Correlation of foot bimalleolar angle with Pirani score to assess the severity of congenital talipes equinovarus deformity

Pragya Jain[a], Anil Mehtani[b], Meenakshi Goel[a], Saurabh Jain[c], Alok Sood[b] and Anil Kumar Jain[c]

Various reported scores for congenital talipes equinovarus are with observer variations and lack in objective evidence of severity of deformity. Anteromedial foot bimalleolar angle (FBM), an objective assessment deformity and correction, was correlated and compared with Pirani scores 0.5–2, 2.5–4, 4.5–6 as grouped I to III for mean and SD in 244 club feet in 137 children. Mean FBM angle of group I to III were 79.72°, 68.4°, and 53.27°, respectively. FBM angle gives objective assessment of severity of deformity and can be used as objective evidence of improvement/deterioration of deformity. *J Pediatr*

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[a]LHMC, [b]Department of orthopaedics, LHMC and [c]Department of orthopaedics, UCMS and GTB, Delhi, India

Correspondence to Dr Anil Kumar Jain, MS(ortho), A 10 part B, Ashok nagar, Ghaziabad, UP 201002, India
Tel: +9811604663;
e-mail: dranilkjain@gmail.com

Introduction

Congenital talipes equinovarus (club foot, CTEV) is one of the commonest congenital orthopedic deformities requiring correction. The treatment of club foot has evolved in last 80 years. Good results by Kite manipulation [1] and soft tissue release when indicated became gold standard. Later on extensive and early surgical release was advocated. With the introduction of Ponseti method [2–4] of manipulation, the pendulum has swung to nonoperative treatment and the correction of foot could be achieved to nearly 90% [5–9]. Even the expected outcome of treatment has evolved from plantigrade albeit relatively stiff foot to plantigrade, soft, pliable foot. Ideally corrected CTEV one with a lasting correction, is plantigrade, pliable, cosmetically and functionally acceptable, obtained within the shortest treatment time and does not necessitates wearing of modified shoes [5].

While treating club feet it is important to classify the severity of deformity and the outcome. The various criteria to assess the severity of deformity are available. The various scores in vogue are Pirani score [10], Dimeglio score [11], Catterrall [12], and Harrold and walker [13] classification. However, all current classifications are still not entirely satisfactory. These all classifications being subjective in nature, have inter-observer and intraobserver variation but they do not give objective evidence of severity of deformity [6]. Pirani scoring is most commonly used and is found to be most useful in view of its being reliable, quick, and easy to use [14,15]. The foot prints were used to assess the severity of deformity and grade of correction achieved, but no correlation between the two was found. Jain *et al.* [16] have used anteromedial foot bimalleolar angle (FBM) on a foot print and suggested it as an objective evidence of severity of club foot deformity and correction achieved.

While treating club foot what the parents want to know: (a) whether the foot will be corrected by treatment? (b) Will the child require surgery? (c) When on nonoperative treatment whether foot is responding to treatment or not? (d) If the foot is showing early recurrence of deformity after correction. (e) Whether an objective and retrievable evidence of improving correction or failure of correction is available or not?

This study is undertaken to correlate the FBM with Pirani score as an objective evidence of severity of CTEV deformity.

Materials and methods

The 244 club feet in 137 children were recorded from club foot clinic of our institute. All idiopathic club feet children attending CTEV clinic and were on manipulation and cast application by Ponseti method were included. The foot deformity with neurogenic causes such as arthrogryposis multiplex congenita, cerebral palsy, spina-bifida were excluded. All the patients who reported for treatment as relapsed foot, later than 1 year or after surgery were excluded.

The severity of deformity as per Pirani score was calculated by two senior faculty members. The Pirani score has six clinical signs of contracture. The each sign is graded according to the following principle, 0 = no abnormality; 0.5 = moderate abnormality; 1 = severe abnormality.

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The six signs are separated into three mid foot and hind foot each. The hind foot clinical signs include severity of posterior crease, emptiness of heel, and rigidity of equinus whereas mid foot signs include curvature of lateral border, severity of medial crease, and position of the lateral part of the head of the talus. Thus, each foot can have a hind foot score between 0 and 3, a mid foot score between 0 and 3, and a total score between 0 and 6.

The foot tracings were recorded by final year medical student who were taught how to record them. One student recorded the foot print and marked points whereas other helped in all foot tracing so as to avoid variation of recording in all patients. The tracings were taken just before the manipulation and cast application. The tracing of affected feet were taken on a sheet of paper. The planter surface of each foot was placed on inkpad. The limb was held by distal leg and the foot was placed on a sheet of paper firmly to have contact of heel, lateral border of foot and toes with the sheet to make a podogram. Any of the imprint of sole, lateral border or toes having double impression, was discarded and repeat foot print was taken to rule out variations. The foot was kept stable on the paper and the level of lateral and medial malleoli were marked. The tibial and fibula was palpated along subcutaneous border downward and most distal point of fibula was marked as lateral malleolus whereas center of most distal prominence of tibia was marked as medial malleolus with a point of dot pen. On each foot print, the long axis of foot was drawn by taking the second toe and most convex part of heel as the two reference points. This line was intersected by a line joining the two malleolar points. The anteromedial angle at the intersection was taken as the FBM angle. Mean of three readings was taken. The whole data were put in Microsoft excel sheet where FBM angle was recorded against each Pirani score. All feet having a Pirani score between 0.5–2, 2.5–4 and 4.5–6 were grouped as I to III. The mean FBM angle was calculated for each group (Figs 1–3).

The mean, range, and SD of FBM angle for each group were calculated. The multiple comparison of each group with others was done by Tukey HSD.

Results

The 244 feet in 137 children with 30 unilateral and 107 bilateral clubfeet were included for analysis. The mean age was 5.8 months. All feet tracings were classified into three groups. The group I (Pirani score 0.5–2) has 154 feet whereas group II (Pirani score 2.5–4) has 50 feet and the group III (Pirani score 4.5–6) has 40 feet.

The mean FBM angle for group I was 79.72° with SD 5.13 (range 67°–92°). The mean FBM for group II was 68.4° with SD 3.83 (range 60°–79°) and in group III was 53.27° with SD 8.01 (range 42°–69°). The difference of mean of group I with rest of the groups was statistically significant (P-value < 0.01). The difference of group II with group I and III was also statistically significant (P-value < 0.01). The difference of means of group III was also statistically significant with I and II (P-value $0 < 0.01$). This suggests the means FBM angle of each group has significant difference with adjacent group.

Discussion

Idiopathic club foot is a complex foot deformity that is difficult to correct. The goal of treatment is to have functional, pain free, plantigrade feet with good mobility, without callus, and without the need to wear shoes [5]. The treatment of club foot is primarily nonoperative and should be instituted as early as possible after birth.

While starting a treatment it is important to describe the treatment and probable outcome to the parents of a baby

Fig. 1

Clinical photograph of foot in group I with Pirani score 1 and foot bimalleolar angle 81°.

Fig. 2

Clinical photograph of foot in group II with Pirani score 3.5 and foot bimalleolar angle 67°.

Fig. 3

Clinical photograph of foot in group III with Pirani score 5.5 and foot bimalleolar angle 40°.

born with CTEV. The condition is variable in severity and clinical course. The classification systems are widely used in orthopedic practice for the assessment of deformity and comparison of the results [10–15]. The ideal grading system for club foot on a severity scale should (a) involve reproducible objective measurement; (b) be easy to learn; (c) be applicable to all form of CTEV; (d) not to be related with age of the patients; (e) the objective evidence is recoverable from a retrospective record review. Several studies have shown that many systems in current use do not have interobserver and intraobserver consistency.

Wainwright [14] assessed the reliability of classification described by Ponseti and Smoley [3], Dimeglio *et al.* [11], Catterall [12], and Harrold and Walker [13]. He

concluded that the system of Dimeglio *et al.* has the greatest reliability but he concluded that current classification systems for the analysis of CTEV are not entirely satisfactory [14].

The Pirani score was evaluated in the management of club foot by Ponseti method [10,14–15]. Seventy club feet children were treated by Ponseti method and evaluated by Pirani score. A significant positive correlation was found between the initial Pirani score and number of the cast required. It was concluded that Pirani score is reliable, quick, and easy to use. The Pirani system is not sensitive and accesses tend to give a diagnosis of moderate abnormality as there are only three levels of scoring 0, 0.5, and 1.

Jain *et al.* [16] have used FBM angle as an evaluation method. 82.5° was mean FBM found in normal Indian infant. Grade I, grade II, and grade III severity of club feet has mean FBM angle of 73.2°, 66.6°, and 54.7°, respectively. The grading system used was as suggested by Harrold and Walker [13]. The system suggested by Harrold and walker grading foot into three grades partly quantifies the ability to correct hence may not be a true reflection of deformity of the foot present. The outcome of treatment was also correlated with FBM angle by Jain *et al.* But the method used to grade the outcome was again very subjective and not commonly used and accepted. However, author believed that FBM angle correlates well with the severity of deformity and correction achieved.

The pathology in CTEV is in the rotation of calcaneus beneath the talus which is reflected clinically as the foot deformities, heel varus, forefoot adduction, and equinus. In FBM, the attempt is made in the foot print to quantify the CTEV deformity depending on the objective assessment of calcaneal rotation. The FBM angle depends on the shape of heel and the position of forefoot. The improvement in the shape of heel and forefoot is a measure of correction of calcaneal rotation [16]. FBM (angle between bimalleolar line and the foot axis) is a combined indirect indicator of forefoot adduction and the hind foot varus (which are main variants of the club foot deformity), although it does not gives the access of the equines (minor variant), also reflected in our series by group 1 cases that is, of Pirani 0.5–2 (mainly equinus with minor adduction/varus) has mean foot biamlleolar angle of 79.2 that is almost near to mean FBM of normal foot that is 82.5 by Jain *et al.* [16]. Although correcting the foot with the serial casting as the forefoot and hind foot deformity (combinedly indicated by FBM) get corrected, the equinus also gets corrected along with it or else can be corrected with tenotomy of the tendo-achillies only and immediately after this the Pirani score improves as the equines score improves.

Pirani score is the most commonly used scoring system hence we though it is worthwhile to correlate FBM angle with respective grade of Pirani score.

We categorized our data into three groups which include two scores each. We found that mean FBM angle of group I to III were 79.72°, 68.4°, and 53.27°, respectively. The FBM angle goes on correcting to the near normal as the foot gets corrected reaching the normal Pirani score. The mean difference in each group was statistically significant. We did found overlap of FBM angle among adjacent groups of Pirani score when we compare range of FBM angle in respective grade. However, if we use podogram with FBM angle in a particular patients along with Pirani score it gives an indirect objective evidence of correction of club feet deformity. It is a cost-effective method as only requires a sheet of paper and inkpad. The objective of this study is not to replace any system of evaluation of clubfoot deformity but to include no cost method to give an objective evidence of improvement/deterioration of clubfoot deformity.

This study suggests that podogram and FBM angle could become one of the objective criteria to be included in assessment method whereas club foot is on treatment by Ponseti method. This gives an objective data and documented record. FBMs, when seen sequentially, can be given as an indirect objective evidence of improvement/deterioration of foot deformity. It is suggested to take a podogram and record FBM angle along with Pirani score just before every manipulation and casting of clubfoot.

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Conflicts of interest

There are no conflicts of interest

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