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Impact Of COVID-19 Pandemic on Management of Congenital Talipes Equinovarus by Ponseti Technique: A Multispeciality Tertiary Hospital Based Retrospective Analytical Study in Northeast India

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ABSTRACT

Background: Congenital talipes equinovarus (CTEV), commonly known as clubfoot, is a common congenital orthopedic deformity requiring early and continuous treatment. The Ponseti technique is the current gold standard, achieving successful correction in more than 90% of cases when regular casting, timely Achilles tenotomy, and strict follow-up with Foot Abduction Orthoses (FAO) are maintained. The COVID-19 pandemic significantly disrupted routine healthcare services worldwide, including pediatric orthopedic care. Lockdown measures, travel restrictions, and reduced healthcare accessibility affected continuity of clubfoot treatment programs. **Methods:** A retrospective analytical study was conducted at a multispecialty tertiary care hospital in Guwahati, Northeast India. Clinical records of children with CTEV who initiated Ponseti treatment before March 25, 2020 were reviewed. Data collected included demographic characteristics, Pirani scores at different treatment phases, number of serial cast applications, Achilles tenotomies performed, follow-up patterns, and FAO compliance. Service delivery parameters before and during the COVID-19 pandemic were compared. Statistical analysis was performed using SPSS version 20.0, with statistical significance set at p0.05. **Results:** A total of 2,034 children with CTEV were registered during the study period, of whom 785 (38.6%) completed treatment under the Ponseti protocol. Overall outpatient attendance declined by 77.23% during the pandemic. The mean number of daily casting cases decreased from 19.63 to 7.22 per day, while tenotomy procedures declined from 10.43 to 2–5 per week. Follow-up interruptions averaging 8.27 ± 2.92 months resulted in a significant increase in mean Pirani score from 1.125 ± 0.81 before lockdown to 2.077 ± 1.17 at the first post-lockdown visit ($p <$ 0.05). Additionally, 28.4% of children were unable to continue FAO use, leading to recurrence of deformity and the need for additional casting. **Conclusion:** The COVID-19 pandemic significantly disrupted clubfoot treatment services, resulting in delayed casting, reduced follow-up, orthosis non-compliance, and partial relapse of deformity. Ensuring continuity of Ponseti programs, improving access to orthotic devices, and strengthening decentralized care services are essential to maintain treatment outcomes during future public health emergencies.

Keywords*: Congenital talipes equinovarus, clubfoot, Ponseti technique, COVID-19 pandemic, Pirani score, treatment interruption..*

INTRODUCTION

Congenital talipes equinovarus (CTEV), or clubfoot, is the most common orthopedic deformity needing intensive treatment[1], affecting about 1.2 per 1,000 live births[2]. Conservative treatment is the first choice, typically involving manipulation and casting[3–6]. In Brazil, the Kite method[3] was long used, requiring many months of treatment and often

ending in partial corrections, necessitating surgery. Limited healthcare budgets and long surgical wait times have contributed to children walking with untreated clubfoot.

The Ponseti technique is the current gold standard for correction. It involves weekly manipulations and casts, an Achilles tenotomy in most cases to correct equinus deformity, and maintenance using Foot Abduction Orthoses (FAOs). Follow-ups are required weekly during correction and at intervals during maintenance[7]. The Ponseti method has a primary correction success rate exceeding 90%[8], and in 80–90% of cases, an Achilles tenotomy is required[8–9].

In 2010, our multi-specialty tertiary care hospital in Guwahati, Assam, India restructured its approach of managing congenital talipes equinovarus (CTEV) by establishing a dedicated clinic with specific outpatient days for clubfoot patients. This reorganization improved care efficiency, reduced waiting times, and enhanced follow-up consistency. A detailed record-keeping system was introduced, documenting clinical progress at each visit, including the Pirani score to assess deformity severity. This structured monitoring enabled timely treatment adjustments and contributed to improved outcomes and better patient compliance.

Impact of COVID-19

The outbreak of the COVID-19 pandemic had a profound impact on routine healthcare services worldwide, including the management of congenital talipes equinovarus (CTEV), commonly referred to as clubfoot.[9-13] Following the World Health Organization's declaration of a global pandemic on March 11, 2020, the Government of India imposed a strict nationwide lockdown starting March 25, 2020. [14,15] In Assam, a state with over 35 million residents, stringent restrictions such as inter-district travel bans significantly reduced access to specialized tertiary care centers. As a result, non-essential medical services, including pediatric orthopedic care, were severely disrupted.[16,17] The Indian Orthopaedic Association recommended postponement of elective surgeries, while orthotic device availability declined, affecting many children in the crucial maintenance phase of treatment. At the same time, the British Orthopaedic Association reclassified Achilles tenotomy procedures as non-urgent on March 2020. Due to these limitations, many families missed follow-ups, leading to a rise in neglected cases.[18-20] The current study retrospectively evaluates the records to understand pandemic's impact on Ponseti method outcomes.

AIMS AND OBJECTIVES

The primary aim of this study was to assess the impact of the COVID-19 pandemic on the established clubfoot treatment program at our tertiary care center. Secondary objectives included identifying key challenges encountered, proposing viable solutions, and suggest strategies to enhance the program's efficacy.

MATERIALS AND METHODS

This study was conducted Gauhati Medical College and Hospital, Guwahati, Assam,India, and included data from all patients who began treatment for congenital talipes equinovarus (CTEV) before March 25, 2020. Information collected included Pirani scores recorded before and after the COVID-19 lockdown, follow-up patterns, and usage of foot abduction orthoses. Additional demographic and clinical data such as the child's age at presentation, gender, affected side (unilateral or bilateral), number of cast applications and Achilles tenotomies performed, and reasons for treatment non-compliance were also documented. Data analysis was carried out using SPSS software version 20.0. Statistical significance was set at a p-value of <0.05 to determine meaningful differences in outcomes related to the pandemic's impact on treatment.

RESULTS AND OBSERVATIONS

A total of 2,034 children with Congenital Talipes Equinovarus (CTEV) were registered for treatment during the study period. Of these, 785 children (38.6%) managed to complete treatment under the Ponseti protocol. The remaining 1,249 patients failed to complete the treatment, 380 children (30.4%) of which were classified as dropouts. Out of the dropouts, nearly half 187 (48.7%) patients stopped treatment before COVID-19 started. The other half of 193 (51.3%) patients stopped after it began. This near-equal split of dropouts before and after the pandemic, along with the overall reduction in follow-up attendance, suggests that the pandemic had a substantial negative impact on treatment continuity and access to care.

Service Delivery before the COVID-19 Pandemic

Before the pandemic, CTEV services were delivered at full operational capacity on a regular basis. The number of children receiving serial Ponseti casting ranged from 10-35 per day (mean=19.63 children/day). Fresh enrolments were consistent, with 18-26 children in each month.During the maintenance phase, when children require continued use of Foot Abduction Orthoses (FAO) and regular monitoring, 15 to 40 patients attended daily (mean=26.6 ± 3.2 children/day), with a mean attendance of. Achilles Tenotomy, an essential step in correcting equinus deformity, was performed 7 to 13 times per week (mean=10.43 ± 1.3 /week). These statistics indicate a well-functioning clinic with regular follow-up and adherence to standard treatment protocols prior to the pandemic.

Impact of the COVID-19 Pandemic on CTEV Services

Following the onset of the pandemic, there was a marked and immediate decline in service utilization. Overall outpatient attendance for CTEV care decreased by 77.23% revealing the profound disruption caused by the pandemic, and these figures fell further during the strict lockdown phase to a staggering figure of 91.41% compared to pre-pandemic levels underscoring the effect of pandemic on the essential orthopedics services.The number of children receiving serial casting dropped significantly to 3–12/day (mean=7.22 ± 1.8 children/ day), with a mean of. Monthly enrolment declined sharply to only 3–5 new patients, reflecting reduced access, delayed presentation, and caregiver reluctance to travel during the pandemic.

Follow-up visits during the maintenance phase were also severely affected, decreasing to 8–16 patients/day. Similarly, the number of Achilles tenotomies performed reduced to 2–5 procedures/week. These findings clearly demonstrate that the pandemic resulted in widespread disruption of essential CTEV services across all phases of treatment.

Treatment Interruption and Recurrence

A total of 247 children (28.4%) were unable to renew or continue use of foot abduction orthoses during the pandemic period. The most commonly reported reasons were transport restrictions, financial difficulties, and limited access to healthcare facilities. As a result, these children experienced clinical recurrence or worsening of deformity.Among these 247 patients, 23.4% required restarting treatment, including manipulation and serial casting after a prolonged interruption ranging from 6 to 19 months, indicating significant delays in follow-up.

In comparison, children who were able to continue using orthoses, even with less frequent follow-up, showed a **smaller increase in deformity severity**. In this group, the **mean increase in Pirani score was 0.69 ± 0.75** over an average interruption period of **10.86 ± 4.88 months**. The relationship between the duration of interruption and increase in Pirani score was **weak and not statistically significant** ($r = 0.31$, $p > 0.05$), suggesting that factors other than time alone—such as compliance, home care practices, and loss of supervision—also played an important role in deformity progression.

Follow-up Patterns During the Pandemic

The pandemic significantly altered follow-up patterns. Most families were unable to maintain weekly visits, which are recommended during active correction and early maintenance phases. Only five families living close to the hospital were able to continue weekly follow-up. The majority of patients attended the clinic once every two weeks or once every three weeks, depending on travel feasibility and local restrictions.

During the pandemic period, 153 children received treatment, with a mean age of 6.79 ± 1.72 months. Of these, 126 children (82.4%) were male, and 27 (17.6%) were female. Bilateral CTEV was present in 92 children, while among unilateral cases, right-sided involvement was more common. This demographic distribution was similar to pre-pandemic patterns.

Limb-Level Analysis (n = 313 Limbs)

Limb-based analysis included 313 treated limbs. The mean initial Pirani score was 5.32 ± 0.97, indicating that most children presented with severe deformity. Prior to the lockdown, children received an average of 8.25 ± 6.33 serial castings.

Just before the lockdown, the mean Pirani score had reduced to 1.125 ± 0.81, which approached but did not reach statistical significance ($p = 0.052$). During the lockdown period, the mean delay in follow-up was 8.27 ± 2.92 months. At the first post-lockdown visit, the mean Pirani score increased significantly to 2.077 ± 1.17 ($p < 0.05$). The average increase in score during the interruption period was 0.95 ± 0.79.

No significant association was found between score progression and age or gender. Most families reported removing casts at home due to inability to attend clinics. After services resumed, restarting treatment required 3 to 10 additional casts, with a mean of 5.6 ± 3.73 castings. A total of 22 Achilles tenotomies were performed, and 19 children initiated FAO use following tenotomy (Table 4).

Analysis of Pirani Scores Across Treatment Phases

Pirani scores were used as an objective measure to assess the severity of deformity and to monitor response to treatment at different stages of care confirming the effectiveness of regular casting, timely tenotomy, and supervised follow-up. There was a highly significant difference in mean Pirani scores across different treatment phases. The greatest reduction in scores was observed between the initial presentation and the final follow-up, confirming the effectiveness of Ponseti treatment when delivered without interruption.

However, during the post-COVID phase, a relative stagnation or increase in Pirani scores was observed, indicating partial regression associated with interrupted care and reduced follow-up. This finding highlights the sensitivity of treatment outcomes to continuity of care, especially during the maintenance phase (Table 3).

Subgroup analysis of 100 children showed that most presented with initial Pirani scores of 5 or higher, indicating severe deformity at first contact. Scores below 4 were uncommon, suggesting late presentation and delayed referral. Higher initial scores were associated with a greater number of castings and an increased likelihood of Achilles tenotomy, emphasizing the importance of early diagnosis and timely intervention.

Key tables

Table 1. Demographic Characteristics and Clinical Presentation of Participants (n = 1,249)

Characteristic	Frequency	Percentage (%)
Sex		
Male	887	71.0
Female	362	29.0
Religion		
Muslim	649	52.0
Hindu	574	46.0
Christian	26	2.0
Age at Presentation		
0–3 months	849	68.0
3–6 months	125	10.0
6 months–1 year	150	12.0
>1 year	125	10.0
Laterality of CTEV		
Unilateral	525	42.0
Bilateral	724	58.0

Table 2. Comparison of Service Delivery Parameters Before and During the Pandemic

Parameter	Pre-Pandemic	During Pandemic
Daily casting cases (mean)	19.63	7.22 ± 1.8
Monthly new enrolment	18–26	3–5
Maintenance phase visits/day	26.6 ± 3.2	8–16
Tenotomies/week	10.43 ± 1.3	2–5
OPD attendance reduction	—	77.23%

Table 3. ANOVA Comparison of Pirani Scores at Different Treatment Phases

Phase	Mean ± SD	Interpretation
Initial Score	5.4 ± 0.6	Severe deformity at presentation
Last Score	3.1 ± 1.7	Significant improvement after initial treatment
Post-COVID Score	2.2 ± 1.3	Partial regression/stagnation
Final Score	0.5 ± 0.7	Near-complete correction

ANOVA: F = 25.3, **$p < 0.001$**

Table 4.Clinical Implications of Pirani Scores by Treatment Phase

Phase	Clinical Implication
Initial	High severity; more casts and higher likelihood of tenotomy
Last	Demonstrates response to Ponseti casting
Post-COVID	Reflects interruption-related regression
Final	Near-zero score confirms successful correction

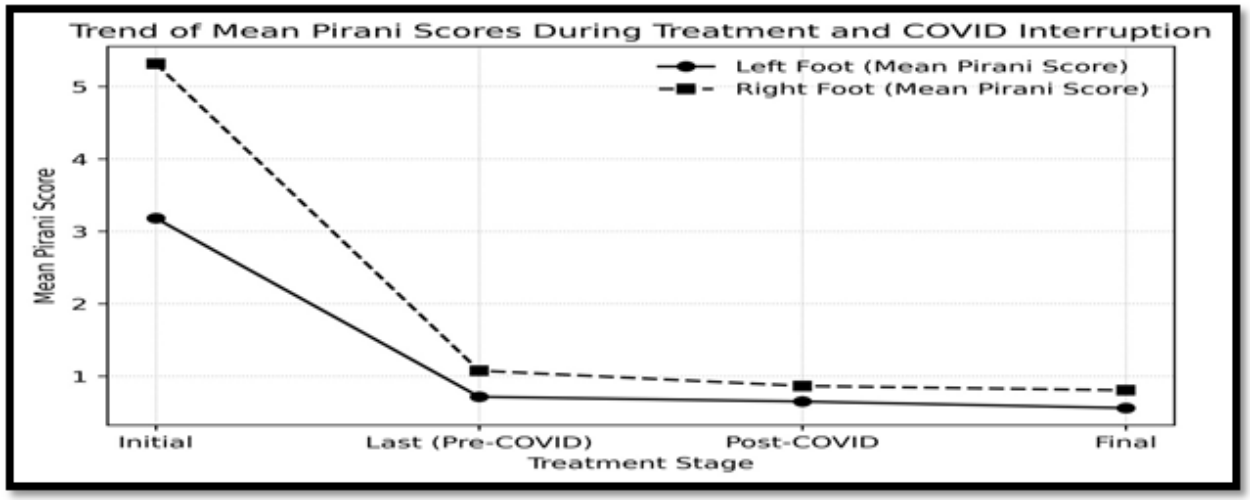

Figure1. Outcome of treatment interpreted during and after COVID Pandemics

Table 5. Limb-Level Comparison of Pirani Scores and Treatment Parameters Before and After COVID-19 Lockdown (n = 313 Limbs)

Parameter	Pre-Lockdown	Post-Lockdown / During Lockdown	Interpretation
Mean Pirani score	5.32 ± 0.97 (at presentation)	—	Indicates severe deformity at initial presentation
Number of castings	8.25 ± 6.33	Additional 3–10 casts (mean 5.6 ± 3.73)	Treatment required more casts after interruption
Pirani score just before lockdown	1.125 ± 0.81	—	Marked clinical improvement achieved before service disruption
Statistical significance (pre-lockdown improvement)	$p = 0.052$	—	Improvement approached significance
Follow-up delay	—	8.27 ± 2.92 months	Long interruption in care during lockdown
Pirani score at first post-lockdown visit	—	2.077 ± 1.17	Significant increase in deformity severity
Change in Pirani score during lockdown	—	+0.95 ± 0.79	Demonstrates relapse or regression due to interrupted care
Statistical significance (post-lockdown change)	—	$p < 0.05$	Worsening after lockdown was statistically significant
Correlation with age or gender	—	Not significant	Progression not dependent on age or sex
Cast removal practice	Clinic-based	Mostly removed at home	Lack of supervision may have contributed to relapse
Tenotomies performed	—	22	Required to correct recurrent equinus
FAO initiation after tenotomy	—	19 limbs	Indicates resumption of standard maintenance protocol

Overall, the majority of children presented with moderate to severe CTEV, requiring prolonged and intensive Ponseti management. The COVID-19 pandemic caused treatment interruption, recurrence, and delayed correction. Regular Pirani scoring proved valuable in monitoring disease progression and treatment response.

DISCUSSION

The present study highlighted the significant impact of the COVID-19 pandemic on the delivery and outcomes of clubfoot management even in a tertiary care centre. Prior to the pandemic, our clinic functioned efficiently with regular enrolment, casting sessions, and follow-up visits, demonstrating the effectiveness of a structured clubfoot program. However disruption of these services was evident during pandemic, in our clinic, castings were delayed by over 8 months. Though global guidelines considered clubfoot treatment semi-elective[16,17,18], delaying it increased Pirani scores. Current study uniquely assessed long-term effects, unlike other global series focused on trauma during the early

pandemic phases[19]. Similar programs worldwide have shown that adherence to the results in successful correction in more than 90% of cases and significantly reduces the need for extensive surgical procedures[21,22].

Our findings showed a dramatic decline in outpatient attendance and treatment services during the pandemic, with overall attendance falling by more than 77%. This disruption mirrors reports from other centres globally where lockdown measures, travel restrictions, and reallocation of healthcare resources affected routine orthopaedic services[23,24]. Firth et al. reported similar interruptions in clubfoot clinics during the pandemic, with reduced clinic attendance and delays in Ponseti casting schedules leading to worsening deformities in some patients[25].

Interruption of the maintenance phase emerged as a major concern in our study. Nearly one-third of children were unable to continue using foot abduction orthoses, resulting in recurrence or progression of deformity. Brace non-compliance is widely recognized as the most important predictor of relapse following Ponseti treatment, as demonstrated by Dobbs et al. and Haft et al., who reported significantly higher recurrence rates among children who discontinued orthotic use[26,27]. The significant rise in Pirani scores at the first post-lockdown visit in our study further supports the sensitivity of clubfoot correction to interruptions in treatment.

Overall, this study underscores the importance of uninterrupted follow-up in Ponseti programs. Strengthening decentralized care, improving access to orthotic devices, and incorporating telemedicine-based follow-up strategies may help sustain treatment adherence during future healthcare disruptions.

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