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Evaluation of outcome of treatment of idiopathic clubfoot by ponseti technique of manipulation and serial plaster casting

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Abstract

Idiopathic clubfoot or congenital talipes equinovarus is the commonest congenital foot deformities having 1 in every 1000 children born worldwide. Around 80% of the cases occur in developing nations. It remains the most difficult to treat. The most widely used treatment is the Ponseti method of manipulation and serial plaster followed by an Achilles tenotomy. This method is effective in 90% of all cases. The objective of this study was to evaluate the outcomes of the Ponseti manipulation and casting method in the management of idiopathic clubfoot. This is a prospective study of 80 feet in 52 children treated by the Ponseti method in the department of Orthopedics, Rajendra Institute of Medical Sciences (RIMS), Ranchi, and Jharkhand. Evaluation of the deformity was done by Pirani score before and after the treatment and the results were assessed. The average number of castings used to correct the deformity was 6.5 times (range: 4 to 12). Tenotomy was performed in 66 (82.5%) of the feet. In all patients, plantigrade foot was achieved. The patients with bilateral clubfeet, higher Pirani score and higher age had inferior final outcome compared to those with unilateral clubfoot, lower Pirani score and lower age. 11 (13.75%) feet had skin excoriation secondary to cast problems and four patients had pain and tenderness at the site of the tenotomy. Recurrence was seen in three cases. 90.38% of parents were completely satisfied with their child's gait and foot appearance.

Keywords: Idiopathic clubfoot, RIMS Ranchi, Pirani score, Ponseti technique

Introduction

Congenital talipes equinovarus (CTEV), commonly called clubfoot, is a congenital condition with deformity of the foot and consists of four components: equines, hind foot varus, forefoot adductus, and cavus [1]. Untreated clubfoot results in pain and disability. Although clubfoot is one of the most known congenital deformities with approximate incidence of one in every 1,000 live births [2], its management, especially in severe cases, is still challenging. The problem is more serious in the developing countries on account of late presentation; higher rate of dropouts (of treatment) and superstitious beliefs attached to this congenital problem. It should always be recognizable at birth but is now frequently diagnosed at 18 to 20 weeks of gestation by ultrasound. Boys are affected 2.5 times as often as girls, and the condition is bilateral in half of the cases. With etiology still unknown, several theories were proposed to explain the origin of clubfoot, considering intrinsic or extrinsic causes, including: intrauterine position of the fetus, mechanical compression or increase of intrauterine hydraulic pressure [3]; interruption in fetal development [4]; viral infections [5]; vascular deficiencies [6]; muscular alterations [7]; neurological alterations [8]; defect in the development of bones structures [9] and genetic defects [10]. However, it seems that clubfoot is considered a multifactorial disease [1].

Three-dimensional bone connectivity is altered in a complex manner and, according to Ponseti [11], the most severe deformities are located in the hind foot, where the talus and the calcaneus are in accentuated equinus, the calcaneus is positioned medially and angulated in varus, and the navicular exhibits accentuated medial deviation. Moreover, the posterior ligaments of the ankle, such as those from the medial and plantar region, are shortened and thickened. The triceps surae, tibialis posterior and flexor muscles of the toes are shortened.

There are several systems to decide the severity of a clubfoot; the most common scoring system used is the Pirani score [12].

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This scoring system uses "...six clinical signs to quantify severity of each component of the deformity. Each component is scored as 0 (normal), 0.5 (mildly abnormal) or 1 (severely abnormal)." This scoring system uses the different views to help visualize the issues in the underlying soft tissue and bony anatomy (see Figure 1). Imaging can also be used to see the relations of the bones. The modality that can offer a better view is ultrasound due to its ability to see non-ossified bone without the need for sedation [13]. MRI has also been used to see the long term effect of talipes equinovarus.

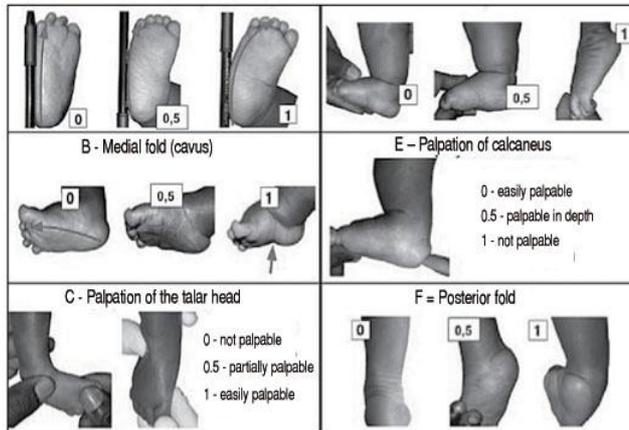


Fig 1: Pirani scoring system.

Various modalities of treatment are ranging from bandages by Hippocrates and plaster casts by Kite or Ponseti to surgical treatment for CTEV but still there is no single modality till date that can boast of achieving the ultimate goal of treatment i.e. functional, pain-free, plantigrade foot with good mobility and without calluses [11]. Nonsurgical management generally led to inadequate correction whereas those who underwent surgery often developed extensive scarring of the soft tissues, residual pain, more stiffness and arthritis in long-term studies [14]. Currently serial casting is known as the gold standard treatment of idiopathic clubfoot [1]. Long-term studies have reported excellent results in using the Ponseti method of club foot manipulation and serial casting accompanied with Achilles tendon tenotomy and foot abduction brace [11, 15]. Ponseti method has showed better range of motion and push-off strength compared to surgical release [16]. It avoids the complications of surgery and gives a painless, mobile, normal-looking, functional foot which requires no special shoes and allows fairly good mobility.

Ponseti claims to avoid open surgery in 89% of cases by using his technique of manipulation, casting and limited surgery [17]. The Ponseti method is divided into two distinct phases: the corrective phase and the maintenance phase. The corrective phase involves manipulation of the foot followed by casting with plaster of paris. The cast holds the stretch achieved through manipulation of tight structures and allows time for soft tissue remodeling and correction of the position of the bones in the foot [18]. Sequential correction of the cavus, adductus and varus of clubfoot occurs around the talus [17]. A percutaneous Achilles tenotomy is usually required to correct the residual equines, followed by 3 weeks in a cast to assist healing. The maintenance phase consists of a bracing regime to prevent recurrence. The foot abduction brace is worn 23 hour a day for the first 3 months and then at night during sleep until five years of age [19].

The purpose of this study was to evaluate the results of the Ponseti method of manipulation and plaster cast application in the management of idiopathic clubfoot.

Patients and Methods

In this study, we reviewed clinical outcomes of 80 feet of 52 children with idiopathic clubfoot who attended Orthopedic OPD, RIMS, Ranchi, Jharkhand between July 2015 to March 2017. Severity of the deformity before and after serial casting, need for surgical releases or any other surgeries and complications were assessed.

The Inclusion Criteria were; age less than two years, unilateral or bilateral idiopathic clubfoot, earlier treated with other methods and willingness to take part in the study while the Exclusion Criteria were; age more than two years, concomitant major illness, atypical or secondary clubfoot and unwillingness to take part in the study.

Patients were evaluated through detailed history and physical examination. Every clubfoot taken up for the study was graded according to the Pirani Severity score [14] & Ponseti technique [17-19] of manipulation and casting was performed for correction.

The treatment phase of Ponseti technique started as soon as the skin condition of the child permitted the use of plaster casts, till that time regular corrective manipulation of the foot by the mother was carried out. This was done by;

- Stabilizing the talus by placing the thumb over the lateral part of its head.
- Elevating the first ray to achieve supination of the forefoot in respect to the mid foot and hind foot.
- Putting on a well-padded toe-to-groin plaster cast by holding this position and molding it well.
- One week later, the first cast was removed and then after a short period of manipulation, the next toe-to-groin plaster cast was applied by stabilizing the talus by placing thumb over the lateral part of its head.
- Holding the supinated foot in abduction while applying the cast.
- Heel varus and ankle equinus were corrected simultaneously because of coupling of the tarsal bones. Weekly plasters were applied till we get 70 degrees of abduction in supination. Correction of residual equinus deformity (Pirani's hind-foot score more than 1 and the mid-foot score less than 1) was accomplished with a percutaneous surgical release of the achilles tendon. After the tenotomy had been performed the final cast was applied with the foot in 70 degree of abduction & 10 -15 degree of dorsiflexion. This cast was retained for three weeks. Upon removal of the final cast, foot abduction brace was used to maintain the foot in its corrected position. At each follow-up, foot was evaluated for deformity correction using the Pirani score. The foot abduction brace were worn 23 hr a day for the first 3 months and then at night during sleep until 3 years of age. Once the child started walking, custom made clubfoot shoes were used during day time. The children were followed up at every three months after corrective phase.

Results

A total 52 children with 80 idiopathic clubfoot were treated by the Ponseti method. There were 31 (59.61%) males and 21 (40.38%) females. 28 (53.84%) patients had bilateral deformities (56 clubfeet) whereas 24 (46.15%) children had unilateral clubfoot. 24 children (46.15%) were of first-born, 17 (32.69%) were of second and 11 (21.15%) were of third or more born. 31 patients (59.61%) were born with normal vaginal delivery out of which 9 were born at home, and 21 (40.38%) were born with the caesarian method. All patients

were diagnosed at the time of delivery and the mean age at the start of treatment (Photo 1) was 3.7 months (range: 3 days to 2 years). Previous family history of clubfoot was present in 7 (13.46%) cases. 11 (21.15%) cases presented within six weeks after birth and 34 (65.38%) cases within 6 months. 38 (73.07%) patients required less than 8 casts for correction, with 2 patients requiring 12 casts. The average number of castings used to correct the deformity was 6.5 times (range: 4 to 12). Tenotomy was performed in 66 (82.5%) feet and most of these had Pirani scores of more than 4.5. 11 (21.15%) patients had previous treatment elsewhere and 2 (3.84%) patients had an Achilles tenotomy. Average Pirani score before casting was 5.3 and post treatment was 0.8 (Photo 2 & 3). A Pirani score of 1 or less was achieved in 87.6% of feet. The average duration of follow-up was 13.8 months (6 months to 20 months). 11 (13.75%) feet had skin excoriation secondary to cast problems. Four patients had pain and tenderness at the site of the tenotomy, and no infection, profuse bleeding or skin slough was observed. In all patients, plantigrade foot was achieved. Recurrence was seen in only three (5.76%) cases. Parent's satisfaction regarding gait and foot appearance were complete in 47 (90.38%) cases, quite in 3 (5.76%), relative in 2 (3.84%), and no satisfaction in 0 (0%).



Photo 1: Showing a 4 month old baby (at initial presentation) with bilateral club foot with Pirani score 5.5 in each foot.



Photo 2: Showing same baby after performing tenotomy (Pirani score 0.5 in each foot).



Photo 3: Showing same baby with foot abduction brace after tenotomy.

Discussion

Clubfoot is a complex deformity of foot that requires meticulous and dedicated efforts on the part of the treating physician and parents for the correction of the deformity. In the past, the most common treatment was surgery. Extended surgical release leads to stiffness and further degenerative changes and it is not acceptable for the first step of treatment [20]. Now a days, manipulation and serial casting are the method of choice for clubfoot deformity [15]. The Ponseti method [11, 17] of correction of clubfoot deformity requires serial corrective casts with long-term brace compliance for maintaining correction. Treatment needs to be started as soon as possible after birth and should be followed under close supervision.

In our study, there were 31 (59.61%) males and 21 (40.38%) female cases. 28 (53.84%) patients had bilateral deformities (56 clubfeet) whereas 24 (46.15%) children had unilateral clubfoot. These findings are comparable to other studies while gender ratio in our study is much less than Pulak S. *et al.* [21]. Pulak S. *et al.* [21] reported bilateral clubfoot in 26.92% cases. Palmer RM [22] explained that females require a greater number of predisposing factors than males to produce a clubfoot deformity.

The order of birth also seemed to have an influence on the occurrence of clubfoot, with 46.15% of cases in the first-born child, which is in accordance with various other studies. 31 patients (59.61%) were born with normal vaginal delivery out of which 9 were born at home, and 21 (40.38%) were born with the caesarian method. Pulak S. *et al.* [21] shows no relationship of clubfoot to the type of birth. All patients were diagnosed at the time of delivery and the mean age at the start of treatment was 3.7 months. The earliest cast applied was at an age of 3 day. The maximum age at which first cast was applied was at twenty one months. Previous family history of clubfoot was present in 7 (13.46%) cases. 11 (21.15%) cases presented within six weeks after birth and 34 (65.38%) cases within 6 months. In Tracey Smythe *et al.* [23] previous family history was present in 10.5% cases.

In our series, 38 (73.07%) patients required less than 8 casts for correction, with 2 patients requiring 12 casts. The average number of castings used to correct the deformity was 6.5 times (range: 4 to 12). It was more than Pulak S. *et al.* [21] (3 to 10 casts, average 4.9) but was less than Ponseti *et al.* [24] (average 7.6 casts) and Tracey Smythe *et al.* [23] (average 7.27

casts) studies. Morcuende ^[25] reported that 90.0% of the patients required five or fewer casts. Higher Pirani score and older age of patient in our study were associated with an increase in the number of casts required to correct deformity.

In our study, tenotomy was performed in 66 (82.5%) feet and most of these had Pirani scores of more than 4.5 at presentation. It shows that tenotomy was required in those patients who initially have severe deformity. Laaveg *et al* ^[26] did tenotomy in 78.0% cases while other studies reported 79 to 93% cases of tenotomy. Reason for higher Pirani score is likely due to tighter connective tissues which are evident in severe deformity and could relate to a biomechanical difference in the collagen itself. Cause for performing tenotomy in previously treated cases was either previous inadequate management or having more severe deformity, as children treated successfully elsewhere would be less likely to present to the clinic. Marleix *et al* ^[27] in a systematic review advised Achilles tenotomy regardless of clubfoot severity while Scher DM *et al* ^[28] advised to do tenotomy after achieving forefoot abduction.

In our study, 11 (13.75%) feet had skin excoriation secondary to cast problems. Four patients had pain and tenderness at the site of the tenotomy, and no infection, profuse bleeding or skin slough was observed. Recurrence was seen in only three (5.76%) cases. Pulak S. *et al* ^[21] showed skin excoriation in 13.20% feet and recurrence in 5.0% cases. Moghaddam MH *et al* ^[29] showed in his study on 85 severe clubfeet found 2 cases of pain and tenderness, & 1 case of mild infection at the site of tenotomy.

Average Pirani score in our study before casting was 5.3 and post treatment was 0.8. A Pirani score of 1 or less was achieved in 87.6% of feet. Parent's satisfaction regarding gait and foot appearance were complete in 47 (90.38%) cases, quite in 3 (5.76%), relative in 2 (3.84%), and no satisfaction in 0 (0%). T. Smythe *et al* ^[23] achieved Pirani score of 1 or less in 85% of feet. J. A. Morcuende *et al* ^[30] found that manipulation and casting resulted in the initial correction of the clubfeet deformity in 90% of the patients. Parents satisfaction regarding gait and appearance of the foot in Moghaddam MH *et al* ^[29] were complete in 94.1%, quite in 4.7%, relative 1.2%, and no satisfaction in 0%.

Conclusion

Results of the clubfoot treatment by Ponseti technique in our study have been good and rewarding and now all the clubfeet are treated in our institution by this technique. Furthermore, the Achilles tenotomy is a procedure with low complication that does not seem to affect the child's walking. Age at presentation and previous history of treatment did not greatly affect the final Pirani score. In a developing country like India and in remote areas, this technique is a very safe, easy, result-oriented and economical method of clubfoot management. Proper motivation and persuading the parents to accept long-term brace treatment helps maintain the correction over a longer period of time and prevents relapse. The study has a number of limitations. There was no comparator (control or other treatment group) within the study. The study participants were self-selected and therefore selection bias cannot be ruled out. In addition, the Pirani score has been reported to have good intra- and inter-rater reliability and validity in young children it is not validated for older children.

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