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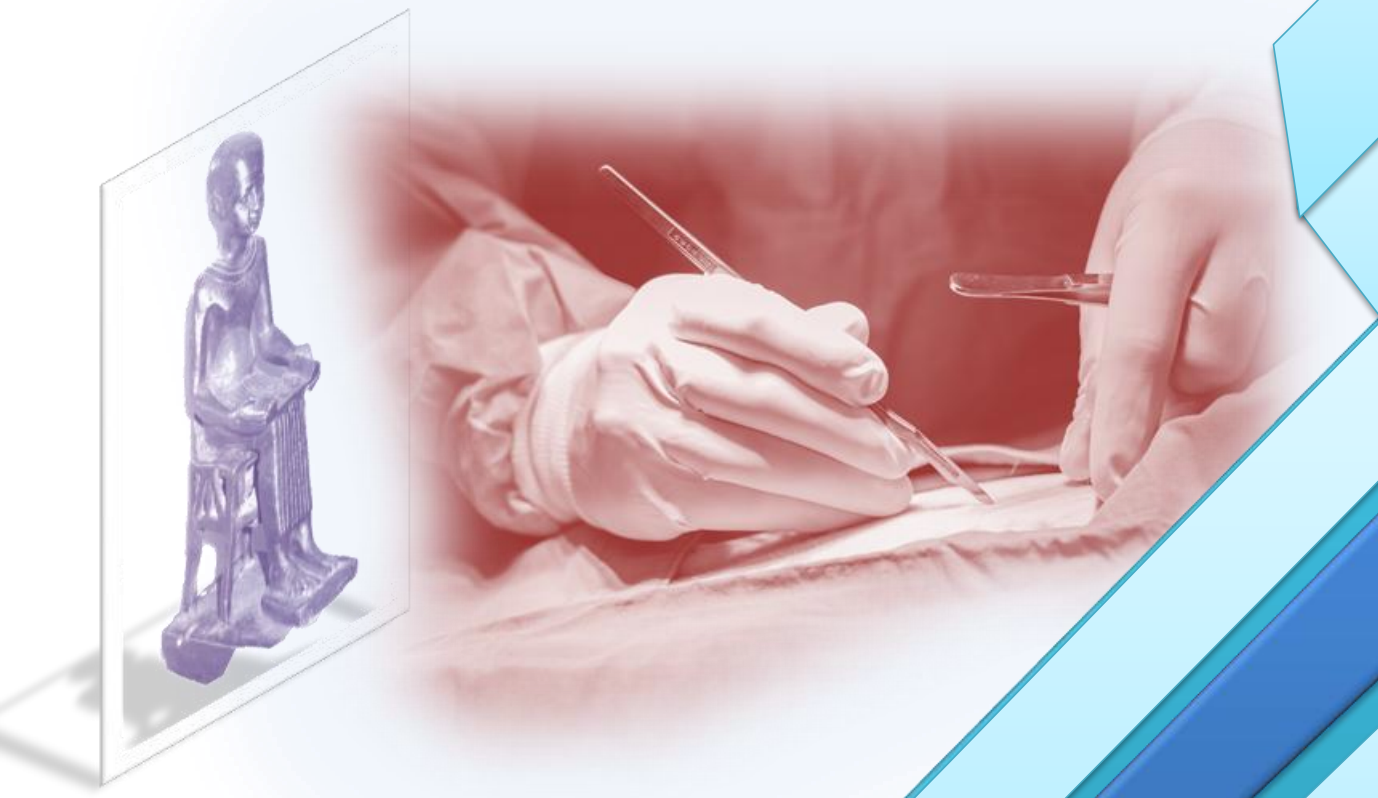

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Original Article

Treatment of Congenital Talipes Equinovarus using Accelerated Ponseti Method by Fast Casting and Needle Tenotomy

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Abstract

Background: Congenital Talipes Equinovarus [CTEV] or clubfoot is a common orthopedic deformity that if untreated, leads to significant functional impairment. The Ponseti method, a non-surgical approach involving gentle manipulations, serial casting, and often percutaneous Achilles tenotomy, has become the gold standard due to its effectiveness in correcting the deformity while preserving the foot function. An accelerated Ponseti method aims to reduce treatment duration.

Aim of the Work: This study aimed to evaluate the efficacy and safety of the accelerated Ponseti technique in managing the clubfoot among 20 infants under three months of age, treated at the Orthopedic Department, Al-Azhar University Hospital in Damietta, Egypt.

Patients and Methods: A prospective clinical trial was conducted from March 2024 to March 2025. Inclusion criteria were infants under three months with idiopathic clubfoot, no prior surgery, and no neurological or syndromic anomalies. The Ponseti technique involved daily manipulations and above-knee casting until 50° abduction was achieved. Percutaneous Achilles tenotomy was performed for residual equinus in most cases. Statistical analysis used SPSS version 26, with a p-value < 0.05 considered significant. Ethical approval and informed consent from guardians were obtained.

Results: The study included 20 infants [average age 2.1 months; 60% male; 35% bilateral involvement]. Initial Pirani scores averaged 5.2 at presentation, improving to 0.9 [an 82.3% improvement]. The average number of casts was 5.6, with intervals of 6 days. Sixty percent of patients require a tenotomy, typically around 2 months of age. Complications were low [15%], primarily mild discomfort [10%].

Conclusion: The accelerated Ponseti method is a safe, effective, and feasible approach for treating congenital clubfoot in infants, particularly in resource-limited settings. It demonstrates high correction rates, low complications and relapses, and high parental satisfaction. Early treatment initiation within the first three months is crucial for maximizing outcomes.

Keywords: Congenital Talipes Equinovarus [CTEV]; Clubfoot; Percutaneous Achilles Tenotomy; Ponseti Method, Pirani score.

INTRODUCTION

Congenital Talipes Equinovarus [CTEV], commonly known as clubfoot, is one of the most frequently encountered congenital orthopedic deformities. It is characterized by a complex deformity of the foot, typically involving four main components: cavus [high arch], adductus [inward turning of the forefoot], varus [inward turning of the heel], and equinus [downward pointing of the foot]. CTEV occurs in approximately 1 in every 1,000 live-births globally, with varying prevalence across different populations and ethnic groups. This deformity if left untreated can lead to significant functional impairment and affect the child's ability to walk properly, often resulting in lifelong physical limitations and challenges with mobility, balance, and self-confidence [1].

The Ponseti method, initially developed by Dr. Ignacio Ponseti in the 1940s and first published in 1963, offers a non-surgical approach to correct CTEV. This method emerged as a groundbreaking shift from traditional, often invasive surgical treatments, and has since been widely accepted as the gold standard in treating congenital clubfoot. The Ponseti method addresses deformity through a carefully sequenced process of gentle manipulations and serial casting, followed by a minimally invasive procedure known as a percutaneous Achilles tenotomy. By gradually correcting the position of the foot, the method enables realignment without the need for extensive surgical intervention, thereby preserving the function and flexibility of the foot [2].

The core principle of the Ponseti method is to utilize the plasticity of a newborn's tissues to realign the bones, tendons, and muscles progressively. The procedure typically begins shortly after birth, ideally within the first few weeks of life when the tissues are most adaptable. The accelerated casting method, which uses shorter intervals between cast changes, aims to achieve correction within a shorter timeframe thus reducing the total duration of treatment. Over a series of casting sessions [typically between 4 to 7 sessions], the deformities are addressed in sequence. First, the cavus deformity is corrected by repositioning the forefoot, followed by abduction of the foot to correct adductus and varus deformities, and finally, equinus is resolved either through manipulation or if necessary, a tenotomy of the Achilles tendon [3].

Following successful casting and if required tenotomy, patients are fitted with a foot abduction brace to maintain the correct alignment and prevent relapse. This brace is typically worn for 23 hours a day for the first three months and then during nighttime and naps until around 4 or 5 years of age. Adherence to the bracing protocol is critical to prevent recurrence of deformity and ensure long-term success. Studies have demonstrated that with consistent follow-up, the Ponseti method results in effective and lasting correction in most cases, often providing patients with near-normal foot function and minimal pain throughout life [4].

The accelerated Ponseti method not only addresses the functional and aesthetic aspects of CTEV but also minimizes the risks associated with invasive surgeries. Previous surgical methods were associated with higher incidences of complications, such as overcorrection, stiffness, and recurrence. In contrast, the Ponseti method has shown favorable outcomes in long-term studies, with a low recurrence rate and minimal adverse effects, underscoring its efficacy and safety. However, despite its high success rates, adherence to the post-treatment bracing phase remains a significant factor in preventing relapses, as children who do not comply with bracing requirements have a higher likelihood of recurrence [5].

AIM OF THE STUDY

The aim of this study was to evaluate the efficacy and safety of the accelerated Ponseti technique in managing clubfoot among infants under three months of age. This study focuses on 20 cases treated in the Orthopedic Department at Al-Azhar University Hospital in Damietta, aiming to contribute valuable insights into early intervention outcomes for congenital clubfoot.

PATIENTS AND METHODS

Study Design: This study was designed as a prospective clinical trial to evaluate the efficacy and safety of the accelerated Ponseti technique in managing congenital clubfoot in infants under three months of age.

Sampling: we did a non-randomized total sampling in which we included all the patients presented to the out-patient clinic who met our inclusion criteria and agreed to participate in our study in the time frame from March 2024 to March 2025.

Population of Study: The study population consisted of approximately 20 infants, each under three months old, presented by various degrees of congenital clubfoot. Seven patients had bilateral diseases, 8 right foot affection and 5 left foot affection. Twelve were males and 8 females.

Study Location: The study was conducted in the orthopedic outpatient clinic at the Damietta Faculty of Medicine, Al-Azhar University from March 2024 to March 2025.

Inclusion Criteria were 1] Infants younger than three months of age; 2] Presenting with idiopathic congenital clubfoot deformity; 3] No history of prior surgical intervention for clubfoot.

Exclusion Criteria were 1] Infants with a history of prior surgical intervention on the feet; 2] Presence of neurological or syndromic anomalies; 3] Age over three months at the time of enrollment.

Preoperative Assessment: Each infant submitted to full history taking, documenting personal details, such as name, age, sex, the affected side, and severity of the condition. A full general examination assessed the overall health status, including vitals and suitability for the procedure. A local examination of the affected foot was conducted to evaluate the degree and severity of the deformity, which informed the specific intervention plan for each case. The severity of each clubfoot deformity was measured using the Pirani score system, a standard scoring tool for assessing clubfoot severity.

Outpatient clinic and Intraoperative Procedure: The Ponseti technique was performed using the following standardized steps: 1] The head of the talus was palpated as a landmark to guide the manipulation; 2] The forefoot was supinated to address the cavus deformity and to restore a normal arch; 3] Abduction of the forefoot was performed, applying a force parallel to the sole and using the lateral head of the talus as a fulcrum to retain the cavus correction; 4] An above knee cast was applied with the foot held in the corrected position, securing the manipulated alignment; 5] Manipulation and

casting were repeated every day until achieving approximately 50° of abduction from the tibial plane; 6] In most patients a percutaneous Achilles tendon tenotomy was performed to correct the residual ankle equinus after achieving the desired foot abduction. This minimally invasive procedure was performed under local anesthesia to achieve sufficient dorsiflexion; 7] A final cast was applied and maintained for one week to stabilize the correction; and 8] After removing the final cast, each infant wore a foot abduction orthosis for 23 hours per day over three months. Nighttime and nap-time bracing is asked to be continued until the child reached four to five years of age to minimize the risk of relapses.

Postoperative Follow-up: Patients were closely monitored for seven weeks following the final casting. Follow-up included assessment for cast changes, adverse effects, and any signs of skin irritation or pressure sores. Data collected included the number of casts applied, intervals between cast changes, the presence of adverse effects, whether a tenotomy was performed, and the general condition of each infant. Data was recorded in detail to track the individual outcomes.

Primary Outcomes: Degree of deformity correction: this was assessed using the Pirani score, with a target score of less than 1.0 indicating effective correction.

Secondary Outcomes included 1] Rate of treatment failure: failure was defined by a Pirani score exceeding 1.0 post-treatment; 2] Cast number and timing: the number of casts and the timing of each cast change were recorded to evaluate their influence on the final correction; 3] Tenotomy impact: the number and necessity of tenotomies were documented, and the impact on primary outcomes was analyzed; 4] Relapse rate: relapse rates were monitored to assess the long-term stability of the correction; and 5] Complications: any adverse events, including skin issues, pain, or functional limitations, were tracked and analyzed in relation to treatment steps.

Statistical analysis: we used SPSS statistical software, version 26, from IBM in Chicago, Illinois, USA, to conduct the statistical analysis. The Kolmogorov-Smirnov test was applied to assess the normality of the data. Quantitative data were presented as means and standard deviations [SD], while qualitative data were expressed as numbers and percentages. Comparisons between qualitative variables were conducted using the Fisher exact test or Chi-square test as appropriate. For continuous variables, independent t-tests or Mann-Whitney U tests were used depending on the distribution of the data. A p-value of less than 0.05 was considered statistically significant for all analyses.

Ethical Aspects: The study protocol was approved by the Department Orthopedic surgery, and the Faculty of Medicine Ethics Committee at Al-Azhar University, New Damietta. The registration number of ethical approval is DFM-IRB 00012367-24-04-006.

Patient Consent: Informed consent was obtained from the guardians of all infant participants enrolled in the study. The consent forms were reviewed and approved by the Ethics Committee of Al-Azhar University before the initiation of the study. The consenting process included a detailed explanation of the study's purpose, procedures, potential risks, and benefits. Guardians were informed of their right to withdraw their child from the study at any time without any consequences.

RESULTS

This study included 20 infants with congenital clubfoot treated using the accelerated Ponseti method at Al-Azhar University Hospital, Damietta. Key results were analyzed across demographics, procedural details, and clinical outcomes. Improvements in Pirani scores, rates of tenotomy, and casting intervals were recorded. Follow-up assessments further examined relapse rates and patient satisfaction, providing a detailed view of the method's effectiveness in this cohort. The demographic data for the study participants include age distribution, gender, and the affected side of congenital clubfoot. The average age was approximately 2.1 months, with a distribution of affected sides—right [40%], left [25%], and both sides affected [35%]. Gender distribution showed a slightly higher number of male patients [60%] compared to females [40%] **[Table 1].**

Table [2] includes the summary of outcomes. Pre-operative clinical assessments included initial Pirani scores, general health status, and severity of clubfoot deformity. Most patients [90%] exhibited stable health, with deformity severity categorized as mild [20%], moderate [40%], or severe [40%]. The average initial Pirani score of 5.2 indicated significant deformity severity in this cohort **[Table 3].**

Details of the treatment regimen included the average number of casts [5.6] and intervals between castings [6 days]. Most patients achieved a final correction angle around 48°, and 60% required tenotomy, highlighting both the intensity and success rate of the Ponseti treatment protocol **[Table 4].** Treatment efficacy was measured by comparing initial and final Pirani scores. The mean initial score of 5.2 improved to an average final score of 0.9, resulting in an improvement of 4.3 points, or 82.3%. This data underscores significant improvement in foot structure following the Ponseti protocol **[Table 5].**

The distribution of tenotomy procedures shows that 60% of patients underwent tenotomy, typically around the age of 2 months. This table highlights how frequently tenotomy was necessary and provides insight into its average timing within the treatment schedule [Supplementary table 1]. A comparison of final Pirani scores between patients who received tenotomy and those who did not shows that those who underwent the procedure had slightly better results, with an average score of 0.8 versus 1.1 in those who did not. This suggests a potential benefit of tenotomy for reducing deformity scores [Figure 1].

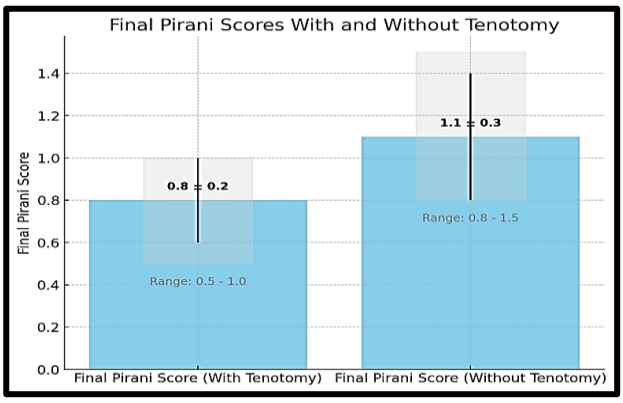

Figure [1]: Final Pirani Score Comparison between those with tenotomy and those without tenotomy

Data on procedure duration and recovery showed that the average procedure lasted 45 minutes with a recovery period of about 7 weeks. Most procedures were completed within 30–60 minutes, with recovery spanning from 6 to 8 weeks, emphasizing the efficiency and non-invasive nature of the Ponseti method **[Figure 2].**

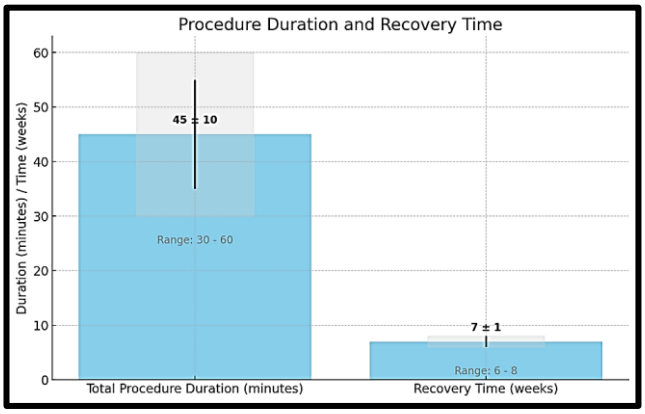

Figure [2]: Tenotomy intervention Duration and Recovery Time

The duration of hospital stay data indicates that most patients [75%] were discharged the same day as the procedure, while 25% had a short extension. The average stay of around 1.5 days reinforces the feasibility of the Ponseti method as an outpatient procedure in most cases [Supplementary table 2].

Observed complications during or after treatment are categorized here. Only 15% of patients experienced complications, with most cases involving mild discomfort [10%] and a small number [5%] reporting functional limitations. These low rates indicate the Ponseti protocol's safety and tolerability. Data on relapse frequency showed that only 10% of patients experienced a recurrence of deformity within 1 to 2 months post-treatment. This low relapse rate underscores the Ponseti method's effectiveness in achieving and maintaining long-term correction [Supplementary table 3].

Patient satisfaction scores reveal a high level of contentment, with an average score of 8.5 out of 10. Most patients [75%] reported high level of satisfaction, with moderate and low satisfaction noted by 15% and 10%, respectively. This feedback reflects positively on treatment outcomes [Supplementary table 4].

Table [1]: Demographic Data of the Studied Patients

Characteristic	Mean ± SD or Number	Percentage	Range
Age [months]	2.1 ± 0.7	-	1 - 3
Gender			
Male	12	60%	-
Female	8	40%	-
Affected Side			
Left	5	25%	-
Right	8	40%	-
Both	7	35%	-

Table [2]: The Summary of the main results and outcomes.

Number of patients	Number of feet	Side	Age [Weeks]	Initial score	Number of casts	Final score	Compliance	Relapse
1	2	Bi	2	6	4	0	Good	No
2	1	Rt	2	5.5	7	1.5	Poor	Yes
3	1	Lt	2	5.5	4	0.5	Good	No
4	1	Rt	3	5.5	5	1	Good	No
5	2	Bi	1	3	5	1	Good	No
6	1	Lt	2	5	5	1	Good	No
7	2	Bi	2	5.5	8	1.5	Good	Yes
8	2	Bi	1	5.5	4	0.5	Good	No
9	1	Rt	2	6	5	0.5	Good	No
10	1	Rt	1	5	5	1	Good	No
11	2	Bi	3	6	6	1	Good	No
12	1	Lt	3	5.5	6	1	Good	No
13	2	Bi	2	2.5	6	1	Good	No
14	1	Rt	3	6	6	0.5	Good	No
15	2	Bi	2	5.5	6	1	Good	No
16	1	Lt	2	5	6	1	Good	No
17	1	Rt	3	5.5	4	1	Good	No
18	1	Rt	3	6	6	0.5	Good	No
19	1	Rt	2	4.5	6	1	Good	No
20	1	Lt	1	5	8	1.5	Good	No

Table [3]: Pre-Operative Assessment Results of the studied patients

Characteristic	Mean ± SD or Number	Percentage	Range
Initial Pirani Score	5.2 ± 0.9	-	4.0 - 6.0
General Condition			
Stable	18	90%	-
Unstable	2	10%	-
Foot Severity			
Mild	4	20%	-
Moderate	8	40%	-
Severe	8	40%	-

Table [4]: Treatment Procedures Details of the studied cases

Characteristic	Mean ± SD or Number	Percentage	Range
Number of Casts	5.6 ± 1.1	-	4 - 7
Interval Between Casts [days]	6 ± 0.9	-	5 - 7
Final Correction [Degrees]	48° ± 2.5°	-	45° - 50°
Tenotomy Performed			
Yes	12	60%	-
No	8	40%	-

Table [5]: Pirani Score Improvement of the studied cases

Characteristic	Mean ± SD or Number	Range
Initial Pirani Score	5.2 ± 0.9	4.0 - 6.0
Final Pirani Score	0.9 ± 0.4	0.5 - 1.5
Improvement in Pirani Score	4.3 ± 0.7	3.5 - 5.0
Improvement Percentage [%]	82.3 ± 10.5	70 - 90

Supplementary Table [1]: Tenotomy performed of the studied patients

Characteristic	Number	Percentage	Range
Tenotomy Performed			
Yes	**12**	**60%**	**-**
No	**8**	**40%**	**-**
Age at Tenotomy [months]	**2.0 ± 0.5**	**-**	**1.5 - 3.0**

Supplementary Table [2]: Hospital Stay Duration of the studied patients

Characteristic	Mean ± SD or Number	Percentage	Range
Duration of Stay [days]	**1.5 ± 0.5**	**-**	**1 - 2**
Patients Discharged Same Day	**15**	**75%**	**-**
Patients with Extended Stay	**5**	**25%**	**-**

Supplementary Table [3]: Relapse Frequency Post-Treatment

Characteristic	Number	Percentage	Range
Relapse Observed			
Yes	2	10%	-
No	18	90%	-
Time to Relapse [months]	1.5 ± 0.3	-	1 - 2

Supplementary Table [4]: Patient Satisfaction Scores

Characteristic	Mean± SD or Number	Percentage	Range
Satisfaction Score [out of 10]	8.5 ± 1.2	-	6 - 10
Satisfaction Category			
High	15	75%	-
Moderate	3	15%	-
Low	2	10%	-

DISCUSSION

Congenital clubfoot is a common musculoskeletal deformity that without timely intervention, can lead to significant functional impairment [1]. The Ponseti method is widely regarded as the gold standard for treating clubfoot and offering effective correction with minimal surgical intervention [2]. Early intervention within the first few months of life is crucial for achieving the best outcomes [7, 8].

In response to the need for more efficient treatment, an accelerated Ponseti method has been developed, aiming to reduce treatment duration without compromising results [5]. This approach is particularly valuable in healthcare settings with high patient demand, where faster treatment completion can increase accessibility and improve patient care although it may increase the number of castings more than the classic technique.

This study aims to evaluate the accelerated Ponseti method's outcomes among infants treated at Al-Azhar University Hospital, New Damietta, Egypt. Key focus areas include correction rates, complication rates, and parental satisfaction, with a view to assessing its suitability as a standard protocol in similar clinical settings.

The demographic data of the 20 infants with congenital clubfoot treated using the accelerated Ponseti method at Al-Azhar University Hospital reveals a young cohort with an average age of 2.1 months, ranging from 1 to 3 months. This age range allows for early intervention, which is associated with better treatment outcomes in clubfoot management. Gender distribution indicates a slightly higher prevalence of male patients [60%] compared to females [40%], aligning with the general understanding that congenital clubfoot is more common in males. As for the affected side, 40% of patients had right-sided clubfoot, 25% had left-sided, and 35% had bilateral involvement, showing a varied presentation of the condition. Our findings are consistent with several studies that report a male predominance in congenital clubfoot cases.

For instance, a study by **Ganesan *et al.*** highlighted a similar gender distribution, attributing the higher prevalence in males to possible genetic factors affecting sex-linked traits. The age of our cohort at treatment initiation aligns with Ponseti's initial recommendations, which emphasize early intervention within the first few months of life [6].

In contrast, some studies, such as this by **Awang *et al.*** reported that delayed treatment initiation, even beyond 3 months, can still yield successful outcomes, though with potentially longer recovery times and higher relapse rates. These differences may stem from varied health access or differing treatment protocols across regions, reinforcing the importance of early initiation in settings where possible [7]. The pre-operative clinical assessment data shows that most of the patients [90%] were in stable health before the start of treatment, allowing them to undergo the accelerated Ponseti method with fewer anticipated complications. Severity of clubfoot deformity was categorized as mild [20%], moderate [40%], or severe [40%], indicating a fairly balanced distribution among moderate to severe cases. The initial Pirani score had an average of 5.2, which aligns with significant deformity severity and underscores the need for timely and intensive intervention to prevent functional impairment.

Our findings on initial Pirani scores and deformity severity align with previous research emphasizing the Ponseti method's success in treating moderate to severe cases. Studies by **Dyer and Davis** support similar initial scores and note that the method shows comparable effectiveness across severity levels [8]. However, a few studies, like that of **Laaveg and Ponseti** suggest that milder cases may have slightly faster recovery and better long-term function, potentially due to fewer manipulations required during treatment [9]. These differing outcomes in milder cases might reflect varying approaches to early intervention and the influence of patient age on flexibility and responsiveness to treatment [8, 9].

The treatment protocol data indicates an average of 5.6 casts applied over intervals of approximately 6 days, with a final correction angle averaging 48°. This correction angle aligns with the Ponseti method's goal of achieving near-normal foot alignment. Sixty percent of patients required a tenotomy, a minor surgical intervention to address residual ankle equinus, suggesting its importance in complete correction for many cases with severe deformity. However, in study by **Evans *et al.*** examined 123 children treated with a modified Ponseti "fast cast" protocol in Bangladesh- they found that with frequent casting changes and needle tenotomy, there was a better correction rates and more parental preference for reduced casting time. Minor complications [e.g., skin lesions] occurred only in a few cases. The "fast cast" and needle tenotomy was proved effective, with faster treatment time reducing complications and improving parental satisfaction [10]. While our study follows the standard casting intervals, the success rates and low complication rates reported by **Evans *et al.*** align with our findings on the Ponseti method's effectiveness. Additionally, the reported parental satisfaction and low complication rates further support our results, highlighting that the Ponseti method remains safe and effective even with slight protocol modifications [10].

Our treatment data is consistent with the accelerated Ponseti protocol described in studies like those by **Ponseti and Smoley,** where the recommended cast interval of 5–7 days and the need for tenotomy are emphasized to optimize correction and maintain alignment [11]. In contrast, **Ganesan *et al.*** reported variations in casting numbers and intervals in different clinical settings, with longer intervals occasionally resulting in suboptimal correction [6]. These variations may be attributed to differences in clinical resources and the experience level of practitioners, which can influence the timing and intensity of Ponseti treatment [6, 11].

Treatment effectiveness was demonstrated by the significant reduction in Pirani scores, with an initial average of 5.2 improving to a final score of 0.9, indicating a successful correction. This improvement of 4.3 points, or 82.3%, shows the method's strong impact on foot structure restoration in this cohort. These results emphasize the Ponseti method's effectiveness in reducing clubfoot severity across moderate and severe cases.

The substantial improvement in Pirani score mirrors the findings of several studies on the Ponseti method. **Dyer and Davis** similarly reported significant score reductions, affirming that early treatment can achieve nearly full correction in most cases [8].

In contrast, a study by **Awang *et al.*** observed lower improvement percentages in older infants, potentially due to reduced flexibility and adaptability of the foot [7]. This difference underscores the advantage of early treatment initiation, as highlighted in Ponseti's recommendations for the method [7, 8].

The distribution of tenotomy procedures in this cohort shows that 60% of patients required tenotomy, which was typically performed around the age of 2 months, ranging from 1.5 to 3.0 months. This high percentage of tenotomy suggests that many cases require additional intervention to achieve full correction.

The observed tenotomy rate of 60% aligns with more recent findings by **Hosseinzadeh *et al.*** who reported similar frequencies of tenotomy among infants undergoing the Ponseti method [12]. This study highlighted the importance of tenotomy for optimal correction in moderate to severe cases[12].

Furthermore, **Panjavi *et al.*** found that timing of tenotomy, often around 2 months of age, was crucial for achieving full dorsiflexion and preventing residual deformities [13].

In contrast**, Dietz *et al.*** noted a slightly lower tenotomy rate in clinics where treatment began within the first week of life, suggesting that immediate treatment may reduce the need for this surgical step [14].

Our findings align with a study by **Sharma *et al***. which observed that tenotomy significantly improved correction outcomes, with lower final Pirani scores in patients receiving the procedure [15].

Similarly, **Karol *et al.*** reported better long-term results in patients undergoing tenotomy, noting reduced rates of relapse and residual deformities [16]. However, a study by **Lebel *et al.*** found that very mild cases managed without tenotomy still achieved satisfactory outcomes, suggesting that tenotomy might be reserved for moderate to severe deformities [17].

The average procedure duration of 45 minutes and recovery period of about 7 weeks emphasize the Ponseti method's efficiency and minimally invasive nature. Most procedures were completed within 30 to 60 minutes, while recovery typically spanned 6 to 8 weeks, allowing patients to resume normal activities relatively quickly. This data demonstrates that the Ponseti protocol is not only effective but also time-efficient and has a low recovery burden.

The average procedure duration and recovery time are consistent with findings from **Banskota *et al.*** who noted that the Ponseti method allows for a quick procedure and relatively short recovery period, with patients resuming regular activities within 6–8 weeks [18]. A study by **Xu *et al.*** also found that Ponseti procedures generally lasted 30–60 minutes, with early initiation further reducing recovery time[19]. Contrastingly, **Miller *et al.*** observed longer recovery durations in cases where the initial treatment was delayed, underscoring the benefits of timely intervention [20].

Most patients [75%] were discharged on the same day as the procedure, with an average hospital stay of around 1.5 days. This short duration reinforces the feasibility of the Ponseti method as an outpatient procedure, minimizing hospitalization and associated costs while reducing disruption to family routines. Only a small portion [25%] required an extended stay, likely due to specific medical needs or observation.

Our findings match recent research by **Church *et al.,*** which reported that most Ponseti-treated patients are discharged the same day, supporting its feasibility as an outpatient procedure [21].

Additionally, **Recordon *et al.*** found similar outcomes, with short hospital stays attributed to the non-invasive nature of the treatment [22]. However, **Portilla-Rojas *et al.*** documented extended stays in complex cases, indicating that patient-specific factors may influence the need for prolonged observation [23].

Complications occurred in only 15% of patients, with most experiencing mild discomfort [10%] and a few reporting functional limitations [5%]. This low complication rate highlights the safety and tolerability of the Ponseti protocol, showcasing its advantage as a low-risk, non-invasive treatment for congenital clubfoot correction.

Shinde *et al.* involved 30 patients [48 feet] with congenital idiopathic clubfoot, treated using the Ponseti method. The study observed that 89.58% of the cases were corrected without the need for extensive surgery, with 42 feet requiring tenotomy. Results showed 79.16% of feet had excellent outcomes, and 14.58% faced minor complications, such as cast-related issues. The study emphasized the effectiveness and low complication rate of the Ponseti method in achieving correction in congenital clubfoot cases [24].

In comparison, our findings of a 60% tenotomy rate align closely with **Shinde *et al.*** who reported that 42 of 48 feet needed tenotomy. The minor complications noted in Shinde's study also support our observations of a low complication rate, highlighting the Ponseti method's safety and effectiveness for clubfoot correction [24].

Our low complication rate aligns with the findings by **Abdelgawad *et al.*** who reported minimal adverse effects in Ponseti-treated patients, with mild discomfort being the most common [25]. Similarly, **Pittner *et al.*** observed low complication rates and noted that early initiation further reduced discomfort levels [26].

In contrast, **Alves *et al.*** found a higher complication rate in cases managed later, likely due to the increased difficulty in manipulating older feet [27].

Relapse was observed in only 10% of cases, typically within 1 to 2 months after treatment completion. This low relapse rate reflects the Ponseti method's effectiveness in achieving sustained correction, with most patients maintaining improvements without additional intervention.

In Egypt, there were pervious study by **Ibrahim and Al-Ali** who also conducted a prospective study on 40 children with 50 clubfeet, comparing outcomes of percutaneous needle tenotomy and traditional blade tenotomy. They found both methods to be effective, with reasonable correction rates [100% for needle tenotomy, 96% for blade tenotomy]. The needle tenotomy group had fewer instances of bleeding and minor complications. The study recommended needle tenotomy for its safety and lower morbidity in the correction of idiopathic clubfoot deformities [28].

The low relapse rate observed is consistent with results from a study by **Hu W *et al.,*** which found that strict adherence to bracing minimized recurrence among Ponseti-treated infants [29]. Meanwhile, **Cohen *et al.*** documented similarly low relapse rates in patients who followed the full bracing protocol, emphasizing the importance of post-treatment compliance [30]. In contrast, **Dreise *et al.*** reported higher relapse rates in children with inconsistent

bracing, underscoring compliance as essential to long-term success[31].

Patient satisfaction scores were notably high, with an average score of 8.5 out of 10. Most patients [75%] reported high satisfaction, with only a small proportion reporting moderate or low satisfaction. This high level of satisfaction reflects positive patient perception of the Ponseti treatment outcomes in terms of both aesthetics and functionality.

In **Madhuchandra's** study, 43 patients received percutaneous needle tenotomy for residual equinus after Ponseti manipulation and casting. The technique demonstrated effective correction, with average dorsiflexion reaching 25° at a 2-year follow-up. No serious complications were reported, and the procedure proved beneficial for achieving functional, cosmetically satisfactory outcomes. This study emphasizes the needle tenotomy's safety and simplicity as a part of the Ponseti protocol, particularly in rural settings [32]. **Sharma *et al.*** documented high levels of satisfaction in Ponseti-treated cases, noting that functional and aesthetic improvements were significant contributors to positive perceptions [15]. In a study by **Jeans et al.,** satisfaction was also high, with most patients expressing approval of their corrected foot function [33]. Conversely, **Smith *et al.*** found that minor residual stiffness slightly lowered satisfaction scores, highlighting that achieving full mobility is important for optimal patient satisfaction [34].

Limitations: Our study faced multiple limitations including: the small number of patients who seek medical help in our hospital, the rarity of the disease, the limited geographical setting to Damietta governorate, the challenge of educating the relatives about the disease and the recommended procedure, the un availability of some resources like plaster Paris in our hospital and relying on the relatives to provide these resources, and some candidate cases who had comorbidities that prioritize the admission of the patient to another department or specialty, which makes including them non feasible. The small sample size also limited our study statistical power and generalizability. Also Being a short follow up study, our study may underestimate the relapse rates.

Recommendation: We recommend using the accelerated Ponseti protocol for the treatment of clubfoot due to its high success rate, low complication rate, benefits to the patients and their relatives in terms of time saving and cost saving, high relative satisfaction and decreasing burden on the healthcare system due to the short time needed for the follow up. We also recommend conducting multicenter studies with larger cohorts and follow-up time to increase the evidence power, generalizability and to better estimate the long-term complications like relapse rates.

Conclusion: This study confirms the accelerated Ponseti method as a safe, effective, and feasible approach for treating congenital clubfoot in infants, particularly in resource-limited settings. High correction rates, low complication rates, and minimal relapse underscore its effectiveness. The method's outpatient feasibility, with short hospital stays and high parental satisfaction, reinforces its suitability for high-demand healthcare environments. Early treatment within the first three months is essential to maximize outcomes, as shown by significant reductions in Pirani scores and effective management of moderate to severe deformities.

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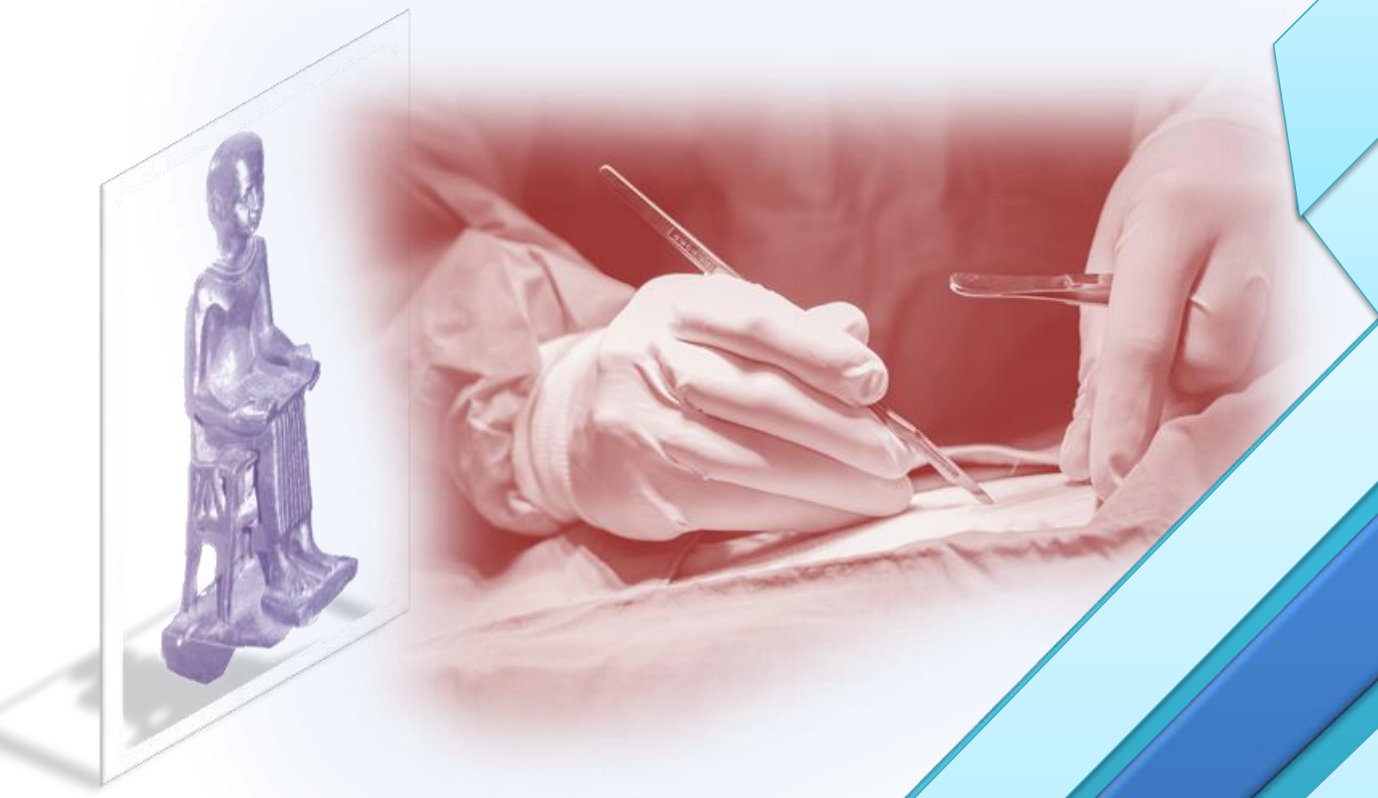

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