

# Early Experience with the Ponseti Method for the Treatment of Congenital Idiopathic Clubfoot

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## Abstract

**Background:** The preferred conservative treatment for congenital idiopathic clubfoot deformity remains a controversial issue.

**Objectives:** To compare the outcomes of two groups of CICF patients who underwent two different treatment protocols.

**Methods:** The study cohort included 72 infants treated in our hospital from August 1998 to December 2002. Group 1 comprised 40 infants (61 clubfeet) who were treated by a traditional method (a modification of the Kite and Lovell technique), and group 2 consisted of 32 infants (48 clubfeet) treated with the Ponseti technique. Both groups were similar in age, gender and severity of the deformity (Dimeglio scoring system).

**Results:** After an average follow-up of 54.9 months (range 44–68), 35 (57%) clubfeet in group 1 required surgical intervention and 27 (44%) clubfeet had a residual deformity at last follow-up. In the Ponseti group, 45 (94%) clubfeet were fully corrected at last follow-up (average 29.2 months, range 16–45) while 3 (6%) clubfeet had residual deformity and required surgery. Achilles tendon tenotomy was performed with no complications in 47 clubfeet (in group 2) at an average age of 2.4 months (range 2–4 months).

**Conclusions:** Even after a relatively short follow-up period, our success rate with the Ponseti approach already appears to be significantly higher and to bear fewer complications than the traditional treatment, in agreement with the results published by other medical centers. We now endorse the Ponseti technique of conservative manipulative treatment for congenital idiopathic clubfoot in our department.

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Congenital idiopathic clubfoot is a common deformity with an incidence rate ranging from 0.36/1,000 to 6.8/1,000 in some populations and about 1.2 per 1,000 births among Caucasians, with a much higher occurrence within affected families [1]. It is agreed by most of the orthopedic community that the initial treatment of CICF should be conservative, although the preferred manipulative treatment remains controversial. According to Cummings et al. [2], "There are almost as many techniques for manipulative treatment of congenital clubfoot as there are authors who write about congenital clubfoot." Gradual correction of the deformity through gentle manipulations followed by serial casting or bandages is the basic principle of initial treatment. The success rates of conservative treatment range from 11% to 58% in different series [3].

CICF = congenital idiopathic clubfoot

Failure of conservative treatment is defined when only partial correction of the clubfoot deformity is achieved by the age of 3–5 months or when there are complications, such as a rocker-bottom foot. Surgical soft tissue release is indicated in such cases. The results of surgical treatment were initially considered to be favorable, with studies of short-term follow-up (2–8 years) reporting good results in 52–91% of cases [4,5]. Recent long-term studies, with a follow-up of more than 10–15 years, however, report disappointing results in terms of pain and functional impairment [4,5]. The short- and medium-term complications of extensive surgery include tissue necrosis, superficial and deep infections, avascular necrosis of the talus, overcorrection, and recurrence of the deformity. Long-term complications include muscle weakness, shortening of the foot, stiffness, and arthritic changes [6–10]. The high rate of failure and complications of surgical treatment led some authors to recommend repeat surgery, but it led to further stiffness, shortening of the foot, weakness and pain [4,5].

Ignacio Ponseti first described his technique of manipulation and serial applications of casts in 1963. His results were very good, avoiding the need for surgery in 89% of his CICF cases [11]. The Ponseti technique is based on a thorough understanding of the anatomy and pathology of CICF. It involves a fairly small number of manipulations (between five and seven) and usually requires performing an Achilles tendon tenotomy under local anesthesia to bring about complete correction of the deformity [12,13]. A long-term assessment of Ponseti's technique by Cooper and Dietz [14] revealed that good and excellent functional results were obtained in 78% of clubfeet at a mean follow-up of 30 years.

As the long-term disappointing results of surgical treatment came to light, there has been renewed interest in the Ponseti method. The purpose of this retrospective study was to compare the outcome of children with CICF treated by the Ponseti technique with those treated by the traditional method.

## Patients and Methods

We introduced the Ponseti method for CICF treatment in October 2000; until then, we had been treating patients with clubfoot according to a modified Kite and Lovell technique [15], hereafter termed 'the traditional method'. Between August 1998 and September 2000, 40 infants (61 clubfeet) were treated according to the traditional method. This approach included manipulation to correct the adduction, and simultaneous supination of the foot. No pressure was applied to the head of the talus, and correction of the

equinus was performed early in the course of treatment. There were no cases of early Achilles tendon tenotomy in this group.

From October 2000 until the present, we have treated 55 infants with 80 clubfeet according to the Ponseti procedure [12–14] and performed tenotomies in 77 clubfeet in the setting of the outpatient clinic. The data in this study refer only to those children who had at least 1 year of follow-up: 32 infants (48 clubfeet) were treated between October 2000 and December 2002; 47 clubfeet underwent percutaneous Achilles tendon tenotomy at an average age of 2.4 months (range 2–4).

For performing the Ponseti procedure, the first metatarsus is first brought in line with the other metatarsi by a supination maneuver. The whole foot is then corrected by an external rotation manipulation. The calcaneus is realigned together with the rest of the forefoot under and in front of the stationary talus. This is achieved by external rotation against pressure applied to the neck of the talus. With this technique, the adduction and supination of all deformed elements are corrected simultaneously. Once all the medial and lateral parameters of the deformity are corrected and 70 degrees of external rotation have been achieved, an Achilles tendon tenotomy is performed to complete the posterior part of the repair.

An above-knee well-molded cast is applied after each stage. The parents remove the cast by soaking it in warm water at home on the day of their visit to the clinic. On each visit, the foot is manipulated by a trained physical therapist and the progress of correction is recorded by means of the Dimeglio scoring system [16]. After the last plaster is removed, a Denis-Brown splint is applied continuously for 3 months and then at night-time until the age of 2 years. We found that a percutaneous Achilles tendon tenotomy performed under local anesthesia in the clinical setting was well tolerated by the infants and the parents.

The classification of the severity of the deformity and the progress of correction are assessed according to the Dimeglio method of clubfoot grading [16]. The clinical evaluation on first and last follow-up is carried out according to the modified Dimeglio-Bensahel score [16] and the functional rating [17] classification systems. All the infants had physiotherapy between plaster removals and replacements.

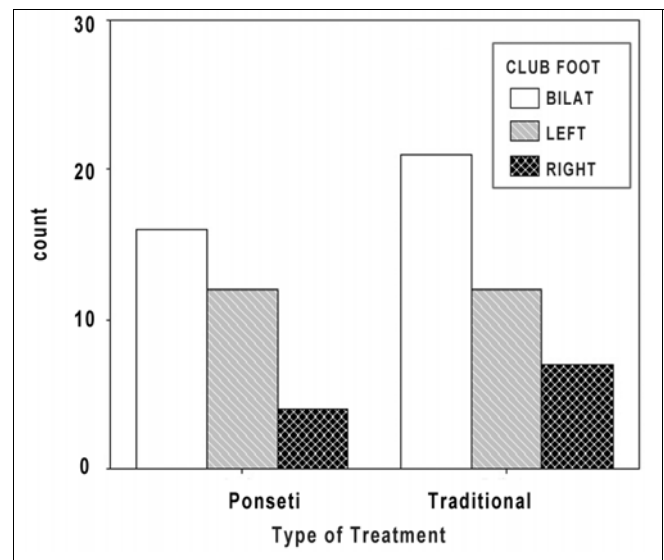
The decision to perform surgery was made by the most senior author (S.W.) based on the correction achieved after manipulations, Achilles tendon tenotomy and bracing.

### Statistical analysis

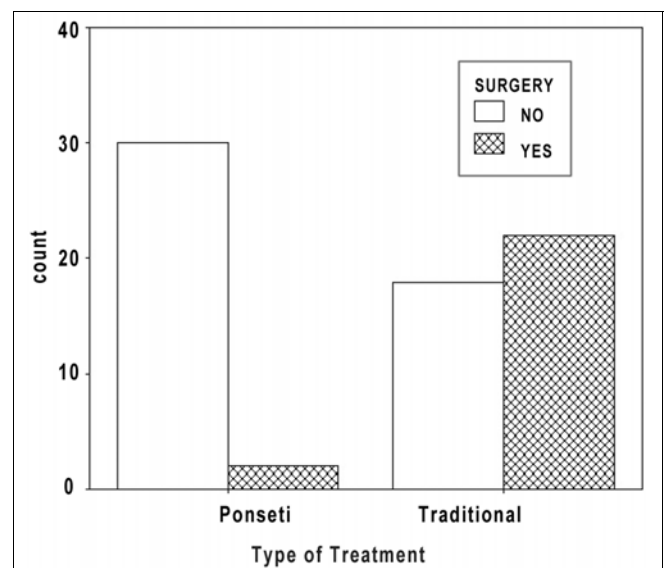
The grading scores for each case were adjusted to a combined scale for further statistical analysis, which included equality of groups (*f*-test) and differences of outcome (paired *t*-test). The significance level was set at  $P < 0.05$ .

### Results

There were no statistically significant differences between the groups in terms of age, gender, or the severity of the grading of the deformities before the initiation of treatment ( $f = 0.960$ ,  $P = 0.331$  and  $f = 0.185$ ,  $P = 0.668$ , respectively). Almost all the patients (96%) were treated immediately after birth, two patients were treated at the age of 3 weeks and one at 6 weeks of age. In none of the groups



**Figure 1.** Distribution according to foot involvement in the Ponseti and traditional groups. There is no difference in the distribution among the groups ( $P = 0.746$ ).



**Figure 2.** Comparison of the number of patients in whom conservative treatment failed and subsequently underwent surgery: Ponseti versus the traditional method.

were there discrepancies in the distribution of the involved feet ( $P = 0.746$ ); hence, 50% had bilateral involvement while the left leg was more affected than the right [Figure 1].

The traditional group included 40 infants (31 males and 9 females; 61 clubfeet), and 21 of them had bilateral CICF [Figure 1]. Before the initiation of treatment they had an average severity score of 12.3 (4.0–19) according to the Dimeglio classification. Treatment started shortly after birth in all the infants. The time in plaster averaged 4.0 months (range 2–6 months), and the average age at the time of surgery was 14.6 months (range 11–22). After an average follow-up of 54.9 months (range 44–68), 35 of the 61 clubfeet (57%) were operated on [Figure 2]. The surgeries included 29 full lateral

posteromedial releases and 6 posterior releases. The operated infants spent an additional 6 weeks in plaster. At last follow-up, 34 of the 61 clubfeet were fully corrected and 27 clubfeet have residual deformity (44%). We used the functional rating system [17] for this older age group at last follow-up, and their average score was 119.6 (60–150). A statistical comparison was not possible since two different scoring methods were used.

The Ponseti group included 32 infants (20 males and 12 females; 48 clubfeet) of whom 16 had bilateral CICF. Treatment started shortly after birth in 29 infants, at age 3 weeks in 2, and 6 weeks in one. An Achilles tendon tenotomy was performed in 47 clubfeet at the average age of 2.4 months (range 2–4), and the time spent in plaster averaged 3.0 months (range 2.5–4.5). This group's follow-up averaged 29.2 months (range 16–45): at the last follow-up, 45 of 48 clubfeet (94%) were fully corrected and 3 clubfeet (6%) had residual deformity. The latter three were operated on and all surgeries included full lateral posterior and medial releases [Figure 2]. There were no complications related to the Achilles tendon tenotomy in any of the cases. Before the initiation of treatment, the clubfeet of the Ponseti group had an average severity score of 11.9 (range 2.0–17) according to the Dimeglio classification, which dropped significantly ( $P = 0.000$ ) to an average of 3.2 (range 0–15) at last follow-up.

## Discussion

The proper treatment of CICF has long been debated in the orthopedic literature. While details on various surgical procedures are easy to find, manipulative techniques and their results are rarely described. In a study from Singapore [18], 174 clubfeet were treated conservatively with a success rate of 58% ( $n=100$ ); the remaining 74 clubfeet were operated on within 5 months of birth. The manipulations were left to the surgeon's discretion and there was no description of what was involved.

A large study of 323 children from Poland [19] emphasized immediate post-delivery casting; the author applied pressure to the sole of the foot at the calcaneo-cuboid area and moved the foot backward, similar to the Kite technique [20] and contrary to Ponseti's recommendations because the rotation of the calcaneus under the stabilized talus is blocked. Some 50% of this group required surgical release [20]. Good results of conservative treatment were presented from Osaka, Japan, where 34 of 36 clubfeet were initially considered to have been successfully treated [21]. The manipulation technique in this group involved strapping over wooden boards and below-knee casting; the follow-up, however, revealed high rates of residual deformities, such as intoeing, forefoot adduction and heel varus [21]. Another study from Tokyo [22] reported a 64% success rate with conservative treatment; 41 of 113 clubfeet were eventually operated. No details were provided regarding the method of manipulation except that Denis-Browne splints were used at a very early stage [22].

Other means of conservative treatment, such as repeated physiotherapy [23] and continuous passive motion [24], are laborious to perform. The subsequent surgery rate following the application of these techniques ranged from 32 to 95%, depending on the initial severity of the CICF [23,24].

None of the methods mentioned above applied early Achilles tendon tenotomy either in the clinical setting or operating room as an integral part of the conservative treatment of CICF.

Our current study compared groups that were well matched in terms of age, gender, and severity of the deformity at initial presentation [16]. Within 22 months of birth, more than 50% of the infants in our traditional group required surgery compared to only 6% of the Ponseti group in a similar period. The time spent in plaster was 25% shorter and residual deformities were fewer at last follow-up in the Ponseti group.

The superior results obtained by our team and by others [11,12] confirm the sound principles developed by Ponseti [12,13]. The key to the success of the Ponseti technique is to realign the calcaneus together with the rest of the forefoot under and in front of the stationary talus. Since the first metatarsus is in pronation in relation to the other metatarsi, trying to achieve correction by pronation of the forefoot will cause a cavus deformity. We found that a percutaneous Achilles tenotomy performed under local anesthesia in a clinical setting was well tolerated and free of complications. The response to this procedure was similar to that of applying a plaster cast, and no long-term weakness of the muscles was recorded following the tenotomy [14]. In a more recent study published by a group in Baltimore, Maryland, the rate of full lateral posteromedial-release for CICF dropped from 94% to 3% as a result of instituting the Ponseti technique [25]. Moreover, the ankle range of dorsiflexion motion and plantarflexion of the Ponseti group improved significantly as compared to patients who had surgery after failure of conservative treatment [25]. The use of the Ponseti technique in our department brought the surgery rate down from 57% to 6% while reducing morbidity and complications.

From our experience, strict adherence to the Ponseti technique of manipulation and timely performance of outpatient clinic Achilles tendon tenotomy enabled the correction without surgery of more than 90% of CICF cases. Due to the short term of our follow-up, it is possible that about 10% of the feet with rigid CICF will relapse sometime between the ages of 2 and 7 years. As advocated by Ponseti, transfer of the tibialis anterior tendon to the dorsum of the foot may successfully repair residual deformity and maintain good long-term results. Finally, even without conducting a cost-effective analysis, it is clear that the Ponseti technique is less costly than procedures that need to be carried out in the operating room.

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