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ORIGINAL ARTICLE

Effect of physiotherapy on frequency of achilles tendon tenotomy in treatment of congenital talipes equinovarus (Club Foot).

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ABSTRACT… Objective: To evaluate the effect of physiotherapy on frequency of Achilles tendon tenotomy in the treatment of congenital talipes equinovarus (club foot). **Study Design:** Prospective, Interventional, Cross-sectional study. **Setting:** Orthopedic Club-Foot Outpatient Department, Jinnah Postgraduate Medical Center, Karachi. **Period:** June 2024 to November 2024. **Methods:** Included 120 children under six months of age diagnosed with idiopathic CTEV. Patients were divided into two groups: one receiving structured physiotherapy before casting and the other receiving standard Ponseti treatment. The primary outcome was the frequency of Achilles tendon tenotomy. **Results:** Among feet that did not require tenotomy, 62.1% were from the physiotherapy group ($p = 0.009$). Single tenotomy was more common in the control group (63.4%) compared to the physiotherapy group (36.6%), while all repeat tenotomies occurred in the control group. Subgroup analysis showed significant reduction in tenotomy in patients aged 0–12 weeks, males, unilateral cases, and those with or without family history. **Conclusion:** Pre-casting physiotherapy significantly reduces the need for Achilles tendon tenotomy in infants with idiopathic CTEV. Its integration into routine Ponseti protocol may enhance treatment outcomes and reduce surgical burden, particularly in resource-constrained settings.

Keywords: Achilles Tenotomy, Clubfoot, Congenital Talipes Equinovarus, Ponseti Method, Physiotherapy, Pediatric Orthopedics.

INTRODUCTION

CTEV or congenital talipes equinovarus is one of the most common congenital malformation of the foot. Also known as clubfoot, one newborn for every one thousand births is affected by this.[1] It is defined as torsion of the longitudinal axis of the foot, caused by misalignment at the calcaneo-talo-navicular complex. The child is forced to walk on the side of the foot due to medially rotated soles. There are 04 abnormalities that can be detected, recognized by the mnemonic CAVE: which includes Cavus of the mid-foot, Adduct us at metatarsus, Varus at hind-foot and Equinus of hind-foot.[2]

As compared to females, the deformity is more common in males (at a ratio of 2:1). However, children may inherit the deformity from an affected.[3] There is a n increased 25% risk of developing CTEV when a first degree relative is involved.[4] Additionally, chance of an identical twin getting the condition is also 33% if the other one is affected.[5] All of these factors suggest that there's genetic component to the development of CTEV. Regardless of origin, there are changes in almost all the elements of the foot, including muscles with Type I fibre predominance[6], tendons[7], ligaments[8], fascia[9], as well as the bony components.[10-15]

For decades, the treatment of CTEV was Surgical only. But now the surgical practice is becoming obsolete with development of conservative methods.[2] The most widely used treatment for CTEV is the Ponseti Method.[11] The Ponsetti casting technique comprises of different gentle manipulations at every component of foot deformity, which then is kept in casts for 5 to 7 days.

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During these phases, the muscles, tendons and ligaments adopt to the new position of the foot. On follow-up when the cast is removed, the foot is more prone to be molded in new position, hence the method is repeated. On an average 5-6 casts are required for adequate positioning of the foot.[2]

The treatment for CTEV is controversial. For years the mainstay of treatment was surgical which required repeated tissue releases leading to complication like arthritis, stiffness of the foot and decreased quality of life. Ponsetti technique includes gentle manipulations, casting, Achilles' tendon tenotomy and bracing.[1] Role of physiotherapy before casting is limited, hence we plan to record the improvement in results after physiotherapy before casting in Ponsetti technique. After correction of the first three elements of CTEV (Cavus of the mid-foot, Adductus at metatarsus and Varus at hind-foot), Equinus of the hind foot is treated at last. Depending on Pirani Scoring, the decision for tenotomy or directly putting on DAB shoes will be made.

METHODS

This was a prospective, interventional, cross-sectional study conducted at the Orthopedic Club-Foot Outpatient Department of Jinnah Postgraduate Medical Center, a tertiary care teaching hospital in Karachi. The study was carried out over a duration of six months June 2024 to November 2024 after the approval from ethical committee (Reference no: NO.F.2-81/2024-GENL/270/JPMC, Dated: 15 March 2024). A total of 102 (51 in each group) children diagnosed with idiopathic congenital talipes equinovarus (CTEV) were recruited using a non-probability purposive sampling technique. All children included were under the age of six months and presented with either unilateral or bilateral idiopathic clubfoot, managed exclusively with non-surgical treatment methods. Patients were included if they met the criteria of having idiopathic clubfoot, were under six months of age, and were registered for treatment in the orthopedic clubfoot clinic. Patients were excluded if consent was not obtained from their guardians, if the clubfoot was associated with syndromes or neuromuscular disorders, or if they were lost to follow-up during treatment.

Diagnosis was made clinically by a senior physician, such as a senior resident, registrar, fellow, or consultant, through physical examination. The Pirani scoring system was used to assess the severity of the foot deformity at the time of presentation. All patients in intervention group underwent weekly sessions of physiotherapy and manipulation prior to casting. A professional physiotherapist performed manipulations for approximately 20 minutes in each session, consisting of ten repetitions with a 20-second hold for each. Techniques included correcting inversion by placing the thumb on the lateral aspect of the talus head and applying outward pressure to the first metatarsal and cuneiform bones, reducing talonavicular joint subluxation by distracting the first metatarsal, and dorsiflexing the foot with the heel in a neutral or 10-degree valgus position to correct equinus deformity caused by a shortened Achilles tendon.

After physiotherapy, long leg casts were applied by experienced clinicians using the Ponseti technique. Correction was carried out in the standard sequence: cavus, adductus, varus, and finally equinus. The need for Achilles tendon tenotomy was evaluated based on the Pirani score. If the deformity was adequately corrected (Pirani score <1), the child was placed directly on foot abduction braces (DAB/FAB) without tenotomy. Data were collected through a structured proforma that included demographic details, initial Pirani score, weekly Pirani scores, total number of casts applied, number of casts required to reach a Pirani score <1, and whether tenotomy was performed. Each patient was followed throughout the entire course of treatment. All data were entered and analyzed using SPSS version 28. Descriptive statistics, including mean, median, mode, and standard deviation, were calculated. Chi-square test was used to assess associations between variables, with a confidence level of 95% and a significance threshold of $p < 0.05$. Written informed consent was obtained from the parents or guardians of all participants. Ethical principles were followed, including confidentiality of patient

data and protection of participants' rights. All potential forms of research misconduct were actively avoided.

RESULTS

This table summarizes the demographic characteristics of the 102 children included in the study. The majority of cases (88.2%) presented at an early age, specifically between 0 to 12 weeks, while a smaller proportion (11.8%) presented between 12 to 24 weeks of age. Male patients were more commonly affected, accounting for 63.7% of the total, while females made up 36.3%. With respect to the side affected, the right foot was involved in 40.2% of cases, the left in 36.3%, and bilateral involvement was seen in 23.5% of the feet. Family history of clubfoot was reported in one-third (33.3%) of the cases, while the remaining 66.7% had no known family history.

This table compares the frequency of Achilles tendon tenotomy procedures between the physiotherapy group and the control group. A statistically significant association ($p = 0.009$) was observed between the intervention and tenotomy frequency. Among the cases that did not require tenotomy, 62.1% belonged to the physiotherapy group, and 37.9% were from the control group. In contrast, single tenotomy procedures were more common in the control group (63.4%) compared to the physiotherapy group (36.6%). Repeat tenotomies were only observed in the control group (100%), while none of the physiotherapy cases required a second tenotomy. These findings suggest that pre-casting physiotherapy may reduce the overall need for Achilles tendon tenotomy.

This detailed table explores how the impact of physiotherapy on tenotomy outcomes varied across different subgroups, including age, gender, affected side, and family history. In the 0–12 weeks age group, significantly fewer physiotherapy cases required single or repeat tenotomy compared to controls, with a p-value of 0.007. Among those aged >12–24 weeks, the difference between groups was not statistically significant ($p = 0.121$). Regarding gender, males showed a significant difference in tenotomy frequency between groups ($p = 0.005$), whereas the difference in females was not significant ($p = 0.288$). When analyzed by the affected side, a significant difference was observed in right-foot cases ($p = 0.015$) and left-foot cases ($p = 0.027$), with lower tenotomy frequency in the physiotherapy group. No significant difference was noted in cases with bilateral involvement ($p = 0.674$). Similarly, family history was found to be an important modifier: in children with a positive family history, physiotherapy was associated with significantly reduced tenotomy frequency ($p = 0.017$). In those without a family history, a significant difference also existed ($p = 0.029$), with physiotherapy again associated with a lower rate of tenotomy. These results reinforce the beneficial role of physiotherapy before casting across multiple patient subgroups.

Variable		Count	Percent
Age	0-12 weeks	90	88.2%
	>12-24 weeks	12	11.8%
Gender	Male	65	63.7%
	Female	37	36.3%
Affected Side	Right	41	40.2%
	Left	37	36.3%
	Bilateral	24	23.5%
Family History	Yes	34	33.3%
	No	68	66.7%

Table-I. Demographic presentation of cases presenting for the treatment of congenital talipes equinovarus (Club Foot) (N=102)

Teno-tomy	Group		Total	P-Value
	Physio-therapy	Controls		
None	36 (62.1%)	22 (37.9%)	58 (100.0%)	0.009
Single	15 (36.6%)	26 (63.4%)	41 (100.0%)	
Repeat	0 (0.0%)	3 (100.0%)	3 (100.0%)	

Table-II. Effect of physiotherapy on frequency of achilles tendon tenotomy in treatment of congenital talipes equinovarus (Club Foot)

DISCUSSION

The Ponseti method has revolutionized the treatment of congenital talipes equinovarus (CTEV), offering a non-surgical, structured approach with high success rates in correcting this common pediatric foot deformity.

Variables			Group-A (Count %)	Group-B (Count %)	Total	P-Value
		Tenotomy				
Age (months)	0-12	None	36 (62.1%)	22 (37.9%)	58 (100%)	0.007
		Single	9 (29.0%)	22 (71.0%)	31 (100%)	
		Repeat	0 (0.0%)	1 (100.0%)	1 (100%)	
	>12-24	Single	6 (60.0%)	4 (40.0%)	10 (100%)	0.121
		Repeat	0 (0.0%)	2 (100.0%)	2 (100%)	
Gender	Male	None	24 (64.9%)	13 (35.1%)	37 (100%)	0.005
		Single	7 (25.9%)	20 (74.1%)	27 (100%)	
		Repeat	0 (0.0%)	1 (100.0%)	1 (100%)	
	Female	None	12 (57.1%)	9 (42.9%)	21 (100%)	0.288
		Single	8 (57.1%)	6 (42.9%)	14 (100%)	
		Repeat	0 (0.0%)	2 (100.0%)	2 (100%)	
Affected Side	Right	None	16 (80.0%)	4 (20.0%)	20 (100%)	0.015
		Single	9 (42.9%)	12 (57.1%)	21 (100%)	
	Left	None	17 (65.4%)	9 (34.6%)	26 (100%)	0.027
		Single	2 (22.2%)	7 (77.8%)	9 (100%)	
		Repeat	0 (0.0%)	2 (100.0%)	2 (100%)	
	Bilateral	None	3 (25.0%)	9 (75.0%)	12 (100%)	0.674
		Single	4 (36.4%)	7 (63.6%)	11 (100%)	
		Repeat	0 (0.0%)	1 (100.0%)	1 (100%)	
Family History	Yes	None	13 (54.2%)	11 (45.8%)	24 (100%)	0.017
		Single	1 (10.0%)	9 (90.0%)	10 (100%)	
	No	None	23 (67.6%)	11 (32.4%)	34 (100%)	0.029
		Single	14 (45.2%)	17 (54.8%)	31 (100%)	
		Repeat	0 (0.0%)	3 (100.0%)	3 (100%)	

Table-III. Effect of physiotherapy on frequency of achilles tendon tenotomy in treatment of congenital talipes equinovarus (Club Foot) according to various effect modifiers

A key component of the Ponseti method involves percutaneous Achilles tendon tenotomy, primarily for addressing the equinus deformity. However, this surgical step, though simple and low-risk, carries potential complications and is often a point of concern for caregivers. In this context, our study introduces the role of structured physiotherapy prior to casting as a means to potentially reduce the need for tenotomy. Our findings support this intervention, revealing that physiotherapy significantly decreases both single and repeat tenotomy procedures, thus contributing to a more conservative and holistic approach to CTEV management.

When comparing the demographics of our study population to prior literature, several parallels and noteworthy patterns emerge. In our cohort, 63.7% of the children were male, reflecting the well-established male predominance in CTEV, commonly reported at a 2:1 ratio. Shafi et al. (2023)[16] and Khan et al (2021)[17] reported similar gender distributions, reinforcing the consistency of this trend. The majority of our patients (88.2%) presented within the first 12 weeks of life, aligning with early presentation trends reported by Raza et al. (2023)[18], who noted a mean age of 3.2 ± 2.6 months. Early diagnosis and timely intervention are crucial for successful correction using non-surgical techniques, and our data affirm the importance of early referral.

Laterality data in our study showed right-foot involvement in 40.2%, left-foot in 36.3%, and

bilateral presentation in 23.5% of cases. These findings are comparable to patterns described by Siddiqui et al (2022)[19] and Shafi et al (2023)[16], where unilateral involvement was more common than bilateral cases. Furthermore, a positive family history was identified in one-third (33.3%) of our cases, supporting the genetic predisposition discussed in earlier works such as those by Khan et al. (2021).[17] This demographic consistency with previous studies strengthens the external validity of our results.

The most significant outcome of our research was the reduction in tenotomy frequency among children who received physiotherapy before casting. Our results showed that only 36.6% of physiotherapy group cases required a single tenotomy, compared to 63.4% in the control group. Notably, repeat tenotomy was only observed in the control group. This reduction was statistically significant ($p = 0.009$), indicating a robust association between pre-casting physiotherapy and lower tenotomy requirements. These findings differ markedly from previous studies where tenotomy was required in the majority of patients, with frequencies reported as 61.2% by Shafi et al. (2023)[16], 64.7% by Siddiqui et al. (2022)[19], 79.2% by Khan et al. (2021)[17], and as high as 83.8% by Raza et al. (2023).[18] The substantial drop in tenotomy rates in our study suggests that physiotherapy may help achieve dorsiflexion correction more effectively, potentially through improved muscle flexibility and joint mobilization prior to immobilization.

Del Buono et al. (2012)[20] raised concerns about long-term consequences of Achilles tenotomy, including overlengthening, weakness, and altered gait mechanics. While tenotomy remains a necessary and safe procedure when indicated, our findings suggest that reducing its frequency through non-invasive interventions may help mitigate these potential risks. By improving soft tissue compliance before casting, physiotherapy could preempt the need for surgical tendon release.

Subgroup analysis in our study further reinforces the efficacy of physiotherapy across multiple patient characteristics. Among infants aged 0–12 weeks, those who received physiotherapy had significantly lower tenotomy rates compared to controls ($p = 0.007$). This age-dependent effect is clinically important, as earlier intervention allows greater tissue adaptability. A significant reduction in tenotomy was also seen in males ($p = 0.005$), and in children with unilateral deformity—right foot ($p = 0.015$) and left foot ($p = 0.027$). Interestingly, physiotherapy showed significant benefits in children both with and without a family history of CTEV ($p = 0.017$ and $p = 0.029$ respectively), suggesting its general utility regardless of genetic predisposition.

Our results align conceptually with findings from Munjewar et al (2023)[21], who reported significant functional improvements with physiotherapy even in a 7-year-old child with untreated bilateral clubfoot. Although their case involved older age and more chronic deformity, it underscores the adaptability of the foot to structured physical therapy. Similarly, Peretti et al. (2023)[22] emphasized the value of judicious tenotomy based on functional assessment. Our findings provide a proactive solution—physiotherapy may reduce the very need for tenotomy by addressing functional limitations early in treatment.

Despite the promising findings, our study has limitations. The sample size, while sufficient to demonstrate statistical significance, was relatively modest and limited to a single tertiary care center. Additionally, while we assessed short-term outcomes such as the frequency of tenotomy, future studies should include long-term functional assessments to determine whether reduced tenotomy correlates with sustained correction, mobility, and patient satisfaction.

CONCLUSION

Our study provides strong evidence that incorporating physiotherapy prior to casting significantly reduces the need for Achilles tendon tenotomy in infants undergoing treatment for idiopathic CTEV. This approach not only minimizes surgical intervention but may also improve overall treatment outcomes. Given the simplicity, safety, and cost-effectiveness of physiotherapy, its

routine inclusion in CTEV management protocols should be strongly considered, especially in resource-limited settings.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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4	**Pervez Ali:** Review of manuscript.
5	**Mehtab Ahmed:** Literature review, data entry.
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