

Original Research Article

Management of congenital talipes equino varus using Ponseti method: 3 year follow up in 166 club feet

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ABSTRACT

Background: Our aim was to study the effectiveness of Ponseti method using Pirani score in children with club foot treated over the past three years at our hospital.

Methods: We studied 111 children with 166 idiopathic club feet who were treated at our teaching hospital between period of January 2012 and January 2017. The foot deformities were assessed using Pirani score at the time of first visit and the scores were recorded with each subsequent visit, with each casting and manipulation until correction of deformity. Tenotomy was performed on all the idiopathic club feet and continued with Steenbeek foot abduction brace (FAB) and the scores were recorded with every follow up and the progress was noted. All the relevant data in terms of treatment and demographics were recorded with dates and maintained.

Results: Total of 166 feet of 111 children was treated out of which 72 were males and 39 were females. 55 children had bilateral involvement remaining were unilateral. Mean Pirani score was 5.5 (range 4-6) when the treatment was started. On an average 5.7 casts (range 3-9) were required before performing a tenotomy. Tenotomy was performed on all the feet (100%) with idiopathic club foot. Foot abduction orthosis was given to all the patients and 108 patients (97.3%) were compliant. Mean Pirani score after three years of treatment was 0.26. Skin complications like blister formation were seen in three children during the course of the treatment. Four patients did not follow up and defaulted. Three patients had relapse or worsening of Pirani score. The recurrence or worsening of scores is thought to be due to poor compliance while using the foot abduction brace.

Conclusions: Ponseti method of treatment for CTEV is very effective, simple, non-invasive and convenient with excellent outcomes over long term with no significant complications.

Keywords: CTEV, Club foot, Ponseti cast, Pirani score, Foot deformity

INTRODUCTION

Congenital talipes equinovarus (CTEV) is also known as club foot it is the most common and complex congenital deformity that is difficult to correct.¹ The incidence of CTEV is one in 1000 live births with male to female ratio being 3:1 and 40% of cases are bilateral.² CTEV has four components midfoot cavus, ankle equinus, forefoot

adductus and hindfoot varus which involves medial rotation of calcaneum, navicular and cuboid bones with respect to talus, also they are adducted and inverted causing the deformities.² Front of the foot is pronated with respect to hind foot even though the whole foot itself is supinated which gives rise to the cavus deformity. Most cases are idiopathic and occur in normal infants but it is also known to be associated with neuromuscular

diseases like spina bifida, various syndromes like arthrogyposis or amniotic band syndrome these form secondary club foot. Postural clubfoot is purely due to position of neonate in utero. Clubfoot can be detected in utero using sonographic assessment but it is mainly a clinical diagnosis and radiographs can help in further assessment. The aim of treatment should be to achieve painless, pliable, plantigrade foot with correction of all the deformities which is functionally and cosmetically acceptable. Untreated cases can cause physical, psychological and socio-economic burden on patients as well as their families. Neglected CTEV is one of the most significant causes of physical disability among congenital musculoskeletal disorders.³ Management of club foot can be operative or non-operative but the latter is accepted worldwide as an initial line of management for idiopathic CTEV.⁴ Combination of initial casting, extensive soft tissue release on the posterior medial side and bony procedures followed by casting again was the traditional method of treatment.⁵ These methods have a long term success rate of only 15% to 50%.^{6,7} A non-operative approach introduced by Ignacio Ponseti uses serial casts to correct the deformity followed by application of a foot abduction splint, percutaneous tenotomy may or may not be required.² Ponseti's method has shown to have success rates of more than 90% over long term follow-up with advantage being that it is less invasive, painless with very low complication rates.⁸ This method has been successfully used to achieve good results when performed by trained clinical specialists in either a teaching hospital setting or in a developing country.⁹ This method is simple and has a conservative methodology making it ideal for a set-up such as ours. We tried to study the effectiveness of this method with three years of treatment in children with idiopathic CTEV treated by the post graduates at our teaching hospital.

METHODS

In our prospective study total of 111 children with 166 club feet were treated using Ponseti method.¹⁰ Patients were selected from cases at our outpatient clinic at department of orthopaedics or those who were referred from department of paediatrics or OBGYN. Patients were treated by the post graduates/residents at our teaching hospital during the period of January 2012 and January 2017 with minimum follow up period of three years, after obtaining ethical clearance from the institutional review board.

All children with idiopathic club foot were included in the study. Secondary club foot, atypical club foot, cases with history of prior surgeries (complex club foot) and children with associated birth anomalies like neuromuscular problems, meningomyelocele, myelocele and arthrogyposis multiplex congenita were excluded from the study. All the children were clinically examined thoroughly including neuromuscular and neurological examination to rule out secondary causes and once confirmed to be idiopathic cause of CTEV, were included

in the study. Significant and relevant data related to the patient were entered in a file specified to that patient and details were added or updated at every visit. Data file included details such as patient demographics, details of physical examination, age at which treatment was started, deformity assessment by Catterall-Pirani scoring system at initial visit as well as weekly follow up, number of weekly casts required before tenotomy, deformity correction details and type of cast applied, number of missed appointments, whether tenotomy was performed or not, tenotomy details and complications associated with it, pre and post tenotomy Pirani score, complications associated with casting, foot abduction splint details and patient compliance.¹¹

Pirani score helps in assessing the deformity in foot and response to the treatment provided. It assesses the hind foot and mid foot deformities each of these have three components each. Hind foot components include posterior heel crease, emptiness of heel and rigidity of equinus. Mid foot components are curvature of lateral border of foot, medial crease and lateral head of talus coverage. Each component is given a score of one if fixed and present, half a point if mild and zero if absent. Maximum score of six represents severe club foot and minimum of zero implies a normal foot; corrected foot can sometimes have residual score of 0.5 or one with normal function.



Figure 1: Abnormal foot at presentation showing varus deformity with forefoot adduction and deep medial and posterior crease.



Figure 2: Serial casts showing improvement in abduction.

Treatment Regime: We used Ponseti method for correction of foot deformities (Figure 1) according to the following regime. Serial casts (Figure 2) were applied by gently manipulating the foot and followed up weekly for recasting noting Pirani score at every visit. The deformities were corrected in the following order of

cavus, adduction, varus and equinus. Adduction and varus deformities were simultaneously corrected while casting. Cavus deformity was corrected by supinating the foot along with elevation of first metatarsal. Once the cavus was corrected adduction and varus deformities were corrected by carefully abducting the foot by giving counter pressure over the talar head taking care to never dorsiflex or pronate the foot. Technique of applying the cast was same for every patient with appropriate manipulation depending upon the stage of correction. The babies were breastfed before the procedure and mothers were made to hold their children so that they would be comfortable and not cry during the procedure. An assistant was made to hold the foot according to the correction required and three inch plaster of paris cast was applied after applying the soft band cotton roll. The casts were snugly fitting making sure it was not too tight, cast was first applied below the knee to achieve appropriate position of foot and the converted to above the knee cast keeping knee in 90 degree of flexion and hips slightly externally rotated. Decreasing Pirani scores indicated that the treatment was working where as an increasing score suggested relapse or failure, in such cases casting was restarted from correction of cavus deformity again. Once we were able to achieve foot abduction of 70 degree but dorsiflexion of foot was less than 10 degrees percutaneous tenotomy (Figure 3) was performed. Before performing a tenotomy mid foot score had to be one or less with talar head coverage score of zero. All the tenotomies were performed under local anaesthesia using a No. 15 blade by making a small puncture on the medial side over the insertion of the tendon, pressure was applied till hemostasis was achieved and cast was applied in a similar manner with foot in full abduction and dorsiflexion. This cast was left for three weeks and patients were called for Steenbeek FAB (Figure 4) to help maintain the position and prevent relapse. The brace was adjusted to keep the affected foot in 70 degree abduction and maximum dorsiflexion, the size of the brace was checked to match the size of the feet and we made sure that the shoes fit appropriately. Parents were then advised about compliance with this device and additional follow-ups if there were issues with ill-fitting or loose shoes. Parents were asked to keep the splint on for no less than 23 hours a day for four months after tenotomy. After that, they were advised to apply the FAB only during day time naps and regular night naps up to the age of four. Patients were followed up on weekly basis initially then followed up once a month to check for compliance and later once in three months till the age of four.

Pirani score was monitored at every visit to check for relapse and final scores were assessed after minimum of three years of follow up. We categorized our final outcomes as excellent, good and poor based on final Pirani score. Excellent outcomes were graded for scores of zero, good when scores were 0.5 or 1 and poor if scores were more than one. To term treatment as successful we needed scores of less than one which

implies good and excellent outcomes correspond to successful treatment (Figure 5). Poor outcomes where scores are more than one suggest treatment failure or relapse which requires reapplication of casts or other surgical intervention if necessary.



Figure 3: Percutaneous tenotomy.



Figure 4: Steenbeek foot abduction brace.



Figure 5: Corrected club foot (right side).

Descriptive statistics were used to compare Pirani scores at presentation and final visits.

RESULTS

Patient demographics are highlighted in Table 1.

Table 1: Patient demographics.

Number of patients : Feet	111:166
Sex - Male : Female	72:39
Involvement - Unilateral : Bilateral	56:55
Side in unilateral - Right : Left	31:25
Age - <1 month : >1 month	61:50
Order of birth – First born : Later born	72:39

All the cases treated were of idiopathic club foot, other causes were excluded from the study. At the beginning of the treatment mean Pirani score was 5.5 (range 4-6). 120 (72.29%) club feet had Pirani score of six and 46 (27.71%) with scores of <6. On an average 5.7 casts (range 3-9) were required to achieve adequate score to perform tenotomy. 100% of the patients under went tenotomy. All the patients were given FAB four weeks after final cast post tenotomy.

Initial correction was obtained in all of 160 (96.39%) feet within four months of follow up using the Ponseti method with Pirani score of one and below. Worsening of scores or relapse of deformity was seen in 6 (3.61%) feet in three children. This worsening of score was mainly attributed to improper use of the FAB and non-compliance with the brace as recurrence was only noted in these three patients. Only four patients did not follow up and defaulted so, were excluded from the study.

Most common complication noted was cast related such as loose cast or cast breakage seen in nine patients, swelling of feet was seen in five children. Next most common complication was blister formation and skin excoriations seen in three children. There were no complications reported after tenotomy and there were no reported serious bleeding or wound issues at the tenotomy site.

Table 2: Final Pirani score and treatment outcome.

Pirani score	Total number of feet n 166 (%)	Treatment outcome	Final result
0	97 (58.43)	Excellent	Successful
0.5	40 (24.10)	Good	Successful
1	23 (13.86)	Good	Successful
>1	6 (3.61)	Poor	Failure

After three years of follow up we found that mean Pirani score was 0.26 in 160 club feet, six club feet were excluded as there was recurrence in these cases. We achieved excellent results outcomes in 97 (58.43%) club feet with Pirani scores of zero after three years of follow up. Good results with scores between 0.5-1 were seen in 63 (37.96%) feet. Poor outcomes with scores of >1 were seen only in three cases in six (3.61%) feet, these cases required further surgical interventions. Which shows our treatment was successful in 96.39% of cases. Results have been summarized in Table 2.

DISCUSSION

CTEV is a very common but complex problem in pediatric patients; it can lead to serious difficulties if neglected. Club feet have been managed by various modalities including surgical approach but Ponseti method using serial casts and manipulation with or without use of tenotomy have shown to be effective and convenient if followed up adequately. This method has

shown to have very good long term success rate.¹⁰⁻¹² Surgical options are invasive and are usually associated with stiffness and weakness which makes Ponseti technique a preferred method.^{13,14} Most of the studies show good short term results but there are very few studies with larger sample size and long term results.¹⁴⁻¹⁷ Various reasons for failure to correct the deformity include improper casting, inadequate tenotomy or under correction of deformity, improper use or application of splint and poor compliance of patients.^{18,19}

In our study we had 6 feet with relapse all of them were due to improper use of the FAB where the patient was non-compliant with the instructions given and would not keep the brace on for adequate hours recommended. We tried to overcome this problem but having special sessions on regular basis to educate and make the parents aware about the problem and the importance of right usage of Steenbeek brace and plaster care, we also motivated the parents to not miss appointments to avoid any drop outs. All the patients with relapse or recurrence were restarted with casting for three to six weeks with further manipulations and tenotomy with proper usage of food abduction brace. If not corrected further surgical management was considered.



Figure 6: Good dorsiflexion achieved after tenotomy.

For a long time it was believed that children who presented early had better results with lower failure rates.¹⁴ But many studies now suggest that age of presentation does not affect the final outcome in terms of achieving good correction and plantigrade foot.¹⁹⁻²¹ Most children in our study were below the age of one month and majority below the age of one, few more than one year. We found no correlation between age of presentation and final outcome in these patients, although these patients required more number of weekly casts before tenotomy. Average number of overall casts per foot was 5.7 casts which is less when compared with average of 7.6 casts with most children requiring five to 10 casts during treatment as shown by Ponseti et al in their series.^{22,23} The number of casts required also depends on the experience and the technique of application and more experienced clinicians require fewer casts.²⁴ We performed tenotomy on 100% of our cases. The reason why tenotomy rates are higher in our study is because of functional requirements of the patients which require squatting so this would allow us to achieve

greater dorsiflexion of 10-15 degrees or more (Figure 6). Compared to our study 84.2% of cases required tenotomy in a study by Pavone et al whereas Bor et al documented 92.3% cases.^{25,26} We did not encounter any serious

complications after tenotomy, although swelling of feet, skin excoriations or pressure sore and cast associated complications were noted. Results of four studies are compared in Table 3.

Table 3: Results of Ponseti method compared in four studies.

	Present study	Pavone et al ²⁵	Bor et al ²⁶	Saif Ullah et al ²⁹
Patients	111	82	74	38
Number of club feet	166	114	117	58
Male: Female	1.85	2.1	1.8	2
Bilaterality	55 (49.6%)	32 (39.0%)	43 (58.1%)	20 (52.6%)
Pirani score at presentation	5.5	5.56	5.09	5.57
Number of casts	5.7	6.6	6.3	3.75
Tenotomy	166 (100%)	96 (84.2%)	108 (92.3%)	50 (86.2%)
Satisfactory outcome	96.4%	95.6%	89.2%	96.6%
Failure/ Relapse	6 (3.6%)	3 (3.7%)	24 (32.4%)	2 (3.4%)

Changulani et al had reported neurovascular damage and Dobbs et al had reported serious bleeding due to peroneal artery and lesser saphenous vein injury.^{27,28} We were able to successfully correct 96.39% of CTEV feet showing excellent to good outcomes with Pirani score or <1 compared to 96.6% feet corrected by Ullah et al.²⁹ Radiographic assessment was not done in our study as study by Roye et al shows that radiographic data had poor utility in evaluation of the outcome.³⁰ Patients can have very good functional feet despite having imperfect feet radiological.³¹ This is the reason we used clinical evaluation including Pirani score to assess to outcome in our patients to give functional, plantigrade and acceptable feet.

CONCLUSION

Ponseti method of treatment for CTEV is very effective, simple, non-invasive and convenient with excellent outcomes over long term with no significant complications. This condition causes unnecessary physical, psychological, social and economic burden on patients and their families. This is why counselling and awareness among parents is important in terms of achieving effective results using Ponseti method, especially in developing countries. We were able to give children functional, flexible, painless, plantigrade and cosmetically acceptable feet without recurrence if parents were adherent with the protocol. Most important aspect of treatment success is dependent on patient compliance and right use of the FAB as instructed.

Ponseti cast can be applied by any one with minimal training to achieve good results as shown by post graduates in our study. Tenotomy should be performed in all cases to achieve good function and minimize recurrence.

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