

Evaluation of Results of Ponseti Technique in Idiopathic Clubfoot using Clinical Evaluation and Radiological Assessment

Abstract

Background: Congenital clubfoot (congenital talipes equinovarus) occurs in approximately one in 1000 live births and is one of the most common congenital birth defects. The Ponseti method is at present a well-established method of treatment for idiopathic clubfoot deformities. **Aim:** The aim of the present study was to evaluate the results of serial casting in clubfoot deformity with Ponseti method on the basis of Pirani's scoring and radiological findings before and after completion of treatment. **Materials and Methods:** A total of 30 patients were enrolled in the study and were treated with Ponseti's casting after grading the severity of deformity clinically by Pirani's scoring and radiological assessment by calculating the talo-first metatarsal angle in anteroposterior (AP) view and talocalcaneal angle in AP and lateral views. The same clinical and radiological assessment was done at the end of treatment before putting a patient on foot abduction orthosis (FAO). **Results:** The average number of casts applied before full correction was 5.56 (range: 5–8). The average duration of treatment was about 6.65 weeks before the patient was put on FAO. Pirani score significantly improved from an average of 5.50 (range: 4–6) on presentation to 0.24 (range: 0–2) after correction of deformity. **Conclusion:** The Ponseti method is an excellent method for the correction of all four deformities associated with congenital idiopathic clubfoot, and we found that the addition of radiographic to clinical evaluation helps in the better assessment of correction. It provides statistically significant results both clinically as measured by Pirani severity score and radiologically assessed by talocalcaneal and talo-first metatarsal angle.

Keywords: Congenital talipes equinovarus, foot abduction orthosis, Pirani scoring, talocalcaneal angle anteroposterior, talo-first metatarsal angle

Introduction

Idiopathic clubfoot or congenital talipes equinovarus is the most common orthopedic congenital deformity. Club foot affects roughly one in every 1000 live births, and it is bilateral in about half of the cases.^[1] The four components of a congenital club foot are cavus, adduction, varus, and equinus. The treatment's purpose is to address four abnormalities and keep them corrected so that the patient can have a functional, pain-free plantigrade foot. Various nonsurgical treatment approaches have been tried, ranging from Hippocrates' bandages and Kite's plaster casts in 1937 to surgical treatment, but no satisfactory treatment for achieving a functional, painless, plantigrade foot with good mobility has yet to be established.^[2,3] However, as more is learned about the etiology and pathoanatomy of clubfoot, the outcomes have improved with time.

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Kite's approach of repair has a number of flaws, according to Ignacio Ponseti. He proposed the manipulation and serial casting approach for correcting clubfoot deformity, and his technique had good results in 89% of the patients.^[4] Ponseti's cases were evaluated by Cooper and Dietz, who reported that 78% of the patients had excellent or good functional and clinical outcomes after an average of 30 years of follow-up.^[5] For the early and most effective treatment of clubfoot, nonsurgical treatment using Ponseti's approach of manipulation and serial casting with percutaneous tenotomy is now used all over the world. Surgery is reserved only in resistant, recurrent, and cases which present at a late stage.^[1,3]

Treatment with the Ponseti technique should begin as soon as possible. It features a treatment phase that comprises weekly casting and mild massage. In most cases, a percutaneous Achilles tenotomy is required

How to cite this article: Jain AK, Kohli N, Bansal N, Sahni G, Aggarwal HO, Mathur M. Evaluation of results of Ponseti technique in idiopathic clubfoot using clinical evaluation and radiological assessment. *Int J App Basic Med Res* 2022;12:43-6.

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Submitted: 02-May-2021
Revised: 12-Nov-2021
Accepted: 28-Dec-2021
Published: 31-Jan-2022

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Access this article online

Website:
www.ijabmr.org

DOI:
10.4103/ijabmr.ijabmr_281_21

Quick Response Code:



to treat equinus. For 3 weeks, the final cast is worn with the foot in 60° of abduction and the ankle in 15° of dorsiflexion. The correction is kept in brace during the maintenance phase, with the foot in 70° of external rotation and 15° of dorsiflexion. It is worn for the first 3 months for 23 h a day and then for the next 3–4 years while sleeping.^[1,3,5]

Ponseti suggested that treatment be evaluated solely by palpation; however, radiography is still used by a small number of orthopedic surgeons. Clinical examination for follow-up and monitoring of correction is subjective and depends on clinical experience. Interobserver variability and erroneous identification of abnormalities are limitations of clinical grading of club foot.^[6]

Analytical radiography is a technique for examining the four primary clubfoot abnormalities.^[7-9] Although the efficacy of radiographs in clinical care and the link of radiographs to clinical findings are debatable, radiographs allow for a reasonably precise assessment of the club foot as early as 2 weeks after birth and the exact degree of rectification after treatment. In research, many metrics have been described to define anatomical deviations in anteroposterior (AP) and lateral radiographs, as well as to precisely record the deformity correction for the evaluation of any corrective procedure.^[9,10]

The present study was conducted with the aim of studying the effectiveness of Ponseti's technique in the management of idiopathic clubfoot and assessing the deformity using Pirani score and radiology.

Materials and Methods

This prospective study was conducted in the department of orthopedics at a tertiary care hospital attached to a medical college in North India between January 2017 and December 2019. A total of 30 cases with 41 clubfeet were taken up for the study. The sample size was estimated on the basis of a single proportion design. The target population from which the cases were considered was around 1000. We assumed that the confidence interval was 10% and confidence level was 80%. The patients were treated conservatively with Ponseti method after taking written and informed consent. The International Guidelines for Biomedical Research involving Human Subjects issued by CIOMS (Geneva 1982) were compiled and a formal ethical committee clearance was undertaken before the study.

Inclusion criteria were age <2 years, idiopathic clubfoot, which can be unilateral or bilateral, and willingness to participate in the research. Exclusion criteria were age more than 2 years, previously treated with different plaster cast application procedures, and previously operated for clubfoot, and atypical or secondary clubfoot, as well as associated neurological or other neurological problems.

Patients were evaluated through detailed history and general physical and local examination. Every clubfoot taken up

for the study was graded according to the Pirani severity score.^[11] Thorough clinical examination to assess the condition of skin, extent of deformity, muscle bulk, joint movement, and neurovascular status of the foot was done. Clinical grading of main deformity of clubfoot was done as per Pirani's score.^[11] Each component was scored as 0 (normal), 0.5 (mildly abnormal), or 1 (severely abnormal). Pirani scoring and the total scores were maintained at each visit on a weekly interval. The least total score for all categories combined was 0 and the maximum score was 6. Radiographs of clubfoot were taken at the first visit before treatment [Figure 1] and were repeated at the end of treatment [Figure 2] when the foot was deemed to be normal as per the Pirani score. The child was positioned by the investigator with the help of the parent. Radiographs were taken to calculate the talo-first metatarsal angle and talocalcaneal angle in both AP and lateral views. All radiographic parameters were recorded by the same radiologist.

Manipulation, casting, and Achilles tenotomy were done with the Ponseti technique by the same team of orthopedic surgeons, led by the primary author. Results were evaluated on the basis of the posttreatment Pirani score and posttreatment radiological angles. The final result was graded as good, if the total Pirani score remained zero; fair, if the total score was 0.5–1; and poor if the total score was more than one.

Statistical analysis

Data were analyzed using IBM SPSS version 20 (IBM SPSS statistics 20.0 for windows 10, Armonk, USA), mean values from Pirani scores were taken before and after procedure, and mean plus standard deviation was taken for the radiological score before and after the procedure. Paired *t*-test was used to find the statistical significance.

Results

With an average age of 24.03 days, 24 out of 30 cases (80%) appeared within 6 weeks (range: 2–120 days). The ratio

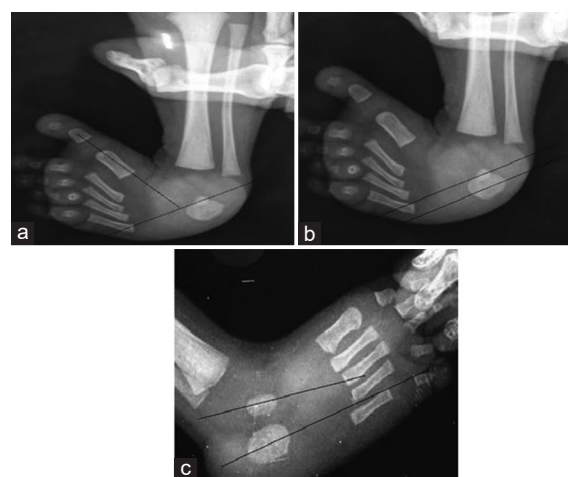


Figure 1: (a) Pretreatment talo-first metatarsal angle. (b) Pretreatment talocalcaneal angle-anteroposterior. (c) Pretreatment talocalcaneal angle-lateral

of males to females was 2:1. Of the 30 instances with 41 clubfeet, 26 cases had flexible clubfeet and 4 cases had rigid clubfeet. Eleven children had bilateral clubfoot, whereas 19 had unilateral clubfoot. There were 10 cases of right-sided participation and 9 cases of left-sided involvement among the 19 cases of unilateral involvement. At the time of the presentation, the cumulative mean Pirani score was 5.5. The average number of casts used in unilateral instances was 5.31, whereas it was 6.04 in bilateral cases. The average number of casts needed to accomplish correction was 5.56, with a range of 5–8. After all of the abnormalities had been corrected, the patient was placed in a foot abduction orthosis (FAO) for an average of 6.65 weeks. A few patients developed plaster sores, treatment had to be deferred for a few days due to plaster sores., the average duration of the cast treatment was slightly longer. During this time, parents were taught how to manipulate the foot. In 36 feet (87.80%) of the instances, percutaneous Achilles tendon tenotomy was required.

The average follow-up period was 15 months (with a range of 6–28 months). The most prevalent consequence was skin excoriation (5/41 feet). The mean Pirani’s score for the right foot was 5.57 pretreatment and 0.16 posttreatment, whereas for the left foot, it was 5.5 pretreatment and 0.3 for posttreatment, which was statistically significant ($P < .0001$), and radiological readings which are shown in Table 1 were also statistically analyzed before and

after treatment. On presentation, the average talocalcaneal angle in AP view for the right foot was 0.45° (range: -8 to 8) and 0.78° for the left foot (range: 6–10). The mean talocalcaneal angle for the right foot after treatment was 22.26° (range: 10–32) and for the left foot was 22.25° (10–30), which was statistically significant. On presentation, the right foot had a mean talocalcaneal angle of 2.68° (range: 0–8) and the left foot had a mean talocalcaneal angle of 4.89° (range: 0–8) in lateral view (range: 0–13). The mean talocalcaneal angle for the right foot after treatment was 30.71° (range: 23–40) and for the left foot was 30.55° (range: 20–38), which was statistically significant. The outcomes were assessed as good, fair, or poor at the conclusion of the study. In this analysis of 41 clubfeet in 30 cases, 31 feet (75.60%) had good or excellent results, 6 feet (14.63%) had fair results, and 4 feet (9.75%) had poor outcomes.

Discussion

Clubfoot is a complicated foot abnormality that requires nonsurgical treatment using Ponseti’s approach. The Ponseti method of clubfoot treatment necessitates manipulation and serial casts, as well as long-term brace compliance, to sustain correction.^[3-5,12] To obtain a plantigrade, painless functional foot without resorting to surgical intervention, treatment should begin as soon as possible. To determine the efficacy of a treatment approach, it must be evaluated critically. Clinical assessment is a commonly applied approach of evaluating treatment outcomes in clubfoot patients who have undergone the Ponseti method.

In past investigations, radiography was occasionally utilized for evaluation. To acquire acceptable quality radiographs, precise alignment of the foot on the film plate is necessary when taking radiographs. Hence, all the feet were positioned by the investigator to minimize errors.^[7,9] In our study, 80% of children with clubfeet presented to us within 6 weeks with an average age of 24.03 days of birth. This may be because of good referral system in our institute. In the present study, 66.66% of patients (20 out of 30) were males and 33.33% (10 out of 30) were females. Male children were more affected than females. Similar results were found in the study done by Bhaskar and Rasal, 2006;^[12] Changulani *et al.*, 2006;^[13] Brewster *et al.*, 2008;^[14] and Pulak and Swamy, 2012.^[15] In our study, 11 cases (36.66%) had bilateral involvement and

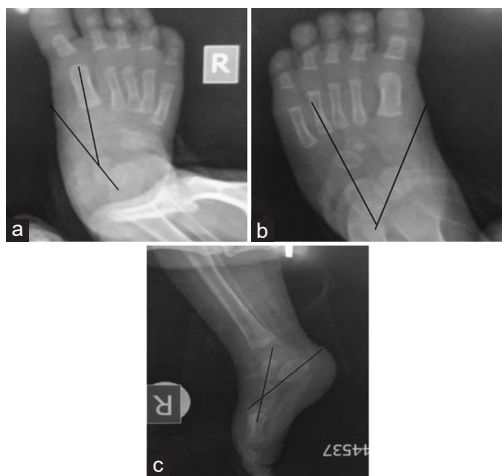


Figure 2: (a) Posttreatment talo-first metatarsal angle. (b) Posttreatment talocalcaneal angle-anteroposterior. (c) Posttreatment talocalcaneal angle-lateral

Table 1: Radiological evaluation

Angles	At presentation mean (SD)		After deformity correction mean (SD)		P
	Right foot (n=21)	Left foot (n=20)	Right foot (n=21)	Left foot (n=20)	
Talocalcaneal angle-AP	0.45 (2.22)	0.78 (3.87)	22.66 (5.36)	22.25 (5.71)	0.0001
Talocalcaneal angle-lateral	2.68 (2.86)	4.89 (4.61)	30.71 (4.78)	30.55 (6.11)	0.0001
Talo-first metatarsal angle	-55.33 (12.66)	-53.5 (11.20)	6.61 (2.64)	7.5 (2.57)	0.0001

AP: Anteroposterior; SD: Standard deviation

19 cases (63.33%) had unilateral. Similar observations were made by Ponseti and Smoley *et al.* in their study in 2009^[16] in which out of total 67 patients, 40 patients had only one foot deformed (60%) and 27 patients had both feet deformed (40%). The number of casts per feet in our study was 5–8 (average: 5.56). In a series by Ponseti and Smoley,^[4] the number of cast per feet was 5–10 (average: 7.6). In another study by Laaveg and Ponseti,^[17] the mean number of casts during their treatment was 7. Those feet which required a greater number of casts in our study had a higher Pirani score at the onset of treatment. In the present study, tenotomy was needed in 87.80% of the cases. Pirani^[11] carried out tenotomy in over 90.0% of his clubfoot patients, and Laaveg and Ponseti^[17] did tenotomy in 78.0% of cases.

In the present study, the mean Pirani score at presentation was 5.50 (range from 4 to 6). Similar findings were found in the study done by Changulani *et al.*, 2006,^[13] and Bhaskar and Rasal, 2006,^[12] where the mean Pirani score at presentation was 5.0 and 5.74, respectively. In our study, relapse of deformity was seen in 4 out of 41 feet (9.75%) which were treated with Ponseti method. Similar findings were observed in studies conducted by Bhaskar and Rasal in 2006^[12] and Brewster in 2008^[14] where relapse rates were 15% and 6.25%, respectively.

We found that the differences between study populations, methodology, and the way that outcomes are described contribute to the variation in the results reported for the Ponseti method. In our study, we added radiological assessment in addition to the clinical evaluation which was mostly used in the previous study in adding radiological assessment for observing the success of Ponseti method; it adds more accuracy to the treatment protocol posttreatment and helps further more orthopedic surgeons for successful outcome of Ponseti method.

Limitation(s)

The limitation of our study was bias in the drawing of the lines to represent axes of ossific nuclei, which often appeared circular at a very young age. Second, there is no standard of patient positioning while taking radiographs. This could be minimized by following the standardized technique of radiography and taking due care.

Conclusion

Congenital idiopathic clubfoot is a complex deformity that requires sincere efforts on the part of the treating surgeon and parents. The Ponseti method is an excellent method for the correction of all four deformities associated with congenital idiopathic clubfoot, and the addition of radiographic to clinical evaluation helps in the better assessment of correction. It is a simple, safe, reliable, and effective method and has good long-term results.

Ethical clearance

Ethical clearance was taken from the Institutional ethics Committee Government Medical College Patiala vide letter no. BFUHS/2K19/11755.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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