

# Evaluation of Effectiveness of Steenbeek Foot Abduction Orthosis in Maintaining Correction in Clubfoot Treatment by Ponseti Method

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**Abstract:** Introduction: The Ponseti method comprises of serial manipulation and a specific casting technique, with Achilles tenotomy, when needed, to correct any remaining equinus deformity, followed by the use of a foot abduction orthosis (FAO). Treatment is evaluated using the Pirani scoring. The Steenbeek brace developed in Uganda by Michiel Steenbeek, is made with local tools and materials. The cost is under 500 rupees and matches the recommendations provided by Dr. Ponseti. Our objective is to evaluate the efficacy of this low cost orthosis in a resource restricted patient population. Materials and Methods: A prospective cohort study was done for 1 year on children presenting at age <1 with clubfoot and treated in our hospital. Children with associated conditions like arthrogyroprosis, spina bifida or other lower limb disorders and previously treated elsewhere were excluded from the study. Results: Out of 50 patients (76 feet). Mean age of starting treatment was 1.24 weeks and mean initial Pirani score was 4.64. Tenotomy was done in 81.6% (62/76). Mean score at brace application was 0.64. Rate of recurrence was 10.5%. Rate of compliance was 89.5%. Recurrence showed highly significant correlation with non compliance ( $p < 0.001$ ). Discussion: FAO is recommended to reduce the risk of recurrence. Compliance is a major factor influencing recurrence. Dennis Brown bar as well the Mitchell Ponseti braces had lower rates of compliance and a high recurrence rates whereas in our study with Steenbeek orthosis compliance was 89.5% and recurrence rate was 10.5% proving it to be a cost effective approach to reduce recurrence in clubfoot in developing countries.

## 1. Introduction

Congenital talipes equinovarus, or clubfoot, is a common deformity where the affected foot is turned inward. It occurs in every 1.2 in 1000 live births and is the most common musculoskeletal congenital birth defect. Males are more commonly affected than females and up to 50% of cases are bilateral. The etiology of congenital clubfoot is largely idiopathic; however, it can be associated with other conditions such as spina bifida, arthrogyroprosis or other syndromes in approximately 20% of the cases (1). Initial treatment for this deformity is predominantly non-operative with serial manipulation and casting. Several methods of manipulation have been used historically; however, Ponseti's method has resulted in the highest success rates and has been reproduced at several institutions (2). The Ponseti technique involves serial manipulation and casting of the feet, with or without an Achilles tenotomy, followed by the use of a foot abduction orthosis (FAO) for maintenance of the correction (3). An integral part of Ponseti treatment is adherence to strict post correction foot abduction. This has traditionally been maintained using straight last shoes connected to a Denis Brown bar. Non-compliance with abduction bracing has been identified by multiple surgeons as a major risk factor for the recurrence of deformity. Recurrence of deformity entails significant time and cost in additional treatment. This can range from repeat manipulation and casting, repeat Achilles tenotomy, tibialis anterior transfer, and soft tissue releases about the foot and ankle (4). There are variety of braces available in the market these days. The newly designed and expensive braces may be economically unobtainable to low-income population (5). The Steenbeek foot abduction brace (SFAB) described by Michiel Steenbeek and acknowledged by Dr Ponseti himself, is of particular interest for developing countries for its low cost factor, the aim of this study was not only to report our short-term results with the Ponseti method, but also to demonstrate the effectiveness of the SFAB for the

immobilization of clubfeet following the casting period in a resource restricted patient population.

## 2. Materials and Methods

A total of 50 patients of age less than 6 months treated with Ponseti technique at the out patient department of Govt Medical College, Jammu between January 2016 and August 2017 were included in the study. Positional, syndromic and neurologic clubfeet were excluded from this study. 40 boys and 10 girls (26 bilateral clubfeet and 24 unilateral clubfeet) were included in this study. The mean age at the beginning of the treatment was 1.24 weeks (8.68 days). Ponseti method was the initial treatment in all cases after grading of the feet by modified Pirani scoring. The mean Pirani score at the beginning of the treatment was 4.62. We closely followed the protocol described by Ponseti and Smoley (5) with weekly manipulation and casting. The first cast aims to correct the cavus deformity by placing the forefoot in supination, in proper alignment with the hindfoot. In the following casts, the adduction and the varus deformities are progressively corrected. With the thumb acting as a fulcrum over the neck of the talus, the foot is gently manipulated outward and then immobilized with a well-moulded toe-to-groin plaster cast. The cast is changed every week. It is only after complete correction of the adductus, which means a range of external rotation of  $60^\circ$  and correction of the varus deformity that correction of the equinus is considered. If at this stage,  $15^\circ$  dorsal flexion of the ankle has not been obtained, then a percutaneous tenotomy of the Achilles tendon is performed under local anesthesia. The foot is then immobilized in maximum dorsiflexion for 3 weeks. After the correction of the deformity, the feet were fitted in the SFAB with  $15^\circ$  dorsal flexion and  $60-70^\circ$  external rotation. The brace was worn full time (23 h per day) for 3 months, followed by a period of part-time wearing of 12-14 h a day. The number of casts, the need of a tenotomy of the Achilles tendon and compliance with the brace and complications were

documented for every patient. Follow-up included re-evaluation of position and obtained correction at the end of the casting period after the period of full-time bracing and during the period of part time Bracing. Results were analysed using the Pirani scoring and any increase in the score was considered as recurrence.

### 3. Results

Out of the 50 Patients 26 had Bilateral and 24 Unilateral (Total of 76 feet) clubfoot. There were 40 boys and 10 girls. Mean age of starting treatment was 1.24 weeks (8.68 days). Mean Pirani Score at the time of starting treatment 4.82. Tenotomy was done in 81.6% feet. (62/76) and Mean score at brace application was 0.64. Recurrence was seen in 4 patients (both b/l i.e 8 feet). Rate of recurrence was 10.5 % which showed highly significant association with non compliance ( $p < 0.001$ ). Mean score at brace application was 0.64 (SD=0.35). Patients were divided into two groups on the basis of age of initial presentation, initial Pirani Score, total number of casts required for correction of deformity, requirement of tenotomy and Pirani score at giving foot abduction brace and statistical tests were done to find any association of the above factors on the outcome.

Age of 1 <sup>st</sup> presentation	Recurrence	No Recurrence	Total
Less than or equal to 2 weeks	2	34	36
>2 weeks	4	10	14

$p$  value = 0.18 (Fischer Exact test)

Initial Pirani Score	Recurrence	No Recurrence	Total
6	4	12	16
<6	8	52	60

$p$  value = 0.58 (Fischer Exact Test)

Total Number of casts	Recurrence	No Recurrence	Total
6 or less	2	26	28
>6	4	18	22

$p$  value = 0.56 (Fischer Exact test)

Tenotomy	Recurrence	Non Recurrence	Total
Yes	8	54	62
No	4	10	14

$p$  value = 0.99 (Fischer Exact test)

Score at giving FAB	Recurrence	No recurrence	Total
1	4	28	32
<1	8	36	44

$p$  value = 0.99 (Fisher Exact test)

Compliance	Recurrent	Non recurrent	Total
Compliant	0	68	68
Non compliant	8	0	8

$p$  value < 0.001 (Highly significant) {Yates corrected Chi square, Fischer exact, Mid P exact}

Four patients were non compliant. 3 had heel ulceration and was managed by wound dressings starting of the ponseti casting again followed by tenotomy and bracing. In the other case the main reason for non compliance was excessive crying by the child was managed again by ponseti and proper counselling of the parents.

### 4. Discussion

FAO is recommended to reduce the risk of recurrence. Compliance is a major factor influencing recurrence. Different types of braces are available and all had variable compliance and recurrence rates, Dobb's Dynamic Brace - 81% Compliance, 19% Recurrence (7); Denis Brown brace - 79% Compliance, 19% Recurrence (11). Results of Denis Brown Brace and the Mitchel Ponseti brace are comparable (12).

The high costs and delays in acquisition of the brace and a lack of orthopaedic stores able to adequately construct the orthotic, also present considerable barriers to sustained brace use in developing nations (13).

**Cost:** Denis Brown brace: 24\$ (Rs 1650), Dobbs Dynamic brace: 110\$ (Rs 7500), Custom solid AFO & foot insert: 257\$ (Rs 17500) (5). In our study with **Steenbeek Foot Abduction Orthosis (SFAO)**.

**Compliance:** 89.5%, Recurrence rate : 15.8%. It is well Tolerated and easily available. It is acceptable and easy to use and is Cost effective (Rs 250)

### 5. Conclusion

Steenbeek Foot Abduction Orthosis use in maintaining correction in club feet treated by Ponseti method is a **cost effective** approach to reduce recurrence in a **resource restricted** patient population (Developing nations) like ours.

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