National Journal of Clinical Orthopaedics

ISSN (P): 2521-3466
ISSN (E): 2521-3474

www.orthoresearchjournal.com
2018; 2(4): 195-198
Received: 20-08-2018
Accepted: 24-09-2018

**Amit Kale**
Professor, Department of Orthopedics, Dr D.Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune, Maharashtra, India

**Clevio Desouza**
Junior Resident, Department of Orthopedics, Dr D.Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune, Maharashtra, India

**Shiju George**
Junior Resident, Department of Orthopedics, Dr D.Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune, Maharashtra, India

**Correspondence**
**Clevio Desouza**
Junior Resident, Department of Orthopedics, Dr D.Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune, Maharashtra, India

# Assessment of the severity of club foot in neonates treated by the ponseti method in correlation with ultrasonography and foot bimalleolar angle

**Amit Kale, Clevio Desouza and Shiju George**

**Abstract**
**Introduction:** Correlation of Pirani score and foot bimalleolar (FBM) angle has been used in few studies but correlation of FBM angle with ultrasonography has never been evaluated so they are being correlated in assessing the severity of clubfoot in neonates treated by Ponseti method.
**Material and Methods:** Thirty-two feet with congenital talipes equinovarus (CTEV) deformity in neonates were prospectively treated by the Ponseti method. FBM angle and ultrasound parameters were measured three times i.e. at the time of initial presentation, at four weeks of treatment and at completion of treatment. The feet were divided according to the Pirani score in groups: one (0-2.0), two (2.5-4) and three (4.5-6). Correlation between FBM angle and ultrasound parameters were evaluated using Pearson correlation/regression.
**Results:** Correlation between FBM angle and ultrasound parameters were statistically significant (p-value < 0.05).
**Conclusion:** Ultrasound has the potential to accurately depict the pathoanatomy in clubfoot. FBM angle and ultrasound are objective methods to assess the severity of clubfoot. FBM angle and ultrasonography correlated in severity of deformity and correction achieved along the course of treatment.

**Keywords:** CTEV, ultrasound, foot bimalleolar angle, pirani score, ponseti method

## Introduction
Idiopathic clubfoot, also known as "Congenital Talipes Equinovarus" or "CTEV" is one of the commonest congenital foot anomalies. The incidence of this condition ranges from 0.9 per 1000 live births to 4-7 per 1000 live births with about 50 % including bilateral cases. This condition can be treated with various modalities which include correction by serial plaster casts as described by Kite and Ponseti and various surgical procedures with satisfactory results [1-5]. However, the gold standard method followed in the management of these cases showing excellent results is the Ponseti method of serial manipulation by weekly cast [6].
Various scores have been used for the assessment of the clinical evaluation of clubfoot, these include 1) Pirani score (PS) 2) Dimeglio score 3) Catterall score 4) Harold and Walker score. These scores being subjective in nature, have observer variations and hence do not give objective evidence of the severity of the deformity [7]. It is to be noted that the cause of recurrence in some cases may be because of the disturbance of the underlying anatomy of these cases even though there was clinical correction in these cases [8-9]. Thus, there is a need for a system that helps in objective evaluation of clubfoot correction during Ponseti treatment.
One of the criteria with which objective evaluation of clubfoot can be done is the Foot bimalleolar angle (FBM). It is a combined indicator of forefoot adduction and hind foot varus. The anteromedial angle between the long axis of the foot and the bimalleolar plane is taken as FBM angle. Its normal value is 82.5 degrees in infants [10]. Serial measurements can be used to assess the severity of deformity and correction achieved.
Many studies have been conducted to study about the role of radiography for assessing the correction achieved but have found the angles not correlating with deformity. This may be due to the non-visualization of un-ossified tarsal bones. Sonography is an alternative imaging modality for assessing severity of club foot. Its advantage over radiography is that it allows better assessment and evaluation of cartilaginous structures which may be un-ossified, bones and surrounding soft tissues. Thus it provides a reliability objectively in the assessment of the deformity and to identify spurious corrections, if any [6].

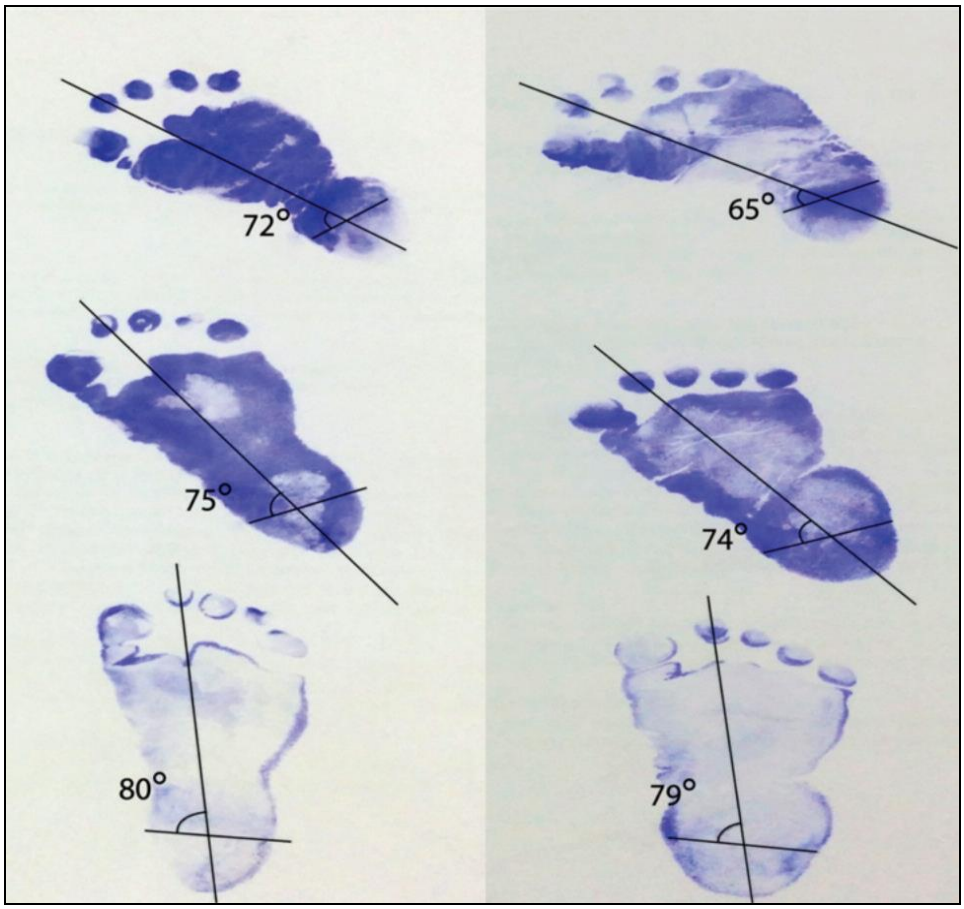
The correlation of Pirani score and Foot bimalleolar angle (FBM) has been used in a few studies [11, 12] but the study of correlating FBM angle with ultrasonography has not been evaluated during treatment of CTEV by Ponseti method, hence we have decided to study this comparison this being the aim of our study.

**Materials and Methods**

This is a prospective observational study. 32 feet of 30 children with CTEV deformities treated with Ponseti method between June 2016 to June 2018 on OPD basis were included in this study. Proper consent was taken prior to including the subjects in the study. All cases of previously or partially treated and/or secondary clubfoot (associated other congenital abnormalities like spina bifida, arthrogryposis, cerebral palsy) were excluded from our study. The feet were graded clinically by the Pirani score which is a simple scoring system based on six clinical signs [13]. The technique used to calculate the FBM angle consisted of keeping the foot in weight bearing position, and foot tracings being taken on a plain white paper. The mid-points of both malleoli were marked on the same foot print by placing a marker on both sides. Long axis was drawn taking second toe and midpoint of most broad part of heel as 2 reference points. Bimalleolar axis, which is the line joining both the malleoli were drawn and the position where it intersected with the long axis of the foot was defined as the FBM angle (Figure 1).

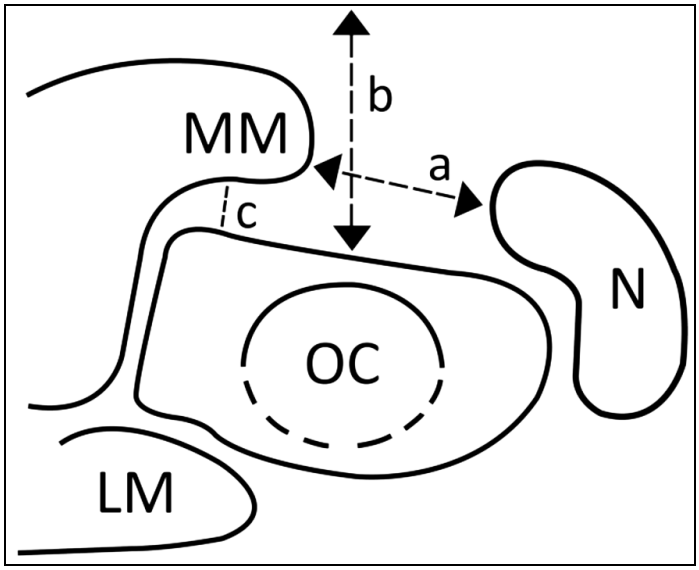
Podograms were made by placing the plantar surface of the feet on inkpad and then firmly placing them on a clean sheet of paper to have good contact of heel, lateral border of foot and all the toes. The involved foot was then subjected to ultrasonography and the following parameters were noted. On the medial projection the transducer was kept more vertical on the medial border of foot in the line of tibia to match the equinus deformity and the medial malleolus navicular distance (MMN) and medial soft tissue thickness (MST) was calculated (Figure 2). On the dorsal projection the transducer was kept at the dorsal aspects of the foot, and the length of tendo-achilles (TAL) was calculated. On the lateral projection the transducer was kept on the lateral border of foot, and the calcaneocuboid distance (CCD) and calcaneocuboid angle (CCA) were calculated.

This was followed by corrective serial casting by the Ponseti method, with the child being asked to follow up at weekly intervals for re manipulation and change of cast till full correction was achieved. Pirani score, ultrasonography and FBM angle were evaluated in the beginning of treatment, at four weeks and at full correction of deformity with or without tenotomy. The Pearson's correlation/ regression test was used by us to determine the correlation between FBM angle and ultrasound parameters.




V1: FBM – 72° and Pirani Score – 5.5
V2: FBM – 75° and Pirani Score – 3.0
V3: FBM – 80° and Pirani Score – 0.5
V1: FBM – 65° and Pirani Score – 5.5
V2: FBM – 74° and Pirani Score – 3.0
V3: FBM – 79° and Pirani Score – 0
*Podograms showing calculation of FBM

**Fig 1:** Foot bimalleolar angle (FBM) at initial visit, second visit and final visit along the course of treatment.




MM=medial malleolus; LM=lateral malleolus; N=navicular; OC= ossification centre of talus; a=distance between the medial malleolus and the navicular (MMN distance); b=medial soft tissue thickness; c=soft tissue thickness within the ankle mortise.

**Fig 2:** Osteocartilaginous relationship on medial projection.

## Results

Our study included 32 feet of 30 children, 2 cases were bilateral and 28 were unilateral who were managed by the Ponseti method. The evaluation done of these patients included the Pirani score, FBM angle and ultrasound parameters which were assessed three times, that are at the time of initial presentation, at four weeks of treatment and at completion of treatment. The mean of FBM angles recorded at baseline was 66.55 degrees, at four weeks was 70.83 degrees and at completion of treatment was 79.23 degrees. It was observed that FBM angle went on increasing with serial treatment and approached close to the normal value of 82.5 degrees. In ultra sonographic evaluation there was visualisation of both ossified and non-ossified structures. The mineralised [art of talar bones appeared as highly reflective surface with acoustic shadowing. The non- ossified cartilaginous structures were poorly echogenic with evenly spaced bright foci within. Using all the three projections various parameters were measured all the three times of ultrasonic evaluation.

Using Pearson correlation it was found that FBM angle showed positive correlation with medial malleolus navicular (MMN) distance and length of Achilles tendon (TA). Correlation was significant (p-value <0.01) (Table 1). Also, it was found that the FBM angle showed negative correlation with medial soft tissue thickness (MST), calcaneocuboid angle (CCA) and calcaneocuboid distance (CCD). Correlation was significant (p-value <0.01) (Table 1).

## Discussion

CTEV is one of the most common congenital anomalies of the foot. Dyer *et al*. suggested that Pirani score was very reliable, easy to memorise and was better than Dimeglio score, so Pirani score was taken to grade severity in our study [13].

The FBM angle which was one of the parameters used in our study uses the footprint as a measure to quantify the deformity on the objective assessment of calcaneal rotation. This angle is a combined indicator of the hind foot Varus and forefoot adduction which are the main variants of club foot deformity although it does not give the access to the component of hind foot deformities by the Pirani score [11]. Jain *et al*. found that the normal value of FBM angle is 82.5 degrees in their study [10]. It is a very cost effective method as it requires only a sheet of paper and ink pad [11].

Ultrasound was found to be an effective, simple and reproducible investigation. The average time taken to carry out the procedure per foot was about 15-20 minutes per foot and was carried out when the baby was asleep. The medial view was used to assess medial malleolus, navicular and talus. It clearly demonstrated the position of the displaced navicular and measured the medial malleolar-navicular (MMN) distance and medial soft tissue thickness (MST). With serial casting the MMN distance showed progressive increase and MST was found to decrease along the course of treatment. When these parameters (MMN and MST) were correlated it was found that there was negative correlation between them which was in concurrence with Khaled *et al*. who also found negative correlation between them in their study (Table 2) [9].

On lateral view examination, there was assessment into the calcaneocuboid relationship. Calcaneocuboid angle is an indicator of medial deviation of cuboid which is essential as, if left untreated, it results in residual deformity. Calcaneocuboid distance (CCD) was also measured. With serial casting both the CCA and CCD showed progressive decrease in the course of treatment. CCA and CCD showed positive correlation in this study which was similar to observation made by Khaled *et al*. (Table 3) [9].

On posterior view examination, the length of tendo-achilles was found to be at a mean of 2.99 at first visit, 3.17 at second visit and mean 3.91 at Completion of treatment in this study. On posterior projection, with serial casting, it was found that length of Achilles tendon showed progressive increase in the course of treatment. Generally casts were required for the complete correction of foot, with requirement of tenotomy in some.

**Table 1:** The correlation of foot bimalleolar (FBM) angle with various sonographic parameters and among each other (p-values)

| Parameters | FBM | MMN | MST | CCA | CCD | TA |
|---|---|---|---|---|---|---|
| FBM angle(degrees) | 1 | 0.75 | -0.60 | -0.76 | -0.68 | 0.75 |
| MMN distance(mm) | 0.75 | 1 | -0.44 | -0.76 | -0.58 | 0.74 |
| MST (mm) | -0.60 | -0.44 | 1 | 0.70 | 0.65 | -0.41 |
| CCA (degree) | -0.76 | -0.76 | 0.70 | 1 | 0.77 | -0.71 |
| CCD(mm) | -0.68 | -0.58 | 0.65 | 0.76 | 1 | -0.62 |
| TA length(mm) | 0.75 | 0.74 | -0.41 | -0.71 | -0.62 | 1 |

FBM= foot bimalleolar angle; MMN= medial malleolar navicular distance; MST= medial soft tissue thickness; CCA= calcaneocuboid
Angle; CCD= calcaneocuboid distance; TA= tendon-Achilles length

**Table 2:** Mean medial malleolar navicular (MMN) distance and mean medial soft tissue thickness (MST) values

| Measurement | | Initiation of Treatment | At 4th Week | At the end of Treatment |
|---|---|---|---|---|
| MMM (mm) | Mean | 0.32 | 0.43 | 0.68 |
| | SD | 0.09 | 0.12 | 0.10 |
| MST (mm) | Mean | 1.25 | 1.19 | 1.06 |
| | SD | 0.06 | 0.10 | 0.09 |

MMN= medial malleolar navicular distance; MST= medial soft tissue thickness

**Table 3:** Mean Calcaneocuboid angle (CCA) and mean Calcaneocuboid distance (CCD) values

| Measurement | | Initiation of Treatment | At 4th Week | At the end of Treatment |
|---|---|---|---|---|
| CCA (degree) | Mean | 21.30 | 18.63 | 23.71 |
| | SD | 2.24 | 5.77 | 10.24 |
| CCD(mm) | Mean | 0.23 | 0.18 | 0.08 |
| | SD | 0.06 | 0.06 | 0.05 |

CCA= calcaneocuboid angle; CCD= calcaneocuboid distance

## Conclusion

This study showed a positive correlation during treatment of CTEV between FBM angle and ultrasound parameters. Ultrasound can be put to use to depict the patho-anatomy in clubfoot. FBM angle and ultrasound are objective methods to assess the severity of clubfoot. The correlation between FBM angle and ultrasonography can be used to determine the severity of Deformity and correction achieved in the course of treatment.

## References


1. Brewster MB, Gupta M, Pattison GT, Dunn-van der Ploeg ID. Ponseti casting: A new soft option. J Bone Joint Surg. 2008; 90(11):1512-5. doi: 10.1302/0301-620X.90B11.20629
2. Metuszeioski L, Gill L, Karski J. Early result of treatment for congenital club foot using the Ponseti method. Eur J Orthop Surg Tramatol. 2012; 22(5):403-6. doi: 10.1007/s00590-011-0860-4
3. Porecha MM, Parmar DS, Chavda HR. Mid-term results of Ponseti method for the treatment of congenital idiopathic clubfoot -(A study of 67 clubfeet with mean five year follow-up). J Orthop Surg. 2011; 6:3. doi: 10.1186/1749-799X-6-3
4. Ponseti IV, Smoley EN. Congenital club foot: the results of treatment. J Bone Joint Surg Am. 1963; 45(2):2261-75.
5. Ponseti IV. Clubfoot management. J Pediatr Orthop. 2000; 20(6): 699-700.
6. Bhargava SK, Tandon A, Prakash M, Arora SS, Bhatt S, Bhargava S. Radiography and sonography of clubfoot: A comparative study. Indian J Orthop. 2012; 46(2):229-35.
7. Sud A, Tiwari A, Sharma D, Kapoor S. Ponseti's vs. Kite's method in the treatment of clubfoot - a prospective randomised study. Int Orthop. 2008; 32(3):409-13.
8. Desai S, Aroojis A, Mehta R. Ultrasound evaluation of clubfoot correction during Ponseti treatment: a preliminary report. J Pediatr Orthop. 2008; 28(1):53-9.
9. Khaled L, Hesham TK. The role of ultrasound in clubfoot treatment: correlation with the Pirani score and assessment of the Ponseti method. Clin Orthop Relat Res. 2010; 468(9):2495-506. doi: 10.1007/s11999-010-1335-3.
10. Jain AK, Zulfiqar AM, Kumar S, Dhammi IK. Evaluation of foot bimalleolar angle in the management of congenital talipes equinovarus. J Pediatr Orthop. 2001; 21(1):55-9.
11. Jain P, Mehtani A, Goel M, Jain S, Sood A, Kumar Jain A. Correlation of foot bimalleolar angle with Pirani score to assess the severity of congenital talipes equino varus deformity. J Pediatr Orthop B. 2012; 21(1):68-72. doi:10.1097/BPB.0b013e32834adb56
12. Anshuman R, Singh M, Jain BK, Verma N, Arora R. Correlation of Pirani score and foot bimalleolar angle in the treatment of idiopathic congenital talipes equino varus by Ponseti method in infants. Acta Orthop Belg. 2016; 82(4):861-5.
13. Dyer PJ, Davis N. The role of the Pirani scoring system in the management of clubfoot by the Ponseti method. J Bone Joint Surg Br. 2006: 88(8):1082-4.