

Original Research Article

Clinical Evaluation of the Pirani and Dimeglio Scoring Systems and their Correlation with the Number of Casting Sessions Using the Ponseti Method for Idiopathic Clubfoot Treatment

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Abstract: **Background:** Few studies have investigated which of the classification systems between Dimeglio and Pirani best correlates with the number of casts required to achieve clubfoot correction. This study aims to analyse the two scoring systems to determine the best in predicting number of casting sessions required for idiopathic clubfoot correction. **Objectives:** To determine the correlation between the Pirani and Dimeglio scoring systems with the number of casts required for correction of idiopathic clubfoot using Ponseti method of treatment. **Material and Methods:** This work was a 12 months prospective interventional study. 55 Patients with 94 idiopathic clubfeet who met the selection criteria and consent given by their Parent/guardian were recruited for the study. Each clubfoot was scored at presentation using the Pirani and Dimeglio scoring systems. All clubfeet were treated using the Ponseti method until correction was achieved (with or without percutaneous tenotomy). The correlation between the two scoring systems and the number of casts required to achieve correction was analysed. **Results:** The mean number of casts required to achieve initial correction was 4.38 (range: 2-7). There was a positive correlation between the Pirani scores at presentation ($r=0.854$, $p<0.001$) and the Dimeglio scores at presentation ($r=0.809$, $p<0.001$) with the number of casts required to achieve correction. Multiple linear regression analysis showed that the Pirani score at presentation significantly predicts the total number of casts better than Dimeglio scores. **Conclusion:** The Pirani score showed better accuracy in predicting the total number of casting sessions required for correction of idiopathic clubfoot.

Keywords: Pirani score, Dimeglio score, Ponseti, Clubfoot.

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INTRODUCTION

Idiopathic clubfoot, is a developmental deformity of the foot and ankle [1-4]. It is the most frequent congenital musculoskeletal anomaly with a global incidence range of 1-2 per 1000 live births [5-7].

The current conventional accepted management of clubfoot in the worldwide orthopaedic community is serial stretching and casting described by Ponseti [8-11].

Numerous classification systems have been proposed to provide an index of severity of idiopathic clubfoot at the presentation that serves as a guide to treatment and prognosis [3,4]. The method proposed by Dimeglio *et al.*, and Pirani *et al.*, are the most widely accepted clubfoot severity scoring systems [12-14]. Few studies have investigated the correlation between Dimeglio and Pirani scoring systems with the number of casting sessions required for clubfoot correction with variable results [3,12,15,16], thereby making it difficult to predict with reasonable accuracy the duration and

outcome of treatment. In our institution, the Pirani scoring system is the only scoring system used to grade clubfoot at presentation and during treatment. No study has been found in our locality to determine which of the classification systems between Dimeglio and Pirani best correlates with the number of casting sessions required for correction. Comparison of the two scoring systems will help to determine the best in predicting the length of treatment. This informed the need to investigate the correlation between the two scoring systems and the number of casting sessions required for clubfoot correction in our locality.

Establishing the best scoring system is of clinical importance in our environment, as it will assist us in predicting with reasonable accuracy, the number of casting sessions required, and hence the duration of treatment to the parents during counselling. This knowledge will go a long way to alleviate the anxiety on the length of treatment, which may have a substantial bearing on parent's compliance and success of treatment.

This study aims to find the correlation between the Pirani and Dimeglio scoring systems with the number of casting sessions required for correction of clubfoot by Ponseti method.

MATERIALS AND METHODS

A 12 months prospective interventional study. The study was approved by the Institution Ethics committee and informed consent was obtained from the parents/guardians of all participants.

Inclusion Criteria

- Patients with idiopathic clubfoot below the age of four years
- Patients who have had no surgical treatment of deformity before the presentation.

Exclusion Criteria

Patients were excluded from the study based on the following criteria:

- Patients with clubfoot older than four years of age
- Patients with neurogenic clubfoot
- Patients with syndromic clubfoot.
- Patients with clubfoot who have had surgical treatment already before the presentation.

Sample Size Determination

The sample size was calculated using the Leslie-kish formula [17].

$$N = \frac{Z^2 PQ}{D^2}$$

Where

N = sample size

Z = standard normal deviate of 1.96, where the confidence limit is set at 95%.

Q = I-P

D = precision = 0.05

P = proportion of the target population estimated to have a particular characteristic. From a pilot survey done at the institution, 2355 orthopaedic cases presented in 2016 through the outpatient clinic and 82 of them had idiopathic clubfoot. This represents approximately 3.5% of the population of patients that presented in 2016. Therefore P = 3.5%.

$$\text{Hence } N = \frac{(1.96)^2 \times 0.035 \times (1-0.035)}{(0.05)^2} = 51.90$$

Approximately 52.

Thus, the minimum sample size for this study was 52. To allow for study attrition; 10% of sample size was added giving a total of 57 patients. 58 patients were recruited and 3 were lost to follow up.

Method

Patients presented via the clubfoot clinic and their demographic data were obtained. Consecutive patients who met the inclusion criteria were recruited for the study after counselling of parents/guardians and informed consent duly obtained. The Pirani and Dimeglio scores at presentation were obtained according to the scoring systems of Pirani [13] and Dimeglio *et al.*, [14] and recorded appropriately patients were seen weekly until correction was achieved.

The first researcher, did most evaluations and treatments. When not available due to clinical duties, it was done by the second researcher who has been well tutored and interested in the research. Treatment was started immediately after initial assessment at presentation and involved gentle serial manipulations and stretching with the application of corrective cast according to the Ponseti method [18-21]. Weekly appointments were given and the cast was removed in plaster room using a plaster shear for assessment of correction. Treatment was continued weekly until correction of at least 60° of foot abduction (without pronation), and ankle dorsiflexion of 15° or more with a normal shaped foot was achieved without any forceful manipulation. If ankle dorsiflexion obtained was not up to 15° after producing abduction up to at least 60°, a complete percutaneous tenotomy of the Achilles tendon was performed [22]. The foot is corrected at this point and the Pirani and Dimeglio scores were assessed and recorded. The cast, after tenotomy was worn for three weeks. All angles were measured with a standard Goniometer. The total number of casting sessions required to achieve correction was also recorded. The patient was subsequently commenced on foot abduction brace to be worn 23 hours a day for the first three months and after that every night until four years of age.

Data Analysis and Presentation

The Data were analysed by the software IBM SPSS Version 22. Categorical variables were presented as frequencies, while continuous variables were

presented as means (standard deviations). The paired samples t-test was used to analyse the difference between the 65 standardized mean Pirani score and the 65 standardized mean Dimeglio score. Pearson's correlation was used to analyse the relationship between both scoring systems, and also between each scoring system and the total number of casts used for correction. Multiple regression analysis was used to evaluate which of the two scoring systems best predicts the number of casts used for correction. A p-value of less than 0.05 was considered significant.

RESULTS

A total of 58 patients (98 idiopathic clubfeet) satisfied the inclusion criteria and were recruited for the study. Three patients were lost to follow-up leaving the study with 55 patients (94 clubfeet). These 55 patients with 94 clubfeet were successfully corrected. 66 of the 94 clubfeet (70.2%) required a percutaneous Achilles tenotomy. Figure 1; shows gender distribution of the subjects

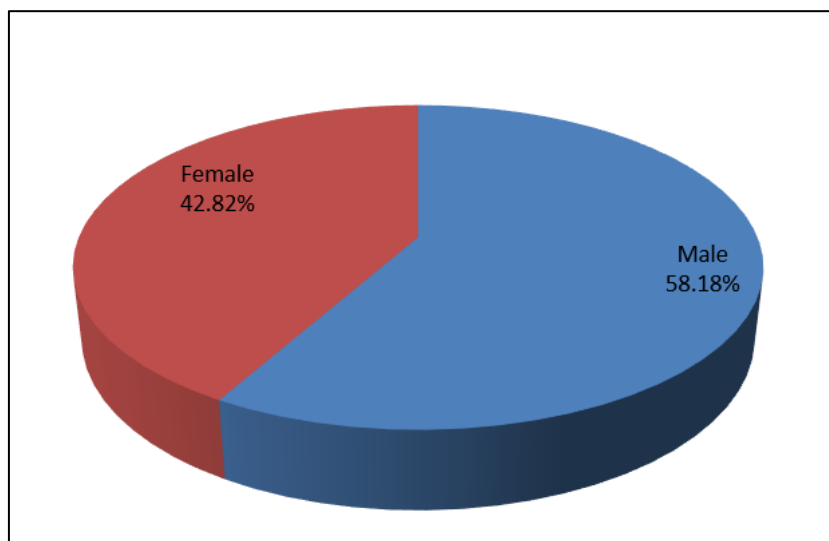


Figure 1: Gender distribution of the subjects

There were 32 males (58.18%) and 23 (42.82%) females that participated in the study.

Table 1: Shows Age Categories of the subjects

<i>Age categories (months)</i>	<i>N</i>	<i>%</i>
0 – 12	38	69.1
13 - 24	10	18.2
25 - 36	5	9.1
37 - 48	2	3.6
Total	55	100

From table 1; 0-12 age group has the highest number of subjects (38), while 37-48 age group has the least number of subjects (2).

Table 2: The frequency of Casting sessions, number of feet and the mean Pirani and Dimeglio scores

<i>Frequency of Casts</i>	<i>No of feet</i>	<i>Mean Pirani score(min-max)</i>	<i>Mean Dimeglio score (min-max)</i>
2	19	2.1 (1.5-3.5)	6.6 (5 – 10)
3	7	2.9 (2 – 4)	9.0 (6 – 14)
4	18	3.7 (3 – 5)	11.3 (9 – 15)
5	23	4.7 (3 – 6)	13.3 (11 – 16)
6	23	5.4 (3.5 – 6)	15.0 (12 – 16)
7	4	5.3 (4.5 – 6)	14.3 (11 – 16)

In table 2; the mean number of casts required for correction was 4.38 (range: 2-7). The number of casts used to achieve correction increases as the Pirani and Dimeglio scores increases.

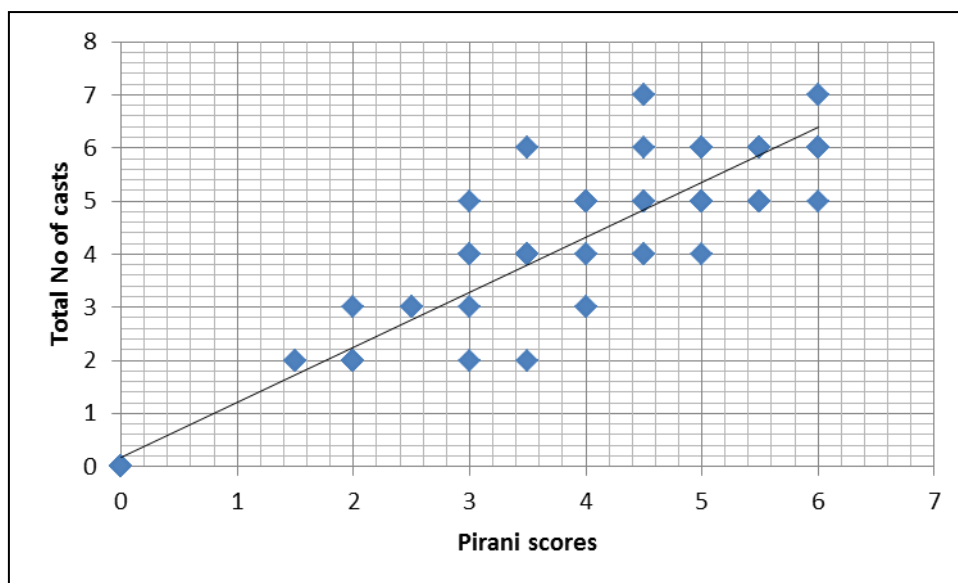


Figure 2: Relationship between initial Pirani scores and the number of casts

In figure 2; the scatter plot showed a positive correlation between the initial Pirani scores and the total

number of casts used in the correction ($r=0.854$, $p<0.001$)

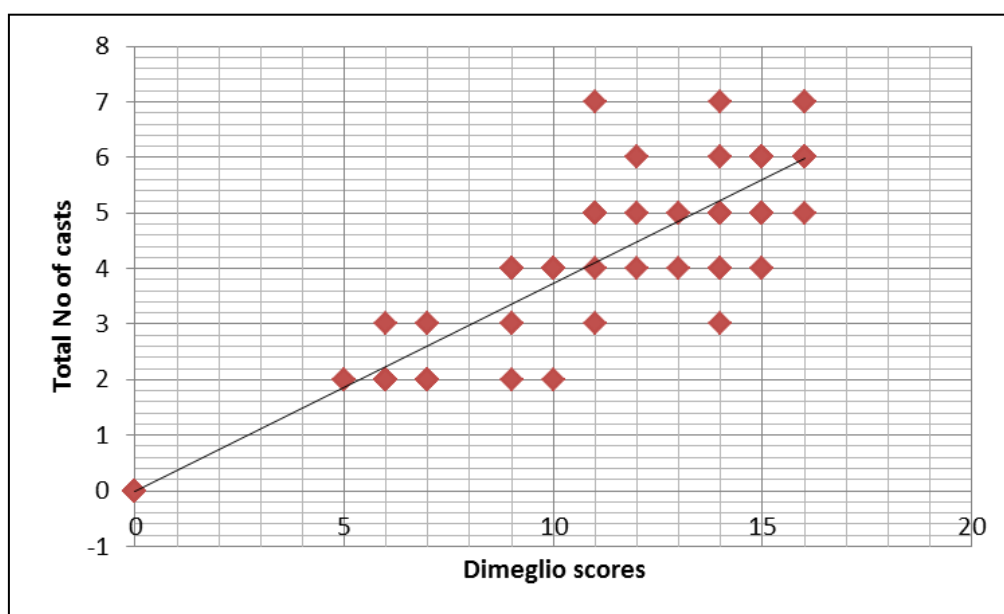


Figure 3: Relationship between the initial Dimeglio scores and the number of casts

In figures 3; The scatter plot showed a positive correlation between the initial Dimeglio scores and the

number of casts used in the correction ($r=0.809$, $p<0.001$).

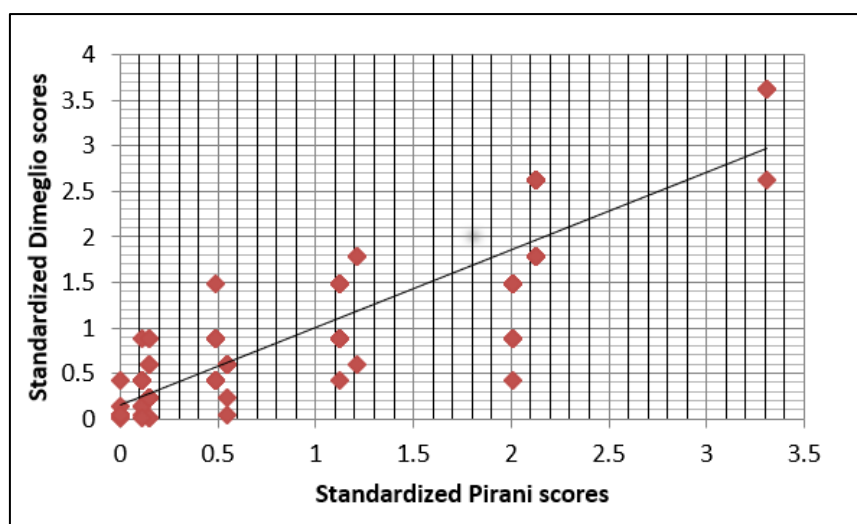
Table 3: The Regression coefficients of the two scoring systems and their confidence intervals

	<i>b</i>	<i>SE_b</i>	<i>t-value</i>	<i>p-value</i>	95% <i>CI</i>
Pirani scores	0.647	0.274	3.709	<0.001*	0.300,0.993
Dimeglio scores	0.134	0.174	1.944	0.055	-0.003,0.270

*= significant value.

CI = Confidence Interval.

In table 3; multiple regression analysis showed that the Pirani scores significantly predicts the total number of casts better than the Dimeglio scores.



Figures 4: The relationship between the Pirani and Dimeglio scoring system at presentation.

In figure 4; the scatter plot shows a positive correlation between the two scoring system at presentation ($r=0.881$, $p<0.001$)

DISCUSSION

The Pirani and Dimeglio scoring systems are the two most widely utilised scoring systems for grading the severity of clubfoot. Both scoring systems have excellent interobserver & intraobserver reliability [24].

This study showed a positive correlation between both scoring systems and the number of casts required to achieve correction, (Pirani: $r=0.854$, $P<0.001$ and Dimeglio $r=0.809$, $P<0.001$). However, the correlation coefficient of the Pirani scoring system was higher than that of the Dimeglio scoring system, a result that is consistent with previous studies [25,26]. This may be because the Dimeglio scoring system, which has a higher number of variables may have some bias [25,26].

The mean number of casts required to achieve correction in this study was 4.38 (range: 2-7). This is similar to the mean value obtained by Dobbs *et al.*, [27], 4.2 (range: 3-7), Lampasi *et al.*, [28], 4.0 (range: 3-7), Sharma *et al.*, [29], 5.1 (range: 3-7) and Chu *et al.*, [4], 5.1(2-8). The tenotomy rate in this study was 70.2% and is similar to that reported by Ponseti, [13] and some other series [14,18,29].

Previous studies have reported variable results in the correlation between the initial Pirani and Dimeglio scores with the number of casts required for clubfoot correction [4,15,16,25-28].

This study found a positive correlation between the initial Pirani score ($r=0.854$, $p<0.001$) and the initial Dimeglio score ($r=0.809$, $p<0.001$) with the number of casts required to achieve correction. This means that as initial Pirani and Dimeglio score increases, the number of casts needed to complete correction also increases.

Similarly, a positive correlation was reported by other studies between the initial Pirani and Dimeglio score and number of casts required to achieve correction [15,28,29].

On the contrary Gao *et al.*, [12], reported a low correlation ($r=0.21$) between the initial Dimeglio score and no correlation ($r=0.12$) between the initial Pirani score and the number of casts required for correction. The difference reported by Gao *et al.*, may be due to the retrospective nature of the research and also incomplete uniformity of treatment and assessment, as the nurses did some evaluation and treatment. In another study, Sinha *et al.*, [30], treated 41 clubfeet in patients aged 1.1 years – 10.3 years, and found that the number of casts required to achieve complete correction had a low negative correlation with initial Pirani score ($r= -0.234$, $P=0.141$) while it has a moderate positive correlation with initial Dimeglio score ($r=0.413$, $P=0.007$). The low negative correlation between the Pirani score and the number of casts reported by Sinha *et al.*, may be as a result of older age group used in their study. Several authors have stated that the Pirani scoring system may be less reliable in the older age group, as the medial and posterior crease gradually disappears as the child grows and the empty heel pad may also decrease with the normal loss of subcutaneous fat as a child grows [27,28].

Multiple linear regression analysis of the two scoring system in this study showed that the Pirani scoring system (95% CI =0.300, 0.993, $P<0.001$) significantly predicts the total number of casts better than Dimeglio scoring system (95% CI = -0.003, 0.270, $P=0.055$).

In conclusion, the Pirani scoring system in this study, was shown to significantly predict the total no of casts required to achieve correction better than the Dimeglio scoring system. Therefore, based on the initial Pirani score, parents can reliably be informed about the

possible number of casting sessions required for correction and duration of treatment.

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APPENDIX I

INFORMED CONSENT

Consent for your child/ward to participate in this study titled “Clinical evaluation of Pirani and Dimeglio scoring systems and their correlation with the Ponseti method of clubfoot treatment.

This study will help in identifying which scoring system that best predicts the number of casts required for correction at the outset of treatment of clubfoot. Your ward’s foot/feet at presentation will be scored using the Pirani and Dimeglio methods before the commencement of treatment and subsequently at each visit.

Your ward/child’s utmost confidentiality will be maintained.

Thanks.

I _____ have been informed about the above subject matter and the details involved and I willingly give consent that my child/ward participate in the research.

Signature of Parent/Guardian

Date

Signature of Investigator

Date

APPENDIX II

DATA PROFORMA

1. DATE: _____
2. NAME (patient with clubfoot) _____
3. AGE: _____ DATE OF BIRTH: _____
4. SEX: _____
5. TRIBE: _____
6. HOSPITAL NO: _____
7. NAME OF PARENT/GUARDIAN: _____
8. PHONE NO: _____
9. ADDRESS: _____
10. SIDE INVOLVED: LEFT _____ RIGHT _____ BOTH _____
11. PIRANI SCORE: AT PRESENTATION: _____
2ND VISIT _____ 3RD VISIT _____
4TH VISIT _____ 5TH VISIT _____
6TH VISIT _____ > 6TH VISIT _____
12. DIMEGLIO SCORE: AT PRESENTATION: _____
2ND VISIT _____ 3RD VISIT _____
4TH VISIT _____ 5TH VISIT _____
6TH VISIT _____ > 6TH VISIT _____
13. NUMBER OF CASTING SESSIONS REQUIRED FOR CORRECTION _____
14. PIRANI SCORE AT END OF CORRECTION _____
15. DIMEGLIO SCORE AT END OF CORRECTION _____
16. ANY ACHILLES TENOTOMY DONE? YES _____

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