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Correlation of Idiopathic Clubfoot Scores with Number of Manipulations and Castings Using Ponseti Method: A Prospective Study in Port Harcourt, Nigeria

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Abstract

Background: Scoring systems are being employed in the objective assessment of the severity of idiopathic clubfoot deformities. Popular among these scoring systems are the Diméglio and Pirani Scoring Systems. This study aims to find the correlation of idiopathic club foot scores (Pirani and Diméglio) with the number of castings by Ponseti method.

Methodology: It was a prospective study carried out over a 12-month period in a tertiary hospital. Children with idiopathic congenital talipes equinovarus under 3 years were included in the study. All data was analysed with the Statistical Package for Social Sciences (SPSS) version 20 for Windows. Pearson correlation coefficient was used to determine the correlation between clubfoot scores and number of castings done.

Results: The study comprised of 42 subjects with a total of 58 feet. Male and females were 45.2% (19) and 54.8% (23) respectively. Idiopathic clubfoot was unilateral in 61.9% of cases. The mean Pirani and Diméglio scores at presentation were 4.58±1.42 and 14.28±3.37 respectively. The mean number of casting sessions required to achieve correction was 4.00±1.19. There was a significant positive correlation between total number of castings with both Pirani scores (r= 0.449, p<0.05) and Diméglio scores (r= 0.619, p< 0.05). Fifty percent (50%) of feet required percutaneous tenotomy in the final stages of correction.

Conclusion: Pirani and Diméglio scores have significant correlation with number of casts a patient will require for correction. Thus, either of these scores can be used and are useful tools in the monitoring of patients' treatment with Ponseti method.

Keywords: Idiopathic Clubfoot, Ponseti, Pirani Score, Diméglio Score, Manipulation and casting.
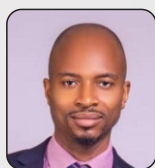
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Introduction

Clubfoot or congenital talipes equinovarus (CTEV) is the commonest congenital orthopaedic malformation identified in Nigeria [1, 2]. Management of this condition ranges from conservative management to several surgical procedures. The treatment has gradually evolved over time from operative procedures to serial manipulation and casting using the Ponseti method, achieving excellent results especially in idiopathic CTEV [3]. The Ponseti method is a distinct treatment technique for clubfoot by serial manipulation developed by Professor Ignacio V. Ponseti at the University of Iowa Hospital [4]. This technique simultaneously corrects various aspects of clubfoot deformity except equinus. Supination of the forefoot to align it with the hind foot is done, followed by abduction of the forefoot under the talus with the fulcrum at the head of the talus. Lastly, the equinus is corrected by dorsiflexion of the foot with or

without the aid of percutaneous Achilles tenotomy [4]. Studies have reported good results with the Ponseti method in idiopathic congenital talipes equinovarus (ICTEV) [5, 6]. Full correction is achieved in up to 95% of cases after about 5-8 cast applications, depending on the age treatment was started [5, 6]. Although the use of scoring systems for the assessment of clubfeet is still controversial, Pirani and Diméglio scoring systems are the most commonly used [7]. The Pirani score is based on 6 clinically assessed parameters: curved lateral border, medial crease, lateral head of the talus, posterior crease, resistant equinus and heel emptiness [8]. Each parameter is scored 0, 0.5 or 1 for no abnormality, moderate abnormality or severe abnormality respectively. The Diméglio score is assessed based on the 3-dimensional nature of the deformity in the sagittal, frontal and horizontal planes: equinus in the sagittal plane, varus in the coronal plane, forefoot adduction in relation to the hindfoot in the horizontal plane, and derotation of the calcaneus-forefoot block in the horizontal plane [9]. Each of the above parameters is scored 1 to 4 points depending on the reducibility of the deformity in the axis being tested. Both scoring systems require no special equipment, are quick and easy to perform and have methodical checklists with drawings to illustrate each parameter.

This study aims to determine the correlation of idiopathic clubfeet scores (Pirani and Diméglio classification systems) with the number of casting of idiopathic congenital talipes equinovarus (ICTEV) by the Ponseti method.

Methods

This was a hospital-based, prospective study with a quasi-experimental design (a non-randomized interventional study) conducted over a period of twelve months from October 2017 to September 2018 in the outpatient orthopaedic clinic. The study population included children with ICTEV under 3 years of age in whom parents provided consent. The exclusion criteria included those who had:

i. Previous manipulation and cast application
ii. Surgical procedures prior to presentation
iii. Clubfoot of other aetiology such as those associated with other syndromes, congenital abnormalities, cerebral palsy or polio

The minimum sample size of 42 children was calculated using Cochran formula, based on a prevalence of 2.2% from a similar study in Obafemi Awolowo University by Mejabi et al [10]. Enrolled participants subsequently had serial weekly Ponseti casting using Plaster of Paris. Scoring was done at every clinic visit with the aid of a goniometer and the scoring template aid/questionnaire till the deformity was corrected and patient was recommended an appropriately sized abduction brace. Tenotomy was indicated to correct the equinus when cavus, adductus and varus were fully corrected but ankle dorsiflexion

remained less than 10 degrees above neutral [3]. Data collected were analysed using the Statistical Software for Social Sciences (SPSS) version 20. The data was tested for normality using Shapiro-Wilks statistics and paired t-test was used to determine the differences in means before and after the intervention. Pearson's correlation coefficient was used to determine the correlation between the number of castings and the scoring systems (Pirani and Diméglio). Wilcoxon signed–rank test and Spearman's correlation coefficient were applied for data that were not normally distributed. A p value of less than 0.05 was considered statistically significant.

Results

Forty-five participants were enrolled of which three patients defaulted treatment and were not included in the final analysis. Some patients had bilateral involvement of feet, thus a total of fifty-eight feet were examined, scored (using Diméglio and Pirani scoring systems) and treated using the Ponseti method. More patients (14 (33.3%)) presented before 3 months of age as shown in Figure 1.

The age range of the patients was from 2 weeks to 30 months of age. The median age of presentation was about 9 months and the mean of study population ± S.D was 9.14±7.60 months.

Twenty-three (54.8%) participants were female and nineteen (45.2%) were male. There were no significant differences in the age and sex distribution of the participants (Table 1).

Twenty-six (61.9%) participants had unilateral involvement and sixteen (48.1%) had bilateral clubfoot. The right limb was
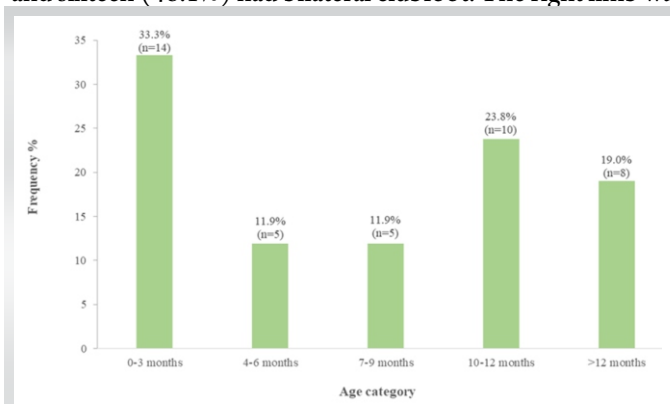

Figure 1: Distribution of age categories among participants in the study.

Table 1: Age and sex distribution of patients in the study			
Age category	**Sex**		
	Male n (%)	**Female n (%)**	**Total n (%)**
<3 months	6 (42.9)	8 (57.1)	14 (100.0)
4 – 6 months	3 (60.0)	2 (40.0)	5 (100.0)
7 – 9 months	2 (40.0)	3 (60.0)	5 (100.0)
10 – 12 months	5 (50.0)	5 (50.0)	10 (100.0)
>12 months	3 (37.5)	5 (62.5)	8 (100.0)
Total	**19 (45.2)**	**23 (54.8)**	**42 (100.0)**
Fisher's exact test = 1.044; p-value = 0.946			

affected more frequently (53.4%, n=31) than the left limb (46.6%, n=27).

Pirani and Diméglio Scoring

The severity as represented by the Diméglio and Pirani scoring system was assessed by calculating the mean score at 1st presentation which was as shown in the Table 2.

The scoring systems showed a uniform progressive relationship week by week till correction was achieved (Figures 2 and 3).

Correlation of initial clubfoot scores and number of casting sessions required.

There was a positive correlation between the number of casting sessions and the Pirani and Diméglio scores. The Pearson correlation coefficient for number of casting sessions with the

initial Pirani and Diméglio scores were 0.499 and 0.619 respectively.

A linear regression equation was also calculated and can be seen in the scatter diagrams in Figures 4 and 5.

Percutaneous tenotomy was performed in 50 percent of participants' feet and it was observed that the average number of casts required was higher for those patients that required Achilles tenotomy.

There was no significant difference in the tenotomy rates based on the initial clubfoot scores (Table 4).

Table 2: Summary measures of Pirani, Dimeglio and Number of Castings for the feet examined in the study (N=58)

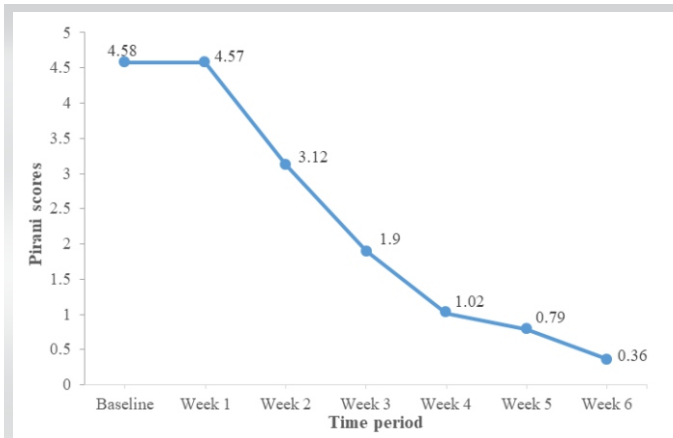| Variables	Mean ± SD
Pirani scores	4.58 ± 1.42
Dimeglio scores	14.28 ± 3.37
Number of castings	4.00 ± 1.19

SD= Standard Deviation

Figure 2: Distribution of mean Pirani scores during follow-up period
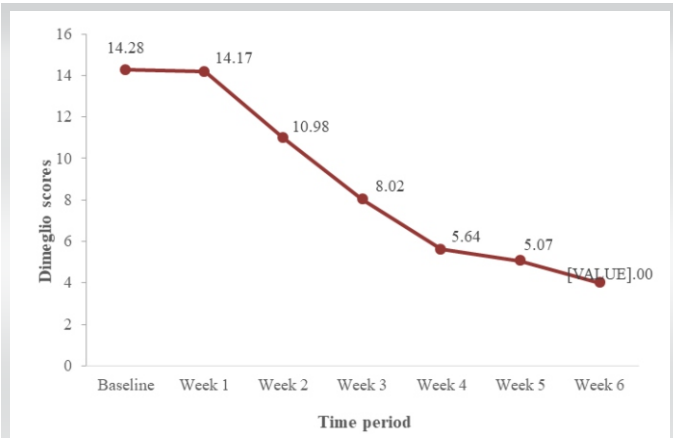

Figure 3: Distribution of Dimeglio score along follow-up period
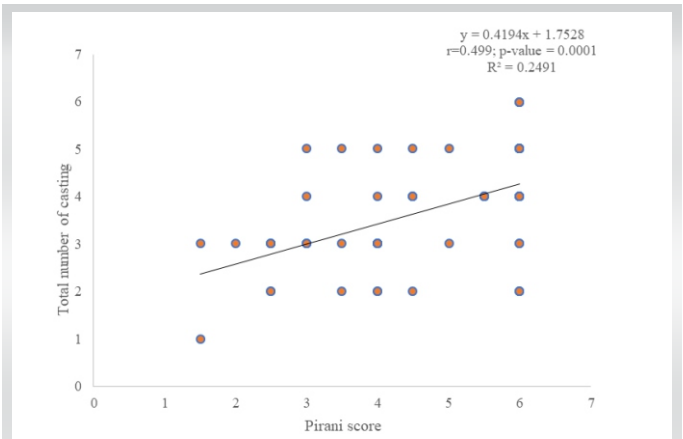

Figure 4: Scatter diagram showing correlation of total number of casts with initial Pirani score
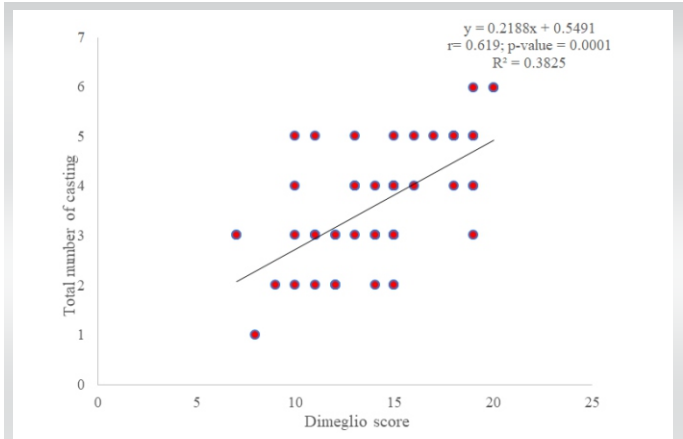

Figure 5: Scatter diagram showing correlation of total number of casts with initial Diméglio scores

Table 3: Comparison of number of castings by presence/absence of tenotomy

	Yes	No	t	p-value
Mean number of castings ± SD	4.10±1.01	3.24±1.21	2.936	0.005*
S.D – Standard deviation		*statistically significant		

Table 4: Comparison of clubfoot scores by presence/absence of tenotomy

Clubfoot scorings	Tenotomy		t	p-value
	Yes	No		
	Mean ± SD	Mean ± SD		
Pirani scores	4.78±1.31	4.38±1.52	1.067	0.29
Dimeglio scores	14.83±2.84	13.72±3.79	1.255	0.215

S.D – Standard deviation

Discussion

The mean Pirani score at initial presentation was 4.58 which was similar to the mean initial Pirani score of 4.48 reported in the study by Dyer et al [8]. The mean Diméglio score in this study was 14.28. In contrast, another study in Romania reported Diméglio scores of 10.3 and 10.6 by two different observers. That study, however, had a larger sample size and spanned a period of 10 years [11]. The average number of casts required to achieve correction was four in the present study which is similar to other studies (4-8 casts) [12–15]. Higher number of casting sessions may be attributed to the inclusion of patients with non-idiopathic clubfeet which are usually more rigid and difficult to correct than idiopathic clubfoot [12].

The results of this study suggest a linear prognostic relationship between the scores obtained at presentation and the number of casts a patient will need to achieve correction. The initial Pirani and Diméglio scores correlated positively with the number of casts the patient required as has been documented in other studies [10, 14, 16]. It was noticed in this study, however, that there was a stronger positive correlation between number of casts and Diméglio scores than the Pirani scores. In contrast, the study by Gao et al showed little or no correlation between the scores and the number of casting sessions required to achieve correction [7]. Although, in that study, coefficients of < 0.21 were taken to have no correlation which was partly responsible for their inference. In that study, Diméglio score had a higher correlation than Pirani score with number of casts as seen in this study.

The percutaneous tenotomy rate in this study was 50%. Similarly, a systematic review by Jowett et al reported tenotomy rates ranging from <50% to 100% in studies adhering to the Ponseti method [17]. Factors that may have affected this include age of presentation, severity of the deformity and proficiency in technique. There was no record of any untoward effect following percutaneous tenotomy in this study. Ultrasound evidence has shown that most tendons are completely healed after 3 weeks of percutaneous tenotomy and casting and all tendons completely healed within 6 weeks in a study done in 8 infants [18]. No significant difference between corrected feet that had percutaneous tenotomy and those that did not have tenotomy in terms of initial scores was seen in our study. In contrast, the study by Scher et al reported increased tenotomy rates in patients with higher initial clubfoot scores [19].

Both the Pirani and Diméglio scores are effective methods of scoring clubfeet, although our results suggest that the Diméglio score has a stronger correlation with the number of casts. This benefit of the Diméglio score in strength of correlation may be outweighed by some of the advantages of the Pirani score which include, fewer parameters to assess, relatively easier and faster to score and thus more feasible in the day-to-day clubfoot clinic setting. In addition, some subjective aspects of the Diméglio score like the assessment of muscle condition which was evaluated by Lampassi et al may require further evaluation using ultrasound or magnetic resonance imaging [19, 20].

Conclusion

There is a significant positive correlation between the initial Pirani and Diméglio scores and the number of Ponseti castings required to achieve reduction of the clubfoot deformity, thus, both scoring systems are valuable tools in the assessment and monitoring of patients with idiopathic talipes equinovarus using the Ponseti method.

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