

To Evaluate the Role of Pirani Score in Deformity Assessment and Management of Club Foot by Ponseti Method – A Hospital Based Prospective Study from Tirupati

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ABSTRACT

BACKGROUND

Pirani scoring system is one of the classification systems in management of club foot which is simple and easy to use. However, there is paucity of studies using Pirani system to determine the severity and monitor progress in the treatment of club foot. We therefore set out with the aim of assessing severity and monitoring the progress of treatment using the Pirani scoring system. The Pirani scoring system, together with the Ponseti method of club foot management, was assessed for its predictive value.

METHODS

It was a hospital-based prospective study of 57 club foot in 41 patients designed to evaluate the role of Pirani score in deformity assessment and management of club foot by Ponseti method. Consecutive patients presenting at the outpatient department at SVRRGGH, Tirupati with idiopathic club foot, and in-patients department with idiopathic club foot were recruited into the study. Informed consent was obtained from parents/guardians of the patients that were recruited in the study. This was a prerequisite for obtaining the ethical approval. Data collected from the study groups was entered into a worksheet, and analysis was performed using the statistical package for social sciences (SPSS) software for windows version 21. Significant statistical inferences were drawn at $p < 0.05$.

RESULTS

The correlation between the midfoot score, hindfoot score, Pirani score and the number of casts to achieve correction was significant ($P = 0.001$). Also, there was correlation between the Pirani score and the need for tenotomy ($P = 0.001$); between the number of casts to achieve correction and the need for tenotomy ($P = 0.001$). Moreover, the progress of treatment can be monitored with the Pirani score ($P = 0.001$).

CONCLUSIONS

Pirani scoring system is a simple, easy, quick and reliable system to determine severity and monitor progress in the treatment of club foot with excellent interobserver variability.

KEYWORDS

Pirani Score, Club Foot, Ponseti Method

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BACKGROUND

The human foot is unique, unlike any other foot in the animal kingdom. It is one of the most distinguished parts of man's whole anatomical make up. Such structural alterations have become a necessity for him to attain a biped posture. Such a foot is deformed inefficient, producing an awkward gait. Club foot is a common structural malformation, occurring in approximately 1 / 1000 live births¹ (eighty percent of the cases occurring in developing countries). Most are untreated or poorly treated. Untreated club foot causes crushing physical, social, psychological, and financial burdens on the patients, their families, and the society. Worldwide, neglected club foot is the most severe cause of physical disability among congenital musculoskeletal defects.

From the time of Hippocrates until today, the orthopaedics are constantly confronted with new techniques and operations in its management. It requires a thorough selection of cases and the use of an appropriate method of treatment. We have passed through the phase of vigorous manipulation to microsurgical operative techniques and correction by external fixator.

Ponseti has developed a manipulation and casting technique for the correction of club foot. The Ponseti has described this in the early 1960s, but it is only in the last decade that its benefits in the initial treatment of club foot deformity have been highlighted. Ponseti method has become an ideal non-invasive treatment option for correcting the club foot deformity in the current era.

There are different classification systems used to determine the severity and outcome of treatment, such as DiMeglio/Bensahel classification system^{2,3} Catterall/Pirani classification system,⁴ Ponseti, and Smoley classification system,^{4,5} Harrold and Walker classification system⁶ and the International Club Foot Study Group 13.

Out of these systems, the commonly used ones are the DiMeglio/Bensahel and the Catterall/Pirani systems.⁴ Between the two, the Pirani scoring system is a simple and easy method to determine the severity and monitor the progress of treatment of club foot.

This dissertation consists of a study of the role of Pirani score in deformity assessment and management of club foot by Ponseti method.

Objectives

1. To assess the deformity of club foot by using the Pirani score.
2. To evaluate the role of Pirani score in the management of club foot by Ponseti method.

METHODS

It was a hospital-based prospective study designed to evaluate the role of Pirani score in deformity assessment and management of club foot by Ponseti method. The study was conducted at the Department of Orthopaedics, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India, from November 2018 to November 2019. Consecutive

patients presenting at the outpatient department at SVRRGGH, Tirupati with idiopathic club foot, and in-patients department with idiopathic club foot were recruited into the study.

Inclusion Criteria

1. Neonates and infants diagnosed as idiopathic club foot at birth.
2. Unilateral idiopathic club foot.
3. Bilateral idiopathic club foot.
4. Patients with their parents giving written informed consent for management and regular follow up.

Exclusion Criteria

1. Patients with a neglected club foot.
2. Patients with a secondary club foot.
3. Patients with atypical and complex club foot.
4. Patients who have not given informed consent.

Ethical Clearance

Ethical clearance has been obtained from the ethical clearance committee of SVMC, Tirupathi. Informed consent was obtained from the parent/guardian. Patient & # 39; s bio-data, clinical examination, and Pirani score at presentation were entered into a structured information sheet.

Corrective serial casts were applied after carrying out manipulations for three minutes, according to the Ponseti method, these castings were done by consultants, senior residents and junior residents in the department that are experienced in Ponseti method of club foot management. The ligaments, joint capsules, and tendons were stretched with gentle manipulations. And above-knee cast with knee in 90-degree flexion was applied after each session to retain the degree of correction obtained and to soften the ligaments. As a result of these, the displaced bones were gradually brought into the correct alignment. Serial manipulation and above-knee cast was continued until 50° – 70° abduction was achieved. The last cast was to correct the equinus, and if ≥ 15° dorsiflexion was achieved, the cast was applied for three weeks, after which the patient had foot abduction brace. However, if the dorsiflexion was less than 15°, the patient then had tendo-Achilles tenotomy to achieve at least 15° of dorsiflexion, thereafter, the patient had cast for three weeks, following which foot abduction brace to retain the correction was applied, after removal of cast.

Patients were made to wear the brace for about 23 hours a day for the first three months after achieving correction, and thereafter, the braces were worn at nights till the patient attains age 4. The Pirani scores of the patients were monitored at the time of presentation and at each weekly visit for correction. Severity in this study was determined based on the number of casting sessions. Mild cases according to this table had less than or equal to 5 casting sessions with or without tenotomy; moderate cases had more than five casting sessions and less than 8 with or

without tenotomy, severe case had more than or equal to 8 casts with or without tenotomy.

Statistical Analysis

The data that were collected included the name, age, sex, initial Pirani scores, number of casting sessions, the need for tenotomy, and Pirani scores at full correction. Data collected from the study groups was entered into a worksheet, and analysis was performed using the statistical package for social sciences (SPSS) software for windows version 21. Frequency distribution for the variables was presented in tables and charts, and significant statistical deductions were made at p & lt ; 0.05. Analysis of variance (ANOVA) is used to compare means in various severity groups in order to know which component of the score best predicts severity. Pearson correlation coefficient was also used to compare mid foot, hind foot, and Pirani scores with the number of casts to achieve correction.

Severity	No. of Casts
Mild	Less than or equal to 5
Moderate	More than five and less than 8
Severe	More than 8

Table 1. Severity of the Deformity Based on Number of Casts

RESULTS

Forty-one patients comprising of thirty-one males (75.6 %) and ten females (24.4 %) with a sex ratio of 3.1 : 1 were included in the study. 6.4 weeks was the median age (range: 1 week - 104 weeks). 30 (73.17 %) patients were below six months of age. 5 (12.19 %) patients were between the age of 7 months to 12 months. 6 (14.63 %) patients were above 1 year of age. Sixteen patients (39.1 %) had bilateral club foot (32 feet) while twenty-five (60.9 %) had unilateral club foot (25 feet). Among the twenty-five unilateral club foot, eleven patients (44 %) were left-sided while the remaining fourteen (56 %) were right-sided. The numbers of club foot managed in these forty-one patients were fifty-seven. Fifty feet (87.7 %) had tenotomy, while seven (12.3 %) feet did not have tenotomy.

Initial Pirani Score (average)

- The average initial Pirani score of the children within six months was 5.333
- The average initial Pirani score of the children from 7 to 12 months was 5.80
- The average initial Pirani score of the children > 1 year was 6.000
- The total average initial Pirani score of the children was 5.488

Final Pirani Score (average)

- The average final Pirani score of the children within six months was 0.450
- The average final Pirani score of the children from 7 to 12 months was 0.600

- The average final Pirani score of the children > 1 year was 0.917
- The total average final Pirani score of the children was 0.537

Average Number of Casts

- The average number of casts for the children within six months was 5.767
- The average number of casts for the children from 7 to 12 months was 6.400
- The average number of casts for the children > 1 year was 8.833
- The total average number of casts for the children was 6.293

The mean number of casting sessions was 6.1 ± 1.21. The mean of the mid-foot score, hind-foot score, and the Pirani score at presentations are 2.719 (0.341), 2.70 (0.339), and 5.421 (0.639).

There was a significant statistical association between the Pirani, mid-foot, and hind-foot scores at presentation and the number of casting sessions patients had (P < 0.001).

In order to assess for the statistical significance of whether the Pirani score can be used to monitor the progress of treatment of club foot using Ponseti protocol, paired T-test was used to compare-

- The Pirani scores at presentation and Pirani scores at a full correction on the one hand.
- The Pirani scores at presentation and whether or not the patient had tenotomy.

This was found to be statistically significant, which means that the progress of treatment of club foot and whether or not the patient will need tenotomy can be assessed using the Pirani scoring system (P < 0.001).

Variable	Mean (SD)
No. of casts to achieve correction	6.105 (1.205)
Mid-foot score at presentation	2.719 (0.341)
Hind-foot score at presentation	2.702 (0.339)
Pirani score at presentation	5.421 (0.639)

Table 2. Demographic Characteristics of Patients and the Number of Casts to Achieve Correction, the Mid Foot Scores, the Hind Foot Scores and the Pirani Scores of the 57 Feet Examined

The mean Pirani score for club foot that had tenotomy at presentation was 5.60 ± 0.440 while that for the feet that did not have tenotomy was 4.143 ± 0.244. This was statistically significant. (t – Value = 8.529; P < 0.001; 95 % C.I. = 1.114 - 1.799)

No. of Cast	N	Initial Pirani Score	Final Pirani Score	Mean Difference	t - value (P - value)	Significance
Mild	12	4.50 ± 0.48	0.21 ± 0.26	2.24	30.178 * (0.000)	P < 0.001 (significant)
Moderate	39	5.62 ± 0.42	0.53 ± 0.11	5.09	73.214 * (0.000)	P < 0.001 (significant)
Severe	6	6.00 ± 0.00	0.92 ± 0.49	5.08	25.394 * (0.000)	P < 0.001 (significant)

Table 3. Correlation between Mild, Moderate and Severe Deformity with Initial and Final Pirani Scores

**significant at 0.01 level; (P & lt ; 0.001) Highly significant

	N	Mean ± S. D	Std. Error Mean	t- Value	Significance
Initial Pirani score	57	5.421 ± .639	.0847	73.280 (0.000)	P < 0.001 significant
Final Pirani score	57	.500 ± .283	.0376	73.280 (0.000)	P < 0.001 significant

Table 4. Correlation between Initial Pirani Score and Final Pirani Score

The mean of initial and final Pirani score is 73.280 with a P value of 0.000, which is less than 0.01; hence, they are highly significant.

Categories	N	Mean (S.D)	Correlation (r) (P-Value)	Significance
Mid foot score	Mild	12 4.67 (0.49)	0.707 (0.000)	P < 0.001** significant
	Moderate	39 6.13 (0.34)		
	Severe	6 8.83 (0.98)		
	Total	57 6.11 (1.21)		
Hind foot score	Mild	12 4.67 (0.49)	0.711** (0.000)	P < 0.001** significant
	Moderate	39 6.13 (0.34)		
	Severe	6 8.83 (0.98)		
	Total	57 6.11 (1.21)		
Pirani score	Mild	12 4.67 (0.49)	0.754** (0.000)	P < 0.001** significant
	Moderate	39 6.13 (0.34)		
	Severe	6 8.83 (0.98)		
	Total	57 6.11 (1.21)		

Table 5. Correlation between Number of Casts to Achieve Correction Versus the Midfoot, Hindfoot and the Pirani Scores

DISCUSSION

Club foot is a common musculoskeletal deformity in our environment,⁷ and Ponseti treatment protocol is the current standard of care globally.⁸ The age range of the forty-one patients studied was 1 to 104 weeks, with a median age of 6.4 weeks. Comparable with the mean age at initial presentation of 6.7 weeks of the study of Sharma A, et al.⁹ This is rather late when compared with figures obtained by workers in developed world such as Zimmerman et al.¹⁰ and Brewster et al.¹¹ Late presentation as seen in our study may be due to lack of awareness among the parents, low socioeconomic status and ignorance regarding the club foot. Some parents thought that the deformity could improve with age, and some patients also had a native bandage for correction. This age disparity at tenotomy was also noted by Adegbehingbe et al.¹² and Goksan et al. The average age of the child at presentation were 10.3 months (range, two weeks to 110 months). In the study of Anil Agarwal & Neeraj Gupta. There is male preponderance with male to female ratio of 3.1 : 1; this is similar to findings by other researchers Pavone V et al.⁴ Lavy CB, Mannion SJ et al.¹³ Ford-Powell VA.¹⁴ Among the 57 patients studied, 39.02 % of the patients had bilateral club foot, while the remaining 60.09 % were unilateral with 44 % on left side and 56 % on right side. similar to the preponderance of unilateral club foot as documented by Ponseti, Matuszewski and Adewole et al. in their studies at different point in time.^{15,16} while in the study of Awang et al. it is opposite to the study where bilateral club foot is more.¹⁷

In our study, 12 feet were in the mild, 34 feet in moderate and 11 feet in the severe group according to the classification earlier stated. Wang et al. in their study in 2009, classify club foot into mild, moderate, and severe based solely on the Pirani score with the highest number in the moderate group similar to the finding in this study.¹⁸

However, Harrold, in 1983 with similar classification, had the highest number in the mild group.¹⁹ In addition to this, 57 feet had Ponseti treatment in this study, 87.7 % of them had tenotomy while 12.3 % did not have tenotomy. Badmus Hakeem David, Adegbehingbe et al.²⁰ in their study, 45 % had tenotomy. P. J. Dyer, N. Davis,²¹ in their study, 60 % had tenotomy. Lebel et al.²² in their study on 56 babies, 73 % of them had percutaneous tenotomy might be due to less initial Pirani score. Of the two groups studied by Xu in Beijing, 87.5 % of each of the groups had tenotomy.²³ In contrast to this, Tindall et al. in their study done in Blantyre, 57 of the 98 feet corrected using the Ponseti treatment protocol did not require tenotomy.²⁴ It should be noted that percutaneous tenotomy could be used to determine the severity of club foot.²⁵

Categories	Variables	N	Mean ± S.D.	P - Value
Pirani score	At presentation	57	5.421 ± 0.639	73.280** (0.000)
	At correction	57	0.500 ± 0.283	
Pirani score	Had tenotomy	50	5.600 ± 0.440	8.529** (0.000)
	Did not had tenotomy	7	4.143 ± 0.244	

Table 6. Association between the Pirani Score at Presentation / Pirani Score at Correction and Pirani Score at Presentation / the Need for Tenotomy

*Paired T-test **significant at 0.01 level (P < 0.001)

Categories	Variables	N	Mean of the Initial Pirani Score (SD)	P Value <
Pirani score	Mild	12	4.500 ± 0.477	0.001
	Moderate	39	5.615 ± 0.421	
	Severe	6	6.000 ± .001	
Number of casts	Mild	12	4.67 ± 0.49	0.001
	Moderate	39	6.13 ± 0.34	
	Severe	6	8.83 ± 0.98	

Table 7. Severity of Club Foot Versus Mean Pirani Score

The average Pirani score for the feet that had tenotomy was 5.60 ± 0.44, which was higher than 4.143 ± 0.244 for the feet that did not have tenotomy. This was similar to the average Pirani score reported by Dyer et al. in their study on the role of the Pirani scoring system in the management of club foot by the Ponseti method done in 2006. Singh in 2009 found a positive correlation between the initial Pirani score and the need for tenotomy.²⁶ In another study by Scher et al. 85.2 % of the patients had a Pirani score of ≥ 5 had tenotomy. Moreover, those that underwent tenotomy required significantly more casts.²⁷ This proves that severe club foot (as predicted by higher Pirani score) may need tenotomy. Hence, both the managing team and the parents of the patient may be better prepared.

The mean number of casting sessions for the affected feet was 6.11 ± 1.21. Pulak et al.²⁵ in Ethiopia 2012 found an average number of casting sessions of 4.9, Awang et al.¹⁷ had an average of 5.2 casting sessions and Laaveg et al.²⁸ in 1980, in the USA had a mean number of casts of 7.

Comparing the initial mid foot scores, hind foot scores, Pirani scores and the number of casts needed to achieve correction, the correlation between the parameters was significant, this implies that the higher the mid foot, hind foot and Pirani scores, the more the number of casting sessions needed by the patient to achieve correction. Since the Pirani score is made up of the summation of mid foot and hind foot scores, this observed positive correlation, which is a directly proportional relationship, is not unexpected. Agarwal et al.²⁹ in 2014 showed a positive

correlation between the initial Pirani scores and the number of casts to achieve full correction in 297 patients with 442 clubfeet. Awang et al.²⁶ in 2014 studied the effect of age, weight, and initial Pirani score on the number of casts needed for full correction and came out with the conclusion that the Pirani score was the only significant predictor among the parameters studied. Some other authors showed the effect of the mid foot, hind foot, and initial Pirani score on the rate at which full correction was achieved.³⁰⁻³² However, Gao et al.³² and Chu et al.⁴ showed no correlation between the Pirani score and the number of casts to achieve correction in the club foot patients treated. Moreover, monitoring the progress of treatment of club foot using the Ponseti protocol employed the paired t-test to compare the initial Pirani scores and the Pirani scores at a full correction on the one hand and the initial Pirani scores and whether or not the patient had tenotomy.

This showed statistical significance, which implies that the Pirani score can be used to monitor the progress of the treatment of club foot using the Ponseti protocol. Pulak et al. in 2012 found out that there was a significant difference between the pre-treatment Pirani scores and the post-treatment Pirani scores in the 40 patients they treated in Ethiopia with the Ponseti method.²⁵ Moreover, Faizan et al.³³ in 2015 showed statistical significance between the pre and post-treatment Pirani scores among 19 patients with 28 clubfeet. Some authors also showed a statistically significant effect of the severity of club foot on the need for tenotomy.^{25,27,25} It was noted that the severity of the club foot determines the number of casts needed to achieve full correction. Mild club foot had fewer numbers of casts than moderate, which also had fewer numbers of casts compared to the severe club foot. The statistical test showed that this is significant. Wang et al.¹⁸ in 2009 showed significant difference in the number of casts to achieve correction in the three groups of mild, moderate, and severe club foot deformities they studied.

This study is one of the few studies assessing the severity of club foot and monitoring progress of treatment using Pirani scoring system done in the developing world. However, it would have been better to have higher sample size than this.

CONCLUSIONS

Congenital idiopathic club foot is a common congenital deformity and a major cause for concern to parents. It is treated by widely accepted Ponseti method as the initial treatment option for club foot. Deformity correction was achieved in all cases by Ponseti method in our study. In our study, club foot was commonly seen in males and more on right side. Unilateral cases were more common than bilateral cases. Delayed presentation was common due lack of awareness in parents, ignorance, and low socio-economic status. At the time of presentation parents need counselling and guidance regarding the treatment protocol, deformity, duration of treatment in cast and requirement of tenotomy. This counselling is necessary to lessen the anxiety of parents. This is achieved by simple and reliable Pirani score.

Pirani score can assess the severity of various components of deformity and useful in monitoring the progress of correction of deformity by Ponseti method. Low Pirani score at presentation were associated with less deformity and were corrected early with a smaller number of casts. Decrease in the total Pirani score during the course of treatment by weekly follow up was associated with gradual correction of deformity.

In our study, high Pirani score at presentation was seen in severe deformity. These cases required a greater number of casts for correction and longer duration of treatment. Our study has shown that high initial Pirani score was associated with tenotomy at the end of cast correction. The present study has its limitations like small sample, short duration of follow-up and including only idiopathic cases of club foot. We conclude that high initial Pirani score at presentation can assess the various components of deformity, number of casts, duration of treatment and need for tenotomy. Decrease in the Pirani score at follow up was seen with correction of deformity. Pirani score is useful in deformity assessment and monitoring the progress of treatment by Ponseti method on idiopathic club foot.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

Financial or other competing interests: None.

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