

THE RULE OF PONSETI TECHNIQUE FOR CORRECTION OF RECURRENT CASES OF CONGENITAL TALIPES EQUINO VARUS

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Abstract

Introduction: Club foot or congenital talipes equinovarus (CTEV) is a congenital foot deformity. Recently, interest has been renewed in the Ponseti casting technique rather than surgery for CTEV. This study evaluates using the Ponseti technique to correct recurrent cases of idiopathic congenital talipes equinovarus. **Methods:** This is a prospective study of 16 patients (25 feet) with recurrent CTEV deformity who presented to the orthopedic outpatient clinic of a tertiary hospital between March 2013 and March 2014. The Ponseti technique was applied to all cases with or without Achilles tenotomy, with Denis-Browne splint application after final cast removal. Patients were assessed for compliance and success at follow-ups for 14 months. The results were classified according to the Pirani score. **Results:** Eleven males (68.75%) and five females (31.25%). Nine patients (56.25%) had bilateral involvement. The average age of patients at the time of presentation was 10 months. The mean number of the casts required was five casts. Tenotomies were performed on 21 feet (84%). According to Pirani score, an excellent score was found in 23 feet (92%), and a good score was found in 2 feet (8%). No relapsing cases were found, and minor complications of swelling, redness, and pressure over the head of the talus were encountered. **Conclusion:** Ponseti serial corrective cast management is an easy and effective method of CTEV correction for idiopathic clubfoot, especially when applied during an early period of CTEV.

Keywords: Congenital Talipes Equino Varus, CTEV, Ponseti, Pirani score, Casts.

1. Introduction

Clubfoot or congenital talipes equinovarus (CTEV) is a term used to describe a complex congenital, contractional malalignment of the bones and joints of the foot and ankle. The individual deformities include the equinus of the hindfoot, varus or inversion of the subtalar joint complex, and cavus (plantar flexion of the forefoot on the hind foot) [1]. In addition to the foot, the muscles in the lower leg are not as large as usual and will not develop correctly [2]. CTEV is one of the common congenital deformities affecting about one infant in every 1000 live births, with 80% of the cases occurring in developing

countries and 20% in developed ones. It affects males more than females, and bilateral deformities occur in 50% of cases [3]. CTEV may be associated with other congenital abnormalities such as metatarsus varus, hernia, congenital hip dysplasia, syndactyly, missing or extra fingers, arthrogryposis multiplex congenita, and myelodysplasias [4]. There are many systems for the classification of CTEV. The systems of Ponseti & Smoley, Harrold & Walker, Catterall, and Carroll are the most used. [5]. The initial treatment of clubfoot is nonoperative. Various treatment regimens have been proposed, including corrective

splinting, taping, and casting. Treatment consists of weekly serial manipulation and casting during the first 6 weeks of life, followed by manipulation and casting every other week until the foot is clinically and radiographically corrected [6]. In recent years, interest has been renewed in the Ponseti casting technique, and many centers now believe that most clubfeet can be treated by Ponseti casting rather than surgery. The Ponseti method consists of two phases: treatment and maintenance. The treatment phase should begin as early as possible, optimally within the first week of life. Gentle manipulation and casting are done weekly. Each cast holds the foot in the corrected position, allowing it to reshape gradually [7]. Generally, five to six casts are required to fully correct the foot and ankle alignment. At the time of the final cast, most infants ($\geq 70\%$) require percutaneous Achilles tenotomy to gain adequate Achilles tendon lengthening. The maintenance phase begins when the final cast is removed, and the infant is placed in a brace (Denis Brown shoes) that maintains the foot in its corrected position (abducted and dorsiflexed) [7]. Thus, this study aims to evaluate the role of the Ponseti technique in correcting recurrent cases of idiopathic congenital talipes equinovarus foot deformity and follow-up, aiming at determining the benefits, drawbacks, and obstacles to this technique.

2. Patients and Methods

This study is a prospective hospital-based intention-to-treat study that has been done on 16 patients with 25 feet recurrent cases of congenital talipes equinovarus foot deformity seeking medical advice at the Orthopedic outpatient clinic of the Department of Orthopedic Surgery of a tertiary hospital, between March 2013 and March 2014. All recurrent cases, post-cast, of clubfoot were recruited, up to the age of 2 years, presenting with idiopathic, unilateral, or bilateral clubfoot. The study excluded recent cases of CTEV, recurrent CTEV

after surgery, talipes equinovarus caused by other etiologies such as neuropathic, osteopathic, or arthrogryptic, and neglected cases of CTEV.

2.1. Ethical consideration

The study protocol was reviewed and approved by the institutional Scientific and Ethical Research Committee (Code Soh-Med-24-08-04PD). The study's procedure and aim were clearly explained to the study participants. Before enrollment in the study, written informed consent was obtained from the participants with an explanation of the benefits and drawbacks of the procedure. The subject could withdraw from the study at any moment; participation was voluntary. In accordance with the Declaration of Helsinki, all steps of data collecting, entry, and analysis were conducted in a highly confidential and private manner. All 25 feet were treated using the Ponseti technique managed by a single surgeon. The participants were subjected to a detailed history taking, including pregnancy and birth history, history of compliance of parents in follow-up after the previous casting, the regular use of the AFO (ankle foot orthosis) to detect the cause of recurrence and family history of previous congenital anomalies in the family with a detailed inquiry into congenital defects of the locomotor system. The cases had thorough clinical examinations to exclude other associated congenital anomalies, including general, systemic, and musculoskeletal screening examinations to identify cases with arthrogryposis. Also, an examination of the hips, mobility of the trunk, and neurological examination were done, along with a thorough examination of the foot. The severity of the foot deformity was classified according to Pirani Scoring System [8]. It is based on hindfoot and midfoot deformities. It comprises three clinical signs for midfoot, curved lateral border, medial creases, and position of the lateral part of the talar head, and three clinical signs for hindfoot, posterior creases, rigid equinus, and empty heel. The scores were classified as 0= no abnorm-

ality, 0.5= moderate abnormality, and 1= severe abnormality. Thus, each foot can receive a midfoot score between 0-3, a hindfoot score between 0-3, and a total score between 0-6.

2.2. Treatment regimen

Treatment was started as soon as possible after referral. It consists of gentle manipulation of the foot and the serial application of long leg plaster cast without anesthesia, as described by Ponseti [9]. This corrective method was explained to parents. First, detection of the deformity component that relapsed was done, and then the cavus was corrected by supinating the forefoot and dorsiflexing the first metatarsal (lifting the first ray). This exaggerates the deformity but is an essential step to unlock the mid-foot. To correct the varus and adduction, the foot in supination is abducted while counter pressure is applied with the thumb against the head of the talus, which makes this method differ from that of the Kite where the lever fulcrum is at the calcaneocuboid joint. The abduction maneuver also led to the correction of the hindfoot varus because of the coupling between the hindfoot joints (subtalar, talonavicular, and calcaneo-navicular). After proper foot manipulation, long leg casts were changed weekly with a new cast application. The manipulations performed lasted about 10 to 15 minutes. These casts were usually sufficient to obtain good correction. In the last cast, the foot should be markedly abducted up to 70° without pronation with 15° dorsiflexion without forceful manipulation. A long leg cast is applied for the three weeks. If dorsiflexion is not obtained up to 15° after achieving the abduction up to 70° and correction of the varus deformity, a simple percutaneous tenotomy of the Achilles tendon is performed. A long leg cast is applied immediately after tenotomy under the effect of anesthesia for a further 4 weeks to allow for the healing of the tendon. All casts were applied using plaster of Paris. After final cast removal, patients were referred to an orthotist for foot abduction

orthosis (FAO) splints to prevent relapse of the deformity which is best accomplished with the feet in well-fitted, open-toed, high-top straight-last shoes attached to a Denis-Browne metal bar of approx. the length between the child's shoulders attached to its ends. The splint maintains the corrected foot in 70° of external rotation to prevent the recurrence of the varus deformity of the heel, adduction of the foot, and toeing-in. The ankle should be in ten-degree dorsiflexion to prevent equinus, which is accomplished by bending the bar with the convexity of the bar distally directed. If the deformity is unilateral, the normal foot is placed in 30° of external rotation. The orthosis is worn full-time (twenty-three hours a day) till weight-bearing age and then at night for 4-6 years with daytime CTEV shoes to prevent further relapse. Parents were advised to ensure splint compliance. Noncompliance was defined as the inability to adhere to the abovementioned criteria and delay changing the splint as the foot size changed.

2.3. Follow up

Patients were assessed at one-month intervals for 14 consecutive months following complete correction of deformity. At each visit, the foot was assessed for any loss of correction, i.e., limitation of ankle motion, empty heel sign, and curving of the lateral border of the foot. The results were classified as excellent if the Pirani score was zero –one point, good if the total score was one point– 1.5 points, and poor if the total score exceeded 1.5 points. The splint fitting and compliance were recorded, and any modifications required were discussed with the family. A relapse was defined as the appearance of slight equinus and varus deformity of the heel, often without increased adduction or cavus deformities of the forefoot. Phone contact was used to monitor patients' follow-up and to improve clinic compliance.

2.4. Statistical methods

Data was entered using SPSS (Statistical Package for Social Science) version 26.0 (IBM®, SPSS, USA). Variables were examined for normality. Categorical variables

were expressed in numbers and percentages. Continuous variables were expressed using mean and standard deviation or median for normally distributed data and interquartile range for not normally distributed data.

3. Results

Our study included 16 patients, 25 feet, who fulfilled our inclusion criteria. They were 11 males (68.75%) and five females (31.25%). Nine patients (56.25%) had bilateral involvement, and seven patients (43.75%) had unilateral involvement (3 right-sided and four left-sided). The age of patients at the time of presentation had an average of 10 months and ranged between 3 months after birth to 2 years, tab. (1) The total duration of the treatment, from the application of the cast to the Denis-Browne Splint, varied from 3 to 9 weeks. The mean number of casts required

was about five. Tenotomies were performed on 21 feet of the 25 involved, representing 84% of the study population, while 4 feet (16%) did not require the tenotomy, tab. (2) & fig. (1). According to the Pirani score, an excellent score was found in 23 feet (92 %), and a good score was found in 2 feet (8 %), fig. (2). Regarding complications, casts were removed due to swelling in two cases, and one cast broke and needed to be changed early. Two patients had a week out of plaster due to a pressure area over the head of the talus. Redness was encountered in 3 cases (18.75%) due to bad hygiene and irritation of the skin by the edge of the cast. Antibiotics were applied over the affected area for 1 day, and casting was applied. Over 14 months, no relapsing cases were found (0%) due to meticulous follow-up and efforts made to make the parents aware of the drawbacks of another relapse, fig. (3).

Table (1) Patient data at presentation. (*The rule of Ponseti technique for correction of recurrent cases of congenital talipes equino varus*)

Patient ID	Age	Sex	Laterality	Side
1	3 months	Male	Bilateral	
2	2 years	Male	Unilateral	Left
3	10 months	Male	Bilateral	
4	16 months	Male	Unilateral	Left
5	12 months	Female	Unilateral	Left
6	9 months	Female	Unilateral	Right
7	11 months	Male	Bilateral	
8	16 months	Female	Bilateral	
9	3 months	Male	Bilateral	
10	4 months	Female	Bilateral	
11	7 months	Female	Unilateral	Right
12	16 months	Male	Bilateral	
13	2 years	Male	Unilateral	Left
14	4 months	Male	Unilateral	Right
15	3 months	Male	Bilateral	
16	3 months	Male	Bilateral	

Table (2) The number of casts needed and the need for tenotomy among the study population.

Laterality	Number of casts needed	Tenotomy	????
1	Bilateral	3	Yes
2	Unilateral	8	Yes
3	Bilateral	5	Yes
4	Unilateral	3	No
5	Unilateral	4	Yes
6	Unilateral	3	Yes
7	Bilateral	7	Yes

8	Bilateral	6	No
9	Bilateral	4	Yes
10	Bilateral	4	Yes
11	Unilateral	5	Yes
12	Bilateral	7	Yes
13	Unilateral	5	No
14	Unilateral	3	Yes
15	Bilateral	8	Yes
16	Bilateral	9	Yes



Figure (1) The need for tenotomy among the study population.

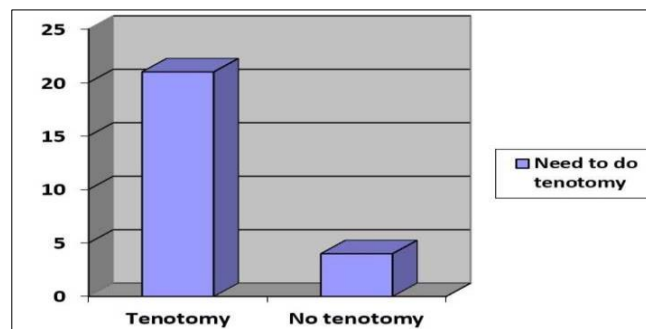


Figure (2) Results of Pirani score among the study population.

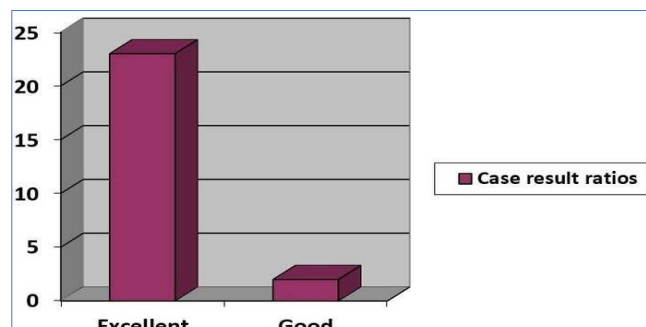


Figure (3) A 16-month-old female patient with bilateral CTEV. A: Pre-cast, B: During cast. C & D: After correction.

4. Discussion

Clubfoot, or congenital talipes equinovarus, describes a complex congenital malalignment of the foot and ankle [10]. The initial treatment of recurrent clubfoot, regardless of its severity or rigidity, is nonoperative by serial manipulation and casting, followed by braces to maintain with or without Achilles tenotomy when necessary [11]. The Ponseti technique is gaining wide-

pread acceptance as the treatment of choice for infants with clubfeet [10]. In the current study, 16 patients, 25 feet, with recurrent cases of CTEV foot deformity were recruited; 11 (68.75%) were males, and 5 (31.25%) were females. More than half of the patients (56.25%) had bilateral involvement. The age of patients at the time of presentation varied from 3 months after

birth up to 2 years. The total duration of the treatment from applying the cast to the Denis-Browne Splint ranged from 3 to 9 weeks, with a mean number of 5 casts required. Tenotomies were performed on 21 feet of 25 (84%) tenotomy, while 4 feet (16%) did not require the tenotomy. That means they achieved correction of the rigid equinus up to 15 degrees when abduction is up to 70 degrees with no residual varus deformity. According to Pirani score, most current study participants had an excellent score (23; 92 %) while only 2 feet (8%) had a good score. Tenotomies were performed on 21 feet of 25 (84%). The results of our study were satisfying as our patients had a much better ankle range of motion, both in dorsiflexion and plantarflexion. These results are comparable to those published by Ponseti when treating primary cases [9]. The possible explanation for this is mainly due to the young age of our patients, which resembles the primary cases. To a lesser extent, the primary pathology in CTEV is soft tissue contractures around the midfoot and hindfoot. At the same time, the bony articulation changes are not initially present as the skeleton is mainly cartilaginous. The purpose of casting is to immobilize the contracted ligaments at the maximum stretch obtained after each manipulation. All the joints are interconnected, and proper bony alignment can be achieved if treatment is started as early as possible. In concordance, a study made in Canada using the Ponseti method to treat primary cases on 51 clubfeet in 35 patients stated that 94% were corrected. Total scores after correction were 1.5 or less, with an average of 6.3 casts per foot. Two-thirds underwent Achilles tenotomy [12]. Another study in Germany on 32 clubfeet who were treated using the Ponseti technique showed an average total score of 4.6, following the Pirani classification. Nineteen feet had been exposed to conventional casting before initiating Ponseti management, and 25 feet (78%) were treated by percutaneous Achilles tenotomy after an average of 6.5 casts. A brace was applied after an average

of 6.9 casts. All of the patients in their study were compliant throughout the treatment. They concluded that applying Ponseti management has improved functional outcomes and successfully avoided open surgery in almost all cases [12]. Data regarding the use of the Ponseti technique in recurrent cases post-casting is scarce. One article about the use of this method in treating recurrent cases post-operative (posterior & medial releases) showed that 11 children (17 feet), with ages ranging from 1.1 to 8.4 years, were treated with this protocol. All were correctable with the Ponseti method with 1 to 8 casts. Casts were applied until the remaining deformities were either or both hindfoot equinus and dynamic supination. Nine feet required a heel cord procedure for the equinus, and 15 required tibialis anterior transfer for dynamic supination. Seven children had excellent results, while two patients had persistent hindfoot valgus, which required hemiepiphysodesis of the distal medial tibia [13]. Complications in the present study were mainly due to parents' noncompliance or bad hygiene, as two casts were removed due to swelling, and one cast broke and needed to be changed early. Two patients had a week out of plaster due to a pressure area over the head of the talus. Also, 3 cases suffered redness of the skin due to bad hygiene and irritation of the skin by the edge of the cast, which was controlled by applying antibiotics over the affected area for 1 day and re-casting.

5. Conclusion

Ponseti serial corrective cast management is an easy and effective method of CTEV correction for idiopathic clubfoot, especially when applied during an early period of CTEV. This decreases the number of casts needed. The parents must be instructed to apply a Dennis Brown Splint for the patients, as it is essential to prevent another relapse.

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