

# Ponseti Treatment of Bilateral Idiopathic Clubfoot: Does the Hand Dominance of the Provider Make a Difference?

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## Abstract

**Introduction:** Congenital talipes equinovarus (CTEV) is the commonest musculoskeletal deformity worldwide. The Ponseti technique is the goal standard for clubfoot treatment. During the correction phase, the provider's right hand manipulates the right foot and the left hand, left foot. Often, one foot is ready for Achilles tenotomy before the other in bilateral clubfoot. **Objective:** To determine the effect of the provider's hand dominance would have on bilateral clubfoot treated with the Ponseti technique. **Method:** This was a prospective cross-sectional study that analyzed idiopathic bilateral clubfoot patients aged 0 - 5 years and treated using the Ponseti technique at FMC Umuahia from October 2019 to September 2020. Informed consent and ethical clearance were obtained. The Pirani scores were obtained and compared at presentation and at each clinic visit. All trained manipulators were right-handed. Two-tailed t-test was used and a p-value less than 0.05 was deemed significant. **Results:** Forty-seven patients participated in the study with an M:F of 2.6:1 and mean age of  $13.79 \pm 13.39$  months. Thirty-six patients (76.6%) had the same Pirani score on both feet at presentation, while the right and left feet were more severely affected in 8 and 3 cases respectively. The mean number of casts before readiness for tenotomy was 4.95 on the right and 5.28 on the left with p-value of 0.042. **Conclusion:** Though the right foot had a worse mean Pirani score on presentation, however, it required fewer casts before readiness for tenotomy than the left.

## Keywords

Hand Dominance, Bilateral, Clubfoot, Ponseti Technique

## 1. Introduction

Idiopathic clubfoot is the seventh most common birth defect and the first for the musculoskeletal system [1]. It consists of four components: forefoot adductus, midfoot cavus, hindfoot varus and ankle equinus [2]. It is bilateral in approximately 50% of cases [3] [4].

The Ponseti technique is a globally accepted standard of treatment which comprises serial manipulation and casting, tenotomy (when indicated) and use of foot abduction braces (FAB) [5]. The treatment goal is to attain a functional, pain-free, plantigrade and shoeable foot, with good mobility [6].

Ibrahim GH *et al.* [7] noted that the feet of patients with bilateral clubfoot are not precisely the same and one foot may be ready for tenotomy before the other in some bilateral clubfeet cases, and attempting to forcefully treat a more severe foot to resemble the less severe foot may lead to complications.

Incel NA *et al.* [8] have proven that the dominant hand is significantly stronger in right-handed subjects but no such significant difference between sides could be documented for left-handed people.

In our literature search, no work has related the hand dominance of practitioners to the rate of correction of bilateral clubfoot. We hope that this paper will add to the body of knowledge and help practitioners know what to expect while treating children with bilateral clubfoot.

## 2. Patients and Method

It was a hospital-based prospective cross-sectional study conducted at Federal Medical Centre Umuahia from October 2019 to September 2020. All children with bilateral congenital idiopathic clubfoot aged 0 to 5 years who presented during the study period and who have not had any form of standard treatment for clubfoot were recruited. Ethical clearance was obtained from the health research and ethics committee of the hospital and consent was obtained from the parent(s) or caregiver of each recruited child.

The Pirani score of each foot was obtained at presentation and subsequently recorded weekly in a tabulated form, and the score obtained was compared with the score of the contralateral foot.

The Ponseti technique was used for all patients. Each foot was gently manipulated by right-handed trained providers of at least senior registrar cadre for 1 to 2 minutes before toe-to-groin cast was applied to maintain the correction. The right hand of the provider manipulated the right foot while his/her left hand manipulated the left foot.

Percutaneous Achilles tenotomy was done when indicated. When one foot was ready for tenotomy before the contralateral foot, manipulation and casting were continued on both feet until the contralateral foot was ready for tenotomy.

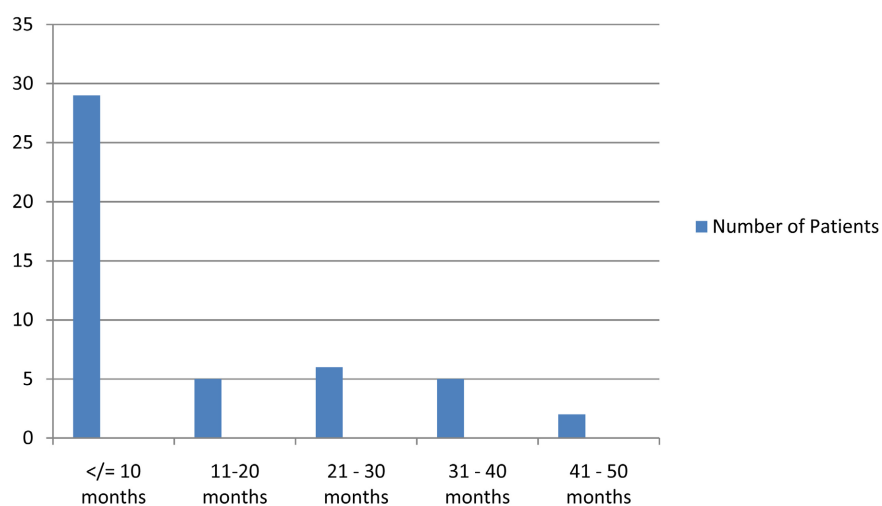
When the clubfoot deformity was fully corrected, foot abduction brace (FAB) was fitted. The brace review was done at two weeks, four weeks and six weeks (3 months) intervals to monitor brace compliance and recurrence.

Data were entered, coded and analyzed with Statistical Package for the Service Solutions (SPSS) of IBM SPSS statistics for windows, version 20. Data were expressed as frequencies for categorical variables and mean  $\pm$  standard deviation for continuous variables. The comparison of the parameters between the two legs and feet was made with a paired samples t-test. All the tests were two-tailed, and a p-value less than 0.05 was deemed significant.

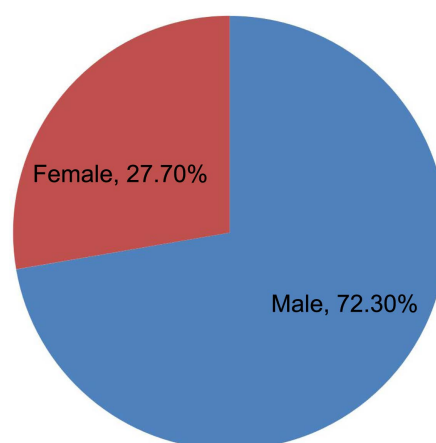
### 3. Results

A total of 47 children with bilateral idiopathic clubfoot participated in the study. The mean age of the patients was  $13.79 \pm 13.39$  months (3 weeks to 50 months) (**Figure 1**). Males were 34 whereas females were 13, giving a male:female ratio 2.6:1 (**Figure 2**).

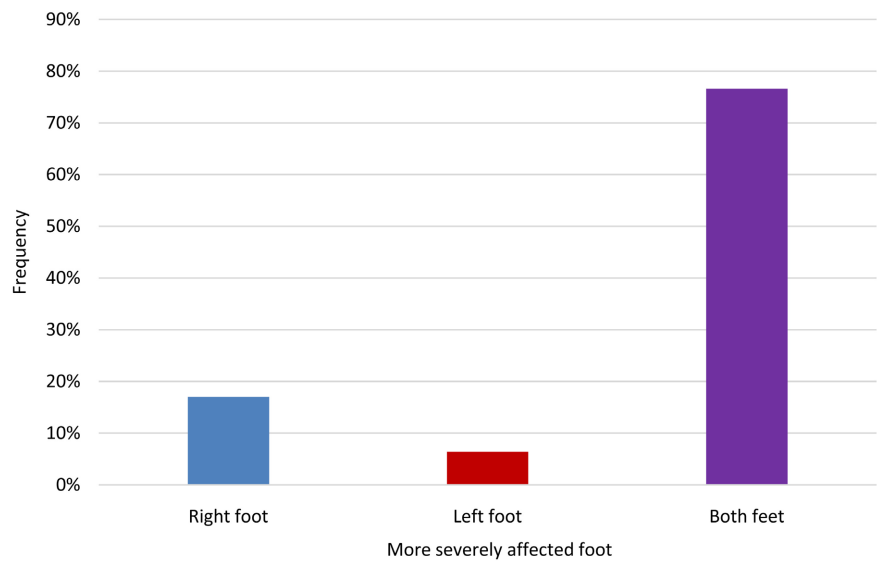
Both feet were similarly affected, *i.e.*, having the same Pirani score, in 36 cases, 76.6%, while the right and left feet were more severely affected in 8 and 3 cases respectively. This finding is statistically significant,  $\chi^2 (2, N = 47) = 40.38$ ,  $p < 0.001$  (see **Figure 3** below).



**Figure 1.** Grouped age of the patients.



**Figure 2.** Gender distribution of the patients.



**Figure 3.** Showing that both feet are similarly affected in most cases.

The mean number of casting required to correct the deformity before bracing, was not significantly different between the right and left feet in the participants with p value of 0.323 (**Table 1**).

However, the mean number of casting before readiness for Achilles tenotomy differs significantly between the patients' two feet, with the right foot requiring few number of casts than the left as shown in **Table 2** (p value = 0.042).

Forty-three patients (91.5%) had Achilles tenotomy on both feet in the course of their treatment (**Figure 4**).

Three patients had pressure ulcer from the cast during treatment. All the ulcers were on the left foot, and this distribution of foot ulcers was statistically significant,  $\chi^2 (1, N = 47) = 35.77, p < 0.001$ .

Recurrence of the deformity occurred in 6 patients (12.8%) while the remaining 41 patients (87.2%) had no recurrence during the follow-up period. The left foot alone recorded the highest recurrence incidence followed by both feet, while no recurrence was seen in the right foot alone. The distribution of recurrence in the feet was significant,  $\chi^2 (2, N = 47) = 47.00, p < 0.001$ , and was shown in **Table 3**.

#### 4. Discussion

The mean age at presentation in our study was higher than the ones found in some of the reviewed literatures [7] [9] [10] [11] [12]. This may be because of cost, poor awareness and cultural beliefs, as also noted by Adegbehingbe OO *et al.* [13] in their series on neglected clubfoot.

The Male: Female ratio showed male preponderance (see **Figure 2**) which was also recorded by other authors who studied idiopathic clubfoot in our environment (not specific for bilateral clubfoot) [9] [10] [14]. Gray K *et al.* [11] who also studied bilateral clubfoot even recorded a higher M: F ratio of 5.6:1. The reason

**Table 1.** Comparison of the mean number of casts required to achieve correction in the patients' feet. Standard deviations of the means are enclosed in brackets.

	Right foot	Left foot	Mean difference	Std error	95% CI	t-stat	p-value
Mean number of casts to achieve correction	6.66 (1.88)	6.68 (1.87)	0.02	0.02	(-0.06 to 0.02)	1.00	0.323

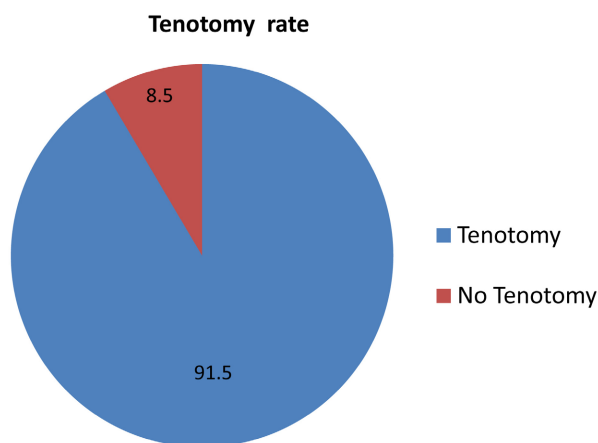
**Table 2.** Comparison of the mean number of casts before readiness for tenotomy. Standard deviations of the means are enclosed in brackets.

	Right foot	Left foot	Mean difference	Std error	95% CI	t-stat	p-value
Mean number of casts before readiness for tenotomy	4.95 (1.50)	5.28 (1.59)	-0.33	0.16	(-0.64 to -0.01)	-2.10	0.042*

\* = significant at 0.05.

**Table 3.** The incidence of deformity recurrence in the feet.

Foot involved	n	%
Right foot (alone)	0	0%
Left foot (alone)	4	8.5%
Both feet	2	4.3%

**Figure 4.** Achilles tenotomy rate.

for this male preponderance may be due to social bias and increased attention towards males, as also suggested by Singh S *et al.* [15]. Palmer RM [16] has also suggested that females require a greater number of predisposing factors than males to produce a clubfoot deformity.

In our study, the Pirani score of both feet at presentation was the same in 76.6% of the patients (see **Figure 3**). This agrees with the work done by Gray K *et al.* (2014) [11] in Australia who also noted a high percentage of patients (85%) with bilateral clubfoot presenting with the same Pirani score in both feet. In the remaining 23.4% of our patients, we noted that the right foot was more severely

affected (see **Figure 3**), but Gray K *et al.* (2014) made no attempt to bring out which foot had a more severe Pirani score in the remaining 15% of their study.

The mean number of the casts before readiness for Achilles tenotomy differed significantly between the patient's two feet, with the right foot having fewer casts than the left foot (see **Table 2**). This can be explained by the fact that the right foot is manipulated by the provider's right hand and the left foot by the provider's left hand [5]. Since all the providers who participated in the study are right-handed and the grip strength on the right hand in right-handed individuals is significantly greater than the grip strength on the left hand, it is likely that the right foot will be better manipulated than the left [8].

The distribution of pressure ulcers was statistically significant as they all occurred on the left. This could be the attempt to forcefully accelerate the left foot's correction to meet up with the right [7]. The left foot's poor manipulation by right-handed trained providers may also contribute to the increased complications on the left [5] [8].

When compared with our study (see **Figure 4**), a comparatively lower tenotomy rate was recorded by Anisi CO *et al.* [17] (66.4%) and Sharma A *et al.* [12] (76.3%). Adewole OA *et al.* [10] recorded even a much lower tenotomy rate (26.6%). The reason for these lower rates may be because they treated children with lower age bracket. Gray A *et al.* (2014) [10] reported a low tenotomy rate of 55% with one patient having tenotomy in just one foot and the reason for having unilateral tenotomy could not be given because it was a retrospective study.

The recurrence rate we recorded was statistically significant on the left (see **Table 3**). This recurrence rate was higher than that recorded by Adewole OA *et al.* [10] after one year of follow-up where they noted that poor brace compliance was the primary reason for the recurrence in their series. The increased recurrence rate on the left foot also points to poor manipulation by right-handed trained providers [8].

## 5. Conclusions

The right foot had a worse mean Pirani score at presentation; however, it required fewer casts to be ready for Achilles tenotomy than the left.

Distribution of pressure ulcers and recurrence also showed that right foot has better manipulation than the left.

This shows that right-handed providers manipulated the right foot better than the left and; therefore, should pay more attention to the left by manipulating the left foot first and double the time of manipulation on the left. These measures will help prevent pressure ulcers on the left.

Secondly, during the initial counseling the parents/caregivers of the children should know that the left foot may lag behind so that they will not be worried if such occurs.

## Limitations of the Study

The study population was small and, therefore, might not be the true representa-

tive of the population.

It was a centre-based study, a multi-centre study would help validate the findings in this study.

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### Conflicts of Interest

The authors have not declared any conflicts of interests.

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