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Treatment of Idiopathic Congenital Varus Equinus Clubfoot by the Ponseti Method: Experience of the Orthopedics and Traumatology Department of Donka National Hospital

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Abstract

Introduction: Congenital varus equinus clubfoot (CVEC) is a complex, three-dimensional deformity of the bones of the foot, their joints, and soft tissues. It is common in Guinea and presents a significant challenge in management. It is the most common foot deformity in pediatric orthopedics, affecting 0.2% of births, with a male predominance. The objective of this study was to evaluate the effectiveness of the Ponseti method in treating CVEC and to identify factors influencing the outcomes. **Method:** This was a prospective descriptive study conducted over 14 months, involving 28 patients aged 0 to 4 years with idiopathic CVEC. The parameters studied included epidemiological, clinical, therapeutic, and evolutionary data. All patients were treated using the Ponseti method, and the Dimeglio score was used to assess treatment effectiveness. **Results:** The study included 19 boys and 9 girls, with a total of 44 clubfeet. Bilateral involvement was observed in 50% of cases. The complication rate was 14%, and the average treatment cost was 56% of the basic salary of a Guinean civil servant. The minimum follow-up was 10 months, with very good and good outcomes in 70.5% of cases. **Conclusion:** Congenital varus equinus clubfoot is a condition that can be effectively managed using the Ponseti method. Its cost-effectiveness makes it a recommended approach in resource-limited countries.

Keywords

Clubfoot, Varus Equinus, Congenital, Idiopathic, Ponseti Method, Outcomes

1. Introduction

Congenital varus equinus clubfoot (CVEC) is a foot deformity characterized by a three-dimensional inversion deformity, combining equinus, hindfoot varus, and adduction of the subtalar and midtarsal joints. It is the most common foot deformity in pediatric orthopedics, affecting 0.2% of births, with a male predominance [1]. While its etiology is unknown, various genetic and environmental factors have been suggested [2].

Bilateral involvement occurs in 50% of cases, with an incidence of 1.52 per 1,000 live births in Europe. Early and orthopedic treatment at birth is essential to prevent worsening of functional prognosis [3].

Without treatment, this anomaly leads to stiffening of the foot and ankle, resulting in disability. The social, psychological, physical, and economic consequences are significant [4].

The treatment of CVEC has evolved qualitatively, from bandaging methods since Hippocrates to surgical correction, before being revolutionized in the early 20th century by the Ponseti method [3]. This is a simple, low-cost method that achieves excellent results (90% - 100% success rates) and is particularly suited to care contexts in under-resourced countries [5] [6].

In the United States, the Ponseti method is widely adopted as it avoids extensive surgery [7]. In India, a comparative study between the Ponseti and Kite methods led care teams to recommend the Ponseti method as the initial conservative treatment for patients with CVEC [8].

In Morocco, Boukerma *et al.* [9] reported 108 cases of CVEC in 71 patients over three years treated with the Ponseti method, achieving an encouraging success rate of 71%.

In low-income countries, where 48% of the population lives on less than $1.25 per day, public health policies in sub-Saharan Africa often prioritize communicable diseases. Non-communicable diseases are an additional public health priority [10].

In Guinea, despite its prevalence, no prior studies have been conducted on CVEC, posing challenges in its management. This is due to parental unawareness of the condition, difficulties in adhering to treatment, and financial constraints that hinder access to care. Consequently, is the prevalence of clubfoot underestimated in Guinea? Is the Ponseti method known, effective, and applied?

This study was initiated to answer these questions, with the objective of evaluating the effectiveness of the Ponseti method and identifying factors influencing outcomes.

2. Patients and Methods

This was a prospective descriptive study conducted over 14 months, from December 1, 2015, to January 31, 2017, involving 44 feet in 28 patients. We included all patients aged 0 to 5 years with idiopathic congenital varus equinus clubfoot (CVEC) treated using the Ponseti method. Patients with secondary CVEC, those

over 5 years of age, those lost to follow-up, and those whose parents did not consent to the method were excluded.

The parameters studied included epidemiological, clinical, therapeutic, and evolutionary data, as well as factors associated with treatment success. The severity of clubfoot was categorized into four stages based on the morphological classification of Dimeglio and Bensahel [1].

We conducted exhaustive recruitment of all patients aged 0 to 5 years with congenital varus equinus clubfoot who met the inclusion criteria.

The Ponseti method involves correcting the deformity through weekly plaster casts combined with a percutaneous tenotomy of the Achilles tendon, which is not systematically performed, to correct residual equinus. This is followed by a maintenance phase using a Steenbeck abduction brace.

The number of casts applied depended on the severity of the clubfoot. Achilles tendon tenotomy was followed by plaster immobilization for 21 days and was performed under local anesthesia in the clinic before the final cast.

The brace was worn until the age of 4 to 5 years. The affected foot was maintained in external rotation at 60˚ - 70˚, and the normal foot at 40˚. For bilateral cases, the rotation was set at 60˚.

Check at 1 month then every 3 months to ensure compliance with wearing the splint, check the condition of the skin, look for signs of recurrence and adjust the splint to growth. Pressure sores observed under the casts were successfully treated with directed wound care.

Patient evaluation during walking was clinical, based on the degree of foot dorsiflexion, the presence or absence of residual deformities, and gait quality as per Boukerma *et al.* [9].

Outcomes were classified as:

- Very good and good: No residual deformity; dorsiflexion ≥ 15˚;
- Fair: Residual deformity (e.g., adduction, internal rotation, hypercorrection);
- Poor: At least two residual deformities (e.g., significant equinus, varus, inability of the foot to rest on the heel, walking on the foot's edge.

The average cost of care amounted to 56% of the parent's base salary.

The minimum follow-up period for this 2-year prospective observational study was 10 months.

3. Results

The 28 children with clubfoot were recruited from a total of 410 patients who consulted the department during the study period, representing a prevalence of 6.8%, with a total of 44 clubfeet. The average age was 1.5 months, ranging from 0 to 48 months. A male predominance was observed, with a sex ratio of 2:1. Half of the patients with clubfoot were seen before three months of age. Moderate forms accounted for 45.45%, and bilateral forms were present in 54.15% of cases.

Seventeen (60.7%) of the parents had unfavorable socioeconomic conditions. Twenty-two of the 28 mothers had undergone ultrasound during pregnancy.

Bilateral involvement was observed in 16 patients (57.14%). The right foot was affected in 8 cases (28.57%), and the left foot in 4 cases (14.29%).

Based on initial grades, the foot was classified as grade II (moderate) in 20 cases (45.45%), grade III (severe) in 14 cases (31.81%), and grade IV (very severe) in 10 cases (22.74%) (Table 1).

Complications during treatment included pressure sores in 3 cases (7%), iatrogenic convex foot in 1 case (2%), and skin lesions in 2 cases (5%).

During follow-up, the mean initial Dimeglio score improved significantly, decreasing from 13 to 0.3 within the first 3 months. It increased to 0.6 at 6 months to stabilize at 1.2 from 9 months to the age of walking (Figure 1, Figure 2).

The approximate total cost of managing a corrected CVEC without recurrence is 860,000 Guinean francs, or approximately 100,000 CFA francs (Table 2).

Based on initial grades, treatment outcomes are inversely proportional to the severity of the clubfoot (Table 3). Additionally, adherence to wearing abduction braces is essential for achieving better results (Table 4 & Table 5).

Table 1. Distribution of the number of casting sessions based on foot severity grade.

Number of Casts	5	6	7	8	9	10
Severity Grade						
Grade II	14	6	0	0	0	0
Grade III	0	6	5	3	0	0
Grade IV	0	1	3	2	2	2
Total	14	13	8	5	2	2

Table 2. Approximate cost of managing a corrected clubfoot without recurrence.

Care Element	Amount (FG)	Number of Times Performed	Cost Per Cast/Foot	Total Cost (FG)
2 Plaster Bands (Biplatrix 20 cm)/foot	50.000	4 to 6	50,000	600.000
1 Soft Band/foot	10.000	4 to 6	-	60.000
Orthopedic Shoes	200.000	-	-	200.000
Total Expenses	-	-	-	**860.000**

Table 3. Distribution of clubfoot outcomes based on initial grades.

Initial Severity	Very Good	Good	Average	Poor
	Count	%	Count	%
Grade II	16	80%	4	20%
Grade III	7	50%	2	14.28%
Grade IV	0	0%	2	20%

Table 4. Distribution of clubfoot outcomes based on compliance with abduction brace use.

Brace Use	Very Good	Good	Average	Poor
	Count	%	Count	%
Yes	12	63.15%	4	21%
No	0	0%	0	0%

Table 5. Distribution of Relapses (15 Feet) after a 6-month follow-up and therapeutic extension.

Relapse Type	Number of Feet	Series of Casts Applied per Foot	Achilles Tendon Tenotomy per Foot
Varus	9	3	0
Equinus	3	2	1
Varus and Equinus	2	5	1
Adduction	1	3	0

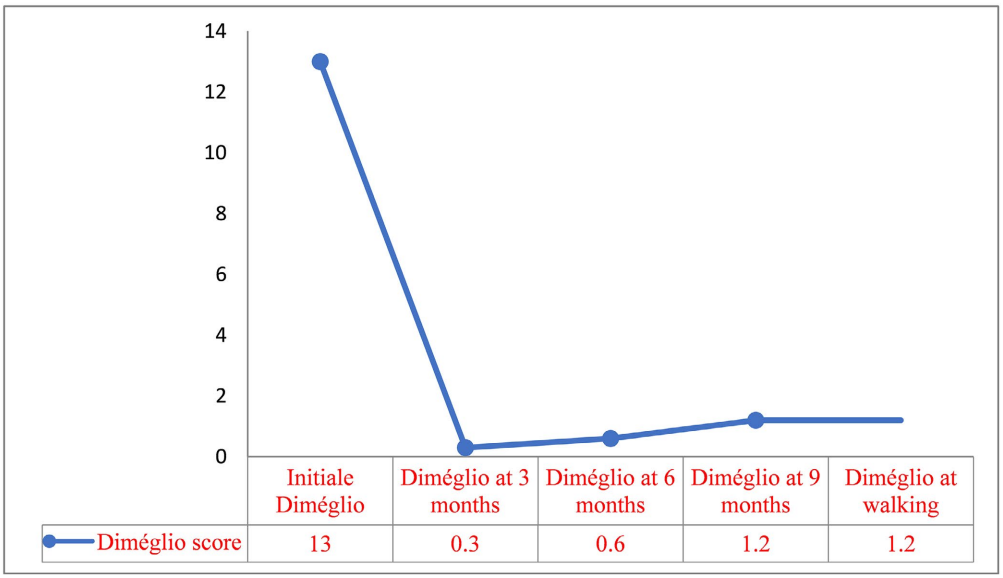

Figure 1. Evolution of the average Dimeglio score over the course of follow-up.

Figure 2. (A) = Congenital equinovarus clubfoot; (B) = Stenberg brace; (C) = Result at 6 months.

4. Discussion

The main limitation of our study was the insufficient follow-up of patients due to missed appointments, often caused by economic constraints or geographical distance. Despite these challenges, we successfully conducted this study, finding a prevalence of clubfoot at 6.8%. In Burkina Faso, GANDEMA *et al.* [4] recorded a rate of 5.35% over nine months. The rate observed in our study highlights the significance of this pathology in Guinea. Its management is not a priority for local authorities, as it does not pose an immediate threat to life, despite the severe functional sequelae it can cause without adequate treatment.

The male prédominances of clubfoot remains a constant in neonatal morbidity and may result from factors such as genetics [5] [11] [12].

Moderate CVEC was the most commonly encountered form in our study. This result aligns with that of GANDEMA *et al.* [4], who reported 35% of moderate cases. In contrast, VELOMALALA *et al.* [13] in Madagascar found a predominance of severe forms (49.58%). This discrepancy may stem from differences in recruitment methods, as their study aimed to address surgical treatment.

The more severe the foot deformity, the greater the number of casts required. BOUKERMA *et al.* [9] used a higher number of casts for Grade III and IV feet, consistent with the results in our series. Successful treatment of these cases requires psychological preparation of parents for the possibility of surgery, weekly follow-ups during the initial treatment phase, and prolonged patient monitoring.

The complication rate recorded in our study is higher than the 5.88% found by GANDEMA et al. [4] who carried out the modified Ponseti method.

Low education levels among caregivers (32.13%) contributed to 17.85% of poor outcomes. A low education level, combined with a lack of medical coverage, led to more frequent treatment abandonment. These complications could be minimized by involving parents in plaster monitoring and ensuring compliance with brace usage.

Education levels may influence the understanding and acceptance of the condition and parents' adherence to treatment. Early intervention is crucial for the success of orthopedic treatment. 70% of patients had very good or good results. The success of orthopedic treatment depends on the early start of care. In Burkina Faso, GANDEMA *et al.* [4] found 20% poor outcomes among children who sought care after 12 months. This highlights the importance of starting CVEC treatment as early as possible to minimize capsuloligamentous contractures and improve the chances of successful orthopedic treatment. Conversely, when the deformity is observed after walking age, surgical intervention may be necessary [14].

During treatment, nine patients were inconsistent with follow-up, often due to distance and low socioeconomic status of the parents.

An initial improvement in the foot's condition led some parents to abandon treatment. Among these, 88.8% experienced poor outcomes, compared to 84.15% very good or good results among patients consistent with treatment. This finding underscores that irregularity is a major factor negatively impacting Ponseti treatment outcomes, regardless of the severity of the clubfoot or the age at the first consultation.

Anatomical reasons could also impact correction. Ippolito *et al.* performed axial MRI scans and reported marked hypoplasia of muscle tissue and increased adipose tissue in the affected legs of patients with unilateral clubfoot, even among newborns [15]. Merrill *et al.* used three-dimensional magnetic resonance angiography (MRA) and reported that 40% of participants with unilateral clubfoot had arterial anomalies in the lower leg [16].

An initial improvement in the foot's condition often led parents to discontinue treatment. Irregular treatment was responsible for 30% of poor outcomes [4]. This remains one of the key factors negatively affecting Ponseti treatment outcomes, regardless of the severity of the clubfoot or the age at the first consultation.

Our findings are consistent with those of BRONFEN [17] and RAKOTONIRINA [7], who reported 21% and 85.7% poor outcomes, respectively, in patients with very severe grades. As with age, the treatment outcome of CVEC is inversely proportional to the deformity grade, increasing the likelihood of tenotomy.

The most critical criteria for successful clubfoot correction include achieving a plantigrade foot, the ability to wear normal shoes without pain, and parental satisfaction [18]. Posture braces worn as long as possible protect the feet from recurrence. In our study, non-compliance with brace usage was linked to socioeconomic and cultural constraints, explaining some poor outcomes. BERGERAULT [3] in France and HABIBOU in Niger [19] prescribed simple shoes purchased from the market, which did not ensure abduction and external rotation of the foot, thus failing to maintain correction. Recurrence rates in their studies were 83% and 65%, respectively.

The combination of soft tissue release and progressive correction using the Ilizarov method in children under eight years old is a safe procedure in cases where closed reduction alone cannot succeed [20].

In some cases, relapse is due to non-compliance with the brace regimen [21]. This underscores that any well-manipulated but poorly braced clubfoot will yield mediocre or insufficient results [22].

5. Conclusion

Idiopathic CVEC is common in our country and presents significant management challenges. The Ponseti method, an effective and low-cost orthopedic treatment, yields good results and is well-suited to the context of underdeveloped countries. However, certain socioeconomic factors limit its effectiveness.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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