



## Modified Ponseti method of management of neonatal club feet

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The aim of this study was to assess the outcome of a new protocol for the management of neonatal clubfeet that can be considered as a modification of the Ponseti method. The modifications consisted of performing the tenotomy of the Achilles tendon prior to the application of the first cast and using only one cast for a period of 3 weeks following tenotomy. We applied the modified method in 50 children (82 club feet) and assessed the degree of deformity using the Pirani and the Dimeglio scoring systems. The minimum follow-up period was 28 months (range : 24-32). The intermediate range follow-up results of this study showed that the modified Ponseti method was associated with a good outcome in 85% of cases of neonatal club feet with a Pirani score of 5 or less and a Dimeglio score of 15 or less. Persistently high Pirani or Dimeglio scores immediately after tenotomy and poor compliance with splintage were predictors of failure of the modified technique.

**Keywords :** Ponseti technique ; club foot ; talipes equinovarus ; Achilles tenotomy.

### INTRODUCTION

The Ponseti method of management of talipes equinovarus has found acceptance in most parts of the world at present and many studies have reported on its effectiveness in decreasing the rates of extensive soft tissue releases in the treatment of club feet (1,5,9,10,12,15). The classical Ponseti method involves the use of around five casts with an interval of one week between each cast applica-

tion (17,11). The first cast is used to hold the forefoot in supination, a counter-intuitive manoeuvre that aligns the forefoot with the inverted hind foot. In subsequent casts, the deformity is corrected by rotating the entire 'calcaneo pedal block' using the head of the talus as the fulcrum. A percutaneous tenotomy of the tendo Achilles is performed in feet with persistent equinus before the application of the 5<sup>th</sup> cast and the post tenotomy cast is maintained for 3 weeks. The total duration of cast application in a child with satisfactory progression of the Ponseti method of treatment is around 6 weeks. Cast treatment is followed by splintage using an abduction foot orthosis until the child is around 3 to 4 years of age.

In this study, the classical Ponseti technique has been modified, with the intention of decreasing the duration of casting and the number of casts required and still achieve results similar to that of the classical Ponseti technique. However, it is important to

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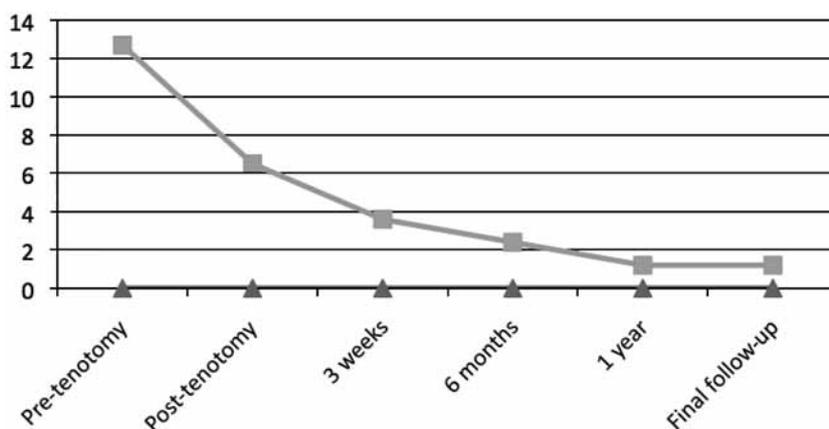


Fig. 1. — Mean Dimeglio scores

see whether such a method is effective in actual practice and this formed the basis for undertaking the present study.

## METHODS

In this prospective study, the modified Ponseti method was used in 82 feet with idiopathic talipes equinovarus. There were 32 children with bilateral club feet and 18 with unilateral club feet. All children were neonates who presented to the hospital within 4 weeks of birth. None of the children had any previous treatment elsewhere. The children had idiopathic club feet without any history of prematurity, other abnormalities or syndromes. There were 41 male and 9 female infants. The study was conducted after obtaining the consent of the ethics committee of the hospital. Written consent was also obtained from the parents of the children after explaining to them that a modification of the classic Ponseti protocol would be applied for management.

The method of treatment was as follows – 1) a percutaneous tenotomy of the tendo Achilles was done at the first visit and a corrective cast was applied ; 2) the first ‘supination cast’ used in the classical Ponseti method was omitted. It should be emphasized here that the supination manoeuvre described by Ponseti (elevating the first metatarsal to correct the cavus deformity) was not omitted. It was the first step in manipulation and it was immediately followed by the subsequent steps of manipulation as described by Ponseti ; 3) only one cast was used for a period of 3 weeks following which, the cast was removed and an external rotation splint was used for maintenance of correction (11). Measurements of

the feet were taken prior to the application of the cast so that the external rotation splint could be prepared and kept ready for application immediately after removal of the cast. The scoring systems of Pirani and of Dimeglio were used for assessing the deformity before and after treatment (6,7). The scores were recorded at the first visit before the application of the cast (before and after tenotomy of the heel cord) and on 6 occasions during the subsequent follow-up period (immediately after cast removal followed by scoring at 3 to 4 month intervals). The minimum follow-up period was 28 months (range 28 to 32 months). A Pirani score of more than 0.5 after removal of the cast at the end of 3 weeks was considered as failure of the ‘single cast’ technique and in these children, one or two additional casts were used to obtain correction.

## RESULTS

The mean Dimeglio score was 12.7 before tenotomy at the first visit (range : 10 to 18). It reduced to 6.5 after tenotomy (before application of the cast) and further reduced to 3.6 after 3 weeks of casting (Fig. 1). The mean Dimeglio score was 1.3 at the final follow-up. The mean Pirani score was 3.5 at the first visit before tenotomy (range : 2 to 5). It reduced to 1.8 immediately after tenotomy. It further reduced to 0.7 after 3 weeks of casting. The mean Pirani score was 0.2 at the final follow-up (Fig. 2).

We evaluated the equinus and varus scores separately in the Dimeglio scoring system to assess how

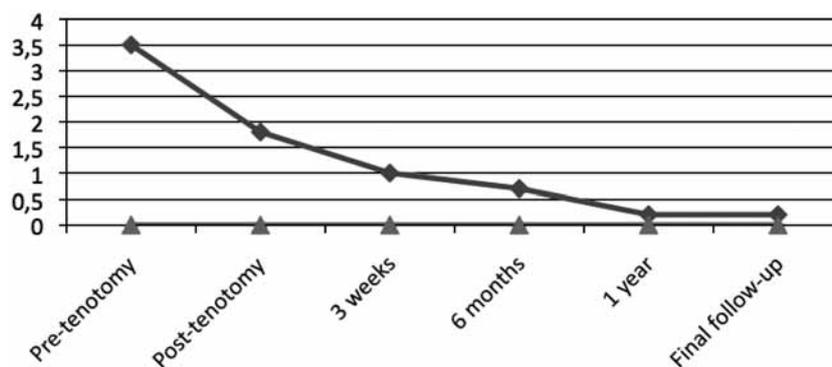


Fig. 2. — Mean Pirani scores

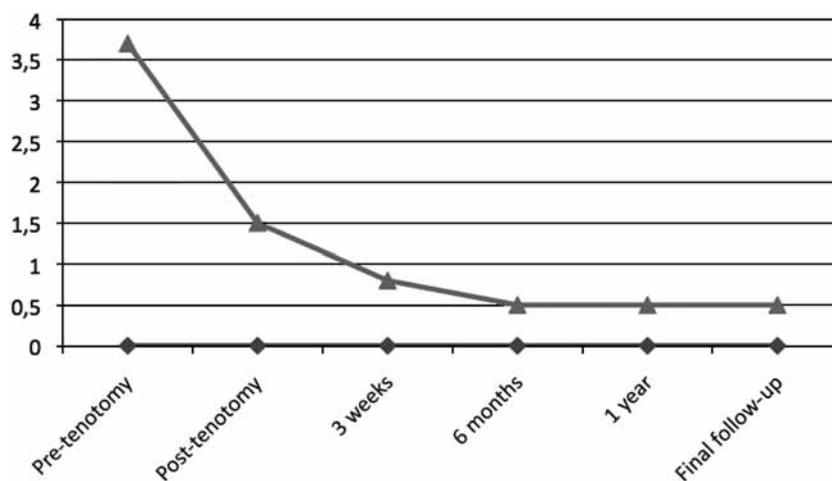


Fig. 3. — Mean Equinus scores (Dimeglio)

the correction of each of these components correlated with the other. The mean equinus score in the Dimeglio system was 3.7 before tenotomy, which reduced to 1.0 post-tenotomy and further to 0.8 at the end of casting. It reduced to 0.5 thereafter (Fig. 3). The mean varus score was 3.6 before tenotomy, which reduced to 1.2 post-tenotomy and further to 0.6 at the end of casting (Fig. 4). Twelve feet of the total 82 continued to have a Dimeglio score above 5 and a Pirani score above 2 at the end of 3 weeks of casting. Thus, the failure rate using the modified technique was 14.7% in the present study. It was noted that the pre-treatment Dimeglio scores were above 15 and the Pirani scores above 4 in 8 of the 12 feet that did not respond well to this method

of treatment. It was also noted that in these 8 cases, the immediate post-tenotomy score showed less than 50% correction compared to the initial pre-treatment score. Poor compliance with the splintage in the follow-up period was another factor noticed in these patients.

## DISCUSSION

The classical Ponseti method has been used in our institution for a number of years with good results. However, it was felt that there was scope for decreasing the duration of casting and reducing the number of casts in infants with idiopathic club feet that respond well to the Ponseti casting technique.

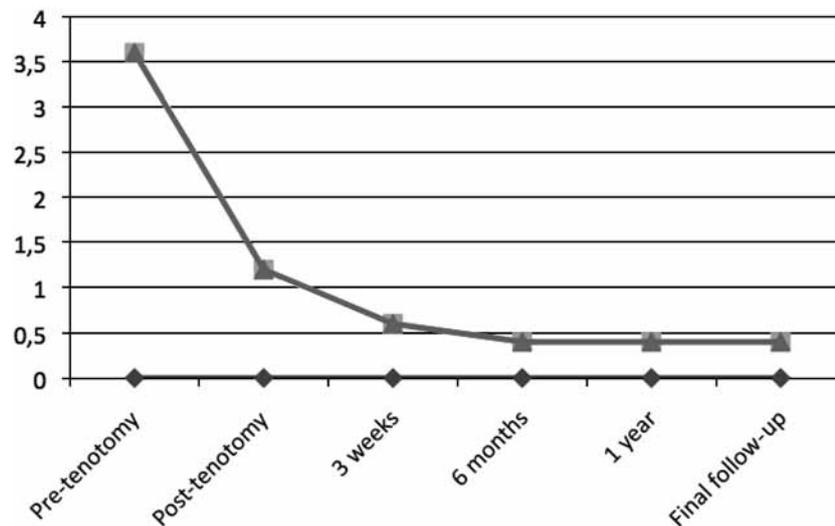
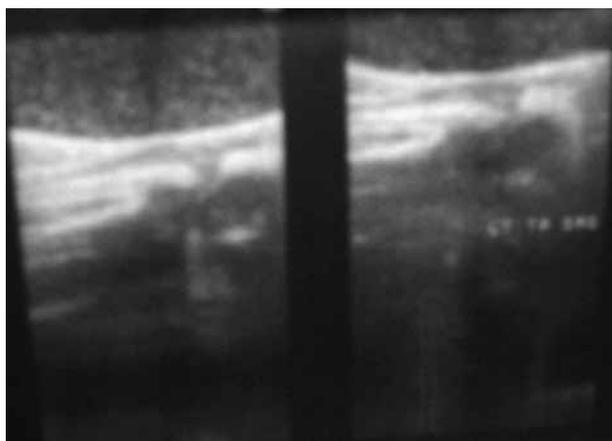


Fig. 4. — Mean Varus scores (Dimeglio)

The first cast in supination advocated by Ponseti was not employed in this study. Maintenance of supinated position for one week in cast has been considered important in facilitating subsequent manipulative reduction (8). While we do not disagree with the initial manipulation of elevating the first metatarsal, we felt that in infants with idiopathic club feet presenting in the first month of life, the supination cast could be dispensed with. After the initial supination manoeuvre, we continued with the remaining steps of the Ponseti method of manipulation in the same sitting. In our study, we did not have difficulty in achieving correction using the Ponseti technique even without the initial cast in supination. It must be stressed here that, supination of the forefoot was indeed the first step in manipulation but we proceeded with the subsequent steps of manipulation without casting the foot in supination for one week.

The second difference from the classical Ponseti method was the performance of a percutaneous tenotomy of the Achilles tendon prior to the application of the first cast itself. One reason for this is that after the tenotomy of the Achilles tendon prior to the fifth cast in the classical Ponseti method, the cast is left on for 3 weeks. Tenotomy during the first visit would allow 3 weeks of casting without the need for

further 3 weeks of cast towards the end. Secondly, division of the tendon would allow better manipulation and better positioning of the hindfoot from the initial stage of treatment itself. The Achilles tendon crosses both the ankle and subtalar joints prior to its insertion onto the calcaneum. A tight tendo Achilles would be expected to interfere with the mobility of the calcaneus at the subtalar joint (13,14). Such rotation of the calcaneus at the subtalar joint is required for the success of the Ponseti technique of manipulation. Early tenotomy of the tendo Achillis would add to the efficacy of the Ponseti technique. It can be argued that the 100% tenotomy rate used in our study is excessive and many tenotomies would have been unnecessary. However, review of literature shows that the tenotomy rates are high even in the classical Ponseti technique and tenotomy is required in nearly three-fourths of children undergoing the Ponseti method of treatment. Reported tenotomy rates have varied between 72% and 97% (3,4,18,19). Tenotomy of the Achilles tendon has been shown to be followed by re-establishment of the continuity of the tendon within 3 weeks and no serious post tenotomy disability has been reported (2). In our study, ultrasonographic examination of the Achilles tendon in 5 children with bilateral clubfeet showed restoration of the continuity of the



**Fig. 5.** — Ultrasonographic picture of Tendo Achillis showing bridging of the tenotomy site.

tendon after 3 weeks following tenotomy (Fig. 5). Secondly, contrasting opinions have been expressed in literature regarding the prediction of the need for tenotomy and no universally accepted guidelines exist at present to aid decision-making regarding tenotomy. In the study by Dyer and Davis, 93% of feet that required tenotomy had an initial Pirani hind foot score of 2.5 or 3. However, a large percentage (53.6%) of the feet that did not require tenotomy also had an initial hind foot score of 2.5 or 3 (7). Scher *et al* reported that feet with an initial Pirani score of 5.0 or more or Dimeglio score of 4 were very likely to need tenotomy (15). Brewster *et al* reported that the mean Pirani score of the feet that required tenotomy varied between 0.5 and 3 at the time of performing the tenotomy (16). In their study, the difference in the mean Pirani scores at presentation between feet requiring tenotomy and not requiring tenotomy was quite small (5.8 and 5.0 respectively).

The third difference was to limit the number of casts to 1 instead of the usual 5 casts in the classical Ponseti method. Morcuende *et al* have already shown that treatment time can be reduced even in the classical Ponseti technique without compromising the outcome (16). They described the 'accelerated Ponseti' technique that showed that the results were similar when the time between the casts was

reduced to 5 days. The '5 day group' required an average of 16 days from the first cast to tenotomy followed by further casting for around 2 weeks after tenotomy. An average of 4 casts was required in both the '5 day' and the '7 day' groups. Since the available literature shows that tendo Achilles continuity is restored at around 3 weeks following tenotomy, we advocate the cast to remain *in situ* for 3 weeks. Scher *et al* reported that the children who underwent a tenotomy required significantly more casts than those who did not (19). This is because, in the classical Ponseti technique, the feet with high initial Pirani scores may need more casts till the stage is reached when the surgeon considers them to be fit for tenotomy and final cast application. This question does not arise with the 'tenotomy first' modification and the number of casts can be minimized.

Nearly 15% of the neonatal club feet did not show significant correction after tenotomy and one cast application. These cases required 2 to 3 additional casts. Dyer and Davis reported that club feet with an initial Pirani score of 4 or more were likely to need at least 4 casts and those with score of less than 4 were likely to require 3 or less casts with the use of the classical Ponseti technique (7). In our study, 70% of the poorly responding club feet (8 out of 12) had an initial Pirani score > 5 and a Dimeglio score > 15. It was also observed that in these feet, the correction immediately following tenotomy (prior to casting) was less than 50% of the pre-treatment score. Thus, suboptimal improvement of scores following tenotomy is probably an indicator of suboptimal outcome following the 3 week casting period.

## CONCLUSION

We have suggested certain modifications in the technique to enable reduction in the duration of treatment and the number of casts, while still adhering to the basic philosophy of Ponseti. Our study was limited to infants presenting to us within one month of birth and the results are valid for this age-group. The tenotomy-first, single cast technique seems to provide good outcome especially in club feet with a pre-treatment Pirani score of 5 or less

and a Dimeglio score of 15 or less. Failures were associated with high initial Pirani and Dimeglio scores in children who did not show considerable reduction immediately after tenotomy. Poor compliance with splintage was another contributory factor. Further studies including randomized trials are required to validate the results of our study.

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