the child immediately if he or she is crying excessively or having one of the above signs.

Importance of keeping limb elevated was also stressed.

Excoriation of skin:

A peculiar observation in neonates and infants in first 1-2 months was excoriation of skin. This could be prevented by application of powder over the delicate skin before application of the cast.

Residual deformity and recurrence:

Out of 30 patients we had one child with recurred deformity due to non-compliance due to occurrence of pandemic COVID-19 for which sequential corrective casting was done.

Outcome of our study corroborates with the studies carried out by the following authors:

Wallace B Lehman[15] MD, studied 50 patients with idiopathic clubfoot deformity treated by Ponseti protocol and reported over 90% of cases will require no other treatment except for percutaneous tenotomy of achilles tendon and almost similar outcome when compared with our study.

John E Herzenberg[16] MD showed 88% good to excellent results and 3 % recurrence in his series of 46 clubfoot treated by Ponseti method which correlates with the result of our study and the number of days in cast treatment was significantly less.

Conclusion:

Based on above study we conclude that. Ponseti method is an excellent conservative method of treatment of Congenital Talipes Equino varus. The patients who have lower Pirani score at initial presentation respond better and faster to the treatment as compared to those who have higher Pirani score at initial presentation. Treatment must start at the earliest possible for better outcome. Long term follow up till 4 years age would be better to assess the relapse rate.

Fig.9: Clinical Photographs

AT PRESENTATION

CAVUS CORRECTION CAST

CAST IN ABDUCTION

AFTER CAST CORRECTION

TENDOACHILLES TENOTOMY

POST TENOTOMY CAST

BRACE MAINTAINENCE [D-B SPLINT]

1 YEAR FOLLOW UP

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