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### Below versus above knee plaster casting for treatment of club foot by Ponseti method. Is it working?

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#### Abstract

**Background:** Since the start of the Ponseti technique for treatment of congenital club foot, some modifications to the original method has been tried with some having good early results.

**Patients and methods:** Forty children with a mean of 10 days presented with sixty-four idiopathic club foot deformities were included. The feet were divided into 2 equal groups; Group A (32 feet) and group B (32 feet). Group A feet were treated by serial gentle foot manipulation and above knee plaster (AKP) casting (classic Ponseti technique) while group B were treated by serial gentle foot manipulation and below knee plaster (BKP) casting (a modified Ponseti technique). The patient were followed up for a mean duration of 26 months ranged from 24 to 30 months. The results were graded as good, bad, and failed, according to the assessment criteria by Pirani *et al.*

**Results:** The mean Pirani score for group (A) before treatment was 5.6 points, became 1.7 points after the last manipulation cast, and 1.15 points at the final follow up. For group (B), it was 5.2 points before treatment, became 1.5 points after the last manipulation cast, and 1.00 point at the final follow up.

**Conclusion:** The presenting technique of serial manipulation and below knee casting was comparable to the original one. It was a cost effective with a good results and very minimal cast related complications.

**Keywords:** club foot, ponseti, pirani, tendoachillis tenotomy

#### 1. Introduction

The Ponseti method for the treatment of clubfoot deformity showed interest in the late 1990s [1]. It involves a series of weekly manipulations and above knee cast applications to correct forefoot adduction, midfoot cavus, and hindfoot varus. Percutaneous Achilles tenotomy is required in most of cases after 4 to 6 weeks to correct the equinus component of the deformity if ankle dorsiflexion is less than 15°. Following the initial complete correction bracing is used to prevent relapse of the deformity for a period of 4 to 5 years. There are many centers reported excellent early results with this method [2-5].

In some locations additional challenges can include financial constraints in relation to transport and other medical expense. The distance, duration and cost of travel to attend clinic appointments [6].

The aim of the work was to evaluate the early results of treatment of club foot by serial manipulation and below versus above knee plaster casting.

#### 2. Patients and methods

Forty children of one week old up to 4 weeks with a mean of 2.5 weeks presented with sixty-four idiopathic club foot deformity were included. Forty-four patients (60%) were bilaterally affected, Sixteen patients (40%) were unilaterally

affected. There were 32 (80%) boys and 8 (20%) girls. There were not any associated anomalies.

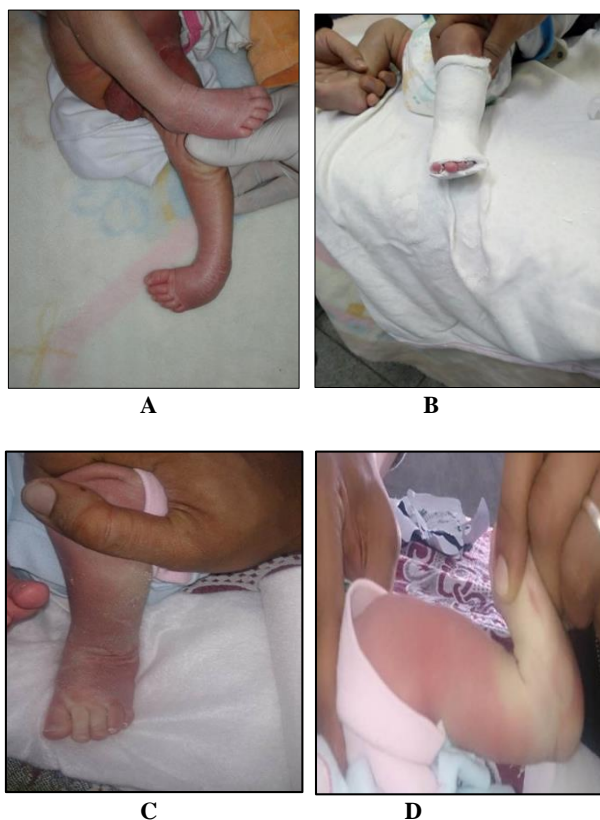
The feet were divided into 2 equal groups; Group A (32 feet) and group B (32 feet). Pirani scoring system was used to evaluate the severity of the deformity before treatment, during, after the last cast removal and at the end of follow up. A total score from 0 to 6 points, with 6 representing the most severe deformity [7].

Group A feet were treated by serial gentle foot manipulation and above knee plaster (AKP) casting (classic Ponseti technique) while group B were treated by serial gentle foot manipulation and below knee plaster (BKP) casting (a modified Ponseti technique) [8,9]. (Fig.1). In feet with BKP; the casts were well molded over a thin layer of cotton to avoid any space between the foot and the cast, a posterior groove at the back of the heel is performed to prevent the cast slippage. The casts were changed weekly in both groups. In both groups; the number of casts were ranged from 4 to 6 times with a mean 5 times according to the clinical evaluation after each cast for each one.

Tendoachillis tenotomise (TAT) were performed for 16 (50%) feet in group A and for 18(56%) feet in group B, It was done when the ankle dorsiflexion was less than 15°. All tenotomise were done under local anaesthesia. After tenotomies each group

was casted with the same pre-tenotomy casting form for a duration of 4 weeks. Locally fabricated foot abduction brace was applied immediately after the last cast removal. The affected foot was fixed in 70° external rotation and the normal one in 45° external rotation. All instructions about the brace use were clarified to the parents by direct face to face contact. The brace was applied for a duration of (23-24 hours)/day, for the first 3 months after the last cast removal, then the time of bracing was decreased by one hour every month till reaching 12 hours/day for 3 to 4 years. Both groups have received the same bracing protocol.

The average cost for each foot in group A was 1,650 Egyptian pounds (range; 1,580 to 1,720). For group B, the average was 900 Egyptian pounds (range; 750 to 950). The total cost included the number of plaster cast rolls, cotton pad, the brace and domestic transportation and medications required to treat any cast associated skin problems. The parents were not charged for the casting sessions and tenotomies as they were performed in (Elhadra University Hospital, Alexandria, Egypt).



**Fig 1:** A; Two weeks old baby with left congenital club foot, treated by serial manipulation. B; 4<sup>th</sup> final below knee plaster cast. C and D corrected forefoot adduction and ankle equinus immediately after the last cast removal.

The patient were followed up for a mean duration of 26 months ranged from 24 to 30 months. The parents were instructed to come for follow up every month for at least the first 6 months. The results were graded as good, bad, and failed, according to

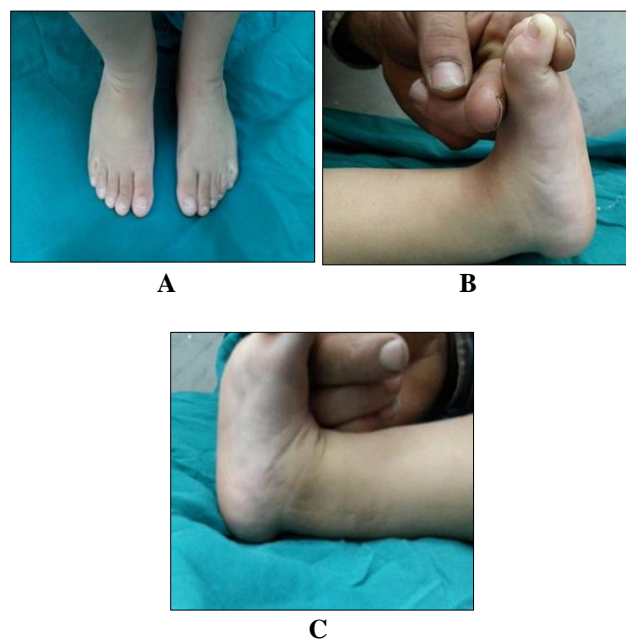
the assessment criteria by Pirani *et al* [7] An approval was given by the institutional review board (IRB) and informed consent was obtained from each parent.

### 3. Results

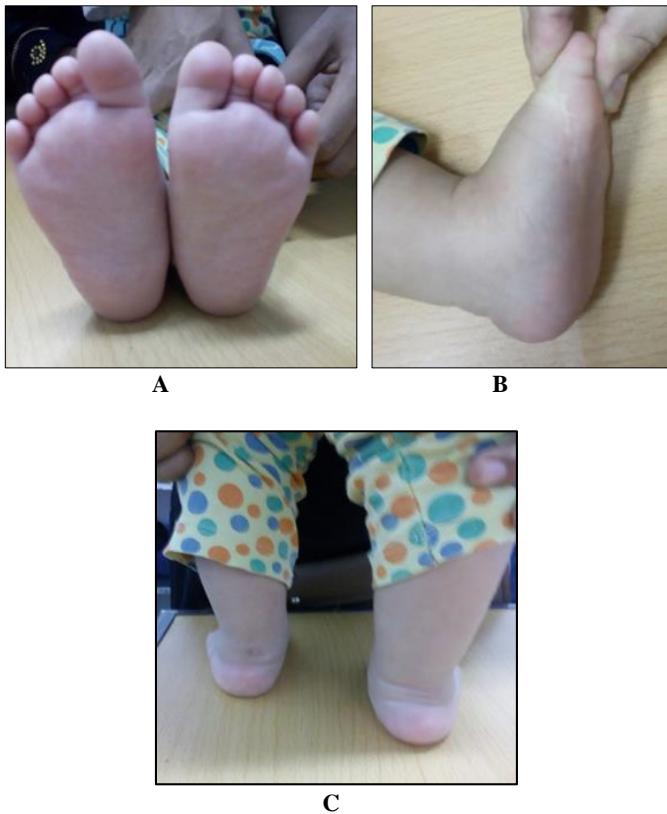
The mean Pirani score for group (A) before treatment was 5.6 points, became 1.7 points after the last manipulation cast, and 1.15 points at the final follow up. For group (B), it was 5.2 points before treatment, became 1.5 points after the last manipulation cast, and 1.00 point at the final follow up. Significant improvement of the scores in both groups (A,B) were noticed from before the start of treatment and after each cast up to the final follow up ( $P = 0.001$ ,  $P = 0.002$  respectively). As regarding group (A): 30 (93%) feet were good (Fig.2), 2 (7%) feet were bad at the end of follow up. The Pirani scores of the two bad feet immediately after last cast removal were (0.5, 0.5) and at the final follow up were (2.0, 2.5). In group (B); 31 (97%) feet were good (Fig.3) and one (3%) was bad, the score of the bad foot was 0.5 immediately after the last cast removal and become 2.5 at the final follow up.

There were not statistically significant relations between age, sex, side affected and number of casts and the final results in both groups (group A:  $P = 0.310$ ,  $P = 0.205$ ,  $p = 0.1000$ ,  $p = 0.510$ , group B:  $p = 0.123$ ,  $p = 0.234$ ,  $p = 0.435$ ,  $p = 0.243$ ). Although, tenotomies were performed in many cases, they had no statistically significant effect on the final results (group A:  $p = 0.090$ , group B:  $p = 0.07$ ). Also there was not statistically significant difference between the mean of the final scores of both groups ( $p = 0.211$ ).

There was statistically significant difference between the average of the costs in both groups ( $p = 0.003$ ).



**Fig 2:** Photograph of bilateral club feet at 24 months follow up treated by classic ponseti technique. A; corrected forefoot. B, C, good dorsiflexion



**Fig 3:** Photograph of left club feet at 25 months follow up treated by modified ponseti technique. A; corrected forefoot. B, good dorsiflexion. C, corrected heel varus.

In group (A); One foot had superficial ulcer (3%) under the cast over the head of talus during serial casting, 8 (25%) had sever dermatitis in the thigh and groin, 2 (6%) had thigh and leg muscle atrophy. In group (B); Two (6%) had superficial ulcer over the head of talus.

#### 4. Discussion

Since the start of the Ponseti technique for treatment of club foot deformity, there has been some modifications to the original technique in literature with some having good early results<sup>[10]</sup>.

The aim of the work was to evaluate the early results of a modified Ponseti method for treatment of club foot by serial manipulation and below knee plaster casting and comparing these results with original Ponseti method that involved serial manipulation and above knee plaster casting with or without TAT followed by bracing. In this study, there was excellent improvement of Pirani score from first visit before treatment and after each cast up to the final follow up, the success rate was reported in 93% of group (A) feet and 97% of group (B). The results in this work were comparable with the results of other centers using the original ponseti method<sup>[2-5]</sup>.

The age at presentation of the first Ponseti cohort of 67 patients was between one week and six months, with initial correction achieved in 83% of cases but with a 53% relapse rate. The

relapses in this cohort were due to short time bracing (21 months)<sup>[11]</sup>. In this study, the mean age was 2.5 weeks with a range from one to 4 weeks, this younger age was believed to be a cause of high success rate in this study especially for the new modified technique in group (B). In this young age the deformities were less rigid and easily corrected, small size feet allowed well application and fitting of the cast, Also the small babies were calm during cast application and had less power to push the leg against the ground and withdraw the leg from the cast. There was not any case with cast slippage reported in this work. Although, the believe in this study that the age at start of treatment was a factor of success, there was no statistically significant relation with the final outcome, this was agreed with several studies<sup>[12-15]</sup>. The reported number of casts required to achieve correction ranged between three and nine<sup>[11, 16, 17]</sup>. In this study; the number of casts required were 4 to 6, this smaller number might be attributed to the younger age, smaller foot, easy application of the cast and more malleable feet, but it had no statistically significant effect on the final outcome in both groups.

Although, Maripuri *et al.*(2013)<sup>[18]</sup>reported unacceptably high failure rates of below knee plaster casts in conjunction with the Ponseti technique, Brewster *et al.* (2008)<sup>[19]</sup> reported a series of 51 patients (80 clubfeet) treated with a below-knee soft cast through 4 years period which gave similar results to studies using above-knee plasters.

Around 80% of those born with congenital club foot each year present in developing countries<sup>[10]</sup>. The presenting modified method of treatment in group (B) was used to decrease the total cost of treatment. This was important in limited resource countries. Moreover, there was marked decrease in cast related complications between the two groups , two foot (6%) only in group (B) had a cast related complications in the form of superficial cast ulcers over the head of talus anterolaterally that were easily treated by dressings under the cast. Eleven (34%) feet in group A had cast related complications in the form of ; one superficial ulcer (3%) over the head of talus during casting that was treated by dressing under the cast , 8 (25%) had sever dermatitis in the thigh and groin that were treated by local corticosteroids , 2 (6%) had thigh and leg muscle atrophy.

Below knee casts allowed proper perineal care by parents to avoid soaking of the cast and dermatitis of the thigh. There were some problems encountered associated with Original ponseti method by others like moisture lesions, hematoma, dermatitis due to occlusion, pressure sores, fractures, leg muscle atrophy and rarely neurovascular complications at the time of TAT<sup>[10, 20, 21]</sup>. Sometimes, improper serial fitting of above knee plaster cast may lead to bowing of the leg due to small soft bone, this problem could be avoided by application of below knee cast.

The relapsed feet in both groups were attributed to brace noncompliance by parents. This cause of relapse was agreed with other studies<sup>[4, 22-24]</sup>.

Although, above knee plaster casting in original Ponseti's method was described before as important to maintain foot abduction, there was no significant difference between both

methods in this study, this again might be attributed to the younger age of all patients with small malleable feet.

## 5 Conclusion

The presenting technique of serial manipulation and below knee casting was comparable to the original one. It was a cost effective with a good results and very minimal cast related complications. It is better to be done for patients up to one month of age. This presenting method is not a substitution to the original ponseti method but it was a trial to decrease the cost in limited income countries as well as to decrease ponseti casting related complications. Further studies in different centers including a larger series to prove the efficacy of this method are required.

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