

Management of Idiopathic Congenital Talipes Equinovarus by Ponseti's Technique-Outcome Analysis

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Abstract

Background: Congenital talipes equinovarus (CTEV), also known as clubfoot, is a common congenital orthopaedic condition characterised by an excessively turned-in foot (equinovarus) and high medial longitudinal arch (cavus). Untreated, it causes permanent impairment, deformity, and agony. Interventions can be conservative (such as splinting or stretching) or surgical.

Objectives: To analyze the outcome of Ponseti's technique in management of idiopathic Congenital Talipes Equinovarus.

Material and Methods: This was a single centre, hospital (inpatient) based, prospective, observational study involving infants less than 6 months of age at the time of enrolment. The clinical result among the study participants were evaluated one year following therapy. The severity of CTEV was assessed using Pirani Score.

Results: A total of 32 infants accounting for 54 feet were treated as a part of this study: 22 participants had bilateral CTEV (44 feet), and 10 participants had unilateral CTEV (10 feet). The success rate of treatment of CTEV among 54 feet treated using the Ponseti technique was 96.29%. Only two feet (in two different participants) did not have the desired outcome. The primary reasons in both cases were non-compliance with the treatment protocol. The median number of casts was 7 per foot (range 3 to 18 casts). Number of casts applied were higher among participants having bilateral CTEV. A total of 72.2% of participants required tenotomy as a part of treatment. The most common complication was soreness (10.5%) followed by the crowding of toes (4.7%). The most difficult deformity to treat is to correct cavus.

Conclusion: Ponseti's technique had very high success rate among young infants who followed treatment protocol and complied with follow up.

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Introduction

Congenital talipes equinovarus, also referred to as clubfoot, occurs in one in 1000 live births and is one of the most common birth defects involving the musculoskeletal system[1]. It consists of four components: Ankle equinus, hindfoot varus, forefoot adductus, and midfoot cavus[2]. Clubfoot deformity is most commonly an isolated birth defect and considered idiopathic, but it may be associated with myelodysplasia, arthrogryposis, or multiple congenital abnormalities[3]. Many theories have been proposed to explain the aetiology of idiopathic clubfoot including vascular deficiencies, environmental factors, in utero positioning, abnormal muscle insertions, and genetic factors[4]. Of the known aetiologies for clubfoot, disorders specifically involving the nervous system comprise the greatest number. The most known aetiologies are distal arthrogryposis and myelomeningocele. Given the vastly different aetiologies of this condition, clubfoot likely represents a final common pathway for disruption anywhere along the neuromuscular unit, including the brain, spinal cord, nerve, or muscle[5]. While it is becoming clearer that clubfoot is multifactorial in origin, genetic factors clearly play a role as suggested by the 33% concordance of identical twins and the fact that nearly 25% of all cases are familial[6]. Though the exact genetic mechanism of clubfoot has not yet been determined, a multifactorial and possibly polygenic causation has been suggested[7].

Although clubfoot is recognizable at birth, the severity of the deformity can vary from mild to an extremely rigid foot that is resistant to manipulation. When untreated, children with clubfoot walk on the sides and/or tops of their feet, resulting in callus formation, potential skin and bone infections, inability to wear standard shoes, and substantial limitations in mobility and employment opportunities[8]. Two classification systems are widely used

in the initial evaluation of clubfoot deformities. One of these classification systems was developed by DiMeglio and the second by Pirani[9]. The Pirani score is a scale ranging from zero to six, where a higher score indicates a more severe foot.

Various conservative or non-conservative treatments have been used to correct clubfoot till date, but it is still challenging to treat the most severe cases of clubfoot. Surgeons have struggled over the years to identify the best method of treatment for the congenital clubfoot deformity. This struggle has lessened over as the Ponseti method has become the primary treatment for idiopathic clubfoot around the world[10]. The Ponseti method is a specific method of serial manipulation, casting, and tenotomy of the Achilles tendon to achieve correction of the clubfoot. Included in the method is the use of a foot abduction brace to prevent relapses as well as strategies to treat relapses once they occur based on age of the child. It takes around four to five weeks to achieve the entire repair of all four components of the clubfoot deformity with the Ponseti method.

The present study was undertaken to study the severity of CTEV deformity using the Pirani score and to assess the functional outcomes of CTEV management by the Ponseti technique in a tertiary care centre of Bundelkhand region of Madhya Pradesh.

Subjects and Methods

This was a single centre, outpatient based, prospective, observational study in the Department of Orthopaedic of a tertiary care hospital. All infants with idiopathic CTEV less than 6 months of age, with no previous history of CTEV treatment at other institute and whose parents gave written informed consent were included in study. CTEV due to Spinal defects or muscle imbalance, CTEV with more than three anomalies, AMC (Arthrogryposis

multiplex congenita), those treated at other institutes or referred out to other institute, relapses cases of CTEV, resistant case of CTEV and whose parents refused to give consent were excluded from the study. The recruitment of the participants and primary data collection was started once the protocol was approved by the Institute's ethical committee. All participants who fulfilled the selection criteria were recruited until the desired sample size was completed. The minimum sample size for the present study was 54 which is derived with the help of SPSS (statistical package for social sciences) software. We approached a total of 41 participants for enrolment in the present study: parents/guardians of 3 participants refused to participate, 6 participants were excluded based on selection criteria and the remaining 32 participants were enrolled in the present study.

Among the 32 participants, 22 participants had bilateral CTEV (44 feet), and 10 participants had unilateral CTEV (10 feet), so total 54 CTEV feet were included in the study. Variables of interest were degree of CTEV severity at the onset of treatment, at the starting of brace application and after 2

months of brace application as per Pirani scoring system. No biasing factor was recognized in the study.

Results and Observations

In the present study, we report the results of 54 CTEV feet managed by the Ponseti technique in infants less than 6 months of age at the time of starting of treatment. Of the 32 enrolled participants 68.75% (n=22) had bilateral CTEV and the remaining 31.25% (n=10) had unilateral CTEV. 50% each were the right and left foot of the participant.

Among the 32 participants, one-third of the participants were female, and the remaining two-thirds were male. The mean age of the participants was 29 (range 8-99) days. The mean birth weight of participants was 2.67 Kg (range 2 - 3.3 Kg). Only 12.5% of participants were born as low birth weight babies and only 6.25 % of participants were born prematurely. About one-fifth of all participants (21%) were born by C-section and the remaining four-fifth were vaginally delivered.

Most of the participants had either a score of 5 points (50%) or 5.5 points (40.7%) before starting the treatment (Table 1).

Table 1: Showing characteristics of idiopathic CTEV patients before treatment

Gender	Frequency	Percentage
Male	21	65.6%
Female	11	34.4%
Age	Frequency	Percentage
<1 month	27	84.4%
1-3 month	2	6.2%
>3 month	3	9.4%
Maturity	Frequency	Percentage
Preterm	2	6.2%
Full term	30	93.8%
Birth weight in grams	Frequency	Percentage
<2500	4	12.5%
>2500	28	87.5%
Type of delivery	Frequency	Percentage
Vaginal	25	78.1%
LSCS	7	21.9%
Birth Order	Frequency	Percentage
1	13	40.6%

2	14	43.8%
3	5	15.6%
Laterality	Frequency	Percentage
Unilateral	10	31.3%
Bilateral	22	68.7%
Anatomical site	Frequency	Percentage
Right	27	50%
Left	27	50%
Baseline Pirani Score	Frequency	Percentage
4.5	3	5.6%
5	27	50.0%
5.5	22	40.7%
6	2	3.7%

The median number of casts was 7 per foot and it ranged from a minimum of 3 casts to a maximum of 18 casts. Number of casts applied were higher among participants having bilateral CTEV. Average number of casts applied in 10 unilateral cases were 5 and bilateral cases were 9. Further, average of 8 cast were need for right foot and an average 5 casts were needed for left foot. In the present study, 72.2% of participants required tenotomy as a part of treatment. We did not observe any serious complications e.g., prolonged or uncontrolled bleeding, or wound infection secondary to tenotomy up to last follow up visit among any participants. The mean and the median age of participants for

starting to wear braces among participants was 3.32 and 3 months, respectively. Table 2 illustrates the Pirani score among the participants at the time of braces and 2 months after the treatment. The mean Pirani score at the last follow-up visit was 0.93. 11.1% of participants had a Pirani score of 0.5, 79.6% participants had a Pirani score of 1.0 and only 5 participants (9.3%) had a score of 1.5. Thus, the success rate of treatment of CTEV among 54 feet treated using the Ponseti technique in the present study was 90.7% at the last follow-up visit which is excellent. The five feet in three different participants did not achieve the desired Pirani score at the last follow-up visit.

Table 2: Showing treatment details of idiopathic CTEV patients

Number of Casts	Frequency	Percentage
3-5	11	20.4%
6-8	33	61.1%
9-18	10	18.5%
Tenotomy required	Frequency	Percentage
Yes	39	72.2%
No	15	27.8%
Age at starting of Braces	Frequency	Percentage
<3 months	40	74.1%
3-6 months	6	11.1%
>6 months	8	14.8%
Pirani score at starting of Braces	Frequency	Percentage
0.5	8	14.8%
1	46	85.2%
Pirani score after 2 months of Braces	Frequency	Percentage

0.5	6	11.1%
1	43	79.6%
1.5	5	9.3%
Complications	Frequency	Percentage
Soreness	9	16.7%
Crowding of toes	4	7.4%
None	41	75.9%

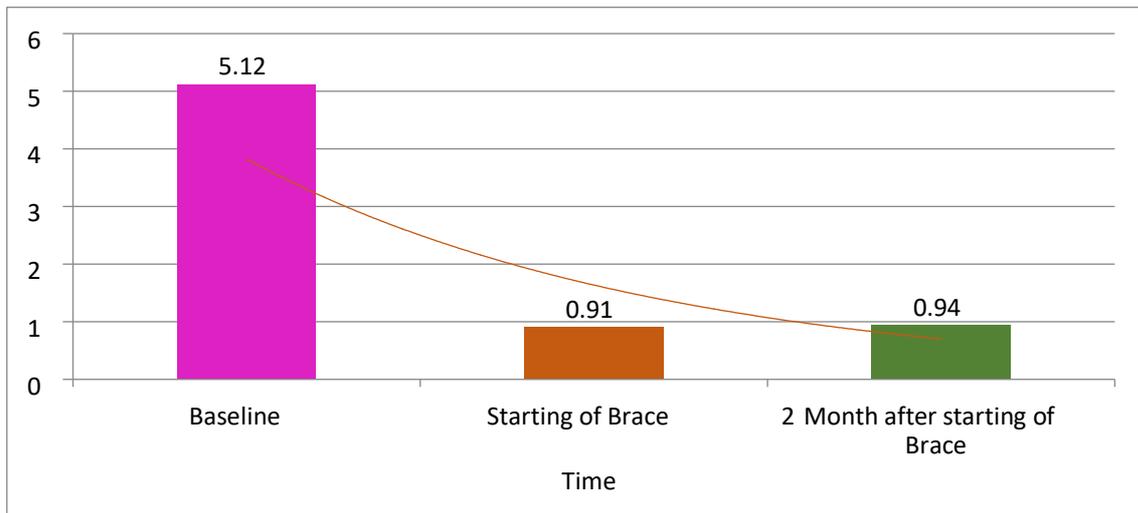


Figure 1: Showing mean Pirani Score before, during and after treatment

In our study the most common deformity to relapse was grade 1 b (dynamic foot adduction or supination of foot) and the most common complication was soreness (16.7%) followed by the crowding of toes (7.4%).

Discussion

The mean age of the participants at the time of presentation in the present study was 29 days. In the present study, we did not observe any relationship or association between late presentation and treatment outcome. Some authors reported that late presentation of treatment does not affect the outcome of the results[11-14]. Pavone et al reported that there is no correlation between the age of presentation and the outcome of the range of motion of the feet even though taking more casts, and the clubfoot was corrected with the range of 5–10 casts in their study[15]. Alves et al found no difference in outcome for patients presenting before or after six

months of age[16]. Jowett et al reported on patients with neglected idiopathic clubfoot presenting up to nine years of age[17]. They achieved successful outcomes in 16 of 24 feet, suggesting that Ponseti treatment may be successful even in delayed presentations.

Later reports have shown successful results with Ponseti treatment in adolescents and young adults, and the oldest reported successful case is an 18-year-old Nigerian woman and 26-year-old Brazilian women[18-19].

Notably, several studies have shown no correlation between age at the start of Ponseti treatment and recurrence, final range of movement at the ankle and the need for additional surgery[11-14]. However, there is still controversy regarding the impact of late presentation of treatment and the outcome of the results. For the assessment of CTEV severity and the success of treatment by the Ponseti

method, most of the studies used the Pirani scoring system or the DiMeglio scoring system[20]. In our study, the mean Pirani scores at baseline, before starting to wear braces, and at 2 months were 5.12, 1.1 and 0.7, respectively. In most of the reviewed studies, the Pirani score after treatment is less than one. One study reported the range of motion as well as the Pirani score, the mean Pirani score was 4.8 before the treatment. Thereafter, a Pirani score of 0 or 0.5 in 78% of the patients, 1 or 1.5 in 22% of the patients, and 3.5 scores were noted in only one patient[21].

The existing literature suggests that there is a positive correlation between the initial Pirani score and the number of casts required to correct the deformity. In the present study, the median number of casts was 7 per foot. The number of casts applied was higher among participants having bilateral CTEV. The average number of casts applied in unilateral cases was 5 and in bilateral cases 9. In Elgohary and Abulsaad's study, an average of 4–7 casts were used to achieve the full correction of the clubfoot for the traditional Ponseti method group[22]. Morcuende et al. (2005) studies tried the accelerated Ponseti technique every 5 days casting instead of 7 days once[23], and Xu studied casting twice a week[24], and the results of both studies showed successful correction as same as the traditional method and also the duration of the treatment period was less than the original method. One study achieved the full clubfoot correction with less than 5 casts in 75% of the cases[25].

Morcuende et al suggested that the number of casts necessary to achieve correction can be used as an indicator of the severity of the deformity[23]. According to Pavone et al more casting is required if the initial deformity is severe or initial treatment is started after 15 weeks of birth[15]. Terrazas-Lafargue and Morcuende showed that the timing of cast removal affected the number of casts required for

correction[26]. Haje et al reported a series of patients treated with a below-knee soft cast which gave similar results to studies using above-knee plasters and avoided the problems with perineal hygiene[27].

A percutaneous tenotomy of tendo Achilles to correct residual equinus may be required at the end of the Ponseti casting. In the present study, 72.2% of participants required tenotomy as a part of treatment. The tenotomy rate in studies adhering to the method varies from < 50% to 100%, with the latter results in patients beyond walking age[28]. In the Segev study, 94% of the feet were corrected successfully in the Ponseti method and tenotomy was performed in 47 feet. At the same time, 6% had residual deformity[29].

In most studies, the tenotomy is performed as an outpatient under local anaesthesia; we also did the percutaneous tendoachilles tenotomy as outpatient procedure only. However, tenotomies under general anaesthetic are also reported[30]. We did not observe any serious complications secondary to tenotomy up to the last follow-up visit among any participants. Changulani et al had a case of neuro-vascular injury that required exploration, ligation of the posterior tibial artery and primary repair of the posterior tibial nerve[31]. Dobbs, Gordon and Walton found bleeding complications in 2% of cases following percutaneous tenotomy of the tendon Achilles[32]. Burghardt, Herzenberg and Ranade reported a patient who developed a pseudoaneurysm following a tenotomy[33].

Pirani score measurement also helps to predict whether the percutaneous Achilles tenotomy is needed or not to correct the equinus. The literature suggests that if the initial score of Pirani is greater than 5, then Achilles tenotomy may be required to correct the equinus but if the score is less than 3, there is no requirement for this surgery[34]. A low score, however, does

not exclude the need for a tenotomy. Some studies reported all parts of the Pirani score including the total score (5.6) and the hindfoot score and the midfoot score at 2.9 and 2.8 respectively, and 94.3% of the cases were referred to tenotomy[35]. In the present study, the success rate of treatment of CTEV among 54 feet treated using the Ponseti technique in the present study was 90.7% at the last follow-up visit. Selmani E. reported that the percentage of the Ponseti method's correction success rate was 96%[36]. Another study by Sud et al.2008, achieved 91.7% in the Ponseti method[37].

Despite initial successful treatment, clubfoot relapses can be still seen in children treated by the Ponseti method of treatment. The relapses of the clubfoot are not uncommon. However, there is a necessity to investigate the relapse pattern, compliance of bracing, the number of casts used in the treatment and the percentages of surgical referrals under two years of age for a clear understanding and better practice to achieve a successful outcome without or reduce relapse.

Conclusion

Experience with correct application of ponseti's method and great attention to serial manipulation and moulding of cast is mandatory to achieve acceptable correction. At the end of study most of the participants had excellent results followed by good and fair. Patients motivation for regular visits and their counselling for cast care, perianal hygiene and strict adherence bracing protocol plays a pivotal role in the management. As most of the patients are from remote areas telecommunication plays critical role in motivating and persuading attenders for following protocols of management and to avoid loss of follow up and resolving even their small concerns. In our study we found that serial casting started only if child's skin permits the use of plaster of Paris cast. Casting within two weeks of birth mostly results in

plaster sores, exfoliation of skin in patient where LHT is 1 (mid foot contracture score). Due to short duration of follow-up we are unable to evaluate the effect of toe shortening and crowding of toes in longterm outcome.

We concluded that ponseti's method is very efficient modality of management of idiopathic congenital Talipes equinovarus till date even in settings with minimal resources and assistance.

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