Analysis of Correlation of Foot Bimalleolar Angle and Pirani Scoring for its Predictive value in the management of Idiopathic CTEV by Ponseti Method

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Citation

Abstract
BACKGROUND- This study was conducted with the aim to study Foot bimalleolar angle (FBA) and Pirani scoring with emphasis on analysis of their correlation for its predictive value in the management of clubfeet managed by Ponseti technique. METHOD & MATERIAL- Total 30 subjects (42 feet) were studied, which were corrected by Ponseti technique. All were evaluated clinically, radiologically, podogrammically and by Catteral Pirani Scoring System, both before and after the correction. RESULTS- Severity of the deformities and clinical correction was assessed by Pirani score. All patients achieved good clinical results as per Pirani score, which was statistically significant. Radiological evaluation showed that all subject achieved the normal range of values. The pre and post correction difference in FBA was statistically significant. CONCLUSION- Foot Bimalleolar Angle proved as one of the indicator of severity of deformity in CTEV, which corresponds with other clinico-radiological parameters. The correlation between FBA and Pirani was found significant, predictive and reproducible.

INTRODUCTION
The CTEV, a hereditary foot deformity is one of the commonest congenital foot anomalies presenting to a paediatric orthopaedic surgeon. Its incidence is 5-6 per 1000 live births, varying with race and geography. Males are more commonly affected in the ratio of 3:1. Bilateral presentation of this deformity is more than 40 percent of cases. All clubfeet are not the same. There is a spectrum of deformity ranging from the newborn positional deformity (which usually corrects with one or two casts) to the stiff callused foot of the adolescent whose deformed foot has never been treated. The goal of any type of CTEV management is to reduce, if not to eliminate all elements of the clubfoot deformity. Hence achieving a functional, pain free, normal looking plantigrade, mobile, callous free and normally shoeable foot. The various factors that have been associated with the poor prognosis in CTEV management are female child, hereditary, late age of presentation, severity of deformity, rigidity of foot, associated cavus, associated clawing of toes and small heel. Kite rationally the whole treatment of clubfoot by conservative means and his technique of manipulation and casting remained popular among orthopaedic surgeons for last many decades with satisfactory to good results. Recently, various workers have shown satisfactory results by Ponseti method of manipulation and serial casting. This technique offers correction of all components of deformity in shortest duration with less incidences of recurrence. Ponseti considered head of talus as the center of all the components of this deformity. Recently an association of internal talar spin and varus component of this deformity has been established. Clinically the talar spin can be measured by Foot bimalleolar axis. This study was conducted to evaluate the clinico-radiological outcomes of CTEV managed by Ponseti method with special emphasis on the evaluation of bimalleolar angle in these patients.

MATERIAL AND METHOD
This observational study was conducted on all the patients of 0-2 years of age since July 2003 to January 2005. All patients were managed on OPD basis.
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Figure 1
Table 1: Demography of Study

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<table>
<thead>
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<tbody>
<tr>
<td>Total Patients-</td>
<td>30</td>
</tr>
<tr>
<td>Total Feet</td>
<td>42</td>
</tr>
<tr>
<td>Age (months)</td>
<td></td>
</tr>
<tr>
<td>22 (73.3%)</td>
<td></td>
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<tr>
<td>26 (20.0%)</td>
<td></td>
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<tr>
<td>02 (6.7%)</td>
<td></td>
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<tr>
<td>Male/Female</td>
<td>24/6</td>
</tr>
<tr>
<td>Bilateral/Unilateral</td>
<td>12/18</td>
</tr>
<tr>
<td>Right/Left</td>
<td>13/5</td>
</tr>
<tr>
<td>Associated Congenital Anomaly</td>
<td>Absent/ Present</td>
</tr>
</tbody>
</table>

All patients of CTEV fulfilling following criteria, such as presenting first time for the management of clubfoot in our OPD, patients managed earlier conservatively but not fully corrected and all previous conservatively corrected clubfoot presented with relapse of deformity, were included. We excluded patients above 02 years of age, previous operated patients and if associated with secondary causes. All patients included in this study were thoroughly assessed clinically including podograms and radiologically. Local examination of the foot documentation included following parameters (i) Shape of the foot (ii) Heel size (iii) Skin creases – mainly posterior and planter (iv) Tendoachilles – whether tight and its insertion (v) Callosities if any (vi) Measurement - Medial border and Lateral border Index” [Medial: lateral] (vii) Deformity (viii) Calf size (ix) Clawing of toes and Cavus, if any (x) Bimalleolar axis. In the radiological assessments, measurements of various angles were done in AP and Lateral view in stress dorsiflexion in all cases. X rays were studied for talocalcaneal angle, talo-1st metatarsal angle, talo-Vth metatarsal angle (all in AP view), talocalcaneal angle, Tibiocalcaneal angle and Calcaneal pitch (all in lateral view). For deformity correction, the classical Ponseti technique was adopted. Catteral Pirani scoring system was used in this study to assess the severity of deformity and to assess the correction achieved after final casting. Podograms were taken to assess the weight bearing portion of foot, length and width of foot before and after completion of treatment. After keeping the foot in weight bearing position, the foot tracings were taken on a plain white paper. Simultaneously the mid points of both malleoli were marked on the same footprint by placing a pencil on both sides. A long ‘axis of foot’ was drawn taking 2nd toe and mid point of most broad part of heel as the two reference points. A line joined the two medial malleoli marks known as ‘bimalleolar axis’, which intersect this long axis of foot. Anteromedial angle of the intersection was taken as ‘Foot Bimalleolar Angle’ (FBA). As described in literature, the normal value of FBA is 82.5°. Feet were classified in-group I, II, III as per the Jain et al study 9 (group I - >73.2°, group II - 66.6° – 73.2° and group III - <66.6°). FBA was recorded before and after the treatment. In Ponseti technique, tenotomy was done in only those cases, in which after the correction of varus, ankle could not be dorsiflexed upto 10°. After every cast application, children were observed for any pressure complications for minimum of 4-6 hours. The parents were educated about any possible complications i.e. bluish discoloration of toes, persistent screaming of child. They were advised to report immediately in case any one of these happened.

Patients were regularly followed up at an interval of seven days. Correction was continued by serial casting till foot was corrected clinically, as per following criteria- Extent of deformity, Position of heel, Range of dorsiflexion, Shape of foot, Sinha Index, active range of eversion and dorsiflexion of foot on stimulating the sole of child and Pirani score. After the clinical correction achieved, podograms were obtained (and FBA was measured) and feet were also evaluated radiologically. Fully corrected non-walking feet were given Dennis Brown splint to be worn for at least 23
hours a day and for walking feet, corrected CTEV shoes were given for the day time and corrected night shoes. The importance of bracing was emphasized to the parents and they were advised to comply strictly with the bracing protocol. All parents were advised to come regularly every month for six months and then six monthly thereafter till the age of 4 years. After that they were told to report in case of relapse of any deformity. In case of relapse, it was corrected by the same technique as was used previously. Cases were considered as failure if a) there was no or incomplete clinico-radiological correction or b) complications like joint subluxation, rocker bottom deformity occurred.

OBSERVATIONS AND RESULTS
Demography of the study has been shown in table. We would present our observations on 30 patients (42 feet) treated prospectively by Ponseti method. The mean pre correction equinus deformity was $47_{14}$°. The mean dorsiflexion achieved after correction was $17.9_{15}$° in these patients. The mean pre correction adduction deformity was $24_{16}$° and the mean post correction abduction achieved was $5_{17}$° in these patients. The mean pre correction heel varus was $39.3_{18}$° while the mean post correction value of varus was $5.5_{19}$°. Before correction 25 (59.5%) feet had cavus deformity, which was corrected in all of these patients. The mean pre correction Sinha index was 0.7 and after correction the mean Sinha index achieved was 1.07.

Figure 2
Figure 1ab : Pre management feet showing extent of deformity

Figure 3
Figure 1c: Pre management radiological evaluation of feet

Figure 4
Figure 2a: Clinical correction achieved at the end of final manipulation. Fig. 2 (b): Post correction Radiological evaluation of corrected feet showing all angle within normal range

Figure 5
Figure 3a: Pre management podograms showing FBA. Fig. 3 (b) – Post management podograms showing correction achieved in FBA

It was found that majority of these patients of CTEV had FBA of grade III before correction, which improved to grade I in all patients. The mean pre correction FBA was $60_{20}$°, which improved to a mean value of $78.7_{21}$°. Before correction the mean Pirani Total score was 5, which was reduced to 0.7 after the correction.
Tenotomy was performed in 15 (71.4%) feet. In cases where tenotomy was done, the mean pre correction Tibiocalcaneal angle was 102.8°, which improved to 68.4° after correction. The mean duration required for the correction of deformity was 31 days and average number of plasters required for correction was 5.

Minor complications developed in 11 (26.2%) feet. These include superficial plaster pressure sore formation in 3 cases (7.14%); abrasions over thigh developing as a result of inadequate padding at superior edge of cast were seen in 6 feet (14.3%). All these were managed by leaving them open with some antiseptic ointment over it. A relapse of deformity was present in 4 feet (9.5%). In all of these 04 patients, the deformity recurred was adduction. On inquiring, parents accepted the poor compliance for the orthosis. These relapses were unrelated with age of presentation and severity of deformity. All these 4 recurrence were managed again successfully by manipulation only. To evaluate our end results, the subjects were graded on a scale of good to poor using Pirani Score. A final Pirani score of 0-2 is regarded as good clinical correction achieved. All patients were reverted to 0-2 group i.e. good outcome.
Figure 8

Table 4: Assessment of subjects using Catteral Pirani score

<table>
<thead>
<tr>
<th>Mean +/-SD</th>
<th>Total (n=42)</th>
<th>Pre</th>
<th>Post</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>24+/-0.5</td>
<td>0.4+/-0.4</td>
</tr>
<tr>
<td>Hindfoot (HFC)</td>
<td></td>
<td>2.6+/-0.3</td>
<td>0.6+/-0.5</td>
</tr>
<tr>
<td>Midfoot (MFC)</td>
<td></td>
<td>5.0+/-0.7</td>
<td>1.0+/-0.7</td>
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</table>

**DISCUSSION**

The Ponseti technique has been accepted by majority of orthopaedic surgeons as method of choice to manipulate and correct CTEV. There is apparently a consensus between these surgeons that by this method, the correction can be achieved early with a low recurrence rate. The explanation given for better deformity correction by Ponseti technique is a) pronation should never be done as it causes the calcaneum to jam under talus. The calcaneum does not rotate and remains in varus b) by using Ponseti technique, calcaneum is allowed to rotate under the talus, which also is free to rotate in ankle mortise. This is achieved by abducting the forefoot in supination with the counter pressure on lateral aspect of head of talus. The philosophy of this technique is that the center of CTEV deformity lies with head of talus with a medial talar spin, which can be measured by FBA.

As majority of cases presented were of less than one year of age with the majority of children being in an age group of 0-3 months (22 patients). Cavus was present in 60% of total subjects, which signifies that it is an important associated deformity of CTEV. We observed that Ist metatarsal was more planter flexed than 5th metatarsal. Improvement in Sinha Index (Medial/ Lateral border ratio) was observed in all subjects although we were not able to achieve complete reversal of medial to lateral border ratio, as probably the duration of observation was short. In unilateral cases, affected foot remains smaller in comparison to the normal foot but was cosmetically acceptable to all parents.

As far as analysis of FBA parameter is concerned, Jain et al (2001) showed improvement from grade III to grade I in 93% of cases, while in present study we were able to bring it in 95.3% of Ponseti case. The FBA improvement achieved in Ponseti group can be associated with gradual correction of varus tilt of hind foot with abduction of foot and thus avoiding pronation of hindfoot.

As per our observations, radiological parameters return to normal range. The possible explanation for this could be that the primary pathology in CTEV is soft tissue contractures around midfoot and hindfoot while the bony articulation changes are not initially present as skeleton is mainly cartilagenous. The purpose of casting is to immobilise the contracted ligaments at the maximum stretch obtained after each manipulation. All the joints are interconnected and proper bony alignment can be achieved if treatment is started early. The difference in pre and post correction Pirani scores in these patients was found statistically significant (p=0.01).

Gokson et al (2006) performed tenotomy in 85% of feet. Ebehardt et al (2006) treated 39 clubfeet with average Pirani score of 4.9 and we showed that tenotomy were necessary to perform in 34 (87.2%) of the clubfeet. Herzernberg et al (2002) performed tenotomy in 31 (91%) of 34 feet where as Segev et al (2005) did in 95% of feet treated. In present study, we performed tenotomy in 72.5% of feet only. Radler et al (2007) showed that only the lateral Tibiocalcaneal angle and degree of dorsiflexion as measured clinically, was changed significantly after tenotomy (p=0.05). In his study he showed that after tenotomy the mean Tibiocalcaneal angle was 69°. Our observations also corresponded to their views as we observed that tenotomy was required in those cases that had severe deformity both clinically (Pirani score >5) and radiologically (Tibiocalcaneal angle >100°). Colburn et al (2003) and Morcuende et al (2004) reported relapses of adduction in approximately 10% and 11% of cases respectively, while in our study it was approximately 9.5%. Like our observations, they also found incompliance with brace as the cause for relapse.
Figure 9
Table 5: Tenotomy in relation to clinico-radiological parameters

<table>
<thead>
<tr>
<th>Tenotomy</th>
<th>Pirani Score (Mean)</th>
<th>Tibiocalcaneal Angle (Mean)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>5.3</td>
<td>0.8</td>
</tr>
<tr>
<td>No</td>
<td>4.9</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Our final results were comparable to study of Ebehardt et al. who treated 41 clubfeet by Ponseti technique of manipulation and presented 95% good results. He emphasised that with this technique, need of extensive surgery has decreased. Results were also comparable to Lourenco AF et al. (2007), Segev et al., Goksan et al and Morcuende et al. with approximately 92%, 94%, 84% and 98% good results respectively.

Figure 10
Table 6: Correlation of FBA with Severity of Deformity

We may conclude that Foot Bimalleolar angle is a clinical parameter to define the severity of idiopathic CTEV, which corresponds with the Pirani scoring. It also correlates with the clinico- radiological parameters of deformity correction in idiopathic CTEV. Foot bimalleolar angle and Pirani scoring is easy, reproducible, predictive and statistically significant.

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