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Original Research Article

Correlation of Initial Pirani Score on The Predictability of Tendo Achilles Tenotomy in Non-Syndromic Congenital Talipes Equino Varus in Early Presentation

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Conflict of interest: Nil

Abstract:

Background: Clubfoot (congenital talipes equinovarus, CTEV) is a common congenital deformity. The Pirani scoring system is widely used to assess deformity severity and monitor treatment response, while the Ponseti method is the standard treatment.

Aim: To determine whether the initial Pirani score predicts the number of casts required and the need for tendo Achilles tenotomy in early-presenting, non-syndromic CTEV.

Methods: This prospective observational cohort study was conducted at Department of Orthopaedics, Mata Gujri Memorial Medical College & Lions seva Kendra Hospital, Kishanganj, Bihar, India from October 2019 to March 2021. Fifty-five neonates (92 affected feet) under three months of age with idiopathic, non-syndromic CTEV were included. All feet were treated using the Ponseti technique. Initial Pirani scores, number of casts, and requirement of tenotomy were recorded. Statistical analysis was performed using SPSS version 21.0 with unpaired t-test and Pearson correlation coefficient; $p<0.05$ was considered significant.

Results: The mean age at presentation was 47.8±20.8 days; 69.1% were male and 67.3% had bilateral involvement. Of 92 feet, 71 (77.2%) required tendo Achilles tenotomy. Mean hindfoot, midfoot, and total Pirani scores were 2.47±0.50, 2.04±0.43, and 4.52±0.90, respectively. Feet requiring tenotomy had significantly higher Pirani scores and required more casts (5.85±0.81 vs 3.66±0.57; $p=0.021$). A strong positive correlation was found between initial Pirani score and number of casts ($r=0.677$, $p<0.0001$).

Conclusion: The initial Pirani score reliably predicts both the need for tendo Achilles tenotomy and the number of casts in early-presenting non-syndromic CTEV treated with the Ponseti method.

Keywords: Congenital talipes equinovarus, clubfoot, Pirani score, Ponseti method, tendo Achilles tenotomy, idiopathic clubfoot.

Introduction

Clubfoot, also known as congenital talipes equinovarus (CTEV), is a common paediatric ailment that affects 1-2 out of every 1000 newborns [1]. With outstanding long-term outcomes (up to 30 years), the Ponseti technique is the most widely used non-surgical treatment for idiopathic clubfoot [2].

A straightforward scoring method with strong interobserver reliability was created by Pirani et al**.** There are six clinical components to it. Each foot receives a score of 0–3 for the middle and hind feet, respectively, for a total of 0–6 points. Each component is evaluated 0 for no abnormalities, 0.5 for mild to moderate abnormality, and 1 for severe abnormality in maximum stretched position based on the degree of abnormality [3, 4].

The DiMeglio classification is another widely used classification for clubfoot [5]. The necessity for major foot surgery was greatly decreased by the Ponseti procedure [6]. Compared to other conventional methods, it offers noticeably better short- and long-term foot alignment [7].

The forefoot gradually corrects with each treatment. The hind foot equinus is more difficult to treat with manipulation because tendons, especially the tendo Achilles (TA), have a lower stretchability than ligaments. TA tenotomy is necessary in many CTEV patients. Pirani score provides sufficient predictability of the number of manipulations, the necessity of TA tenotomy, and the treatment's ultimate result [8].

Over 180 years have passed since the pathological anatomy of idiopathic clubfoot was initially characterized. When Scarpa initially reported the morbid anatomy in 1818, he proposed that the talus's osseous abnormalities were the main reason, with the other tarsal bones around the talus being the secondary cause. There have also been reports of muscle anomalies alone or as a subsequent cause of bone malformations. The pathophysiology and etiology of clubfoot in fetuses and babies have been the subject of several outstanding investigations based on gross anatomy, computed tomography, and microscopy [9,10].

Seven idiopathic clubfeet have been dissected in an effort to determine novel findings and explain the genesis of this illness, as well as to identify the osseous and cartilaginous deformities and assess the anomalies of clubfoot macroscopically.

To assess tibiofibular torsion, we quantified the angle between a wire positioned transversely across the tibial condyles and another wire across both malleoli. The tibiofibular torsion in both normal feet and benign clubfeet varied from 20° to 23°. In cases with severe and very severe clubfoot, the angle of the talus was seen to range from 12° to 18°.

In benign clubfoot, the talus was positioned in the ankle joint almost in a neutral position; the plantar flexion reduced as the clubfoot's severity increased and peaked at grade IV. The trochlea's longitudinal axis and the neck's medial and downward shift generated an angle α in the horizontal plane. Our clubfeet's angle α varied from 37° to 41° in grades I–IV. The two normal feet had angles of 33° at week 27 and 27° at week 36.

The torsion of the first and second metatarsals did not differ between normal feet and club feet. In specimens three through seven (grade III and IV), the angle between the long axes of metatarsus I and II varied from 16° to 20°. It measured 6° and 8° in the two typical feet. There are 26 bones in the foot. The Talus, Calcaneus, and Navicular are the most pertinent for this congenital malformation. The best way to understand the underlying malformation of clubfoot is to break it down into four parts, which are represented by the initial letters of the word CAVE. Cavus, Adductus, Varus, and Equinus are these parts. Midfoot is affected by the Cavus and Adductus deformities, whereas hindfoot is affected by the Varus and Equinus malformations [11].

The initial component of the clubfoot deformity is a cavus in the midfoot. The foot's arch is higher than usual.due to the first metatarsal being plantarflexed with respect to the hindfoot and calcaneum [11].

Equinus refers to an increase in the foot's plantarflexion. With respect to the tibia, the entire foot points downward. Thus, the fourth component of the clubfoot deformity is the equinus of the hindfoot [11].

This study examines the relationship between the initial Pirani score and the number of manipulations, the need for TA tenotomies, and the end result, including recurrence, in the population of eastern Bihar, India.

Methodology

Study Design: The Department of Orthopaedics, Mata Gujri Memorial Medical College & Lions seva Kendra Hospital, Kishanganj, Bihar, India

Study Period: The study was conducted from October 2019 to March 2021, a span of eighteen months.

Study Population: During the trial period, all consecutive patients who visited the Orthopaedics outpatient department with congenital talipes equinovarus (CTEV) were assessed for eligibility.

Sample Size: The study included 55 patients who met the inclusion and exclusion criteria. When bilateral involvement occurred, each foot was assessed and, if necessary, examined independently.

Inclusion Criteria

- Idiopathic CTEV, either unilateral or bilateral
- Cases that are not syndromic
- The patient's age upon presentation, ranging from birth to three months
- Patients for whom treatment and follow-up were approved by their parents or guardians

Exclusion Criteria

- Clubfoot syndrome
- Cases of relapse
- Cases that were previously handled outside of the study procedure

Study Tools and Materials

- Bandages made of plaster of Paris (POP)
- Rolls of cotton
- Saw for cutting plaster
- Facilities for a small operating room
- Common clinical examination instruments
- MGM Medical College (MGMMC) amenities

Clinical Evaluation: The Pirani scoring method was used to clinically assess each patient at presentation and at weekly follow-up visits.

The baby was evaluated in a supine posture, ideally when eating and comfortable.

Pirani Scoring System: The Pirani score consists of six clinical signs, each graded as:

- 0 – no deformity
- 0.5 – moderate deformity
- 1 – severe deformity

These are grouped into:

- **Hindfoot Contracture Score (HFCS):**
  - Posterior crease (PC)
  - Empty heel (EH)
  - Rigid equinus (RE)

Possible HFCS range: 0–3

- **Midfoot Contracture Score (MFCS):**
  - Curvature of lateral border (CLB)
  - Medial crease (MC)
  - Lateral head of talus palpability (LHT)

Possible MFCS range: 0–3

The total Pirani score ranged from 0 to 6, with higher scores indicating more severe deformity.

Treatment Protocol: The Ponseti technique was used to care for every patient. Every week, serial correction castings were placed. Cavus, adduction, varus, and equinus abnormalities were corrected one after the other.

Tenotomy: The degree of ankle dorsiflexion was measured following the treatment of forefoot abnormalities. According to normal Ponseti procedure, a percutaneous tendo Achilles tenotomy was carried out when ankle dorsiflexion was less than thirty degrees.

Outcome Measures

- Initial Pirani score
- Need for tenotomy
- Number of cast members required
- Final correction achieved

Data Collection: Age upon presentation, sex, laterality, side involved, and family history were among the demographic factors noted. Pirani scores, the quantity of casts, and the need for tenotomies were among the clinical factors.

Statistical Analysis: After being properly coded and verified for accuracy and completeness, the data was imported into the Statistical Package for the Social Sciences (SPSS), version 21.0, for statistical analysis. Frequencies and percentages were used to summarize categorical variables, while mean ± standard deviation was used to represent continuous variables. The unpaired t test was used to compare continuous variables between groups. The Pearson correlation coefficient was used to assess the association between the Pirani score and the number of casts needed. Statistical significance was defined as a p value of less than 0.05.

Ethical consideration: The Institutional Ethics Committee of Department of Orthopaedics, Mata Gujri Memorial Medical College & Lions seva Kendra Hospital, Kishanganj, Bihar,India, granted ethical approval. All participants' parents or legal guardians provided written informed permission. Throughout the trial, patient anonymity was upheld, and there was no danger beyond usual care".

Result

Table 1 delineates the age distribution of the research participants. In the current study, participants were under 3 months of age. In the current study, the majority of cases were aged between 31 and 60 days (47.3%), followed by 29.1% of patients aged 0 to 30 days, and 23.6% aged between 61 and 90 days. The average age of the research participants was 47.8 ±20.81 days.

Table 1: Age Distribution

Age Group (days)	Frequency	Percentage (%)
0–30	16	29.1
31–60	26	47.3
61–90	13	23.6
Total	**55**	**100**
Mean Age	47.8 ± 20.81 days	

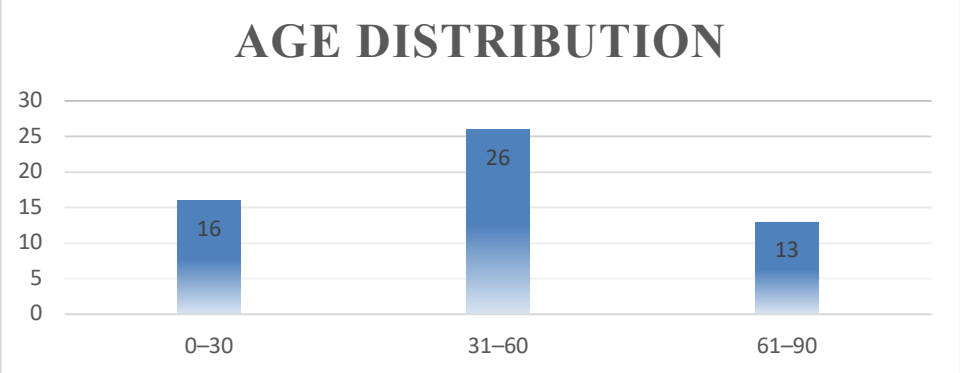

Figure 1: Age Distribution

In the current study, there was a male majority of 69.1% (38) and 30.9% (17) female patients. The data is shown in Table 2.

Table 2: Sex Distribution		
Sex	**Frequency**	**Percentage (%)**
Male	38	69.1
Female	17	30.9
Total	**55**	**100**

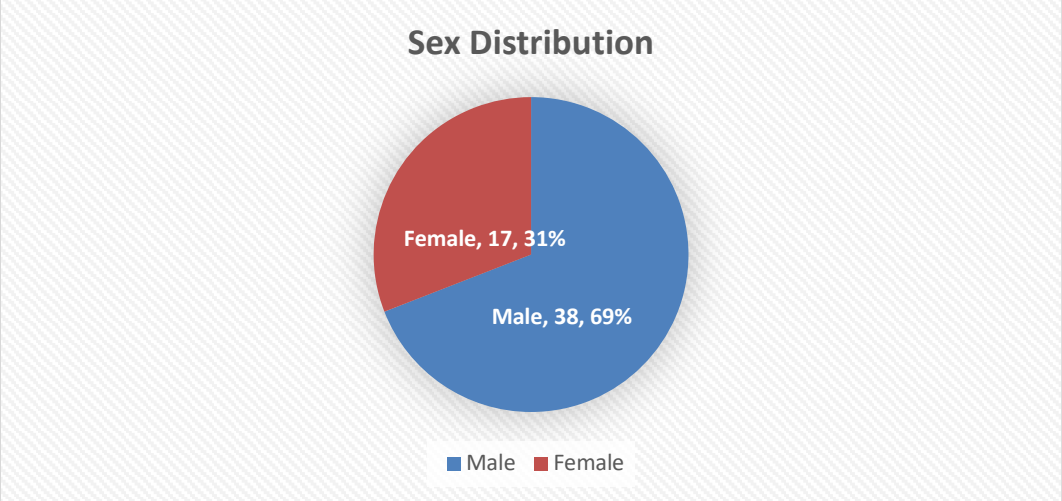

Figure 2: Sex Distribution

In the current study, of the 55 instances, 37 (67.3%) exhibited bilateral involvement, whereas 18 (32.7%) showed unilateral involvement. The data is shown in Table 3.

Table 3: Laterality		
Laterality	**Frequency**	**Percentage (%)**
Unilateral	18	32.7
Bilateral	37	67.3
Total	**55**	**100**

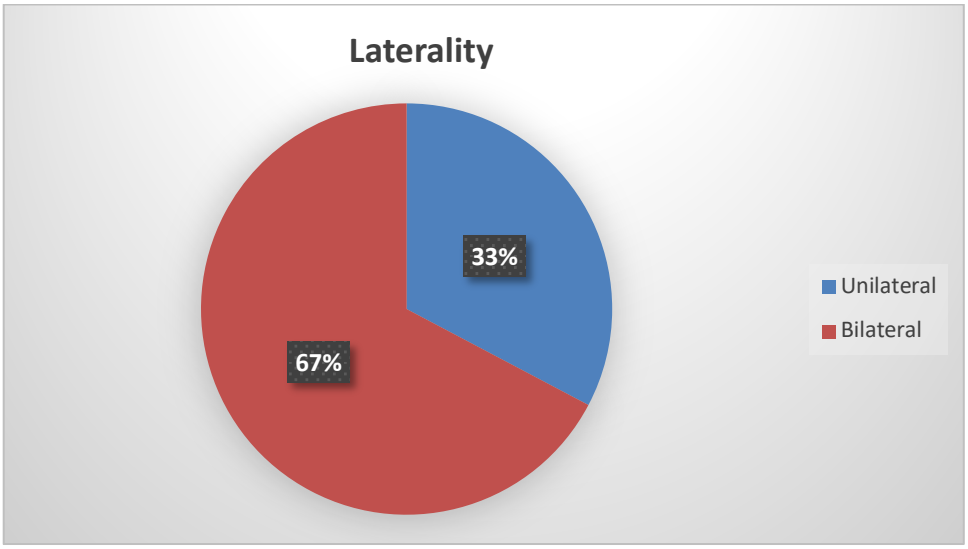

Figure 3: Laterality

The current investigation comprised 92 feet in total. Of the 92 feet, 51.1% (47) included the right side, while 48.9% (45) involved the left. Table 4 displays the data.

Table 4: Side of Involvement (n=92)		
Side	**Frequency**	**Percentage (%)**
Right	47	51.1
Left	45	48.9
Total	**92**	**100**

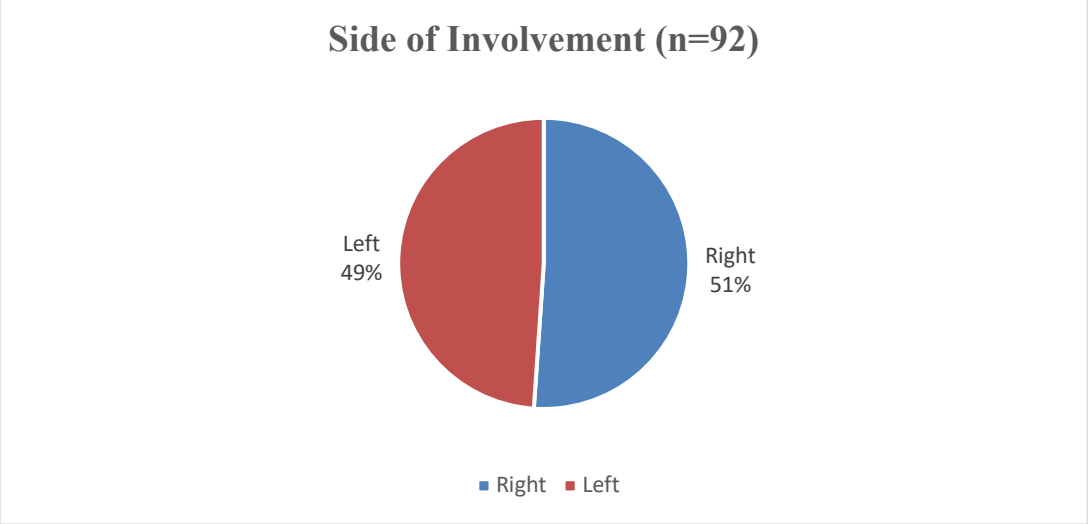

Figure 4: Side of Involvement

In 12.7% (7) of the patients, there was a positive family history of congenital talipes equino-varus (CTEV). Table 5 has data.

Table 5: Family History of Congenital talipes equino-varus (CTEV)		
Family History	**Frequency**	**Percentage (%)**
Yes	7	12.7
No	48	87.3
Total	**55**	**100**

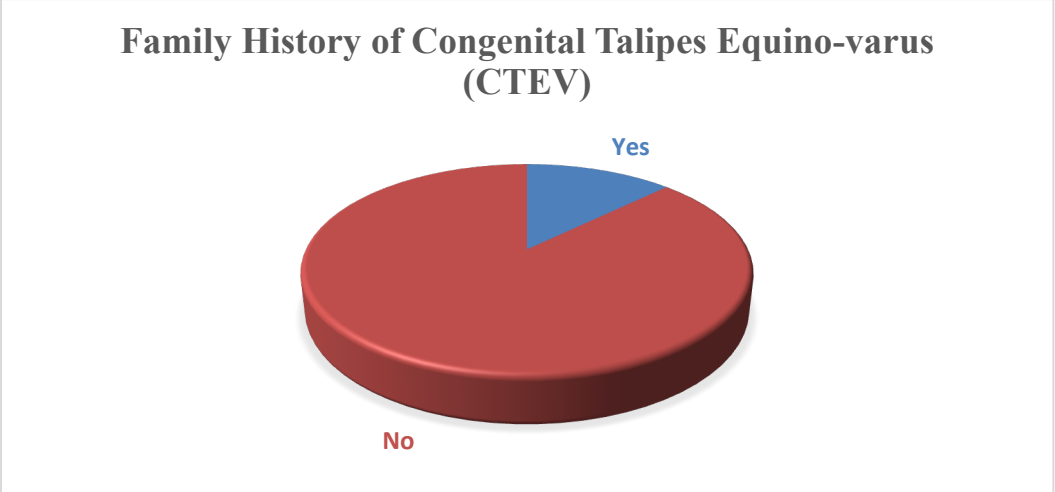

Figure 5: Family History of Congenital talipes equino-varus (CTEV)

71 (77.2%) of the 92 feet with congenital talipes equino-varus (CTEV) required tenotomy. Table 6 displays the data.

Table 6: Incidence of Tenotomy		
Tenotomy	**Frequency**	**Percentage (%)**
Yes	71	77.2
No	21	22.8
Total	**92**	**100**

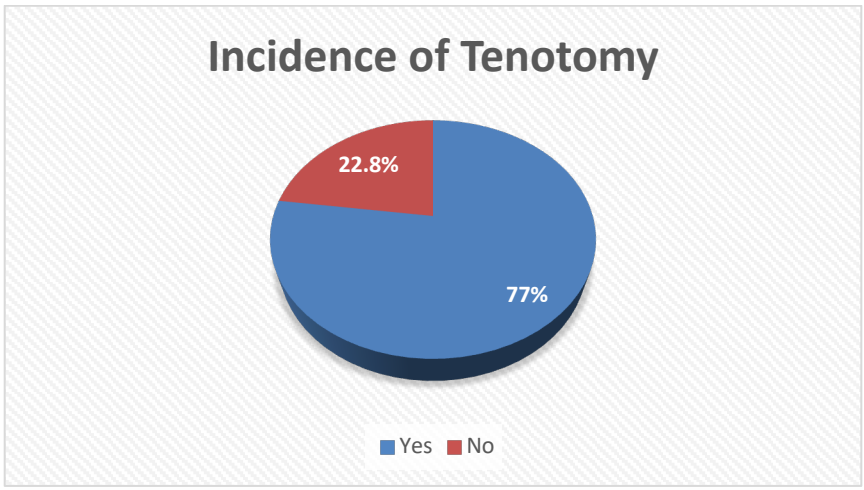

Figure 6: Incidence of Tenotomy

Table 7 displays the average hind foot score, mid foot score, and Pirani score for 92 feet affected by congenital talipes equino-varus (CTEV). The average initial hind foot score was 2.47 ±0.50, the mid foot score was 2.04 ±0.43, and the Pirani score was 4.52 ±0.90.

Table 7: Initial Pirani Score	
Score Component	**Mean ± SD**
Hindfoot Score	2.47± 0.50
Midfoot Score	2.04 ± 0.43
Pirani Score	4.52± 0.90

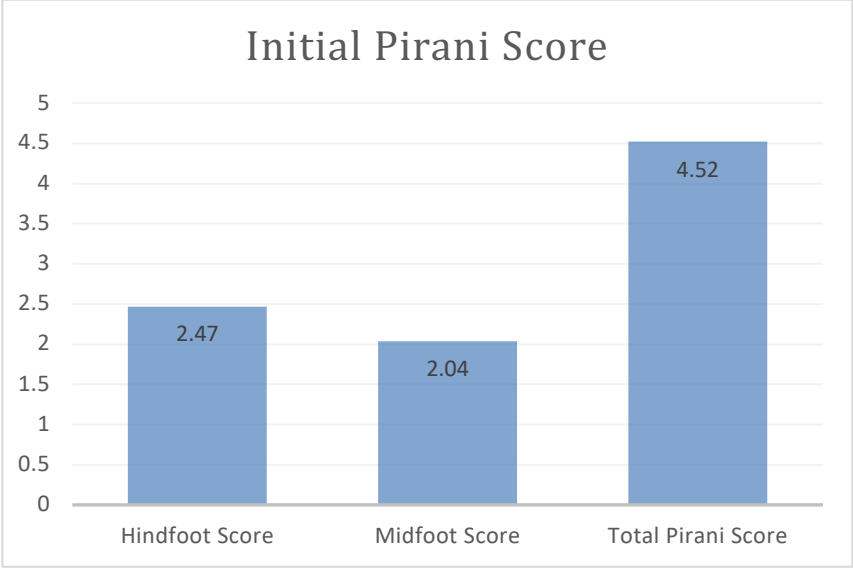

Figure 7: Initial Pirani Score

The Pirani score components for the tenotomy and non-tenotomy groups are compared in Table 8. For the tenotomy group, the mean first hind foot score was 2.69 ±0.29, while for the non-tenotomy group, it was 1.73 ±0.29. The mean initial hind foot score for the tenotomy and non-tenotomy groups differed significantly (p value = 0.001). For the tenotomy group, the first midfoot score was 2.23 ±0.26, while for the non-tenotomy group, it was 1.40 ±0.25. The mean initial midfoot score for the tenotomy and non-tenotomy groups differed significantly (p value = 0.007). For the tenotomy group, the initial Pirani score was 4.92 ± 0.42, while for the non-tenotomy group, it was 3.14 ± 0.41. The initial Pirani scores for the tenotomy and non-tenotomy groups differed significantly (p value = <0.0001).

Table 8: Association between the components of Pirani scores between tenotomy and non-tenotomy groups			
Component	**Tenotomy Group (Mean ± SD)**	**Non-Tenotomy Group (Mean ± SD)**	**p-value**
Hindfoot Score	2.69 ± 0.29	2.02 ± 0.24	0.001
Midfoot Score	2.23 ± 0.26	1.40 ± 0.25	0.007
Pirani Score	4.65 ± 0.44	3.90 ± 0.96	<0.0001

For 92 feet, an average of 5.31 ±1.26 cast members were needed. The tenotomy group needed 5.85 ± 0.81 casts, while the non-tenotomy group needed 3.47 ± 0.66. Casts were substantially more common in the tenotomy group than in the non-tenotomy group (p value = 0.021). Table 9 displays the data.

Table 9: Association regarding number of Casts between tenotomy and non-tenotomy group		
Group	**Mean Number of Casts ± SD**	**p-value**
Tenotomy (n = 39)	5.85 ± 0.81	0.021
Non-Tenotomy (n = 11)	3.66 ± 0.57	

The relationship between the initial Pirani score and the number of casts needed to repair the deformity is seen in Table 10. The initial Pirani score and the number of casts needed to cure the deformity were positively correlated, according to Pearson's significant correlation coefficient (r value = 0.677, p value = <0.0001).

Table10: Correlation between Initial Pirani Score and Number of Casts required		
Variable Comparison	**Pearson Correlation (r)**	**p-value**
Pirani Score vs Number of Casts	0.677	<0.0001

The initial Pirani score and the number of casts needed to cure the deformity were strongly positively correlated in the tenotomy group (r = value 0.814, p value = <0.0001). Table 11 displays the data.

Table11: Correlation between Initial Pirani score and number of Casts required in Tenotomy Group		
Variable Comparison	**Pearson Correlation (r)**	**p-value**
Pirani Score vs Number of Casts	0.814	<0.0001

Additionally, the initial Pirani score and the number of casts needed to cure the deformity were positively correlated in the non-tenotomy group (r value = 0.521, p value = 0.015). Table 12 displays the data.

Table12: Correlation between Initial Pirani score and number of Casts required in Non-Tenotomy Group		
Variable Comparison	**Pearson Correlation (r)**	**p-value**
Pirani Score vs Number of Casts	0.521	0.015

Discussion

Congenital idiopathic talipes equinovarus, commonly referred to as clubfoot, is a congenital defect marked by a permanent change in the foot's shape and connection to the leg, making it impossible for the foot to physiologically rest on the ground [1]. Clubfoot, also known as congenital talipes equinovarus (CTEV), is a common paediatric ailment that affects 1-2 out of every 1000 newborns [2]".

In order to restore as much of the physiologic morphology and function of the foot as feasible to enable plantigrade posture and appropriate gait, the therapy should focus on correcting all of the deformity's components (cavus, forefoot varus, hindfoot varus, equinus).

Clubfoot can be effectively cured without surgery if it is identified at birth. Manipulations and serial casting, as described by Ponseti et al., or manipulations and functional taping, as described by Masse et al., can successfully repair reducible abnormalities in a high proportion of instances when applied to infants or toddlers [3,4].

For the treatment of idiopathic clubfoot, the Ponseti serial corrective cast is widely acknowledged as an efficient and cost-effective approach [5–11]. Serial corrective manipulation, a particular cast application technique, and, if necessary, a percutaneous tendo Achilles tenotomy are all part of the Ponseti procedure [12]. According to recent research, the method's effectiveness rate is close to 98% [13].

Each foot may respond differently to nonoperative therapy depending on the degree of the clubfoot deformity. To record the severity of the clubfoot deformity's components, Pirani et al. developed a straightforward grading system [14]. Each of the six deformity components receives a score of 0 for no deformity, 0.5 for moderate deformity, and 1 for severe deformity. Of these six clinical indicators, three are associated with the midfoot and three with the hindfoot.

As a result, each foot can have a total score between 0 and 6, a mid-foot score (MFS) between 0 and 3, and a hind foot score (HFS) between 0 and 3. It has been demonstrated that the Pirani scoring method has strong inter-observer reliability [15].

The goal of the current study was to determine the correlation between the initial Pirani score and the prediction of the need for a tendo achilles tenotomy in patients with non-syndromic CTEV who are treated during the first three months of life.

The current study was carried out at M.G.M. Medical College & L.S.K. Hospital's Orthopaedics Department in Kishanganj, Bihar. The current study included 55 patients with non-syndromic congenial talipes equino varus who were seen for therapy within the first three months following birth.

As a structural deformity that is readily apparent to everyone, congenital talipes equinovarus, or clubfoot, is the most frequent congenital abnormality that orthopaedic surgeons see and a major source of worry for the parents of such kids [16].

In their investigation, Deshmukh and Kulkarni identified the function of the Pirani score system in predicting the Ponseti procedure therapy for idiopathic clubfoot. 132 idiopathic club feet in 89 children were chosen based on their observations of the clinical presentation and demographics. Of the 132 cases, 17 (19.1%) were female and 72 (80.9%) were male. 54.5% (72) of the instances impacted the right side, whereas 45.5% (60) involved the left. 11.4% (15) of the patients had a positive family history of CTEV [17].

In their study, Sharma A et al. evaluated the Pirani score's function in predicting the number of casts and its capacity to indicate the necessity of tenotomy in the Ponseti technique of clubfoot therapy. In terms of the research participants' demographics, they said that 66 cases were treated in total. 34 instances, or 51.5% of the total, were younger than one month. The oldest kid in the research was seven months old, while the youngest was five days old. There was a male majority, with 52 cases (78.8%) being male and 14 cases (21.2%) being female. Bilateral participation was seen in 44 of the 66 instances. The right side was more frequently affected in unilateral situations (14 cases, 64%). For patients recorded early in the research, the highest follow-up period was 30 months, while the minimum follow-up period was 12 months [18].

The majority of instances in the current study (47.3%) were between the ages of 31 and 60 days, followed by patients between the ages of 0 and 30 days (29.1%) and 61 and 90 days (23.6%). The research participants' average age was 47.8 ±20.81 days. With 69.1% (38) male patients and 30.9% (17) female patients, there was a male preponderance in our research. 37 (67.3%) and 18 (32.7%) of the 55 patients had bilateral and unilateral involvement, respectively. The current investigation comprised 92 feet in total. Of the 92 feet, 51.1% (47) included the right side, while 48.9% (45) involved the left. In 12.7% (7) of the patients, there was a positive family history of congenital talipes equino-varus (CTEV).

Therefore, based on the findings of the current study and other research, we may propose that the Pirani score is a reliable indicator of the necessity of tenotomy and aids in estimating the quantity of casts needed.

Conclusion

According to the study's findings, one of the most prevalent congenital abnormalities that orthopaedic surgeons deal with is congenital talipes equinovarus, or clubfoot, which continues to be a major cause of worry for parents. A number of scoring systems have been established to evaluate the severity and response to clubfoot therapy, with the Pirani scoring system being the most popular due to its dependability and ease of use. The Ponseti approach has become the gold standard for clubfoot care. greater initial Pirani scores were positively correlated with the need for tenotomy in the current investigation, as evidenced by the mean Pirani score at presentation being greater in patients who needed tenotomy than in those who did not. These results imply that the Pirani score can be used to estimate the number of casts needed during therapy as well as to predict the likelihood of tenotomy.

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