

Correlation of Pirani Score and Ultrasound in Assessing the Severity of Clubfoot in Neonates Treated by Ponseti Method

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Abstract

Aim: The aim of this study is to correlate Pirani score and ultrasound in assessing the severity of clubfoot in neonates treated by Ponseti method.

Materials and Methods: A total of 32 ft with idiopathic congenital talipes equinovarus deformity in neonates were prospectively treated by Ponseti method. Pirani score and ultrasound parameters were measured 3 times, i.e., at the time of initial presentation, at 4 weeks of treatment, and at completion of treatment. Feet were divided according to Pirani score in groups: One (0–2.0), two (2.5–4), and three (4.5–6). Correlation between ultrasound parameters and Pirani score was evaluated using one-way ANOVA and Tukey test.

Results: Correlation between Pirani score and ultrasound parameters was statistically significant ($p < 0.05$).

Conclusion: Ultrasound has the potential to accurately depict the pathoanatomy in clubfoot. Ultrasound is objective method to assess the severity of clubfoot. Pirani score and ultrasound correlated in severity of deformity and correction achieved along the course of treatment.

Keywords: Idiopathic congenital talipes equinovarus, Pirani score, Ponseti method, ultrasound.

Introduction

Clubfoot also called as “Congenital talipes equinovarus” or “CTEV”. It is idiopathic and one of the most common congenital condition. Incidence of CTEV is 5–6 per 1000 live birth and is one of the most common congenital foot anomaly being more common in male compared to female (male:female - 3:1). The problem is more alarming in the developing countries on account of late presentation [1-5]. It is a complex deformity comprising of forefoot adduction, hindfoot varus, hindfoot equines, and talo-navicular subluxation. The Ponseti method of serial manipulation by weekly casts is currently the gold standard for treatment of clubfoot in infants with excellent results [6]. Pirani score ranges from 0 to 6. It is an objective criterion to assess the severity of correction of deformity [7,8]. Pirani scoring is most commonly used and is found to be most useful as it is reliable, quick, and easy to use. Correction of the deformity during serial manipulations has so far been assessed on clinical grounds only, using Pirani score system. However, clinical assessment remains subjective and unreliable as there is no direct evaluation of anatomical relationships. It is seen

that in about 15% of cases spurious correction can occur, i.e., they show clinical correction, but underlying anatomy is still disturbed which may be the

cause of recurrence [9,10]. Thus, there is a need for an objective evaluation of clubfoot correction during Ponseti treatment. Sonography is an alternative imaging modality for assessing severity of clubfoot. It has emerged as a promising imaging modality for musculoskeletal conditions due to its dynamic capability and visualization of cartilaginous structures and soft tissues [6]. It can determine the pliability of various compartments of clubfoot and their correction on manipulation [7]. It is cost effective, readily available, with no radiation hazards and being easily performed repeatedly to assess correction. This provides a reliable and objective method to assess the deformity and spurious correction if any. It is a promising modality, but it is subjective dependent and requires an expert radiologist with adequate experience in musculoskeletal deformity. The correlation of Pirani score and ultrasound has not been evaluated in successive stages of treatment by Ponseti method. Our purpose therefore was to determine whether a correlation exists between ultrasonographic parameters and the Pirani score during treatment, and hence, this study was done.

Materials and Methods

After taking clearance from the institutional ethical committee and consent of the parents/guardian of the patients, 30 untreated neonates (32 ft) of either sex with idiopathic clubfoot were managed in CTEV clinic, at a tertiary care center in this prospective level IV study. Cases not included were as follows:

1. Previously/partially treated

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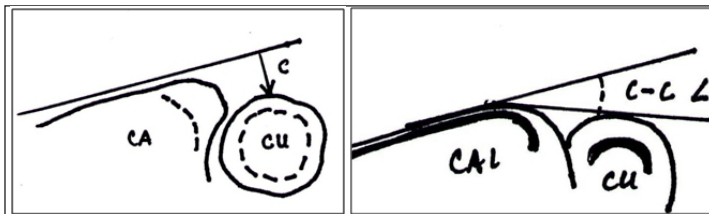


Figure 1: Diagram showing osteocartilaginous relationship on lateral projection. CU - Cuboid, CA - Calcaneum, c - calcaneo-cuboid distance (C-C distance), C-C calcaneo-cuboid angle (C-C angle). There is medial displacement of cuboid in relation to calcaneus and medial inclination of calcaneocuboid joint.

2. 2° clubfoot (associated other congenital abnormalities such as spina bifida, arthrogyrosis multiplex congenital, and cerebral palsy)

3. Consent not given by parents or guardian.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors. The feet were graded clinically by Pirani score. This was done to see the correction and effectiveness of the treatment by Ponseti method (Table 1). The involved foot of the child was subjected to ultrasonography by experienced radiologist, and the following parameters were documented (Table 2).

Corrective serial casting by Ponseti method was applied, and child was followed up at weekly intervals for remanipulation and change of cast, till full correction was achieved. Pirani score and ultrasonography were evaluated in the beginning of treatment, at 4 weeks and at full correction of deformity, with or without tenotomy, irrespective of time duration. To correlate ultrasound parameters with Pirani score, one-way ANOVA followed by Tukey test was used.

Result

This study includes treatment of 30 children, 2 cases were bilateral and 28 were unilateral (32 feet) who were managed by Ponseti method. Pirani score and ultrasound parameters

Deformity		Severe	Mild	Absent
Hind-foot deformity	Posterior heel crease	1	0.5	0
	Empty heel	1	0.5	0
	Rigidity of equinus	1	0.5	0
Mid-foot deformity	Curvature of lateral border of foot	1	0.5	0
	Medial crease	1	0.5	0
	Lateral head of talus	1	0.5	0

	Position of transducer	Parameter seen
Medial Projection	Vertically on the medial border of foot in line of tibia	MMN
		MST
Dorsal projection	At the dorsal aspects in various positions of foot	TAL
Lateral projection	On lateral border of foot	CCD
		CCA

MMN: Medial malleolus navicular distance, MST: Medial soft tissue thickness, TAL: Length of tendo Achilles, CCD: Calcaneocuboid distance, CCA: Calcaneocuboid angle

were measured 3 times, i.e., at the time of initial presentation, at 4 weeks of treatment, and at completion of treatment. Pirani score went on decreasing with serial treatment and became zero at completion of treatment with or without tenotomy (Table 3). Ultrasonographic parameters were measured 3 times using 3 projections each time.

On medial projection

On medial view, medial malleolus navicular distance (MMN) and medial soft tissue thickness (MST) were found to correlate with Pirani score using one-way ANOVA and subsequently by Tukey test. $p < 0.01$ which is highly significant (Table 4).

On lateral projection

On lateral view, calcaneocuboid angle (CCA) and calcaneocuboid distance (CCD) were correlated with Pirani score using one-way ANOVA and subsequently by Tukey test (Table 5). Fig. 1 shows diagram showing osteocartilaginous relationship on lateral projection CU - cuboid, CA - calcaneum, c - calcaneo-cuboid distance (C-C distance), and C-C calcaneo-cuboid angle (C-C angle). There is medial displacement of cuboid in relation to calcaneus and medial inclination of calcaneo-cuboid joint.

On posterior projection

On posterior projection, length of Achilles tendon was correlated with Pirani score using one-way ANOVA and subsequently by Tukey test. $p < 0.01$ which is highly significant (Table 6).

Dynamic evaluation for talo-navicular relationship

Serial no.	Visit one	Visit 2nd	Visit final
1	5	3	0.5
2	5.5	3.5	1
3	6	3.5	0.5
4	5.5	3	0.5
5	5	3	0.5
6	5	3	0
7	5	3	0.5
8	5.5	3.5	0.5
9	6	3	0
10	5	3	0
11	5.5	3.5	0.5
12	5.5	3.5	0.5
13	6	3.5	0.5
14	5.5	3	0.5
15	5.5	3	0.5
16	5.5	3	0
17	6	3	0.5
18	5.5	3	0.5
19	5	3	0.5
20	5.5	3	0
21	6	3.5	0.5
22	6	3.5	1
23	5.5	3	1
24	5	3	0.5
25	5.5	3	0
26	6	3.5	0.5
27	5.5	3	0
28	6	3	0.5
29	5.5	3	0
30	6	3.5	1
31	5.5	3	0.5
32	5.5	3.5	0

On dynamic evaluation for talo-navicular relationship, coverage of talus by navicular was studied, and it was found that with serial casting along the course of treatment there was no talar coverage when the foot corrected. On correlating with Pirani score using Chi-square test, p value was found to be < 0.01 which is highly significant.

Discussion

Pirani score went on decreasing with serial casting with Ponseti method along the course of

Parameters	Visit first	Visit second	Visit final
MMN			
Mean±SD	0.32±0.09	0.43±0.12	0.68±0.10
MST			
Mean±SD	1.25±0.06	1.19±0.10	1.06±0.09
p value	0	0	0
MMN: Medial malleolus navicular distance, MST: Medial soft tissue thickness, SD: Standard deviation			

Parameters	Visit first	Visit second	Visit final
CCA			
Mean±SD	21.30±2.24	18.63±5.77	9.90±1.99
CCD			
Mean±SD	0.23±0.06	0.18±0.06	0.08±0.05
p value	0	0	0
CCD: Calcaneocuboid distance, CCA: Calcaneocuboid angle, SD: Standard deviation			

Parameter	Visit first	Visit second	Visit final
TAL			
Mean±SD	2.99±0.36	3.17±0.41	3.91±0.29
p value	0	0	0
TAL: Length of tendo Achilles, SD: Standard deviation			

treatment. The significance of treatment (p value) was <0.01. Hence, there was a significant reduction of Pirani score with treatment showing the effectiveness of Ponseti method in correcting the deformity. Ultrasound assessment and Pirani score were done in all children at the baseline when the child presented, subsequently at around 4 weeks, and finally, at completion of treatment using three views - medial, lateral, and posterior. It was found to be a simple and reproducible investigation. The examination was done when the baby was asleep. The medial view was used to assess medial malleolus, navicular, and talus. Shiels et al. in their study of 13 clubfeet and 35 normal feet of 24 patients [11]. Bhargava et al. in their study of 31 patients reported similar values of MMN in their

study [6]. Serial sonographic monitoring of these parameters with Ponseti treatment gave an objective assessment of severity of clubfoot. Desai et al. in their study of 32 clubfeet found MMN distance as an objective parameter to monitor effects of treatment [9]. However, he did not assess MST, talonavicular relationship, and other ultrasonographic parameters. When these parameters (MMN and MST) were correlated, it was found that there is a negative correlation between them. On lateral view, the calcaneo-cuboid relationship was assessed. CCA is an indicator of medial deviation of cuboid which is essential as if it is left untreated, it results in residual deformity. Gigante et al. found CCA (mean 20°) and Bhargava et al. found CCA (mean 23.71°, standard deviation [SD] 10.24) in their study [6,12]. Aurell measured CCD with a mean of 0.25 and SD 0.13 and Bhargava et al. found the CCD with a mean of 0.34 and SD 0.19 [6,13]. These values were similar to our study. With serial casting, both CCA and CCD showed progressive decrease and showed positive correlation in this study. On posterior projection, with serial casting, it was found that length of Achilles tendon showed progressive increase along the course of treatment. Correlation of all ultrasonic parameters with Pirani score was found using one-way ANOVA and by Tukey test. It was found that $p < 0.01$ which is highly significant.

Conclusions

To the best of our knowledge, this is the only prospective study showing correlation of Pirani score and ultrasonic parameters during treatment of idiopathic CTEV. Ultrasound has the potential to accurately depict the pathoanatomy in clubfoot. Ultrasound is an objective method to assess the severity of clubfoot. Pirani score and ultrasonography correlated in severity of deformity and correction achieved along the course of treatment.

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