

# Evaluation of the utility of the Ponseti method of correction of clubfoot deformity in a developing nation

Ankur Gupta · Saurabh Singh · Pankaj Patel · Jyotish Patel · Manish Kumar Varshney

Received: 15 September 2006 / Revised: 23 September 2006 / Accepted: 24 September 2006 / Published online: 18 November 2006  
© Springer-Verlag 2006

**Abstract** Clubfoot is the commonest congenital deformity in babies. More than 100,000 babies are born worldwide each year with congenital clubfoot. Around 80% of the cases occur in developing nations. We treated 154 feet [mean Pirani score (total) 5.57] in 96 children (78 males, 18 females) by the Ponseti method from January 2003 to December 2005. A prospective follow-up for a mean duration of 19.5 months (range 6–32 months) was undertaken. After six months of treatment the Pirani score was reduced to zero for all patients. The results show that corrective surgery, sometimes multiple, can be avoided in most cases which are usually associated with the development of a stiff, painful foot. Low socio-economic status and illiteracy prevailing in developing nations increases the prevalence of neglected clubfoot that is still harder to correct. Integration into various programs and proper use of available resources can decrease neglected clubfoot and improve chances of successful and timely correction of deformity. Bracing constitutes an important part of treatment and proper motivation and education of the parents mitigates the chances of losing correction. The Ponseti method of correcting clubfoot is especially important in developing

countries, where operative facilities are not available in the remote areas and well-trained physicians and personnel can manage the cases effectively with cast treatment only.

**Résumé** Le pied bot est parmi les déformations les plus habituelles chez l'enfant. Plus de 100.000 enfants naissent chaque année avec un pied bot congénital. 80% des cas proviennent des pays en voie de développement. Nous avons traité 150 cas de pieds avec un score de Pirani moyen de 5.57 chez 96 enfants. 78 étaient de sexe masculin, 18 de sexe féminin. Nous avons utilisé la méthode de Ponseti de janvier 2003 à décembre 2005. Une étude prospective a été réalisée sur une période de 19,5 mois (6 à 32 mois). Après six mois de traitement, le score de Pirani a été réduit à 0 chez tous les patients. Le résultat montre qu'une correction chirurgicale peut être parfois nécessaire dans les cas présentant un pied raide et très douloureux. L'utilisation de toutes les ressources nécessaires permettent de diminuer le nombre de pieds bots négligés et d'améliorer les chances de succès du traitement de cette déformation. Le traitement orthopédique est une part importante du traitement et la motivation et l'éducation des parents augmentent les chances de succès et diminuent les pertes de correction. La méthode de Ponseti est très importante dans les pays en voie de développement (80%) où les conditions opératoires ne sont pas très faciles et nécessitent un personnel entraîné.

---

A. Gupta · S. Singh · P. Patel · J. Patel  
Department Of Orthopaedics, Smt. Nathibaa Hargovinddas  
Lakshmi Chand Municipal Medical College,  
Ellis Bridge, Ahmadabad, India

M. K. Varshney  
Department of Orthopaedics,  
All India Institute of Medical Sciences,  
New Delhi, India

S. Singh (✉)  
C-28, sector-40, Noida  
201301 Uttar Pradesh, India  
e-mail: drsaurabhsinh@gmail.com

## Introduction

Clubfoot is a complex developmental deformation. The genes responsible for clubfoot deformity are active starting from the 12th to the 20th weeks of foetal life and lasting until three to five years of age [4, 11, 19]. The deformity has four components: equinus at ankle, varus at hindfoot,

forefoot adductus, and cavus. The goal of treatment is to attain a functional, pain-free, plantigrade foot, with good mobility. Many of these cases are untreated or poorly treated, leading to neglected clubfoot. These children undergo extensive corrective surgery, often with disturbing failures and complications. Revision surgeries are also thus more common. Although the foot looks better after surgery, it is stiff, weak, and often painful. After adolescence, pain increases and often becomes crippling. Clubfoot in an otherwise normal child can be corrected in two months or less with the Ponseti method of manipulations and plaster cast applications, with minimal or no surgery [10, 13–15]. This method is particularly suited for developing countries, where there are few orthopaedic surgeons in rural and remote areas. The technique is easy to learn by allied health professionals, such as physiotherapists and orthopaedic assistants. The treatment is economical and easy on the babies.

### Materials and methods

Ninety-six children (154 feet) were treated by the Ponseti method between January 2003 to December 2005 at Vadilal Sarabhai Hospital, Ahmadabad, India. The cases were referred to us from paediatric wards, paediatric surgery wards and gynaecological wards. We put up clubfoot awareness posters during Pulse Polio Programmes and train the supervisors at these camps to screen for the deformity in each child and report those cases and refer them to our hospital as soon as possible. All the patients were treated on an outpatient programme. Every clubfoot under Ponseti management was “scored” each week for HS (hind-foot score), MS (mid-foot score), and G (total score). Manipulation and casting were carried out on an out-patient department basis without any anaesthesia or sedation. The general principles of the Ponseti method for manipulative correction were followed; correcting all components simultaneously, starting from pronation and leaving equinus for the last. Below-knee casts, extended to above-knee casts, were applied for three weeks and further, as per correction achieved. Scores were plotted on a graph showing where the foot was on the roadmap of treatment, visually and easily reassuring parents of satisfactory progress. Tenotomy was done when  $HS > 1$ ,  $MS < 1$  and the head of the talus is covered. Before performing tenotomy, it was assured that the foot is sufficiently abducted. This was done in the operation theatre as a short day-care procedure and the patients were discharged on the same evening. Just before tenotomy, the brace measurements were taken so that by the time the patient was to be fitted with the brace it would be ready. End of cast treatment was determined when after the last cast at least  $30^\circ$  of passive dorsiflexion was possible,

the foot was well corrected, and the operative (tenotomy) scar was minimal. A Steenbeek brace was applied immediately after the last cast is removed, three weeks after tenotomy. For unilateral cases, the brace was set at  $70^\circ$  of external rotation on the clubfoot side, and  $40^\circ$  on the normal side. In bilateral cases, it was set at  $70^\circ$  of external rotation on each side. The bar should be of sufficient length so that the heels of the shoes are at shoulder width. The bar should be bent  $5\text{--}10^\circ$  with the convexity away from the child, to hold the feet in dorsiflexion. The braces have been supplied to all the patients free of cost by ALTSO (A Leg To Stand On), an American non-government organisation. The brace should be worn full-time (day and night) for the first three months after the tenotomy cast is removed, then the brace should be worn for 12 hours at night and two to four hours in the middle of the day, for a total of 14–16 hours (nights and naps protocol) during each 24-hour period. In the brace, the knees are left free. Bracing was continued for up to four years of age. After applying the brace for the first time after the tenotomy cast was removed, the child returns according to the following schedule.

- Two weeks (to check for compliance issues)
- Three months (to teach the nights-and-naps protocol)
- Every four months until age three years (to monitor compliance and check for relapses)
- Every six months until age 4 years
- Every one to two years until skeletal maturity

During follow-up, the relapses, if any, were treated appropriately. Equinus required repeat tenotomy, while forefoot adduction, cavus and intoeing were all treated with repeat casting.

Special clubfoot clinics were organised, where patients on splints were called and used to share their experience with the new patients in casts. We maintained a good photographic record of all the patients and showed these to the new patients, which assured them about this relatively new method for them.

### Results

A total of 154 feet [78 males (81%) and 18 females (19%)] in 96 children were treated by the Ponseti method and the results were assessed in the present series, carried out from January 2003 to December 2005. Fifty-eight children had bilateral clubfeet (116 feet), 26 were unilateral on right side and 12 were left sided. One hundred and one feet (65.5%) were of first-born children, 46 feet were of second born. One hundred and forty-two feet (92.2%) were of children born full-term (Table 1). The most common associated congenital anomaly in our studies was myelomeningocele (four cases). Next common was spina bifida (two cases).

**Table 1** Number of clubfeet in relation to type of birth in the series

Type of birth	No. of clubfeet (percentage)
Preterm	8 (5.2%)
Full term	142 (92.2%)
In vitro fertilization	4 (2.6%)

One hundred cases (65%) presented within six weeks (Table 2). The total mean score at presentation was 5.57. The corresponding HS and MS were 2.82 and 2.75, respectively. The majority of cases (71%) required five casts to complete correction, with a mean of 4.9. The average duration of cast application was 4.94 weeks, a majority of whom (107 cases; 70%) were treated for five weeks (Table 3). Tenotomy was required in 146 feet (95%) and most of these had Pirani scores of more than 5. The score at six months follow-up was reduced to zero in all the cases (100%). The average duration of follow-up was 19.5 months (range six–32 months). Nine cases of relapse (five forefoot adduction, one equinus, two cavus, one toe inlaving) were encountered during follow-up. Equinus required repeat tenotomy, while the rest were all treated with repeat casting.

## Discussion

Clubfoot or congenital talipes equinovarus is a complex deformity of foot that requires meticulous and dedicated efforts on the part of the treating physician and parents for the correction of the deformity. The Ponseti method [13–16] of correction of clubfoot deformity requires serial corrective casts with long-term brace maintenance of the correction. The guidelines regarding patient selection and treatment protocol vary between investigators [1–3, 6–8, 12, 16], but in general the treatment needs to be started as soon as possible and should be followed under close supervision. This study demonstrates the effective use of manpower, integration with other programs and guided motivation to identify the cases and correction of the

**Table 2** Number of clubfeet in relation to age at presentation in the series

Age at presentation	No. of clubfeet (percentage)
<3 weeks	48 (31%)
3–6 weeks	52 (34%)
6–9 weeks	30 (20%)
9–12 weeks	12 (8%)
3–6 month	8 (5.2%)
6–9 month	4 (2.6%)

**Table 3** Duration of cast application

Weeks of treatment	No. of clubfeet (percentage)
3 weeks	6 (3.9%)
4 weeks	22 (14%)
5 weeks	107 (70%)
6 weeks	15 (9.7%)
7 weeks	2 (1.3%)
8 weeks	2 (1.3%)

deformity in all the cases (100%) without the use of extensive surgery.

In this series, the male to female ratio is high (male:female, 4:1) in comparison to the series of Cowell and Wein [4] and Yamamoto [19] (male:female, 3:1). Palmer [11] explained this by suggesting that females require a greater number of predisposing factors than males to produce a clubfoot deformity. Social bias and increased attention towards males in our region can account for the higher incidence in males in our study. The order of birth also seemed to have an influence on the occurrence of clubfoot, with 65% of cases in the first-born child, which is in accordance with various other studies [1, 3, 4, 6, 7]. Another important observation in our study was that four patients were born out of in vitro fertilisation. There was no relationship of clubfoot to the type of birth.

Of the children with clubfeet presented to us, 85% were within nine weeks of birth because of good referral organisation. We put up clubfoot awareness posters during Pulse Polio Programmes and train the supervisors at these camps to screen for the deformity in each child and report those cases and refer them to our hospital as soon as possible. We also carry on special clubfoot clinics for such patients, where our old patients on night splints are called and they share their experience with the new patient's parents and assure them about the treatment, improving motivation and compliance. Results were better if this method of treatment was started as early as possible after birth. The earliest cast applied was at an age of one day. The maximum age at which a cast was applied was at nine months.

The number of casts per feet in our study was three to ten (average 4.9). In a series by Ponseti et al. [12], the number of cast per feet was five to ten (average 7.6). In another study by Laaveg et al. [8], the mean number of casts during their treatment was seven. Morcuende [9, 10] reported that 90% of the patients required five or fewer casts. Over a period of time, with more experience, people have started changing plaster casts at shorter intervals [9] and fewer casts per feet give faster results. Those feet which required a greater number of casts in our study had a Pirani score of 6 at the onset of treatment. The duration of casts

for more than 85% of feet was five weeks or less (Table 3). The duration decreased over time as we mastered the technique and started getting faster correction.

Ponseti et al. [12] reported five–12 weeks' duration of casts (average, 9.5 weeks). In another study by Laaveg et al. [8], the average duration was 8.6 weeks. Morcuende et al. [9] reported an average time from the first cast to tenotomy as 16 days for one group and 24 days for another group in the same study. Their study showed that the duration of plaster casts can be decreased by using the accelerated Ponseti protocol for clubfoot treatment. In our study, tenotomy was needed in 95% of the cases and these patients had initial Pirani score >5. It shows that tenotomy was required in those patients who initially have severe deformity. It is advisable to do tenotomy after achieving forefoot abduction and when one is in doubt about equinus correction [17]. Pirani carried out tenotomy in over 90% of his clubfoot patients. Laaveg et al. [8] did tenotomy in 78% cases. In the study by Dobbs et al. [5], tenotomy was required in 91% cases; also, four patients had severe bleeding after tenotomy. We did not come across any such complication.

We have only included those patients with follow-up of more than 6 months. Ponseti had a series with a long follow-up [8, 10, 13]. The results for the current series have been very encouraging. The results of our series are comparable with any other published major study. The most common relapse seen was forefoot adduction (five cases); this was due to non-compliance of the brace and also partly due to application of the brace incorrectly at home when parents removed them for bathing. Since most of the patients in the current study are from the lower class, educational level is low and thus they fail to understand the importance of the proper way to reapply the brace to maintain correction. Strict instructions for the brace application, motivation by dedicated personnel, peer comparison and more frequent follow-up have led to increased compliance of the brace for these patients and early detection of any relapse, if any. Morcuende et al. [9] reported a 6% relapse rate in compliant patients and 80% in non-compliant patients. The underlying cause for the relapse in the compliant group was underlying muscle imbalance of the foot and ligament stiffness. We encountered only one case of equinus relapse, which was due to brace removal by patient. This was corrected by repeat percutaneous tenotomy and application of corrective casts for three weeks. Cavus and forefoot adduction was encountered initially due to non-compliance of the brace but later on with regular follow-up and strict brace compliance these relapses were encountered less often. In the study by Morcuende et al. [9], who used the accelerated Ponseti protocol for clubfoot on 230 patients (319 clubfeet), 36 had relapses (11.65%). Ponseti et al. [12]

reported a high incidence of relapse in their earlier studies (56%). In another study by Laaveg et al. [8], relapse was seen in 47% (49 clubfeet).

In a study by Thacker et al. [18], 44 idiopathic clubfeet treated with casting using the Ponseti method followed by Steenbeek foot abduction brace application. The feet of patients compliant with the brace use remained better corrected than the feet of those patients who were not compliant. We also used a Steenbeek foot abduction brace in our study. After six months of treatment (at the time when patients were on night splints) the Pirani score had become zero, indicating successful correction of the clubfoot deformity. Graphs were plotted for each patient, as recommended by Pirani.

The Ponseti method of conservative clubfoot treatment is an excellent method of club foot treatment, of which there have been successful results in western countries [1–3, 6–16]. The follow-up of patients treated with this deformity has been over 40 years in some of these studies and these persons are leading a normal life now. It avoids the complications of surgery and gives a painless, mobile, normal-looking, functional foot which requires no special shoes and allows fairly good mobility. Results of the clubfoot treatment by Ponseti technique in our study have been good and rewarding and now all the clubfeet are treated in our institution by this technique only. In a developing country like India, where there is a dearth of proper operative facilities in remote areas, this technique is a very safe, easy, result-oriented, economical method of clubfoot management. The study shows that managing a good referral by proper education and motivation along with integration into other programs improves the outcome not only in terms of age at presentation but also for deformity correction. Proper motivation and persuading the parents to accept long-term brace treatment helps maintain the correction over a longer period of time and prevents relapse.

## References

1. Brand RA, Laaveg SJ, Crowninshield RD, Ponseti IV (1981) The center of pressure path in treated clubfoot. *Clin Orthop Relat Res* 160:43–47
2. Colburn M, Williams M (2003) Evaluation of the treatment of idiopathic clubfoot by using the Ponseti method. *J Foot Ankle Surg* 42(5):259–267
3. Cooper DM, Dietz FR (1995) Treatment of idiopathic clubfoot: a thirty-year follow-up note. *J Bone Joint Surg Am* 77(10):1477–1489
4. Cowell HR, Wein BK (1980) Genetic aspect of clubfoot. *J Bone Joint Surg Am* 62(8):1381–1384
5. Dobbs MB, Gordon JE, Walton T, Schoenecker P (2004) Bleeding complications following percutaneous tendoachilles tenotomy in the treatment of clubfoot deformity. *J Pediatr Orthop* 24(4):353–357

6. Herzenberg JE, Radler C, Bor N (2002) Ponseti versus traditional methods of casting for idiopathic clubfoot. *J Pediatr Orthop* 22(4):517–521
7. Ippolito E, Farsetti P, Caterini R, Tudisco C (2003) Long-term comparative results in patients with congenital clubfoot treated with two different protocols. *J Bone Joint Surg Am* 85(7):1286–1294
8. Laaveg SJ, Ponseti IV (1980) Long-term results of treatment of congenital clubfoot. *J Bone Joint Surg Am* 62(1):23–31
9. Morcuende JA, Abbasi D, Dolan LA, Ponseti IV (2005) Results of an accelerated Ponseti protocol for clubfoot. *J Pediatr Orthop* 25(5):623–626
10. Morcuende JA, Dolan LA, Dietz FR, Ponseti IV (2004) Radical reduction in the rate of extensive corrective surgery for clubfoot using the Ponseti method. *Pediatrics* 113(2):376–380
11. Palmer RM (1964) Genetics of talipes equinus varus. *J Bone Joint Surg Am* 46:542–556
12. Ponseti IV, Smoley EN (1963) Congenital clubfoot: the results of treatment. *J Bone Joint Surg Am* 45(2):2261–2275
13. Ponseti IV (1992) Treatment of congenital clubfoot. *J Bone Joint Surg Am* 74(3):448–454
14. Ponseti IV (1994) The treatment of congenital clubfoot. *J Orthop Sports Phys Ther* 20(1):1
15. Ponseti IV (1998) Correction of the talar neck angle in congenital clubfoot with sequential manipulation and casting. *Iowa Orthop J* 18:74–75
16. Ponseti IV (2000) Clubfoot management. *J Pediatr Orthop* 20(6):699–700
17. Scher DM, Feldman DS, Van Bosse HJ, Sala DA, Lehman WB (2004) Predicting the need for tenotomy in the Ponseti method for correction of clubfeet. *J Pediatr Orthop* 24(4):349–352
18. Thacker MM, Scher DM, Sala DA, Van Bosse HJ, Feldman DS, Lehman WB (2005) Use of the foot abduction orthosis following ponseti casts: is it essential? *J Pediatr Orthop* 25(2):225–228
19. Yamamoto H (1979) A clinical, genetic and epidemiologic study of congenital clubfoot. *Jinrui Idengaku Zasshi* 24(1):37–44