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A COMPARATIVE STUDY OF STANDARD AND ACCELERATED PONSETI METHODS IN TREATING IDIOPATHIC CONGENITAL TALIPES EQUINOVARUS

SUBHASH RAWATE [1], PRAVIN JANGDE [2], DIWAKAR KUMAR BHUARYA [3], CHANDRASHEKHAR INDORIA[4*]

[1] Associate professor, Department of Orthopedics, Bharat Ratna Late Shree Atal Bihari Vajpayee Memorial Medical College, Rajnandgaon, Chhattisgarh, India
[2] Associate professor, Department of Orthopedics, Late Shri Lakhiram Agrawal Memorial Govt. Medical Collage, Raigarh, Chhattisgarh, India
[3] Senior Resident, Department of Orthopedics, Bharat Ratna Late Shree Atal Bihari Vajpayee Memorial Medical College, Rajnandgaon, Chhattisgarh, India
[4] Associate professor, Department of Pathology, Bharat Ratna Late Shree Atal Bihari Vajpayee Memorial Medical College, Rajnandgaon, Chhattisgarh, India

Corresponding Author: Chandrashekhar Indoria
Department of pathology, BRLSABVM GovernmentMedical College, Pendri, Rajnandgaon, Chattisgarh,India,491441
Mobile number--+918818967626,+919406355748
E-mail id—dr.csindoria@gmail.com

Abstract

Background: Idiopathic congenital talipes equinovarus (CTEV), or clubfoot, is a common congenital deformity affecting approximately 3.25 per 1,000 live births in India. The Ponseti method, a gold standard for CTEV management, offers high efficacy through sequential manipulation and casting, with the standard protocol involving weekly cast changes. The accelerated Ponseti method, reducing casting intervals to 3–5 days, has been proposed as a time-efficient alternative, particularly for resource-limited settings.
Patients and Methods: This prospective, comparative study evaluated the efficacy of standard versus accelerated Ponseti methods using the Pirani scoring system. Ninety children with idiopathic CTEV were randomized into standard (weekly casting) or accelerated (biweekly casting) groups.
Results: Both treatment methods demonstrated equivalent improvements in Pirani scores and similar rates of Achilles tenotomy and relapse over one year. However, the accelerated Ponseti methods significantly reduced treatment duration ($p < 0.0001$), addressing logistical and economic challenges while maintaining comparable clinical outcomes.
Conclusion: These findings affirm the accelerated Ponseti method as an effective alternative, particularly for low-resource settings, by enhancing treatment accessibility and adherence without compromising correction quality. Future research with larger cohorts and extended follow-ups is warranted to validate long-term benefits.

Keywords: Ponseti Techniques, Accelerated Ponseti Techniques, Congenital Talipes Equinovarus, Pirani scoring system.

Introduction

Idiopathic congenital talipes equinovarus (CTEV), commonly referred to as clubfoot, is a complex congenital deformity with a global incidence of approximately 1 in 1,000 live births [1]. However, the incidence varies significantly based on ethnicity and geographic location. In India, the pooled prevalence of CTEV is estimated at approximately 3.25 per 1,000 live births (95% CI: 2.15–4.35) [1]. This condition is characterized by four distinct deformities: **cavus** (elevated medial longitudinal arch), **adduction** (medial deviation of the forefoot), **varus** (inversion of the hindfoot), and **equinus** (plantar flexion of the ankle) [2]. Together, these abnormalities result in a rigid, non-plantigrade foot. If untreated, CTEV can lead to severe functional impairment, chronic pain, and progressive musculoskeletal deformities, significantly impacting quality of life and mobility[3].

The advent of the **Ponseti method** has revolutionized the management of idiopathic CTEV, with reported success rates exceeding 90%. This method employs a structured protocol of serial manipulations and weekly cast applications to progressively correct the deformity. A critical component of the Ponseti protocol is percutaneous Achilles tenotomy, performed to address residual equinus deformity, followed by the application of an abduction orthosis (brace) to maintain the corrected alignment and prevent relapse[4]. By minimizing the need for extensive surgical interventions, the Ponseti method has emerged as the gold standard in the management of CTEV. Its widespread adoption underscores the importance of early diagnosis and prompt initiation of treatment to optimize functional outcomes and mitigate long-term disability associated with this condition. The standard Ponseti method generally employs weekly casting intervals; however, the accelerated Ponseti method reduces these intervals to 3–5 days, potentially resulting in a shorter treatment duration without negatively impacting outcomes [5]. Accelerated treatment protocols are particularly relevant in low-resource settings, where logistical challenges, along with psychological and financial pressures, often hinder the effectiveness of the standard approach.

This study aims to compare the efficacy of the standard and accelerated Ponseti methods, as evaluated using the modified Pirani scoring system. The Pirani Score is a straightforward and reliable instrument for assessing the severity of clubfoot and monitoring progress in its evaluation and treatment [6]. This scoring system employs various views of the foot to enhance the visualization of issues related to the underlying soft tissue and bony anatomy. The assessment of the foot can be completed in less than one minute, and it does not require specialized technical equipment [7]. By evaluating these parameters, this research seeks to determine the feasibility and benefits of implementing the accelerated protocol across diverse clinical settings.

Materials and Methods

Study Design

A prospective, comparative study was conducted at the Department of Orthopaedics, Bharat Ratna Late Shri Atal Bihari Vajpayee Memorial Government Medical College, Rajnandgaon, India, from January 2022 to January 2024. Institutional Ethical Committee approval was obtained, and written informed consent was secured from all participants' guardians.

Participants

Inclusion Criteria:

- Children (birth–2 years) with idiopathic congenital talipes equinovarus (CTEV), unilateral or bilateral, and no associated anomalies or prior treatment.

Exclusion Criteria:

- Patients >2 years, history of prior treatment, syndromic or secondary CTEV, or non-compliance with follow-up.

Participants were randomized into:

- **Group A (Standard Ponseti Group):** Weekly Manipulations and cast changes.
- **Group B (Accelerated Ponseti Group):** Twice weekly Manipulations and cast changes.

Treatment Protocol

Both groups underwent Ponseti method-based management. Initial correction targeted cavus via gentle elevation and abduction of the first metatarsal, with counter-pressure on the talus. Casts were applied above the knee:

- SPG: Weekly changes.
- APG: Changes every 3–4 days.

Tendo Achilles Tenotomy (TAT) was performed as needed, followed by a three-week final cast and subsequent bracing. A locally fabricated foot abduction brace was utilized to maintain alignment, with adjustments for:

- Unilateral: 60–70° external rotation (clubfoot) and 30–40° (normal side).
- Bilateral: 70° external rotation on both sides.

Bracing continued until age 3–4 years to sustain correction and prevent relapse.

Outcome Measures

Primary outcomes were assessed using the Pirani score, which rates six clinical signs (0 = normal, 0.5 = mild, 1 = severe) across midfoot and hindfoot (total score: 0–6). Scores were recorded at key intervals:

- Baseline.
- Post-final cast.
- Post-tenotomy.
- Six months and one year post-tenotomy.

Secondary outcomes included treatment duration, tenotomy incidence, and relapse rates at one-year follow-up.

Statistical Analysis

Data were analyzed using software IBM SPSS. Continuous variables (e.g., Pirani scores, treatment duration) were presented as means ± SD and compared using independent t-tests. Categorical variables (e.g., tenotomy rates, relapse) were analyzed using chi-square tests. $P < 0.05$ was considered statistically significant.

Results

A total of 90 patients, accounting for 154 affected feet, were enrolled in the study. Participants were evenly distributed between the two groups: Standard Ponseti Group (Group A) and Accelerated Ponseti Group (Group B), with 45 patients in each group. Of these, 64 cases were bilateral (30 in Group A, 34 in Group B), and 26 were unilateral (15 in Group A, 11 in Group B). Baseline characteristics, including age and laterality, showed no statistically significant differences between the groups, ensuring demographic and clinical comparability.

Treatment Outcomes

Both groups exhibited significant improvements in Pirani scores, reflecting effective correction of the deformities. The extent of improvement was comparable between the groups, with no statistically significant intergroup differences, indicating that both the standard and accelerated protocols were equally efficacious.

The incidence of Tendo Achilles Tenotomy (TAT) was similar across both groups, demonstrating no significant difference in the necessity for this procedure between the two treatment protocols. Similarly, the total number of casts required for deformity correction did not vary significantly between Group A and Group B.

Treatment Duration

A notable difference was observed in the total treatment duration. Patients in Group B, treated with the accelerated protocol, completed their course significantly faster than those in Group A ($p < 0.0001$), highlighting the efficiency of the accelerated approach without compromising treatment outcomes.

Relapse Rates

At the one-year follow-up, relapse rates were comparable between the two groups, underscoring the long-term effectiveness of both treatment protocols in maintaining the correction achieved.

Table 1: Comparative Outcomes of the Standard Ponseti Method and Accelerated Ponseti Method in the Treatment of Idiopathic CTEV

Outcome Measure		Group A Standard Ponseti (Mean ± SD or %)	Group B Accelerated Ponseti (Mean ± SD or %)	p-value
Sample Size (n)		45	45	--
Age (in days)		110±31.42	120±47.12	0.10
Unilateral		15	11	0.48
Bilateral		30	34	0.36
Baseline Pirani Score (precast)	**Left foot**	4.1±1.32	4.4±1.58	0.57
	Right foot	4.2±1.43	4.4±1.26	0.21
Final Pirani Score(at tenotomy/ end of treatment)	**Left foot**	0.4±0.12	0.4±0.14	0.06
	Right foot	0.4±0.09	0.4±0.06	0.80
After 1 year	**Left foot**	0.25±0.03	0.25±0.02	0.16
	Right foot	0.20±0.05	0.20±0.04	0.15
Duration of treatment -1 st cast to tenotomy interval (days)		34.52±9.32	16.86±5.12	**<0.001**
Achilles Tenotomy Rate (%)		78.25%	69.81%	0.25
Relapse Rate at 12 Months Post-Treatment (%)		15.9%	15.2%	0.11
Number of cast needed		7.6±2.4	8.2±3.7	0.08

Discussion

Significance of Early Correction

Early and effective correction of CTEV is paramount for preserving normal foot function and enabling optimal developmental outcomes. The Ponseti method remains the cornerstone of CTEV management due to its high efficacy and non-invasive nature. Nevertheless, practical challenges, including significant travel distances to treatment centers and the associated psychological and economic burdens on families, particularly in resource-limited settings, necessitate the exploration of more time-efficient approaches, such as the accelerated Ponseti technique.

Treatment Duration and Compliance

The accelerated Ponseti method offers a significant reduction in treatment duration compared to the standard protocol, a finding corroborated by multiple studies. Meta-analyses by Alsayed et al [8] and Savio & Maharjana et al [9]reported reductions of 19.2 days and 24.25 days, respectively. Similar outcomes have been consistently observed in studies by Radler et al. [10], Elgohary et al[11], Kumar et al [12], Islam et al [13], Singh et al [14], and Ahmed et al [15]. This reduction in treatment duration is of substantial clinical relevance, as it enhances patient compliance by minimizing the frequency of hospital visits, travel-related stress, and economic costs. Families are relieved of prolonged disruptions to their daily routines, including work commitments and educational responsibilities. These logistical advantages translate to higher adherence to treatment protocols, thereby potentially improving clinical outcomes.

Efficacy of Deformity Correction

Both standard and accelerated Ponseti techniques demonstrated comparable efficacy in deformity correction, as evidenced by similar improvements in Pirani scores—a validated and widely utilized metric for quantifying the severity of clubfoot. These results align with the research conducted by Singh et al [14], Savio & Maharjana et al [9], and Alsayed et al [8], affirming the non-inferiority of the accelerated protocol in achieving effective correction.

Interestingly, some studies, including those by Ahmed et al [8] and Hussain et al[16], reported statistically significant faster improvements in Pirani scores within the accelerated treatment groups. This suggests that the accelerated protocol may not only reduce the treatment duration but also expedite the initial clinical improvement, an important consideration in achieving patient and caregiver satisfaction.

Tenotomy Rates and Relapse Prevention

The present study observed no significant differences in Achilles tenotomy rates or relapse rates between the two groups, aligning with findings from previous investigations [16, 17, 18]. However, relapse prevention remains heavily reliant on adherence to post-correction bracing protocols. Proper caregiver education on the correct use of braces, rigorous follow-up schedules, and addressing socioeconomic barriers to compliance are critical for sustaining long-term correction.

Studies have emphasized the importance of consistent brace use in preventing recurrence, highlighting it as a determinant of treatment success [19,20]. Enhancing caregiver awareness through structured educational programs and simplifying brace designs may further bolster compliance rates.

Psychosocial and Economic Implications

The accelerated Ponseti technique offers substantial psychosocial and economic benefits, particularly in resource-limited environments. By reducing the frequency of hospital visits and the overall treatment duration, this method alleviates the financial and logistical challenges faced by families. These advantages are particularly relevant in rural and underserved areas, where healthcare access is constrained, and the opportunity costs of prolonged treatments are disproportionately high.

In addition to its clinical merits, the accelerated protocol minimizes the psychological burden on caregivers by expediting the treatment process, fostering greater engagement, and improving the overall experience of care delivery.

Limitations and Recommendations

This study is limited by its relatively small sample size and short follow-up duration, which restrict the ability to draw robust conclusions about long-term outcomes. Future research should include larger, multicenter cohorts with extended follow-up to evaluate the durability of corrections and their implications for functional outcomes and quality of life.

Conclusion

The accelerated Ponseti method provides a safe and effective alternative to the standard protocol, offering comparable outcomes in deformity correction while significantly reducing treatment duration. By addressing logistical, psychological, and financial barriers, this approach represents a significant advancement in the management of CTEV, particularly in resource-constrained settings. Continued efforts to refine and validate this protocol through large-scale studies and longer follow-ups will further establish its role in optimizing patient outcomes.

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