

THE TREATMENT OF CONGENITAL CLUBFOOT BY PONSETI METHOD

Dan Cosma, Nini Gheorghe, Dana Vasilescu

University of Medicine and Pharmacy "Iuliu Hațieganu" Cluj-Napoca

13, E. Isac st., 400023 Cluj-Napoca, România

dcosma@umfcluj.ro

Abstract: Clubfoot is a complex foot malformation that occurs separately from other bone and joint malformations. Beginning with the year 2003, the team of the Department of Pediatric Orthopedics of the Rehabilitation Clinical Hospital Cluj-Napoca was the first to have applied the Ponseti method in our country for the treatment of clubfoot. In the period 2011-2013, 51 children passed the inclusion criteria in this group: 33 boys and 18 girls. Correction with the Ponseti method required 1 to 7 casts. The period needed for corrections varied from 1 to 6 weeks. The percutaneous tenotomy of the Achilles' tendon was necessary in 68 feet (92%). At the age of 18 months, 2 patients, i.e. 4 feet (5%) needed correction completion by postero-medial release. The Ponseti method is safe, efficient in the conservative treatment of clubfoot and decreases the number of surgical interventions needed for the correction of the deformation.

1. Introduction

Clubfoot is a complex foot malformation that occurs separately from other bone and joint malformations.

In 1996, in the USA, 2224 newborns with clubfoot were reported, i.e. an incidence at birth of 0.6‰ [1].

Ponseti considers that every year, in the world, more than 100.000 children are born with clubfoot. Quite a large percentage of the mentioned cases occur in developing countries and the majority remain untreated or are improperly treated leading to physical, social, psychological and financial issues for the patients, their families or the society. In the world, the neglected clubfoot is the most often occurring case of physical disability due to the bone and joint congenital malformations.

All orthopedists agree that the initial treatment should be non-surgical and start immediately after birth [1-9]. For the pediatric orthopedic surgeons, the selection of the conservative method of treatment so that when the bone reaches maturity the morphology and functionality of the foot may be considered acceptable is quite a challenge [10]. The aim of the treatment consists in correcting all the components in the deformation of the foot (equinus, varus, cavus, forefoot adduction), so that a quasi-normal appearance and a proper function can be supplied to the patient. Due to the foot plantigrade aspect, the child could then wear usual shoes and no callosities will be formed.

The conservative methods require various techniques of manipulation and plaster cast immobilizations, physical therapy, and Dennis-Browne orthoses application to preserve the correction induced by manipulation and immobilizations. The success rate of the conservative methods generally ranges between 11-70%, though some authors consider that conservative methods are efficient only with moderate cases [11].

The failure of the orthopedic treatment leads to the surgical treatment of the severe clubfoot. The most frequently used surgical methods are those derived from the Turco procedure, consisting in a posterior-medial

release (PMR). Numerous orthopedists that are supporters of the surgical treatment favor an extended posterior-medial release. The Cincinatti approach is frequently used as its short term success of 52-91% of the patients is high [5]. The outcomes are, however, less spectacular in long term cases. In such patients, pain and foot stiffness leading to premature arthritic modifications can be found. Effects of the kind can be explained by the onset of adherent skin scars, lesions of the articular surfaces of the foot bones and diminishing of the muscular strength due to the numerous tendon lengthenings required by the surgical treatment.

Beginning with the 1950, Ponseti developed a non-surgical corrective method for clubfoot [12]. This method requires weekly manipulations, followed by long-leg cast immobilizations. Usually, after 4-5 weeks, all the deformations are corrected, except for the equinus. More than often, in order to remedy the last mentioned malformation, it is necessary to practice the percutaneous tenotomy of the Achilles tendon. The clinical correction achieved by this method led to a functional, plantigrade foot, where the postero-medial release (PMR) was no more necessary in 89% of the patients. Good results were maintained in 78% of the patients in a follow up interval of 30 years [11].

Beginning with the year 2003, the team of the Department of Pediatric Orthopedics of the Rehabilitation Clinical Hospital Cluj-Napoca was the first to have applied the Ponseti method in our country. As the results of the use of the Ponseti method have not been analyzed until now in Romania, we have started a cohort study with the aim to present the results of the Ponseti method in our series.

2. Material and method

The inclusion in the present study was based upon the following criteria:

- children suffering of clubfoot, exhibiting no other congenital foot deformation;
- under 18 months of age children;

- children treated between 2011-2013.

The criteria of exclusion for study purposes were:

- neurological clubfoot;
- other syndromes associated (arthrogryposis, mielodysplasia etc);
- postural clubfoot.

In the period 2011-2013, 51 children passed the inclusion criteria in this group: 33 boys and 18 girls, out of which 23 presented the deformation on both sides and 28 on one side, i.e. 74 feet. The feet were scored according to the Dimeglio-Bensahel classification.

The patients began the treatment as soon as possible after birth. The treatment consisted in a series of manipulations and plaster casts as described by Ponseti [12]. After each manipulation session, the long-leg cast was applied and then it was changed after 5-7 days.

The first element of the Ponseti method consists in the cavus correction by aligning the forefoot with respect to the hindfoot. The cavus appears as an outcome of the forefoot relative torsion with respect to the hindfoot and the plantar flexion of the first metatarsal. Usually, cavus is corrected after 1-2 plaster casts (Figure 1).



Figure 1. Cavus correction by the forefoot supination

The correction of the cavus deformity represents an essential element that needs to be reached before the manipulations begin to correct abduction and varus. By aligning along the same plane the metatarsals, cuneiforms, cuboid and navicular, the lever arm needed to avoid the side rotation of the navicular, cuboid and calcaneus is achieved.

The rest of the deformities in clubfoot, except for the equinus, can be corrected by abducting the foot about the talus. The talus head becomes the rotation centre of the corrections to be made.

After talus stabilisation, the foot is abducted by supination up to the maximum possible and kept so for about 60 seconds. The distal to talus abduction of the foot makes the calcaneus relieve from the under talus in supination (varus) (Figure 2).



Figure 2. Varus correction by abducting the forefoot

The amplitude of the lateral displacement of the navicular bone to the talus head increases with the correction of the deformity. The total correction should be achieved after 3-4 plaster casts. The foot is never in pronation during these manipulations.

The equinus is partially corrected together with adduction and varus. This occurs due to the calcaneus dorsiflexion with the talus abduction. The correction of the equinus should not be attempted before the varus of the hindfoot is corrected. When the percutaneous tenotomy of Achilles' tendon is done before getting a 50-60° abduction, the equinus will not be properly placed back.

Following the 4th plaster cast, the cavus, adduction and varus will be fully corrected. Equinus will be corrected by the percutaneous tenotomy of Achilles' tendon (Figure 3).



Figure 3. Percutaneous tenotomy of Achilles' tendon

After the removal of the last cast, the Dennis-Browne orthoses were used. Orthoses were worn permanently for three months after the removal of the last plaster immobilization. After that, the orthoses were worn 12 hours during the night and 2-4 hours during the day, i.e. 14-16 hours out of 24 hours. The protocol was applied continuously until the age of 3-4 years.

3. Results

Our study group consisted of 51 children (74 feet), under treatment between 2011-2013, according to the Ponseti method. The mean follow-up period was 24 months (limits 18-36 months).

The average age of the treatment onset was 2±0.96 months (with the limits of 2 weeks and 14 months). In this group,

46 (90.2%) were under 6 months, and 5 patients (9.8%) over 6 months old.

The majority of the patients (37 patients) in this group had not undergone any treatment previously. 14 patients (27.45%) had been treated previously conservatively with plaster casts from an average age of 1.5 ± 0.75 months. The number of plaster casts varied from 1 to 7 (average = 4), during an average period of 2 ± 0.62 months. None of the previously treated patients had undergone the Ponseti method.

In the moment of the beginning of the treatment in our department, all the patients exhibited the four clinical deformations in clubfoot (equinus, varus, cavus and forefoot adduction) partially corrected or not corrected at all. The average Dimeglio-Bensahel score for this group was 10.7 points, with limits 4 and 18 points.

Correction with the Ponseti method required 1 to 7 casts (average = 5). The period needed for corrections varied from 1 to 6 weeks (average 5 ± 1 weeks). The percutaneous tenotomy of the Achilles' tendon was necessary in 68 feet (92%).

The average amplitude of the foot dorsiflexion before tenotomy was $0^{\circ} \pm 10^{\circ}$, after tenotomy it increased to 20° (between limits $0-35^{\circ}$, $p=0.01753$). The mean Dimeglio-Bensahel score after the treatment was 3.6.

After the last cast, all the patients (51 patients-74 feet) were put in Dennis-Browne or Dennis-Browne type orthoses.

At the age of 18 months, 2 patients, i.e. 4 feet (5%) needed correction completion by postero-medial release.

No infections, skin necrosis, neurovascular lesions or abundant hemorrhage after tenotomy was found in any patient.



Figure 4. Clubfoot treated by Ponseti method: before and after treatment

4. Discussions

In spite of the fact that the group treated with the Ponseti method has represented our learning curve, we are satisfied with the results reached. The application of the Ponseti method in our series helped avoid PMR in 95% of the cases. Only two patients (4 feet) required posterior-medial release at the age of 18 months. This was required by the

complex form of bilateral clubfoot, in the case of a patient, and to intolerance to the plaster cast in the case of another patient with bilateral clubfoot.

The Ponseti method was developed and described by Ignacio Ponseti at the University of Iowa in 1950 for the conservative treatment of clubfoot, in an attempt to achieve a functional, plantigrade foot, without resorting to surgery [13]. The long-term results of the method have shown positive values in 85-90% of the cases, if the method was rigorously applied [11, 14-15]. The use of the same method in other places had poorer results associated to complications (persistence or development of cavus, false correction of the midfoot, flattening of the talar dome) [11]. With the making of the Ponseti method more known, more studies have been carried out for its results assessment. Ponseti et al. noticed the diminishing of the number of cases which required ample surgical operations in their study group. Morcuende [16] had positive results in 98% of cases, with a 11% recurrence rate, mainly due to non-compliance with the Dennis-Browne orthoses. Finally, 2.5% needed postero-medial release and 2.5% transfer of the anterior tibial tendon. Herzenberg [17] has found that PMR was necessary for 1 foot of 34 studied, as compared to the control group where 32 out of 34 feet necessitated PMR. Lehman [18] assessed the early results with his patients and had positive results with the children under 7 months who also used the Dennis-Browne orthoses according to the medical recommendations. Ippolito [19] observed long-term favorable results in the Ponseti group as compared to the control group, where other methods were used. Cooper and Dietz [11] showed that the percutaneous Achilles's tendon tenotomy is a benign procedure that does not induce long term muscular strength negative effects.

5. Conclusion

The Ponseti method is safe, efficient in the conservative treatment of clubfoot and decreases the number of surgical interventions needed for the correction of the deformation. In addition, it can be applied successfully to all infants under 2 months old, who have or have not been subjected to previous conservative treatments.

6. References

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