

## MANAGEMENT OF CONGENITAL TALIPES EQUINOVARUS WITH PONSETI TECHNIQUE IN CHILDREN UNDER 2 YEARS OF AGE

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### Abstract

**Background and Objectives:** CTEV is a complex congenital deformity of the foot and occurs due to the confluence of genetic & environmental factors. If it is not treated promptly and accordingly, it limits patient mobility and results in a painful foot. In most cases, it is treated conservatively using the Ponseti technique. This method was developed by a Japanese orthopedic surgeon Ignatio Ponseti who successfully treated CTEV in infants without extensive surgery. It is a manipulative technique with percutaneous release of tendoachilles that allows the ankle to obtain correction. This study was conducted to assess the functional outcomes of CTEV management by Ponseti method.

**Methods:** Ethical approval was obtained from the Ethical Review Board Of Services Hospital Lahore. This descriptive study was conducted at the department of orthopedic surgery from December 2018 to December 2020. A total number of 120 patients having CTEV deformity of the foot, aged less than 2 years, were included in the study. From these, 70 children had bilateral foot involvement. It was treated with 5-7 casts with each cast applied for 07 days according to the Ponseti method. In the final cast, a percutaneous Achilles Tenotomy was performed, where the deformity was restricted to 10 degrees from the neutral. After completion of casts, each patient was braced with Foot Abduction Brace.

**Results:** We used Pirani Score for pre- and post-operative assessment of correction of deformity via Ponseti method. There were 91% excellent results achieved through this method, whilst 6% of patients had good results and 3% had poor results.

**Conclusion:** Ponseti technique has got good functional & cosmetic results. It is economical and easy to apply.

**Key words:** Club foot, Pirani Shafique score, Ponseti technique, CTEV

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Congenital Talipes Equinovarus (CTEV) is the most common musculoskeletal deformity of the foot in neonates with confluence of genetic and environmental factors.<sup>1</sup> The incidence is 1 in 1000 birth with a male to female ratio of 2:1. The deformity is bilateral in 50% of the cases.<sup>2</sup>

Considering the genetic cause, parents of affected children have a 2.5 to 6.5 % risk of this deformity in

their next child. In 25% of cases, the cause is familial.<sup>3</sup> Although family history is important, the hereditary nature varies with population group e.g., in Polynesian nation the incidence is 50%. Numerous theories have been proposed for the development of CTEV, yet the etiology is still unknown.<sup>5</sup> This developmental deformity starts in the 2<sup>nd</sup> trimester of pregnancy.<sup>4,5</sup> CTEV may be associated with arthrogyposis, developmental dysplasia of the hip (DDH), myelomeningocele and tibial hemimelia.<sup>6</sup> The resultant three-dimensional deformity of the foot is characteristic of this malformation.<sup>7</sup>

In CTEV, all bones that make up the skeleton of foot are involved, with talus being the principal bone affected. A combination of malpositioned tarsal bones,

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calf muscle deformity and leg shortening are hallmark features of this deformity. The head and neck are displaced medially while the body is in equinus. Talus is rotated in the horizontal, sagittal, and coronal plane, and the talonavicular joint is subluxed. Calcaneus is in equinus and in varus and metatarsal shafts achieve the adducted position.

Tendons involved in equinus are tendoachilles, FHL, FDL and tight intrinsic muscles, while varus is because of stiff tibialis posterior, tibialis anterior and tendoachilles. Tendons responsible for forefoot adduction are tibialis posterior.<sup>8</sup>

Sakale in his research described several non-operative techniques like french, kites and Copenhagen technique that were practiced by orthopedists for a very long period for the management of idiopathic club foot but they were not very popular because of their lower success rates.<sup>9</sup> Historically, the first conservative procedure to correct this deformity was introduced by Hippocrates in 400 B.C. It consisted of manipulations and bandages. Later, forceful manipulations with Thomas wrench were introduced by Hugh Owen Thomas. All these procedures caused damage to the already deformed foot. The procedure consisting of manipulation and casting was introduced by Joseph Hiram Kite in 1939 who claimed the success rate of 90% in patients if treatment is started before the age of one. However, most of the surgeons reported poor results with the Kite method. In 1970 Turco devised an extensive soft tissue release procedure. Many variations of extensive soft tissue release were devised in 1980 to 1990. Surgical treatment results in foot stiffness, overcorrection, under correction arthritis and poor quality of life. The French method technique is a form of daily stretching manipulations, involving stretching of underactive muscles and stimulation by applying various strappings to hold the foot in corrected position was usually a preferred treatment in developed countries and this method was usually carried out by a trained physiotherapist.

In 1948 another technique was introduced by Ignacio V Ponseti which showed a high success rate. This technique was slow to accept initially, and its

use was limited in IOWA only. It has been widely accepted for the past few years.<sup>10</sup> Now, in lot of studies, it has been proved as an excellent method for the correction of CTEV.<sup>11</sup> It has been shown to correct the deformity in 95% of the cases.<sup>12</sup> This technique obviates the need for posteromedial soft tissue release and is based upon the basic understanding of patho-anatomy of congenital talipes equinovarus deformity. Only 10% of patients require surgical treatment beyond tenotomy to achieve good functional outcomes. It is a gold standard for neonates presenting with this deformity.<sup>10</sup> The low cost of this treatment technique makes it an acceptable method in countries with a low-income setting.<sup>13</sup> Among 193 United Nation countries, it has been accepted as an ideal technique in 113. This method has 2 phases i.e., casting phase and maintenance phase. It requires 5-7 casts with each cast lasting for 5-7 days. In the final cast, tenotomy is performed to correct the equinus and this cast is applied for 3 weeks. In the maintenance phase, an abduction brace is applied till the child is of walking age. For three months, the brace is worn full time and afterwards at night only. It is applied for 3-5 years. Casting starts when the child is 1-2 weeks old. Among the 4 components cavus is corrected first then adductus and varus followed by equinus.

In a country with limited resources like Pakistan, majority of club foot deformities can be corrected with Ponseti method in the first 6-8 weeks of life.<sup>14</sup> The objectives of our study are to describe all four elements of deformity and to assess pain free, functional foot with the aim of avoiding permanent disability so that the child can wear adequate footwear.<sup>15</sup> Our study would provide an efficient clinical tool for making treatment decisions for Club foot deformities.<sup>16</sup>

5% of infants have atypical or complex club foot. These infants have short, rigid feet with stiff ligaments that offer resistance to stretching. These babies require specialized modified treatment. There is now universal agreement that non operative treatment should be adopted regardless of the severity of club foot.<sup>17</sup>

**METHODS**

After approval from the Ethical Review Board of the hospital, this descriptive, study was conducted on an outpatient basis, at the department of orthopedic surgery, Services hospital, Lahore. The study was conducted from December 2018 to December 2020. 120 patients aged less than 2 years were included in the study through non-probability, convenience sampling method. Seventy patients had bilateral foot deformity. A thorough history and clinical examination was carried out for each child. All children greater than 2 years, with brain, spine or any other neurological involvement were excluded from the study. After written informed consent was obtained from the parents, we applied Ponseti cast to each child. Each child was assessed with Pirani Score before and after the application of the cast. Each cast was applied for 7 days, 1-3 casts for cavus correction, fourth cast for correction of adductus while Achilles tenotomy was done for the fifth cast in 60 children who had dorsiflexion of less than 10-15 degrees. A predesigned proforma including patient demographic data, physical examination findings, including Pirani Score before, after and at the end of treatment was noted. Total Pirani Score is 6, excellent score is less than 1.5, if it is in range of 1.5 dash 2 it is good and more than 3 is poor. Moreover, the total number of Ponseti casts applied, number of patients undergoing tenotomies and complications such as pressure sores, skin breakdown, bleeding at the tenotomy site and blister formation were also recorded.

In the maintenance phase, Denis Brown Brace was applied for the first three months. It was worn for 24 hours and then only at night till 3 years of age. Each child was followed on a weekly basis till the final cast, and then monthly for three months. After 3 months, each patient was followed quarterly for 3 years from the application of first cast.

Statistical analysis done using SPSS version 17. Mean and standard deviation was calculated for numerical variables. Qualitative variables were mentioned in terms of percentages and frequencies. To see the effects on outcomes, we applied the post stratification independent t-test and one way ANOVA test.

Statistical difference between pre & post treatment Pirani Score was determined by paired t-test. A p-value of 0.05 was considered as significant.

**RESULTS**

The total number of patients in our study were 120, with 70 patients having bilateral deformity. Thus, the total number of feet that underwent Ponseti cast were 190. There were 80 males and 40 females with male to female ratio of 2:1. Right foot was involved in 75 (62.50%) patients while the left foot was involved in 45 (37.50%). Age range was 21 days to 370 days (48±67.2Days). Before application of cast, Pirani Score for right foot was 2.0 to 6 (Mean 4.92±1.06), while for left foot it was 1.5 to 6 (mean 5.12±0.88). After completion of treatment, it was 0-2.0 (mean 0.12±0.40), on right foot, and in the left foot it improved to 0-1 (mean 0.6±0.20). (Table 1). 110 patients

*Table 1: Pirani Score at Final Follow up*

Parameter n=120	PIRANI Score Right foot		PIRANI Score Left foot	
	Freq. (%age)	Mean±SD	Freq. (%age)	Mean ± SD
<b>Age</b>				
< 6 months	34 (45.4)	0.72±0.21	20 (44.4)	0.80± 0.20
6 – 12 months	32 (42.6)	0.15± 0.40	17 (37.8)	0.12± 0.30
12–24 months	09 (12.0)	0.35±0.30	08 (17.8)	0.30± 0.21
<b>Gender</b>				
Male	52 (69.3)	0.19± 0.52	25 (55.6)	0.62 ±0.12
Female	23 (30.7)	0.12 ± 0.20	20 (44.4)	0.12± 0.23

(180 feet) had excellent results (91%), 06 patients had good results (5%) while poor results were present in 4 patients (3.9%). Tenotomy was done in 110 patients (91%)

The average number of casts applied were 4 to 9 (5.58+-1.70). No complication was reported in our study with casting or tenotomy.

**DISCUSSION**

CTEV is one of the most common congenital musculoskeletal disorders of the foot. Its etiology is poorly understood.<sup>1</sup> The Ponseti method is a less invasive technique being accepted globally for correction

of club foot deformity. It has got a high success rate, is easy to perform and is economically acceptable for the poor population particularly in countries with limited resources.<sup>2</sup> Surgical treatment is expensive, has a high complications rate and is time consuming.<sup>3</sup>

During the maintenance phase, use of BRACE has a key role in preventing recurrence and failure of treatment. Motivation, education and counselling of parents are important factors to prevent the recurrence of deformity after Ponseti method. Parents should be briefed and reassured for brace compliance to achieve the long-term success of treatment.<sup>6</sup>

In our study there were 80 males & 40 females with ratio of 2:1. The number of casts applied were 5-7. 91% of patients (110) had excellent results with painless plantigrade foot, 6% with good results and 3% had poor results.

In a similar study S.K. Bhatiwal had excellent results in 92% of the patients while poor results were present in only 3% of the cases. They concluded that the Ponseti method is a very useful and effective technique for correction of club foot deformity up to 2 years of age. These results are consistent with our study.<sup>10</sup>

In another study conducted by Molhotra et al on 356 patients for treatment of CTEV with Ponseti method, they concluded that Ponseti method has good functional and cosmetic outcomes in 94.45% of patients at their last follow up. According to them it is an economical, safe, and easy procedure for correction of this deformity.<sup>11</sup>

In his study, Sakale et al. deduced that Ponseti method is an excellent technique which avoids the complications exerted by surgical procedures. It allows for a good, functional, painless, and mobile foot. Moreover, it is economical, safe, and performed easily.<sup>7</sup>

Gunalan R et al. conducted a study on 31 patients with 45 idiopathic Club foot. They concluded that many patients with CTEV have late presentation. However, the Ponseti method has achieved high success rates and even relapsed cases can be treated successfully.

Ahmed et al. conducted their study on 40 patients through non probability purposive sampling, they came

to the conclusion that Ponseti method has significantly high success rate in children under 2 years of age.<sup>10</sup>

In another study conducted by Bina S et al. in 2020, they deduced that Ponseti method has produced significantly better short term results when compared with KITE technique.<sup>11</sup>

In his study Ganesan et al. reviewed 12 articles in children under 2 years of age. They concluded that Ponseti method is a very effective technique for correction of club foot deformity. However, relapses are common with this method which is due to non-compliance and non-adherence to the bracing component of treatment during the maintenance phase.<sup>16,17</sup>

All these studies reveal that Ponseti method is an excellent method for correction of all four components of CTEV.

Our study reveals short term results with short duration of follow up. Moreover, the sample size was also small in our study. It should include a study with a larger sample size and a long duration of follow up. Relapses are very common in Ponseti method which should also be included in outcome in studies with longer duration. In the evaluation of outcome of the clubfoot treatment by Ponseti method, we used Pirani scoring system. Other scoring such as Dimeglio scoring system as outcome measurement scale for assessing the clubfoot deformity. It should also be included as this measurement scales would predict whether the percutaneous Achilles tenotomy is needed or not to correct the equinus.<sup>13</sup>

## CONCLUSION

Ponseti method is an effective, easy to learn, easy to apply and economically acceptable treatment of club foot deformity. It is an excellent technique in a country with limited resources. It requires improved health awareness, counselling and briefing especially during the bracing phase to improve the success of treatment.

### Ethical Approval:

The ethical Approval for this study was obtained from SIMS/Services Hospital, Lahore. (Reference No. 38/11)

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