

## IDIOPATHIC CONGENITAL TALIPES EQUINOVARUS: AN EVALUATION IN CHILDREN TREATED BY THE PONSETI METHOD

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### ABSTRACT

#### BACKGROUND

Long-term success reports by Dr. Ponseti with the Ponseti method in the treatment of congenital idiopathic clubfoot have led to a renewed interest in this method among paediatric orthopaedists.

The purpose of this study is to evaluate mid-term effectiveness of Ponseti method for the treatment of congenital idiopathic clubfoot.

#### MATERIALS AND METHODS

Of 93 babies (26 girls, 67 boys) with idiopathic clubfoot who began treatment at Assam Medical College and Hospital between April 2014 and June 2016. 85 patients (22 girls and 63 boys) with 127 clubfeet (71 right feet, 56 left feet) were included in the study. 42 cases were bilateral and 43 were unilateral. Minimum age 6 days and maximum age 3 years (SD 0.64 years). Presentation was categorised as either early or late. 26 (30.59%) of 85 babies who presented for treatment were 28 days or younger versus 59 (69.41%) of 85 babies who presented for treatment were late presenters.

#### RESULTS

Mean no. of cast required was 5.1. 26 feet (20%) did not require Achilles tenotomy. Higher initial severity scores at presentation were associated with the need for tenotomy. 31 (36%) had poor brace use and 54 (63%) had good brace use. Of 26 babies who presented early for treatment (28 days or younger), 11 (42.3%) had poor brace use and 15 (57.7%) had good brace use. However, in 59 babies who presented late, a larger percentage had good brace use (39 babies) than poor brace use (20 babies). No additional surgery was required for 60% of the brace intolerant patients. Final dorsiflexion was adequate for 117 (92%) of 127 feet. The final ankle motion (i.e., plantar flexion, dorsiflexion) was no different between early and late presenters.

#### CONCLUSION

Ponseti method is a safe and satisfactory treatment for congenital idiopathic clubfoot with mid-term effectiveness.

#### KEYWORDS

CTEV, Ponseti Method, Tenotomy.

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**INTRODUCTION:** Congenital Talipes Equinovarus (CTEV), also known as clubfoot, is one of the most common congenital deformities. While there is some association with neuromuscular disease, chromosomal abnormalities, different syndromes or extrinsic causes, others occur in otherwise normal infants and are classified as idiopathic congenital talipes equinovarus.

While idiopathic is the most common cause though not yet fully understood, it is one of the most common birth deformities that affecting over 2,00,000 newborn children every year in the world.<sup>1</sup>

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In India every 10 minutes a child is born with clubfoot i.e. over 50,000 children are born with clubfoot deformity every year (1 per 500 birth).<sup>1</sup>

Clubfoot is usually defined as a fixation of the foot in adduction, supination and varus.

Three bones, the calcaneus, navicular and cuboid are medially rotated in relation to the talus and are held in adduction and inversion by ligaments and tendons. Although, the foot is supinated, the front of the foot is pronated in relation to the back of the foot causing cavus. Diagnosis is mainly based on clinical evidence even if prenatal diagnosis is possible through sonographic assessment.

The purpose of this study was to report our caseload in evaluating the short-midterm effectiveness of the Ponseti method<sup>2,3</sup> for the treatment of idiopathic clubfoot in a series of infants with this anomaly.

Current treatment of idiopathic CTEV consists of serial casting using the Ponseti method to gradually correct the deformity followed by bracing to maintain correction.

The aim of treatment is to obtain anatomically and functionally normal feet in all patients. However, this is

unrealistic as the deformity of bone, joints, muscles, tendons and ankle, leg and foot ligaments are sometimes too severe to be fully corrected.

Conservative treatment of clubfoot is an accepted practice and has been reported to result in good correction ranging in 50%-90% of cases.<sup>4,5,6</sup> Serial casting tends to prevent further tightening of the contracted structures prior to surgery.<sup>5,6</sup> Treatment should be started early to ensure better outcomes<sup>7</sup> allowing optimal growth of bone (particularly the talus) and maintenance of joint mobility.<sup>8</sup>

**AIMS AND OBJECTIVE:** The purpose of this study was to evaluate the mid-term effectiveness of the Ponseti method<sup>4</sup> for the treatment of congenital idiopathic clubfoot.

**MATERIALS AND METHODS:**

**Inclusion Criteria:** Age less than 3 years, unilateral or bilateral CTEV and willingness to participate in the study.

**Exclusion Criteria:** Age over 3 years, earlier operated cases, concomitant major illness, secondary clubfoot and unwillingness to participate in the study.

We retrospectively studied the medical records of 93 babies (26 girls, 67 boys) with idiopathic clubfoot who began treatment at Assam Medical College and Hospital between April 2014 and June 2016. We did not call back patients for clinical followup specifically for this study. Of the 93 patients, we excluded 8 because they were lost to follow up or they were unable to return for followup. 85 patients (22 girls and 63 boys) with 127 clubfeet (71 right feet, 56 left feet) were included in the study.

42 cases were bilateral and 43 were unilateral. Overall, the mean age at presentation 169.78 days. Median age 60.83 days; minimum age 6 days and maximum age 3 years (SD 0.64 years).

Presentation was categorised as either early or late. Early presentation was defined as 28 days or younger and late presentation was defined as older than 28 days. 26 (30.59%) of 85 babies who presented for treatment were 28 days or younger versus 59 (69.41%) of 85 babies who presented for treatment were late presenters.

The club feet were treated with strict Ponseti protocol.<sup>2,9</sup> At the time of presentation, the clubfoot deformities were graded with the Pirani six-point initial severity score.<sup>10,11</sup>

The score was obtained at initial evaluation for all feet in the series. Information obtained from the medical records included ankle range of motion (i.e., dorsiflexion, plantar flexion) measured with a handheld goniometer, any previous treatment, tolerance to the brace (i.e., foot abduction orthosis), need for percutaneous Achilles tenotomy, number of pre-tenotomy casts applied and need for additional surgical procedures were also taken.

We defined a good outcome as requiring no surgery or minor surgery. During routine followup visits, we asked the parents whether they followed the strict brace protocol. We defined good brace use as fulltime use for at least 3 months followed by at least 9 months of night time use,<sup>12,13</sup> anything less was considered poor brace use. We made this assessment based on questioning the parents during follow up examinations.

All babies were examined to determine ankle range of motion. Ankle dorsiflexion measurements were categorised as either inadequate (less than 5°) or adequate (5° or greater).

**RESULTS:** The age distribution has been found out and it is as follows (Table 1).

Age Group (in months)	No. s (n)	(%)
<1	26	30.59
1-6	36	42.35
7-12	14	16.47
>12	9	10.59
<b>Total</b>	<b>85</b>	<b>100.00</b>

**Table 1: Age Distribution**

The mean initial Pirani severity score of the babies who presented early for treatment (28 days or younger) was 5.2 and late presenters was 5.1 (Table 2).

Group	No. of feet	Mean	Median	Minimum	Maximum
Early	43	5.2	5	3	6
Late	84	5.1	4	2	6
<b>Total</b>	<b>127</b>	<b>5.1</b>	<b>4.5</b>	<b>2</b>	<b>6</b>

**Table 2: Pirani Score**

The babies who had previous treatment had lower initial severity scores (Table 3).

Previous treatment	Mean	Number of feet	±SD	Median	Minimum	Maximum
No	4.18	124	1.25	4.00	0.50	6.00
Yes	3.00	3	-	-	-	-
<b>Total</b>	<b>4.16</b>	<b>127</b>	<b>1.25</b>	<b>4.00</b>	<b>0.50</b>	<b>6.00</b>

**Table 3: Previous Treatment**

Fewer casts were required to treat children who was treated previously.

Previous Treatment	Mean Number of Casts	Number of Feet	±SD	Median	Minimum	Maximum
No	5.3	124	1.46	0.00	0.00	10.00
Yes	4.96	3	-	-	-	-
<b>Total</b>	<b>5.1</b>	<b>127</b>	<b>1.46</b>	<b>0.00</b>	<b>0.00</b>	<b>10.00</b>

**Table 4: No. of Cast**

Babies who underwent previous treatment needed fewer casts (Table 4).

We observed an association between the total number of casts applied and the need to undergo additional surgery (other than percutaneous Achilles tenotomy) (Table 5) 26 feet (20%) did not require Achilles tenotomy. Higher initial severity scores at presentation were associated with the need for tenotomy.

TENOTOMY	<28 days (Early)		>28 days (Late)		Total N
	N	%	N	%	
No	10	23.1	16	18.6	26 (20%)
Yes	33	76.9	68	81.4	101 (79%)
<b>Total</b>	<b>43</b>	<b>100</b>	<b>84</b>	<b>70.59</b>	<b>127</b>

**Table 5: Tenotomy**

Brace use was evaluated in 85 babies and was almost evenly distributed: 31 (36%) had poor brace use and 54 (63%) had good brace use. Of 26 babies who presented early for treatment (28 days or younger), 11 (42.3%) had poor brace use and 15 (57.7%) had good brace use (Table 7). However, in 59 babies who presented late, a larger percentage had good brace use (39 babies) than poor brace use (20 babies). Brace intolerant patients might still avoid additional surgery. No additional surgery was required for 60% of the brace intolerant patients.

Compliance	Early	Late	Total
Good	15 (57.6%)	39 (66.1%)	54 (63.5%)
Poor	11 (42.3%)	20 (33.8%)	31 (36%)
<b>Total</b>	<b>26</b>	<b>59</b>	<b>85</b>

**Table 6: Brace Compliance**

Final dorsiflexion was adequate for 117 (92%) of 127 feet. The final ankle motion (i.e., plantar flexion, dorsiflexion) was no different between early and late presenters.

Dorsiflexion	Number of feet (n)	Percentage (%)	Dorsiflexion
Adequate (5 degrees or greater)	117	92.75	Adequate (5 degrees or greater)
Inadequate (less than 5 degrees)	10	7.25	Inadequate (less than 5 degrees)
<b>Total</b>	<b>127</b>	<b>100.00</b>	<b>Total</b>

**Table 7: Dorsiflexion**

Age At Presentation	Mean Dorsiflexion	Number of Feet	±SD	Median	Minimum	Maximum	p value
<28 days (Early)	15.00	43	7.80	15.00	6.00	25.00	0.0556225
>28 days (Late)	12.57	84	6.26	15.00	3.00	20.00	

**Table 8: Dorsiflexion**

Age At Presentation	Mean Plantar Flexion	Number of Feet	±SD	Median	Minimum	Maximum	p value
<28 days (Early)	50.11	43	23.34	54.00	30.00	60.00	0.5741261
>28 days (Late)	48.63	84	19.86	50.00	25.00	65.00	

**Table 9: Plantar flexion**



**Picture 1: Children in Foot Abduction Brace after Correction of Deformity (FAB)**

**DISCUSSION:** The Ponseti technique has been available for more than 50 years, but only Ponseti and colleagues have reported long-term followup.<sup>7</sup> The literature otherwise contains primarily short-term followup studies. The goal of this study was therefore to evaluate midterm results with a minimum 1-year followup. We specifically asked; (1) if the number of casts required was associated with age at presentation (28 days or younger or older than 28 days); (2) if the number of casts applied was associated with the severity of the initial severity score at presentation; (3) if the need for additional surgery was associated with the initial severity and (4) if the results were different for early versus late presenters. Finally, we used an outcome tool to gauge parent satisfaction with the treatment.

One of the limitations of the study is the reliance on parent-reported data such as brace use. When we believed the brace was not used correctly, we talked to the parents and they normally confirmed our suspicions. Another limitation is the variability of measuring ankle dorsiflexion. To lessen measurement variability, only the senior author measured the range of motion. Babies who were partially, but unsuccessfully treated at other centres had lower initial scores (Table 3) required fewer Ponseti casts (Table 4) and required slightly fewer percutaneous Achilles tenotomies. This indicates the previous treatment had some positive effect on the initial deformity. Based on our experience, we believe some treatment is better than none, but we prefer to have the children referred to us as early as possible because the overall treatment time is shorter for children who are treated by us from birth.

The initial severity score was associated with the need to perform tenotomy. In the literature, approximately 90% of children undergoing Ponseti treatment need a tenotomy.<sup>14</sup> We found the number of Ponseti casts applied predicted the need to perform additional surgical procedures; a foot that requires many casts for the initial correction is more likely to require future additional surgery.

In our study, the Ponseti method proved successful with 92% of feet (117 feet) achieving a good outcome. Other authors have reported short-term results with the Ponseti technique. Ippolito et al<sup>15</sup> compared babies treated with different protocols (Ponseti and the Marino-Zuco method). In the Ponseti group, 78% of the feet had excellent or good results as compared with only 43% feet in the non-Ponseti group. Ippolito et al<sup>16</sup> also reported excellent results in 18 of 49 feet treated with the Ponseti method and only two of 47 feet treated with the non-Ponseti technique. In another study,<sup>2</sup> only two of nine feet treated with the Ponseti method required major surgery, whereas 13 of 19 feet treated with the Copenhagen technique required major surgery. A study from Romania<sup>8</sup> compared results of a local Romanian treatment protocol and the Ponseti method. At 18 months, only four (5.1%) of 78 feet treated with the Ponseti method required PMR, whereas 13 (17.6%) of 74 feet treated with the Romanian method required PMR for the completion of treatment.<sup>8</sup> Colburn and Williams<sup>6</sup> found only three of 57 feet treated by the Ponseti method required extensive surgical correction. This pattern of good short-term results

has been replicated in many recent studies.<sup>1,2,4,6,8,9,14,16</sup>

Relapses are associated with deviating from the Ponseti brace protocol.<sup>4,14</sup> However, strictly following the brace protocol seems to be the major challenge of the Ponseti method. Many authors report brace intolerance rates of 30% to 49%.<sup>1,7,11,14</sup> Our brace intolerance rate was as high as 36%. Brace protocol deviation might occur for a number of reasons. Possible reasons can include the feet either (1) not being fully corrected before being placed in a brace or (2) the development of a relapse despite brace wear making continued brace use impossible. Various authors have suggested modifying the brace to improve brace tolerance.<sup>5,15</sup> In our study, late presenters were more brace tolerant. Children who were late presenters failed initial treatment at other centres and the parents might have felt motivated to strictly follow the Ponseti brace protocol while undergoing treatment at our centres. Dobbs et al<sup>11</sup> reported better brace tolerance when the parents had more than a high school education.

Not strictly following the Ponseti brace protocol does not always preclude a good result. In another study,<sup>1</sup> 30 brace intolerant patients required no additional surgery. In our study, 100% of the brace intolerant patients required no additional surgery. However, we have no way to reliably predict, which brace intolerant patients are more or less likely to relapse. Therefore, physicians should strongly recommend that all patients use the brace according to the strict Ponseti protocol.

Several authors have studied whether the initial age at presentation impacts the results of treatment. Abdelgawad et al<sup>1</sup> reported a 6.6% failure rate in patients who presented late for treatment (mean age, 36.3 weeks). Lehman et al<sup>17</sup> reported failure in five feet that presented late for treatment (mean age, 34 weeks). Other studies have suggested age at presentation does not affect the end result of treatment; 19% of patients were older than 6 months in the Morcuende et al study,<sup>18</sup> all 17 patients who presented for treatment after walking age achieved full correction in the Lourenco et al study<sup>19</sup> and good results were achieved in our previous study<sup>3</sup> that consisted of babies whose average age was 5 months. We found no relation between the final ankle dorsiflexion or plantar flexion and the patients' age at presentation for treatment. Age at presentation was not associated with the need to perform additional surgery. Dobbs et al<sup>11</sup> reported the prevalence of recurrence was not dependent on the age at presentation for treatment (even if older than 1 year), the initial severity of the deformity or whether the baby had any previous treatment mainly casting before referral. However, in our study, babies who had undergone previous treatment before referral had advantages in terms of fewer cast changes needed and better initial scores.

The initial severity score did not predict the need for additional surgery. This was also reported by Lehman et al.<sup>17</sup>

**CONCLUSION:** The Ponseti method is a simple and effective method for treating idiopathic clubfoot. Adhering to the Ponseti brace protocol is a major challenge of the

method and it has a direct effect on the success of treatment. Because we do not have reliable criteria to foresee, which patients who deviate from the brace protocol will still achieve correction, all parents should be strongly encouraged and properly educated to use the brace according to the Ponseti protocol.

Most children with clubfoot have a normal quality of life and behave and function at a level that is not dissimilar to children born with normal feet. Although, our data show the Ponseti method provides reproducible results with midterm followup, it will be important to continue following these cohorts into adolescence and adult life to affirm Ponseti long-term studies.

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