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## A study on accelerated Ponseti method for correction of congenital talipes equinovarus and evaluation of results

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### Abstract

**Introduction:** One of the most prevalent types of birth defects affecting the lower limb is talipes equinovarus, which is present from birth. It is characterized by ankle going into equines, hind foot going into Varus, forefoot into adductus and mid-footcavus. Its incidence is estimated to be about 1-2 in every 1000 live births and male child being more commonly effected than female child (with male: female ratio of 2:1) more commonly being bilateral. Correction of congenital talipes equinovarus with the Ponseti approach of weekly manipulation of the deformity followed by lengthy leg cast is successful, minimally intrusive, and affordable. Except for the horses, the deformity can be fixed in four to five weeks. Reducing the length of time a kid is in correction is necessary to ease the child's and family's physical, mental, and financial suffering. Morcuende *et al.* and Xu created faster and modified protocols that take just 5 days to fix the foot, and they discovered that the outcomes were comparable to the standard technique. The purpose of this dissertation is to evaluate the efficacy of the accelerated Ponseti technique in the treatment of idiopathic congenital talipes equinovarus, as well as the risks and benefits of this procedure.

**Aim of the study:** The purpose of this study is to evaluate the efficacy of the accelerated PONSETI method in the correction of idiopathic congenital talipes equinovarus in children less than 2 years of age.

**Materials and Methods:** The study was provisionally approved by the institutional ethics committee, Andhra medical College, Visakhapatnam. Children under the age of two years who were diagnosed with idiopathic clubfoot and treated with the accelerated ponseti method at king george hospital between august 2020 and august 2022 were evaluated in this prospective group study.

**Conclusion:** The Ponseti method for correction of clubfoot is known to be the standard treatment regimen in clubfoot. In our study we have investigated the shorter regimen of modified accelerated Ponseti technique that uses the ponseti method with a modification of twice weekly casting instead of the standard once weekly changing of the casting. There was no need for major soft tissue release treatments to rectify the abnormality in any of the youngsters. Parents reported no complaints about their children's ability to walk normally after getting treatment. There were complications in few cases like pressure sore and relapses in 10% of cases that were tackled effectively with our treatment regimen. There were no other complications such as the cast associated skin allergies, cast loosening, swelling of foot and toes, vascular compromise, rocker-bottom foot, post Tenotomy neurovascular damage and wound infections. It was found that the duration required for correction is shortand all the patients have shown good compliance to the treatment regimen. Patients who have idiopathic CTEV and who are compliant with treatment show that the accelerated Ponseti method is just as safe, easy, effective, and efficient as the standard ponseti method.

**Keywords:** Ponseti method, congenital talipes equinovarus, evaluation of results

### Introduction

One of the most prevalent types of birth defects affecting the lower limb is talipes equinovarus, which is present from birth.

- It is characterized by ankle going into equines, hindfoot going into Varus, forefoot into adductus and midfootcavus.
- Its incidence is estimated to be about 1-2 in every 1000 live births and male child being more commonly effected than female child (with male: female ratio of 2: 1) more commonly being bilateral.
- Correction of Congenital Talipes Equinovarus with the Ponseti approach of weekly manipulation of the deformity followed by lengthy leg cast is successful, minimally

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intrusive, and affordable. Except for the horses, the deformity can be fixed in four to five weeks.

- Reducing the length of time a kid is in correction is necessary to ease the child's and family's physical, mental, and financial suffering.
- Morcuende *et al.* and Xu created faster and modified protocols that take just 5 days to fix the foot, and they discovered that the outcomes were comparable to the standard technique.
- The purpose of this dissertation is to evaluate the efficacy of the accelerated Ponseti technique in the treatment of idiopathic congenital talipes equinovarus, as well as the risks and benefits of this procedure.

### Aim of the study

The purpose of this study is to evaluate the efficacy of the accelerated PONSETI method in the correction of idiopathic congenital talipes equinovarus in children less than 2 years of age.

### Materials and Methods

The study was provisionally approved by the institutional ethics committee, Andhra medical College, Visakhapatnam. Children under the age of two years who were diagnosed with idiopathic clubfoot and treated with the accelerated ponseti method at king george hospital between august 2020 and august 2022 were evaluated in this prospective group study.

### Inclusion criteria

1. All infants under the age of two with idiopathic club foot.
2. No other congenital abnormalities associated to this.
3. Participation in the study requires parental consent.

### Exclusion criteria

1. Children older than two years.
2. Children who have been diagnosed with a congenital or neurological condition.
3. History of previous conservative or surgical intervention.

### Methodology

#### Accelerated Ponseti technique for management of idiopathic clubfoot

The treatment is started as early as possible after the birth. Birth and family history is taken, deformity is assessed and rated as grade I, grade II, grade III, or grade IV using the system of Dimeglio *et al.* Pirani clinical scoring is used to determine both

the initial and final Pirani scores for each foot. Clinical follow-up of participating patients will continue for at least six months after end of direct intervention. The children are treated according to the accelerated Ponseti protocol that includes parent counselling followed by serial manipulation and above knee casting as in standard Ponseti technique but the protocol is accelerated but changing the cast twice every week. Correction of cavus followed by adductus and Varus and finally equines was done by gentle manipulation and above knee casting was done. The cast was removed only in the OPD 1-2 hours before next cast is applied. The child is evaluated and scored according to Pirani score before every cast. Tenotomy is done when the forefoot score is less than 1 and hind foot score more than 1 which is followed by an above knee cast for 3 weeks in corrected position.

### Postoperative Protocol

#### Bracing protocol

After 3 weeks have passed since the tenotomy, the final cast is taken off, and the brace is put in. The device consists of a bar to which open-toed high-top shoes made on a straight last are attached. In situations of unilateral clubfoot deformity, the brace is positioned to allow for 60-70 degrees of external rotation on the clubfoot side and 30-40 degrees on the normal foot side. When applied bilaterally, 70 degrees of external rotation is applied to each side. A good length for the bar is one that allows the heels of the feet to be at shoulder width. Incorrectly prescribing a bar that is too short causes the youngster to experience discomfort. Having a brace that is too small is a typical cause of noncompliance. For the feet to be held in dorsiflexion, the bar should be bent 5-10 degrees, with the convexity facing away from the kid.

For the first three months after the final cast is removed, the brace is worn 24 hours a day, seven days a week. After that, the child should wear the brace for 14-16 hours every day, including 12 hours at night and 2-4 hours during the day. The child will continue to follow this procedure up to the ages of 3 and 4 years. follow up protocol:

2 weeks to troubleshoot compliance issues

3 months to graduate to nights and naps protocol

Every 4 months to monitor compliance and check for relapse

Every 6 months until age of 4 years

Every 1 to 2 years until skeletal maturity

### Evaluation of Results

A. Excellent	<ol style="list-style-type: none"> <li>1. All aspects of the malformation are fixed.</li> <li>2. Aesthetically appropriate plantigrade foot</li> <li>3. Pliability of the subtalar joint</li> <li>4. When there is a bilateral deformity, the degrees of dorsiflexion on both sides must be more than ninety degrees.</li> </ol>
B. Good	<ol style="list-style-type: none"> <li>1. Total deformity correction including all visible signs of improvement</li> <li>2. An otherwise normal, mobile, and fully plantigrade foot exhibiting just a little degree of chronic metatarsal adductus.</li> </ol>
C. Fair	<ol style="list-style-type: none"> <li>1. Plantigrade and functionally acceptable foot</li> <li>2. Cosmetically less acceptable</li> </ol>
D. Poor	<ol style="list-style-type: none"> <li>1. Loss of correction and recurrence of deformity which requires soft tissue release</li> </ol>

### Results

In this study, we looked at CTEV correction using the accelerated Ponseti approach in 43 individuals with idiopathic clubfoot who were less than 2 years old. Three patients could not be located for further evaluation.

- a) In a group of 40 patients, 26 were male and 14 were female.

Thirty patients were less than six months, seven were between six months and one year, and three were older than two years.

- b) 21 patients had bilateral deformity, 12 patients had right sided unilateral and 7 had left sided unilateral deformity. A total of 61 feet were included, 33 right and 28 left.

- c) At presentation 18 patients had Dimeglio grade 4, 13 had Dimeglio grade 3 and 9 had Dimeglio grade 2 deformity.
- d) Patient scores at the beginning of the study ranged from 4.59 for those aged 0-6 months, 4.44 for those aged 6-12 months, and 5.25 for those aged 1-2 years.
- e) The average number of casts needed for correction for patients of age between 0-6 months was 4.59, 6-12 months was 4.44 and 1-2 years was 5.25.
- f) The average duration for correction for patients of age between 0-6 months was 18.33 days, 6-12 months was 17.2 days and 1-2 years was 31.33 days.
- g) Thirty young toddlers had an Achilles tenotomy. Tibialis anterior tendon transfers or substantial soft tissue releases were not required on any of the feet.
- h) Five patients had a recurrence of their deformity, three with forefoot adduction and two with equines deformity; all five required more plasters, and two required additional Achilles Tenotomies.
- i) 5 patients had pressure sores over head of the talus region, all of them healed subsequently
- j) The results were excellent in 51 feet (85%) and good in 10 feet (15%).

S. No	Result	Number of Feet	Percentage
1.	Excellent	51	85%
2.	Good	10	15%
3.	Fair	0	
4.	Poor	0	

## 1. Complications

Cast complications	
Skin allergy or irritation	0
Cast loosening	0
Cast related pressure ulcers	5
Swelling of foot and toes	0
Circulation problems	0
Rocker bottom foot	0
Muscle atrophy	0
Post Tenotomy complications	
Neurovascular damage	0
Wound infection	0
Brace related complications	
Poor brace compliance	5

### Statistical analysis

The means of the pre- and post-test Pirani scores were compared, and the statistical significance of the difference was determined, using the paired 't' test.

### The analysis was performed as follows:

If n is the total number of feet included in the study, we calculate the difference between initial Pirani score ( $x_i$ ) and final Pirani score after correction ( $y_i$ ) which is denoted as  $d_i$ . This is calculated individually for every foot with i ranging from 1 to n. The difference is then summed up to result in  $\sum d$  where  $\sum d = d_1 + d_2 + d_3 + \dots + d_n$ . Similarly  $d^2$  is also calculated individually for all the feet and summed up as  $\sum d^2 = d_1^2 + d_2^2 + d_3^2 + \dots + d_n^2$

The  $\alpha$  value is 0.10 and the degree of freedom is calculated as n-1. Then we calculate the t value using the formula

$$t = \frac{\sum D}{\sqrt{\frac{n \sum D^2 - (\sum D)^2}{(n-1)}}}$$

$\sum d$	$\sum d^2$	n-1	t-test	$\alpha$	t-stat
279	1313.5	60	45.292	0.10	1.296

t- test > t- stat

Therefore, we can conclude that after the intervention the Pirani scores have decreased significantly.

## Discussion

The most common musculoskeletal birth abnormality is congenital talipes equinovarus, or clubfoot.<sup>[3]</sup> The overall incidence of 1 in 1000 live births<sup>[3, 5]</sup>. Eighty percent of the time, clubfoot is the only visible abnormality<sup>[1, 3]</sup>. Idiopathic clubfoot accounts for around 85% of all cases of the disease<sup>[1, 3]</sup>. It occurs bilaterally in 66% of instances and is more prevalent in men than females (2:11 male to female ratio)<sup>[11]</sup>.

Hippocrates' writings from 300 B.C. provide the oldest recorded evidence of clubfoot and its treatment, and since then, the approach has ranged from pure conservative therapy at first to more surgical intervention and back to increased conservative control<sup>6</sup>. Due to poor outcomes in terms of mobility and the existence of discomfort after surgical intervention<sup>[7]</sup>, clubfoot surgery is no longer recommended in the contemporary day.

The goals of therapy are to eliminate the foot abnormalities, restore normal function, and create a Plantigrade foot so that the patient may wear conventional footwear and avoid arthritic degenerations later in life.

The good results of Ponseti's clubfoot 9 treatment protocol were first reported in 1963. As early as 1980, he shared the findings of a 10-year follow-up on his procedure. In the years since, the standard protocol for treating clubfoot has included weekly manipulation and above-knee casting beginning as soon as possible after birth, followed by percutaneous Achilles Tenotomy and Tibialis anterior tendon transfer if necessary, and finally a foot abduction brace worn until the age of 4-5 years<sup>[11]</sup>. Studies using ultrasound scans have shown that the ponseti approach successfully treats clubfoot by normalizing the aberrant tarsal bone connections that characterize the condition. The Ponseti approach is also useful for fixing the aberrant forms of separate chondro-osseous structures brought on by shifts in the mechanical stress of young, quickly growing tissues.

In as many as 98% of instances, the Ponseti technique was able to eliminate the need for surgical intervention<sup>[11]</sup>. But the major drawback in this method in developing countries is the poor compliance to the treatment because of the long duration of the treatment added with lack of education, awareness and poor economic condition of the people<sup>[15, 16]</sup>.

This led to investigations for shorted treatment regimen for correction of clubfoot. Morcuende *et al.* (2005)<sup>[17]</sup> revealed the findings of a faster and modified procedure that required just 5 days to complete. Casting twice weekly, Xu RJ released his findings in 2011<sup>[18]</sup>. They discovered that the feet could be corrected in much less time than the conventional procedure required, with the same results<sup>[17, 18]</sup>.

Several classification systems have been proposed for determining the severity of clubfoot deformity; however, the Pirani scoring system has been found to be the most useful in determining not only the severity of the deformity, but also the

rate of deformity correction, the necessity of Tenotomy, and the timing of bracing<sup>[19]</sup>.

Our study included 61 feet of which 51 (85%) had excellent outcome and 10 (15%) had good outcome. The average duration for correction for patients of age between 0-6 months was 18.33 days, 6-12 months was 17.2 days and 1-2 years was 31.33 days,

showing a significant decrease in time required for correction particularly in children of age less than 1 year. Achilles Tenotomy was done in 30 out of 40 patients (75%). 5 patients had pressure sores that healed subsequently. 5 patients had relapse of the deformity with 3 having relapse of forefoot adduction and 2 having relapse of equines deformity.

**Table 1:** Average initial Pirani scores-Comparison with similar studies

S. No	Study	Pirani Score	
1.	Our Study <i>et al.</i>	4.63	
2.	Barik <i>et al.</i> (2018) <sup>[20]</sup>	Standard group	Accelerated group
		5.02 +/-0.78	5.02 +/-0.73
3.	Islam <i>et al.</i> (2020) <sup>[21]</sup>	Standard group	Accelerated group
		4.67 +/- 0.73	4.35 +/- 0.76
4.	Elgohary <i>et al.</i> (2015) <sup>[22]</sup>	Standard group	Accelerated group
		5.17 +/- 0.62	5.13 +/- 0.61
5.	Ahmed <i>et al.</i> (2019) <sup>[23]</sup>	5.5	
6.	Harnett <i>et al.</i> (2010) <sup>[24]</sup>	Standard group	Accelerated group
		5.0	5.5

**Table 2:** Average no. of casts needed for correction-comparison with similar studies

S. No	Study	Average no. of casts needed for correction	
1.	Our Study <i>et al.</i>	5.7	
2.	Barik <i>et al.</i> (2018) <sup>[20]</sup>	Standard group	Accelerated group
		5.23 +/-0.59	4.72 +/- 0.61
3.	Islam <i>et al.</i> (2020) <sup>[21]</sup>	Standard group	Accelerated group
		6.3 +/- 1.2	6.1 +/- 1.4
4.	Elgohary <i>et al.</i> (2015) <sup>[22]</sup>	Standard group	Accelerated group
		4.88 +/- 0.88	5.16 +/- 0.72
5.	Ahmed <i>et al.</i> (2019) <sup>[23]</sup>	6.0	
6.	Harnett <i>et al.</i> (2010) <sup>[24]</sup>	Standard group	Accelerated group
		5.0	5.0

**Table 3:** Average duration needed for correction – comparison with similar studies

S. No	Study	Average duration needed for correction (In Days)	
1.	Our Study <i>et al.</i>	19.67	
2.	Barik <i>et al.</i> (2018) <sup>[20]</sup>	Standard group	Accelerated group
		54.38 +/-8	33.88 +/- 9.03
3.	Islam <i>et al.</i> (2020) <sup>[21]</sup>	Standard group	Accelerated group
		58.2 +/- 8.3	39.5 +/- 5.2
4.	Elgohary <i>et al.</i> (2015) <sup>[22]</sup>	Standard group	Accelerated group
		33.36 +/- 6.69	18.13 +/- 3.02
5.	Ahmed <i>et al.</i> (2019) <sup>[23]</sup>	29	
6.	Harnett <i>et al.</i> (2010) <sup>[24]</sup>	Standard group	Accelerated group
		42	16

**Table 4:** Average final Pirani scores - comparison with similar studies

S. No	Study	Pirani Score	
1.	Our Study <i>et al.</i>	0.12	
2.	Barik <i>et al.</i> (2018) <sup>[20]</sup>	Standard group	Accelerated group
		1.20 +/-0.46	1.50 +/-0.00
3.	Islam <i>et al.</i> (2020) <sup>[21]</sup>	Standard group	Accelerated group
		0.34 +/- 0.38	0.35 +/- 0.31
4.	Elgohary <i>et al.</i> (2015) <sup>[22]</sup>	Standard group	Accelerated group
		0.49 +/- 0.42	0.52 +/- 0.38
5.	AHMED <i>et al.</i> (2019) <sup>[23]</sup>	0.59	
6.	Harnett <i>et al.</i> (2010) <sup>[24]</sup>	Standard group	Accelerated group
		0.5	0.5

**Table 5:** Percentage of cases tenotomy was performed in – comparison with similar studies

S. No	Study	Tenotomy Performed	
		Yes	No
1.	Our Study <i>et al.</i>	75%	25%
2.	Barik <i>et al.</i> (2018) <sup>[20]</sup>	84%	16%
3.	Islam <i>et al.</i> (2020) <sup>[21]</sup>	84.42%	15.58%



4.	Elgohary <i>et al.</i> (2015) <sup>[22]</sup>	93.8%	6.2%
5.	Ahmed <i>et al.</i> (2019) <sup>[23]</sup>	80%	20%
6.	Harnett <i>et al.</i> (2010) <sup>[24]</sup>	15%	85%

**Table 6:** Final outcome with accelerated Ponseti method – comparison with similar studies

S. No	Study	Outcome (in percentage)			
		Excellent	Good	Average	Poor
1.	Our Study <i>et al.</i>	83%	17%	0%	0%
2.	Barik <i>et al.</i> (2018) <sup>[20]</sup>	78%	22%	0%	0%
3.	Islam <i>et al.</i> (2020) <sup>[21]</sup>	66%	33%	0%	0%
4.	Elgohary <i>et al.</i> (2015) <sup>[22]</sup>	82%	18%	0%	0%
5.	Ahmed <i>et al.</i> (2019) <sup>[23]</sup>	74%	26%	0%	0%
6.	Harnett <i>et al.</i> (2010) <sup>[24]</sup>	80%	20%	0%	0%

**Table 7:** Relapse - Comparison with similar studies

S. No	Study	Relapse rate	
1.	Our Study <i>et al.</i>	12.5%	
2.	Barik <i>et al.</i> (2018) <sup>[20]</sup>	Standard group	Accelerated group
		15%	11%
3.	Islam <i>et al.</i> (2020) <sup>[21]</sup>	Standard group	Accelerated group
		12%	8%
4.	Elgohary <i>et al.</i> (2015) <sup>[22]</sup>	Standard group	Accelerated group
		14.7%	15.6%
5.	Ahmed <i>et al.</i> (2019) <sup>[23]</sup>	10%	
6.	Harnett <i>et al.</i> (2010) <sup>[24]</sup>	Standard group	Accelerated group
		13%	11%

In all 5 cases of relapse it was observed that the cause for relapse has been the poor compliance to the abduction brace. All of them were treated with reapplication of plaster casts until correction of deformity with 2 cases needing second percutaneous Achilles Tenotomy followed by abduction brace application again.

Insufficient brace compliance, a lack of parental education, a severe deformity, and a technical error in the casing all play a role in why the ponseti brace often fails to correct a deformity <sup>[15, 16]</sup>.

Relapse may be prevented in certain cases by ensuring that patients adhere to the bracing procedure and by following up with them on a frequent basis to check for proper brace fit and make adjustments as necessary. To avoid a recurrence of the deformity, it is crucial to advise and educate the parents about the need of treatment compliance and the various challenges that may arise during the bracing phase.

There were no other complications such as the cast associated skin allergies, cast loosening, swelling of foot and toes, vascular compromise, rocker-bottom foot, post Tenotomy neurovascular damage and wound infections.

There was no need for major soft tissue release treatments to rectify the abnormality in any of the youngsters. After treatment, each kid had full range of motion in both legs and their parents reported no complaints about their children's ability to walk normally.

There were also a few drawbacks in our study- the sample size is not large enough and further studies with larger sample sizes are needed to draw conclusive evidence

The period of follow-up in our study is not long enough to detect all the cases of relapse as the clubfoot is known for relapse till the age of 5 years and a total follow-up till age of 5 years is needed to identify all the cases of relapse in the study population.

## Conclusion

The Ponseti method for correction of clubfoot is known to be the

standard treatment regimen in clubfoot. In our study we have investigated the shorter regimen of modified accelerated Ponseti technique that uses the ponseti method with a modification of twice weekly casting instead of the standard once weekly changing of the casting.

There was no need for major soft tissue release treatments to rectify the abnormality in any of the youngsters. Parents reported no complaints about their children's ability to walk normally after getting treatment.

There were complications in few cases like pressure sore and relapses in 10% of cases that were tackled effectively with our treatment regimen. There were no other complications such as the cast associated skin allergies, cast loosening, swelling of foot and toes, vascular compromise, rocker-bottom foot, post Tenotomy neurovascular damage and wound infections.

It was found that the duration required for correction is short and all the patients have shown good compliance to the treatment regimen.

Patients who have idiopathic CTEV and who are compliant with treatment show that the accelerated Ponseti method is just as safe, easy, effective, and efficient as the standard ponseti method.

## Conflict of interest

On behalf of all the authors the corresponding author states that there is no conflict of interest.

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Not available

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