

## ORIGINAL RESEARCH

### “AN OBSERVATIONAL STUDY ON MANAGEMENT OF IDIOPATHIC CTEV BY PONSETI METHOD”

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#### ABSTRACT:

**Introduction:** Children’s foot disorders are frequent presentations to a range of health professionals and represent huge concern among the parents. Congenital talipesquinovarus (CTEV) also known as clubfoot, is one of the most common congenital bone deformities. While some cases are associated with neuromuscular disease, chromosomal abnormalities, different syndromes or extrinsic causes, others occur in otherwise normal infants and are classified as idiopathic congenital talipesquinovarus (CTEV).The purpose of this study was to report the short term outcome of effectiveness of the Ponseti method for the treatment of CTEV in a series of children with this anomaly.

**Objective:** To evaluate the outcome of Ponseti technique among idiopathic CTEV patients by using Pirani severity scoring system in tertiary care hospital, Secunderabad.

**Materials and methods:** This is an observational study which was conducted among 50 subjects with idiopathic CTEV in the Orthopaedic OPD at Gandhi hospital – Secunderabad over a period of 2 years from November 2018 till November 2020.

**Results:** The total number of feet in the complete study was 66.The mean age at presentation of the patients was 3.69 months. Male to female ratio was 2.5:1.The average number of casts applied was 7.01. Almost 21(42%)patients have been treated only with serial manipulation and casting. Rest 29(58%) patients required tenotomy for correction among which patients with initial pirani score of 5 and above had undergone more number of tenotomies compared to less than 5 piraniscore.The outcome was excellent in 87.87% of overall treated feet, good in 7.57% and Poor results in 4.54%.

**Conclusion:** This study confirms the effectiveness and good reproducibility of the Ponseti technique and found the Pirani scoring system to be practicable, easily measurable and helpful in the management of idiopathic clubfoot to attain functional, painless, plantigrade foot with good mobility and without callosities.

**INTRODUCTION:**

Children's foot disorders are frequent presentations to a range of health professionals and represent huge concern among the parents. Both particular paediatric conditions and foot development result in many changes and variations to foot appearance. It is important that foot problems are differentiated from growing trends, that foot pain is well diagnosed, and that any treatment is based upon best available evidence.

Congenital talipes equinovarus (CTEV), also known as clubfoot, is one of the most common congenital bone deformities which causes impairment of mobility(1). While some cases are associated with neuromuscular disease, chromosomal abnormalities, different syndromes or extrinsic causes, others occur in otherwise normal infants and are classified as idiopathic congenital talipes equinovarus (CTEV)(2).

The latter is a common but still not fully understood disorder of the lower limb. More than 150,000 – 200,000 babies are born worldwide each year with CTEV. The published data over the last 55 years for clubfoot in LMIC (Low and Middle income countries) suggests a birth prevalence in the range of 0.5 to 2.0 cases / 1,000 live births, which results in an estimated 7 to 43 cases of clubfoot / year / million population, dependent mainly on birth rate(3) and the overall ratio of affected males to females is 2.5:1.(4). Although most cases are sporadic occurrences, families have been reported with clubfoot as an autosomal dominant trait with incomplete penetrance. Bilateral deformities occur in 50% of patients. In patients with bilateral deformity, the severity and response to treatment is highly correlated between the two feet.

The hindfoot is held in a firm position of equinus, with a tight heel cord. There is retraction and atrophy of the gastrosoleus muscles; the calcaneus is inverted in varus position; and the forefoot is held in adduction and supination, but still less supinated than the hindfoot, producing a cavus deformity with a medial and a posterior skin crease, more pronounced in severe cases(5). On palpation, the change in kinematics is apparent(6). Diagnosis is mainly based on clinical evidence even if prenatal diagnosis is possible through sonographic assessment.

**OBJECTIVES:**

- To evaluate the outcome of Ponseti technique among idiopathic CTEV patients by using Pirani severity scoring system in tertiary care hospital, Secunderabad.
- To evaluate the outcome by attainment of functional, painless, plantigrade foot with good mobility and without callosities.

**MATERIALS AND METHODS:**

This is an observational study which was conducted among 50 children diagnosed with Idiopathic CTEV. This study was conducted in the Orthopaedic OPD at Gandhi hospital – Secunderabad over a period of 2 years.

**INCLUSION CRITERIA:**

- Any child with idiopathic CTEV

- Unilateral or bilateral clubfoot

### EXCLUSION CRITERIA:

- Earlier treated with other methods of plaster cast application
- Earlier operated for clubfoot
- Seriously ill children
- Atypical/ secondary clubfoot

### PROCEDURE:

- Detailed history taken from the respective parents/ guardian and detailed head to toe examination of the child has been done to arrive at a diagnosis of idiopathic CTEV
- After taking proper consent from the parents/caretaker, Ponseti technique was used to correct the foot deformity
- **Ponseti technique:** Treatment phase includes serial manipulation and above knee casting every week started within 2 weeks from the date of birth, followed by Achilles Tenotomy which is indicated for those where equinus is not corrected with only manipulation and casting
- Maintenance phase follows after correction of deformity where Steenbeek brace was applied to each child and followed up.
- Deformities of each child has been evaluated using Pirani severity scoring system during first presentation and assessed every week before applying Ponseti cast. The score was plotted in Pirani scoring sheet and the final outcome of the treatment with Ponseti technique has been interpreted.

- We graded our results as excellent, good and poor based on final Pirani scoring (7)

0 to 0.4: excellent,

0.5 to 1: good

>1: poor

Excellent and good results were a reflection of the success of the treatment while the poor results were deemed as failures and offered surgical treatment.

### PIRANI SCORING SYSTEM

PARAMETERS	MILD	MODERATE	SEVERE
<b>HINDFOOT CONTRACTURE SCORE:</b>	0	0.5	1
Posterior crease	Multiple fine creases	One or two deep creases	Deep creases of arch change contour
Empty heel	Tuberosity of calcaneus easily palpable	Tuberosity of calcaneus more difficult to palpable	Tuberosity of calcaneus not palpable
Rigid equinus	Normal ankle	Ankle neutral, but not	Cannot dorsiflex to

	dorsiflexion	fully dorsiflexes	neutral
<b>MIDFOOT CONTRACTURE SCORE:</b>	<b>MILD 0</b>	<b>MODERATE 0.5</b>	<b>SEVERE 1</b>
Medial crease	Multiple fine creases	One or two deep creases	Deep creases of arch change contour
Curvature of Lateral border	Straight	Mild distal curve	Curve at Calcaneocuboidal joint
Head of talus	Navicular completely “reduces”; lateral talar head cannot be felt	Navicular partially “reduces”; lateral talar head less palpable	Navicular does not reduce; lateral talar head easily palpable

Each foot is assigned a total score, the maximum being 6 points, with a higher score indicating a more severe deformity.

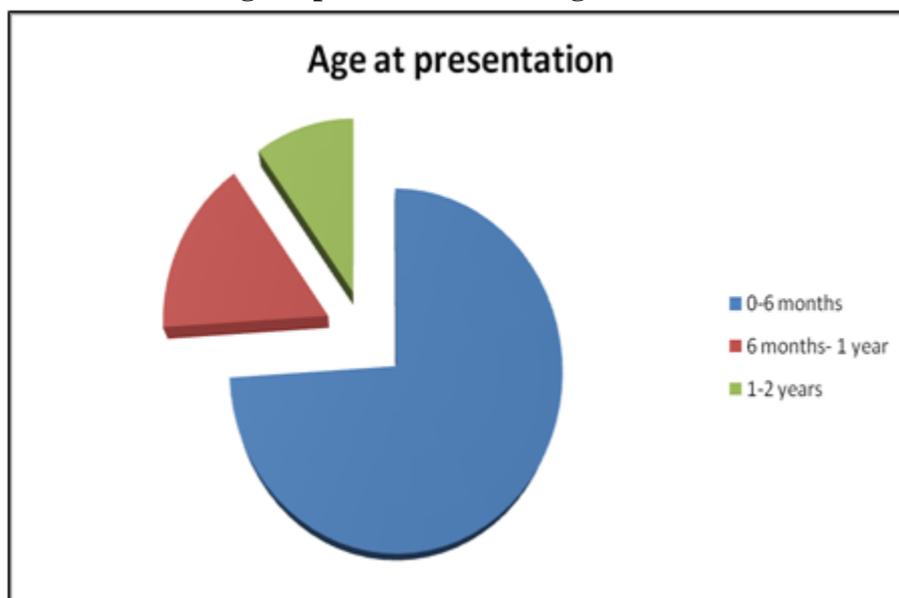
**RESULTS**

**AGE AT PRESENTATION**

**Table 1: Distribution of age at presentation among CTEV children**

Age	No. of children	Percentage
0–6 months	37	74%
6 months – 1 year	8	16%
>1 year	5	10%
<b>Total</b>	<b>50</b>	<b>100%</b>

**GRAPH 1: Distribution of age at presentation among CTEV children**

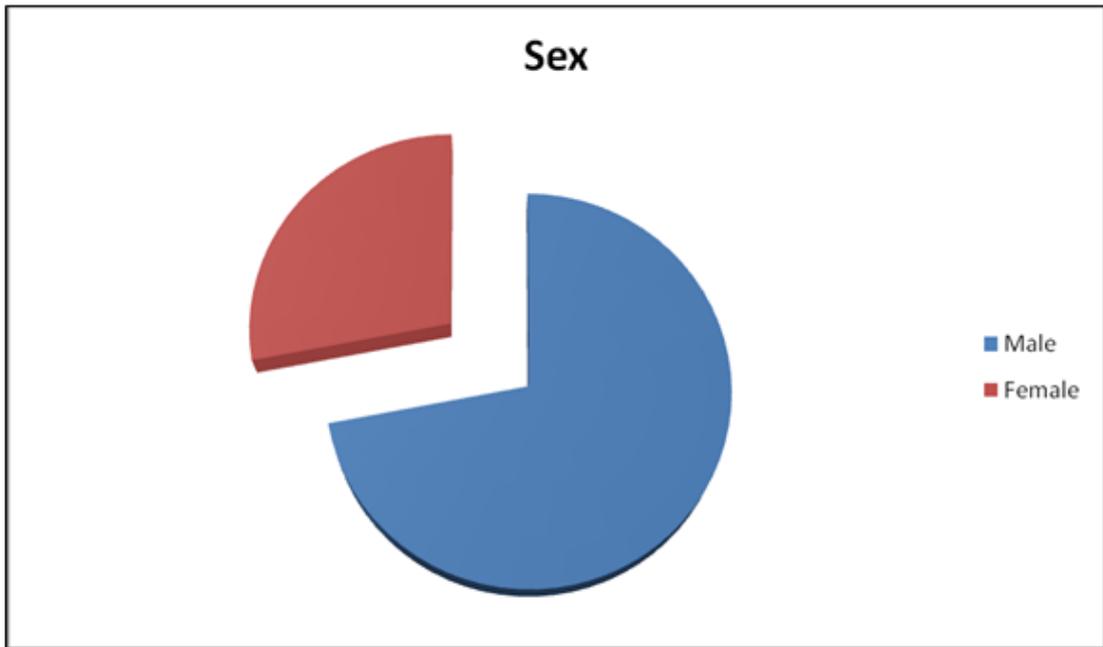


**SEX DISTRIBUTION**

**Table 2: Distribution of gender among CTEV children**

Sex	No. of children	Percentage
Male	36	72
Female	14	28
Total	50	100

**Graph 2: Distribution of gender among CTEV children**

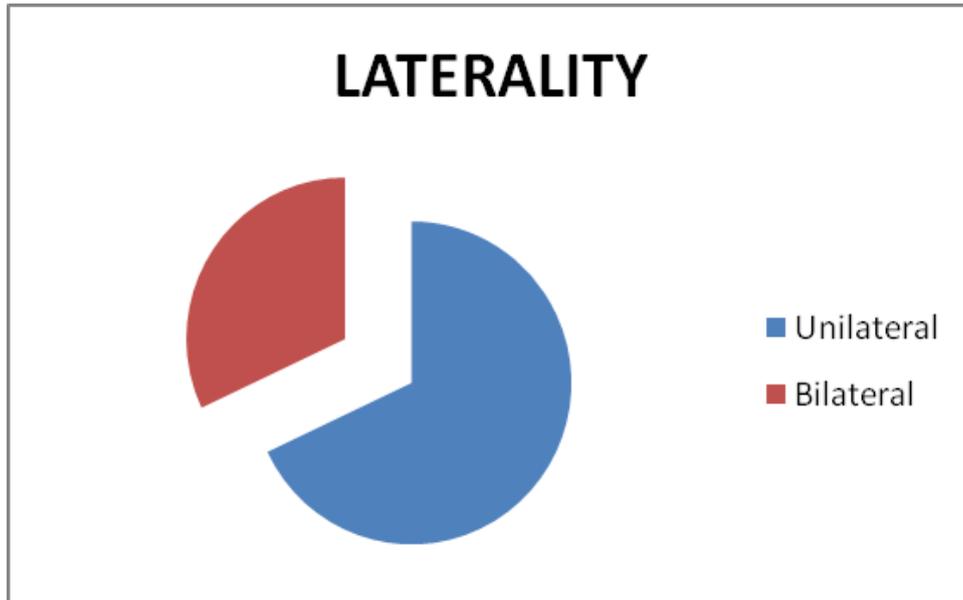


**SIDE OF INVOLVEMENT**

**Table 3: Distribution of laterality among CTEV children**

Laterality	No. of children	Percentage
Unilateral	34	68%
Bilateral	16	32%
Total	50	100

**Graph 3: Distribution of laterality of CTEV among CTEV children**



Out of 50 cases, 34 cases were unilateral (right or left) and 16 cases were bilateral. Among those 34 unilateral cases, 23 patients had right foot deformity and 11 cases had left foot deformity.

**Table 4: Sidewise distribution of feet among CTEV children**

SIDE	NO.OF CASES	PERCENTAGE
RIGHT	23	67.64
LEFT	11	32.35
Total	34	100

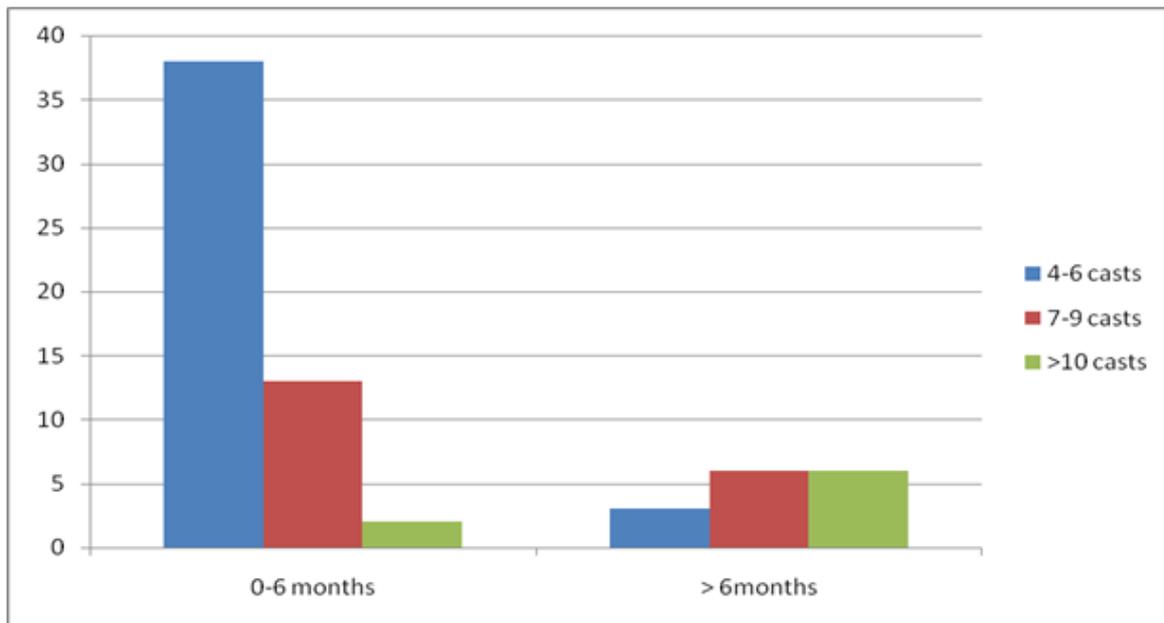
#### NUMBER OF CASTS APPLIED PER CHILD AGAINST AGE OF PRESENTATION

**Table 5: Age vs Number of casts applied among CTEV children**

Age	Number of Casts applied						Total	
	4-6		7-9		≥ 10			
< 6 months	27		22		2		51	
> 6 months	6 mths – 1 yr	3	3	6	5	6	4	15
	>1 year		0		1		2	
Total	30		28		8		66	

Average number of casts applied for each foot was 7.01. As there is increase in number of casts as age increases, there is a correlation between age at presentation and number of casts required to correct the deformity. p value is 0.0004903 which is significant (<0.005) calculated using chi square test.

**Graph 4: Age vs Number of casts applied among CTEV children**



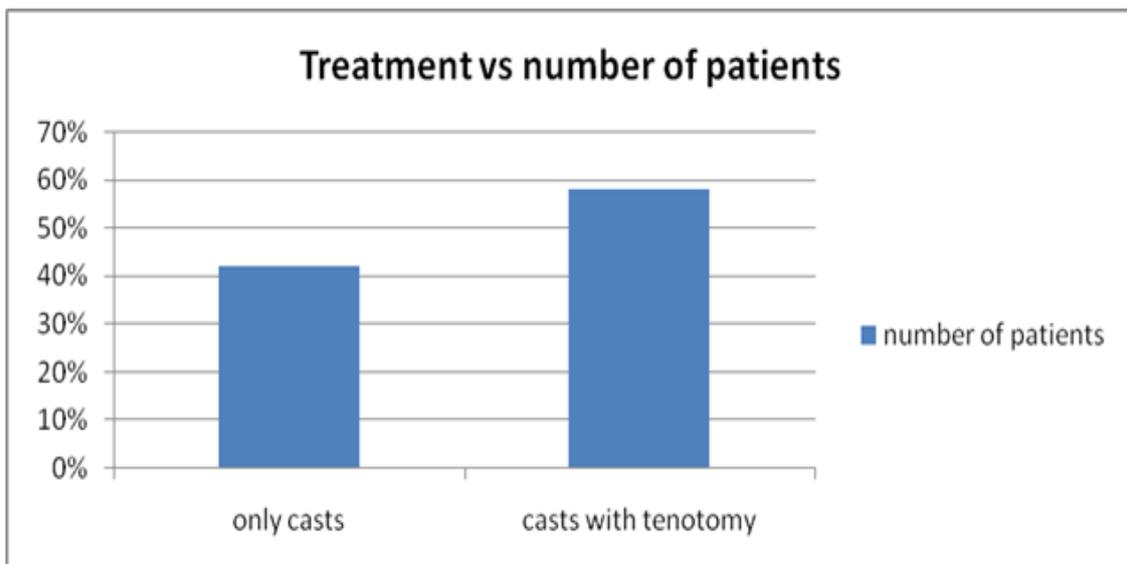
**ACHILLES TENOTOMY**

32 patients have been treated with only manipulation and casting. 18 patients have been treated with Achilles tenotomy after manipulation and casting.

**Table 6: Distribution of tenotomy among CTEV children**

Treatment	Number of Patients	Percentage
Only casting	21	42%
Casting with tenotomy	29	58%
Total	50	100%

**Graph 5: Distribution of tenotomy among CTEV children**



**INITIAL PIRANI SCORE AND TENOTOMY**

Out of 29 children who had undergone tenotomy, 27 presented with initial pirani scoring of 5 and more whereas only 2 children presented with initial score of 3 to 4.5 which shows correlation between initial pirani scoring and tenotomy as p value is significant (0.0001) based on chi square test.

**Table 7: Initial pirani scoring VS Requirement of Tenotomy**

Initial Pirani scoring	No. of patients undergone tenotomy	Percentage patients undergone tenotomy	No. of patients without tenotomy	Percentage of patients without tenotomy
0-4.5	2	3.03%	17	25.75%
5-6	27	40.90%	4	6.06%

**Table 8: Distribution of feet based on initial pirani scoring**

Group	Pirani Score	No. of Feet	Percentage
I	1.5 to 2.5	0	0%
II	3.0 to 4.5	25	40.90%
III	5 and more	41	59.10%
Total		66	100%

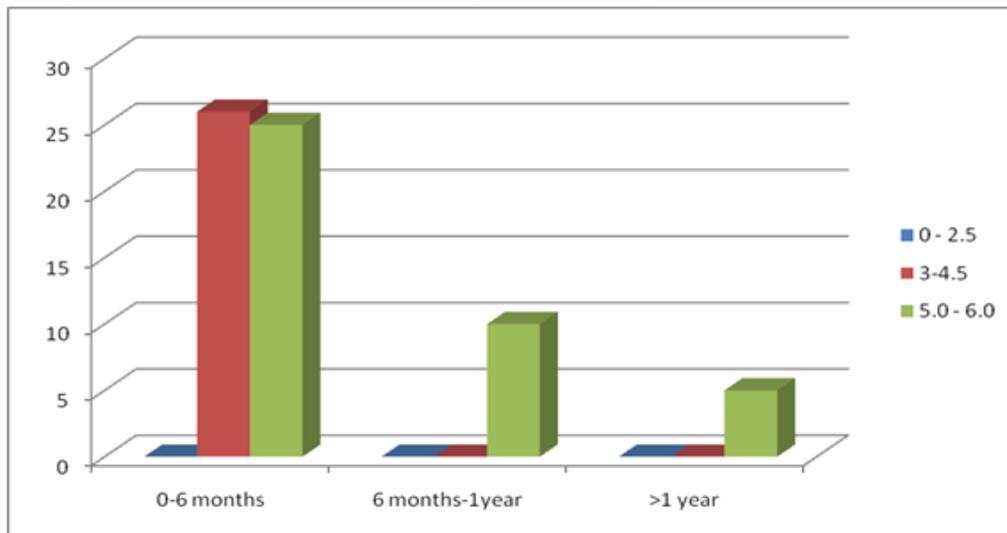
**AVERAGE INITIAL AND FINAL PIRANI SCORING****Table 9: Average initial and final pirani score among CTEV children**

Age	Average initial Pirani score	Average final pirani scoring
0-6 months	4.79	0.009
6months – 1 year	5.50	0.2
>1 year	6.0	1.2

The significance of the treatment was tested using difference between two means(initial and final pirani scoring) and the p value was <0.0001 which is significant

**AGE WISE DISTRIBUTION OF INITIAL PIRANI SCORING:****Table 10: Age wise distribution of initial pirani scoring**

AGE OF PRESENTATION	Initial Pirani scoring			TOTAL
	0-2.5	3-4.5	5-6	
0-6 months	0	26	25	51
6months – 1year	0	0	10	10
>1year	0	0	5	5
<b>TOTAL</b>		<b>26</b>	<b>40</b>	<b>66</b>

**Graph 6: Age wise distribution of initial pirani scoring**

In our study, 50 children with idiopathic CTEV were involved and treated them with serial manipulation and above knee casting using Ponsetitechnique. The mean age of children at the time of presentation was 3.69 months.

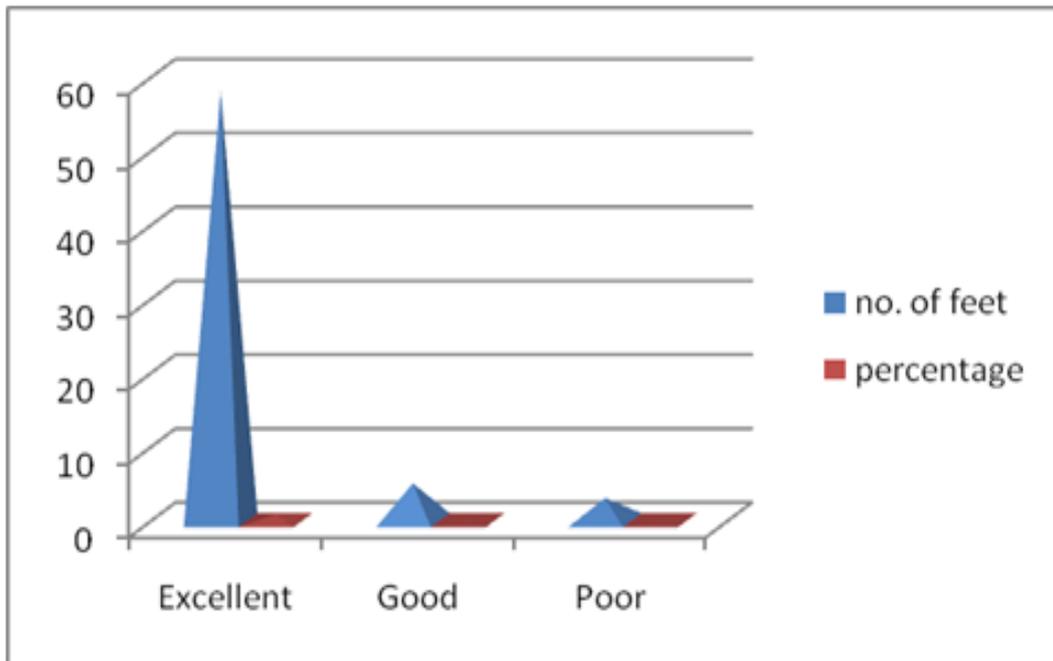
A 6 point Pirani scoring system was used to evaluate the progression of treatment. The average initial pirani score calculated at the time of presentation was 4.79,5.50,5.70 for age <6 months, 6 months to 1year and>1 year respectively where 40.90% of feet had initial pirani score between 3-4.5 and 59.10% of feet had score of 5 and more.The average number of casts applied for each child until correction of deformity or until tenotomy if necessary was 7.01.Foot with initial pirani score of 5 and above had undergone more number of tenotomies compared to less than 5 score.

In our study, out of 66 feet of 50 children, about 58(87.87%) feet gave excellent results , 5 feet(7.57%) gave good results and 3 feet(4.54%) gave poor results based on pirani scoring.

Considering overall patients with excellent and good results as single group with percentage of proportion being 95.45% and patients showing poor results as another group with percentage 4.54%.p value is calculated using difference between 2 proportions and came out to be <0.0001 which is significant.

**Table 11: Results based on final pirani score**

Results	No. of feet	Percentage
Excellent	58	87.87%
Good	5	7.57%
Poor	3	4.54%
Total	66	100%

**Graph 7: Results based on final pirani score****Figure 1: Baby of Neelima**

A 15days old female child presented with the right sided congenital talipesquinovarus (CTEV) deformity with initial pirani score of 6 which was managed by serial ponseti casting and percutaneous Achilles tenotomy with final pirani score of 0 after 7 weekly casts and the result came excellent with no complications

**(a)(b) At presentation (c)At 4<sup>th</sup>week(d) At6<sup>th</sup>wk(e)(f) Achilles Tenotomy (g)after applying steenbeck brace (h)6months followup**



**Figure 2: Baby Parthu**

A 26weeks old male child presented with the right sided congenital talipes equinovarus (CTEV) deformity with initial pirani score of 5 which was managed by serial ponseti casting with final pirani score of 0 after 6 weekly casts and the result came excellent with no complications

**(a)(b) At presentation (c)After 2wks(d)(e)After4wks(f)(g)after applying steenbeck brace (h)(i)followup**



## DISCUSSION:

Congenital talipes equinovarus is the commonest of all congenital deformities. It is the most common deformity appreciated in developing nations like India where socioeconomic status is poor. Its incidence is about 0.5 to 2 in every 1000 live births.

Ponseti method of treatment is the simple, economical and non surgical technique followed for the treatment of CTEV where the early intervention and the serial monitored treatment gives positive results. If the deformity is neglected as prevalent in poor socioeconomic background and families with lack of awareness, the deformity progresses and the foot becomes permanently deformed with formation of callosities and ulceration over the dorsolateral aspect of foot.

Ponseti proposed reducing the deformity with successive casts. The goal is not to correct the apparent deformation, but on contrary, to impose a simultaneous supination and abduction of the foot. Once the calcaneopedal block has been derotated, percutaneous tenotomy of Achilles tendon is performed. Ponseti mainly stressed on keeping the talar head as the fulcrum instead of calcaneocuboid joint as done in Kite's method.

In our study the average age of presentation to our OP was 3.69 months as supported by similar kind of studies like **Malhotra R<sup>(7)</sup>** where average age group of presentation was 4.03 months and **Pavone V<sup>(8)</sup>** in which the mean age at initiation of treatment was 14 days (range 3-81 days). Our study has 72% of male children and 28% of female children with male to female ratio of 2.57:1 which is comparable to a study by **M.Changulani et al<sup>(9)</sup>** in which 50 patients (75.75%) were males and 16 patients (24.24%) were females.

Our study had 68% with unilateral, 32% with bilateral deformities as compared to other studies done by **Ponseti et al<sup>(10)</sup>** where 60% were unilateral clubfoot and 40% were bilateral clubfoot deformities, by **Christian Saetersdal<sup>(11)</sup>** where 60% were unilateral and 40% were bilateral and **Majji Chandra Sekharam Naidu<sup>(12)</sup>** where 24(70%) had unilateral deformities and 10(30%) had bilateral deformities.

Among 34 unilateral patients, about 23(67.64%) patients had right foot involvement and 11(32.35%) had left foot involvement as compared to study of **Pavone V<sup>(8)</sup>** where about 68.29% were right sided and in a study by **Majji Chandra Sekharam Naidu<sup>(12)</sup>** about 44% are right sided and 26% are left sided.

Requirement of Achilles tenotomy occurred in 29(58%) patients for complete correction of deformity and 21(42%) patients were corrected only by manipulation and casting compared to other studies in **Shaik Ajez<sup>(13)</sup>** and **J.O.Mejabi<sup>(14)</sup>** where 51.72% and 65.7% respectively. It is advisable to do tenotomy only after achieving forefoot abduction.

Out of 29 patients who had undergone Achilles tenotomy, 93.10% had initial pirani score 5 and above. As the initial pirani scoring increases the need for tenotomy also increases in our study. It shows that tenotomy was required in those patients who initially have severe deformity (p value- 0.0001 which is significant).

The average total number of casts applied to achieve correction was about 7.01 and the maximum number of casts applied was 12 and there was a correlation between the number of casts and age of presentation where children presented with age more than 6 months required more number of casts as compared to the rest (p value -0.000493 which is significant) which was supported by other studies where 6.9(5-10) by **Malhotra R<sup>(7)</sup>**, 7.2 by **Christian S.et al<sup>(11)</sup>**, 8(4-15) by **Majji Chandra Sekharam Naidu<sup>(12)</sup>** and **AK Vaishy<sup>(15)</sup>** reported 7.59.

**Table 12: Comparison of mean number of casts applied with other studies**

STUDIES	MEAN NO. OF CASTS APPLIED
Our study	7.01(4-12)
Malhotra R <sup>(7)</sup>	6.9(5-10)
Christian S.et al <sup>(11)</sup>	7.2(3-13)
Chandra Sekharam Naidu <sup>(12)</sup>	8(4-15)
ArunK.Vaishy <sup>(15)</sup>	7.59

The mean pirani score at the time of presentation was 4.79 for less than 6 months of age, 5.50 for 6 months to 1 year and 6 for more than 1 year. Moreover we found that those clubfeet which had lesser initial pirani score of 4 and less were more amenable to correction and responded relatively early when compared to those with higher initial pirani score of 4.5 to 6. 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 7.39 and the average number of casts required to achieve full correction of deformity in patients with Pirani score of 4 and less was 5.53.

The average initial pirani scoring for each age group <6 months, 6months to 1year and >1year was 4.79, 5.50,6.0 respectively and the average final pirani scoring was 0.009, 0.2, 1.2 respectively. The significance of the treatment was tested using difference between two means(initial and final pirani scoring) where the difference was -4.818, standard error was 0.144 with 95%confidence interval of - 5.1043 to -4.5317, DF (degrees of freedom ) 98 and the p value came out to be <0.0001 which is statistically significant.

Steenbeek foot abduction brace was used in this study after correction of deformity. It consists of shoes mounted to a bar in a position of 15 degrees of dorsiflexion and 70 degrees of external rotation. For unilateral deformity, the normal foot was kept in 30 to 40 degrees of external rotation. The distance between the shoes was set at about 1 inch wider than the width of the infant's shoulders. we advised the parents to continue brace for 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. So adequate training and counselling has been given to the parents and frequent follow-up has been done. Without a strict follow-up bracing program, relapse will be more common. This is in contrast to a relapse rate of only 6% in compliant families (**Morcuende et al.**)<sup>(16)</sup>

During the course of our study only about 3 children got superficial pressure sores and 2 children got crowding of toes, 2 children had bruising over the thigh, 4 got breakage and slippage of cast when child was little old . Superficial pressure sores were managed by removing the cast and let the feet cast free for 4days to 1week until sore gets healed and dry and subsequent casts were continued with adequate padding over the pressure points. Bruises over the thigh have occurred due to tight compression by cast at the thigh level, so we applied more padding with everted edges and applied not too tightly making it soft and comfortable to the child. We managed overcrowding of toes by applying the casts with adequate spacing of toes and the casts were trimmed at the end to expose dorsal surface of all toes upto metatarsophalangeal joints so that toes will be free, spacious and blanching if any can be addressed immediately which we did not get any. There were slippage and breakage of casts in children with little old age which was managed by reinforcing and reapplication of casts. There were no other major complications like rockerbottom feet and flat feet and deep sores.

The final outcome of our study was evaluated based on the pirani score post treatment and followup. Out of 66 feet treated in our study about 87.87% of feet showed excellent results, 7.07% showed good results and 4.54% showed poor results. This is comparable to study by **Sakale H et al.**<sup>(17)</sup> which had 92% excellent results and where as in a study by **Malhotra R**<sup>(7)</sup> about 88.4% has shown excellent to good results. All 3 patients who showed poor results were presented initially to our clinic at the age of more than 1 year. This favours that early presentation provides better results.

Our overall results proved that despite various surgical and nonsurgical options are available for the treatment of clubfoot deformity, Ponseti technique has very good efficacy and our final outcome showed that clinically the feet were functional, painless, flexible, plantigrade and cosmetically acceptable with good mobility and without any callosities.

**CONCLUSION:**

Congenital talipes equinovarus (CTEV) is the commonest of all congenital foot deformities in which idiopathic being most common. Despite many methods have been proposed by many people for the treatment of clubfoot deformity, the Ponseti method has been accepted worldwide as a safe and effective method of treatment. Although Ponseti method has been developed long time back, the relevance it has in present day is very important. This technique can also be used in cases of relapses which reduces the need for major corrective surgery which may be associated with complications like weakness, stiffness of all joints of the foot and ankle, pain which may increase during adolescence resulting in crippling.

In our experience in this study, our data were similar to the ones in literature, confirming the effectiveness and good reproducibility of the Ponseti technique.

We have also found that Pirani scoring system is practicable, easily measurable and helpful in assessing initial and final Pirani score and the final outcome of Ponseti technique.

But the success of this treatment method is dependent on primary commitment from the family which required proper counselling from the practitioner regarding early onset of the treatment, correct use of the brace in order to prevent the relapses, complications of the casts and attentive participation to the scheduled follow ups.

We conclude that Ponseti method is an easy, effective, efficient and economical mode of management of idiopathic congenital talipes (CTEV) to attain functional, painless, plantigrade foot with good mobility and without callosities.

**LIMITATIONS:**

- Small sample size
- Difficulty in follow up due to COVID 19 pandemic
- A long term follow up of five to ten years could have been more significant to evaluate further recurrences

**CONFLICTS OF INTEREST**

None

**SOURCE OF FUNDING**

None

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