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Posteromedial Soft-Tissue Release After Ponseti Method Failure in Idiopathic Congenital Clubfoot: A Descriptive Study of Patients Admitted to the Pediatric Orthopedics and Traumatology Department of the Abderrahim Harouchi Mother-Child Hospital

Kisoka Matando JD[1]*, Mohamed ARIHI[1], Bijtro CHAFIK[1], Abdelmounim CHERQAOUI[1], Yassine CHERQAOUI[1], Hajjar ROUAGHI[1], Mustapha ABOUMAAROUF[1] and Badianjile Kena[2]

[1]Department of Pediatric Orthopedics and Traumatology, Abderrahim Harouchi Mother-Child Hospital, Morocco.

[2]University of Kinshasa, University Hospital Center of Renaissance, and Reverend Kim University, Morocco.

***Correspondence:**

JD Kisoka Matando, Department of Pediatric Orthopedics and Traumatology, Abderrahim Harouchi Mother-Child Hospital, Morocco.

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ABSTRACT

Introduction: *Congenital talipes equinovarus (CTEV), or clubfoot, is a common neonatal orthopedic malformation characterized by a complex three-dimensional deformity combining equinus, varus, and adduction. Despite the efficacy of the Ponseti method as the standard of care, certain resistant, neglected, or late-diagnosed forms require surgical intervention via posteromedial release (PMR).*

General Objective: *To describe the epidemiological, clinical, therapeutic, and outcomes profile of patients who underwent posteromedial release for congenital talipes equinovarus in a pediatric orthopedics and traumatology department.*

Specific Objectives: *To determine the sociodemographic and clinical characteristics of patients operated on for CTEV.*

- *To describe the modalities of conservative (orthopedic) and surgical management.*
- *To evaluate functional outcomes following posteromedial release.*
- *To identify the primary postoperative complications and causes of treatment failure.*

Materials and Methods: *This was a retrospective descriptive study conducted at the Pediatric Orthopedics and Traumatology Department of the Abderrahim Harouchi Mother-Child Hospital in Casablanca between January 2018 and December 2021. The study included 48 patients aged 0.9 months to 16 years who underwent surgery for CTEV. The analyzed variables encompassed sociodemographic data, clubfoot type, associated anomalies, therapeutic modalities, and postoperative outcomes. Statistical analysis was performed using Jamovi software (version 2.3.28).*

Results: *Among the 48 included patients, 65% were male, yielding a sex ratio of 2:1. The mean age was 5.5 ± 4.23 years. Idiopathic forms accounted for 60.4% of cases, of which 39.6% were bilateral. The primary associated anomalies were developmental dysplasia/congenital dislocation of the hip (14.3%), arthrogryposis (10.7%), and cerebral palsy (10.7%). The majority of patients (90%) demonstrated good treatment adherence. PMR was primarily performed following the failure of conservative treatment. The main observed complications were recurrence, skin necrosis, and postoperative infections. Surgery performed after the walking age constituted the primary cause of therapeutic failure.*

Conclusion: *Early management of CTEV using the Ponseti method effectively reduces the need for surgical intervention. However, posteromedial release remains a critical option for resistant or neglected cases. A well-indicated surgical intervention, combined with tailored postoperative immobilization and physical therapy, improves functional outcomes and minimizes the risk of complications.*

Keywords
Congenital talipes equinovarus, Ponseti method, Posteromedial release, Pediatric surgery, Postoperative complications.

Introduction
Congenital talipes equinovarus (CTEV), commonly referred to as clubfoot, is one of the most frequent congenital orthopedic malformations in children. It is a complex, three-dimensional foot deformity that combines hindfoot equinus, calcaneal varus, forefoot adduction, and global foot supination [1,2]. Without early intervention, this anomaly alters weight-bearing patterns and progressively compromises ambulation as well as the child's overall functional development.

The global prevalence of CTEV is estimated at approximately 1 to 2 cases per 1,000 live births, characterized by a male predominance and bilateral involvement in nearly 50% of cases [3]. This incidence remains higher in limited-resource settings, where barriers to accessing specialized care exacerbate diagnostic and therapeutic delays [3]. CTEV can be classified as idiopathic, which accounts for approximately 80% to 90% of cases, or secondary to neurological, syndromic, or genetic conditions such as arthrogryposis, myelomeningocele, or specific chromosomal abnormalities [4,5].

The precise etiopathogenesis of CTEV remains incompletely understood. Multiple genetic, embryological, and environmental factors have been implicated in its occurrence. A positive family history, specific neuromuscular abnormalities, and intrauterine developmental disruptions have been reported as predisposing factors for this malformation [1]. Clinically, the diagnosis is typically established at birth based on the characteristic appearance of the foot. In the absence of appropriate management, this anomaly can progress into a rigid deformity, leading to severe functional impairment, chronic pain, skin ulcerations, and significant locomotor disability [2].

For several decades, the Ponseti method has served as the gold standard for the treatment of idiopathic CTEV [6]. Based on progressive manual manipulations followed by serial casting, and frequently incorporating a percutaneous Achilles tenotomy, this technique yields excellent functional outcomes when initiated early [7,8]. However, certain severe, neglected, recurrent, or conservative-treatment-resistant forms necessitate surgical intervention [9].

Among the proposed surgical techniques, posteromedial soft-tissue release (PMR) remains one of the most widely utilized interventions for complex forms or following conservative treatment failure [10]. This surgical procedure aims to correct the capsuloligamentous and musculotendinous contractures responsible for the deformity. Despite its efficacy, PMR carries risks of several complications, including recurrence, joint stiffness, cutaneous trophic disorders, infections, or residual deformities, particularly when management is delayed or technically suboptimal [11,12].

In developing nations, particularly in Morocco, the management of CTEV faces several challenges, including delayed diagnosis, insufficient specialized follow-up, socioeconomic constraints, and limited accessibility to specialized healthcare centers. These factors contribute to an increased prevalence of neglected and complicated forms that require more invasive surgical interventions. In this context, it is crucial to evaluate the epidemiological, clinical, and therapeutic characteristics of patients undergoing surgery for CTEV, as well as the outcomes achieved through posteromedial release in our daily clinical practice.

Objectives
The general objective of this study was to describe the epidemiological, clinical, therapeutic, and outcomes profile of patients who underwent posteromedial release for congenital talipes equinovarus in a pediatric orthopedics and traumatology department.

The specific objectives were to:
- Determine the sociodemographic and clinical characteristics of patients operated on for CTEV.
- Describe the modalities of conservative and surgical management.
- Evaluate functional outcomes following posteromedial release.
- Identify the primary postoperative complications and causes of treatment failure.

Materials and Methods
Study Design and Setting
This was a retrospective descriptive study conducted at the Pediatric Orthopedics and Traumatology Department of the Abderrahim Harouchi Mother-Child Hospital in Casablanca, covering a period from January 2018 to December 2021.

Study Population
The study population consisted of patients who underwent surgical management for congenital talipes equinovarus (CTEV) during the specified study period.

Inclusion Criteria
Patients were included in the study if they met the following criteria:
- Aged between 0.9 months and 16 years.
- Diagnosed with idiopathic, neurological, or syndromic CTEV.
- Managed surgically via posteromedial release (PMR).
- Documented with complete and exploitable medical records.

Exclusion Criteria
The exclusion criteria were:
- Patients treated exclusively with conservative methods without surgery.
- Patients operated on using alternative surgical techniques.
- Incomplete or unexploitable medical records.
- Patients lost to postoperative follow-up.

Sample Size
A non-probability exhaustive sampling method was applied. A total of 48 patients meeting all inclusion criteria were enrolled in the study.

Variables and Data Collection
Data were extracted from medical charts, operative registries, and hospitalization summaries. The analyzed variables included:

- **Sociodemographic characteristics:** age and sex.
- **Clinical characteristics:** type of CTEV, affected side, and associated anomalies.
- **Therapeutic modalities:** prior conservative treatment, specific surgical technique performed, and type of postoperative immobilization.
- **Outcome data:** postoperative complications, recurrence, causes of therapeutic failure, and functional evolution.

Statistical Analysis
Data entry and statistical analyses were performed using Jamovi software (version 2.3.28). Quantitative variables were expressed as mean $\pm$ standard deviation, whereas qualitative variables were presented as frequencies and percentages.

Ethical Considerations
Strict confidentiality regarding the collected clinical data was maintained throughout the study. Patient data were fully anonymized prior to analysis. The study was conducted in compliance with the ethical principles governing biomedical research and received formal authorization from the department's institutional review board.

Results
General Characteristics of the Patients
A total of 48 patients who underwent surgery for congenital talipes equinovarus (CTEV) were included. Male patients predominated, accounting for 31 cases (65%), resulting in a sex ratio of 2:1. The mean age of the cohort was 5.5 ± 4.23 years. Idiopathic forms represented 60.4% of cases, and bilateral involvement was observed in 39.6% of patients.

Table 1: Sociodemographic and Clinical Characteristics of Patients.

Variables		Frequency (n)	Percentage (%)
Sex	Male	31	65
	Female	17	35
Type of CTEV	Idiopathic	29	60.4
	Neurological	6	12.5
	Associated Pathologies	5	10.4
	Polymallformative Syndrome	4	8.4
	Neglected CTEV	4	8.4
Affected Side	Left	12	25
	Right	9	18.8
	Bilateral	19	39.6

The mean age of the patients was 5.5 ± 4.23 years.

Associated Anomalies
The primary associated orthopedic anomalies were congenital dislocation of the hip (14.3%), arthrogryposis (10.7%), and genu valgum (10.7%). The most frequent neurological anomalies were cerebral palsy and myelomeningocele, each identified in 10.7% of cases.

Table 2: Associated Anomalies in Patients Operated on for CTEV.

Associated Anomalies	Frequency (n)	Percentage (%)
Orthopedic Anomalies		
Congenital dislocation of the hip	4	14.3
Arthrogryposis	3	10.7
Genu valgum	3	10.7
Neurological Anomalies		
Cerebral palsy	3	10.7
Myelomeningocele	3	10.7
Polymalformative Anomalies		
Genu varum	2	7.1
Scoliosis	1	3.6

Therapeutic Management
The majority of patients initially received conservative orthopedic treatment consisting of the Ponseti method combined with physical therapy. Conventional posteromedial release was the primary surgical technique utilized, performed in 29 patients (60.4%). In most instances, this intervention was indicated following the failure of conservative management. The Cincinnati approach was utilized in 2 patients, with stabilization achieved via Kirschner wires. Regarding postoperative immobilization, 90% of patients underwent cast immobilization, while 10% were managed with splints.

Postoperative Complications and Outcomes
Postoperative complications were predominantly characterized by recurrences, skin necrosis, and infections. Recurrences accounted for 40% of late complications and primarily affected patients whose initial care was provided in the private sector. The primary causes of therapeutic failure were surgery performed after the walking age (30%), delayed initial management (20%), and technical errors (18%).

Table 3: Therapeutic Modalities of the Patients.

Therapeutic Variables	Frequency (n)	Percentage (%)
Initial Conservative Treatment		
Ponseti Method + Physical Therapy	39	81.3
Ponseti Method Alone	4	8.3
Physical Therapy Alone	5	10.4
Surgical Technique		
Classical Posteromedial Release	29	60.4
Cincinnati Approach	2	4.2
Percutaneous Tenotomy	6	12.5
Double Arthrodesis	2	4.2
Postoperative Immobilization		
Cast	43	90
Splint	5	10

Table 4: Postoperative Complications and Causes of Therapeutic Failure.

Variables	Frequency (n)	Percentage (%)
Postoperative Complications		
Recurrences	8	40
Skin necrosis	3	15
Infection / Localized fibrosis	1	5
Treatment Adherence		
Good	43	90
Poor	5	10
Causes of Therapeutic Failure		
Surgery after the walking age	15	30
Delayed management	10	20
Technical factors	9	18
Infectious causes	1	2

Discussion

Congenital talipes equinovarus (CTEV) remains one of the most frequent congenital orthopedic deformities encountered in pediatric surgery [1,2]. The present study aimed to describe the epidemiological, clinical, therapeutic, and outcomes characteristics of patients undergoing posteromedial release within our hospital context.

In our series, male patients predominated, accounting for 65% of cases, with a sex ratio of 2:1. These findings align with data reported in several international studies, which consistently demonstrate a male predominance in CTEV [3,13,14]. The mean age of our patients was 5.5 ± 4.23 years, reflecting a substantial delay in management within our context. Similar observations have been reported in multiple limited-resource countries, where barriers to accessing specialized care lead to late consultations and favor the development of complicated or neglected forms [3,15].

Idiopathic forms accounted for 60.4% of cases in our study. This proportion is lower than those reported in several international series, where idiopathic cases typically reach 80% to 90% [1,4,16]. This discrepancy could be attributed to the specialized tertiary nature of our institution, which preferentially receives a higher volume of complex, neurological, or syndromic deformities. Bilateral involvement was present in 39.6% of patients, a finding close to literature data reporting frequencies ranging between 40% and 50% [2,3]. The primary associated conditions identified were congenital hip dislocation, arthrogryposis, cerebral palsy, and myelomeningocele, associations that have been extensively described in prior literature [4,5,17].

Regarding therapeutic management, the majority of patients initially received conservative treatment based on the Ponseti method combined with physical therapy. For several years, the Ponseti method has been globally recognized as the first-line treatment for idiopathic CTEV due to its high efficacy and low complication rate [6-8,18,19]. Numerous studies have demonstrated that early initiation of treatment significantly improves functional outcomes and markedly reduces the necessity for surgical intervention [7,8,20].

However, specific situations still require surgical intervention, particularly resistant, recurrent, or neglected forms [9,10]. In our study, conventional posteromedial release was the primary surgical technique performed. This procedure allows for adequate correction of the capsuloligamentous and tendinous contractures responsible for the deformity [10,21]. Our findings align with those of Segev et al., who reported satisfactory functional outcomes following properly executed posteromedial release [22].

Surgery performed after the walking age represented the leading cause of therapeutic failure in our series. This finding corroborates literature data showing that delayed management reduces the remodeling potential of the foot bones and increases the risks of recurrence, stiffness, and residual deformity [11,15,23]. Consequently, several authors recommend early surgical correction prior to the acquisition of ambulation to optimize long-term functional outcomes [20,24].

The complications observed in our study were dominated by recurrences, skin necrosis, and postoperative infections. Recurrences occurred primarily in patients whose initial management took place in non-specialized structures. These outcomes underscore the absolute necessity of strict adherence to therapeutic protocols and the critical role of rigorous postoperative follow-up [18,25]. Trophic complications, particularly skin necrosis, have also been widely documented following extensive posteromedial release, especially in cases involving aggressive soft-tissue handling or underlying vascular anomalies [11,26].

Treatment adherence was good in 90% of the patients in our study. Several studies have demonstrated that family compliance plays a decisive role in preventing recurrences, particularly regarding the prolonged use of foot abduction braces following orthopedic correction [19,27]. Poor compliance and premature discontinuation of treatment remain major contributors to therapeutic failure in developing countries [28].

Our study has certain limitations. Its retrospective design introduces potential information bias related to the quality and completeness of medical records. Furthermore, the relatively small sample size and the lack of a standardized long-term functional scoring system limit the generalizability of our findings. Finally, being a single-center study, certain results may not fully reflect national clinical practices.

Despite these limitations, this study provides valuable data on the surgical management of CTEV in our region. It highlights the paramount importance of early diagnosis, strict protocol compliance, and specialized postoperative follow-up to minimize complications and recurrences. Prospective, multicenter studies incorporating long-term functional assessments are required to better evaluate the outcomes of posteromedial release in African and Maghrebian contexts.

Conclusion

Congenital talipes equinovarus is a frequent orthopedic pathology where early management heavily conditions the long-term functional prognosis. In our study, idiopathic forms predominated, with a substantial frequency of bilateral involvement and associated neurological or orthopedic conditions. The Ponseti method remains the gold standard first-line treatment, yielding excellent outcomes when initiated early and adhered to correctly.

However, posteromedial release maintains an essential role in managing resistant, recurrent, neglected, or late-presenting forms. The results of our study demonstrate that surgery performed under optimal technical conditions, combined with appropriate postoperative immobilization and rigorous physical therapy, achieves satisfactory deformity correction. Conversely, delayed management, performing surgery after the walking age, and technical insufficiencies significantly elevate the risk of complications and recurrences.

Improving neonatal screening, ensuring accessibility to specialized centers, expanding practitioner training, and strengthening postoperative follow-up protocols are indispensable steps to optimize therapeutic outcomes in our setting. Prospective, multicenter studies with long-term functional follow-up remain necessary to further refine the outcomes of posteromedial release and enhance overall therapeutic strategies for congenital talipes equinovarus.

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