What Proportion of Patients Need Extensive Surgery After Failure of the Ponseti Technique for Clubfoot?

R. Baxter Willis MD, FRCSC, Mazen Al-Hunaishel MD,
Luis Guerra MD, MSc, Ken Kontio MD, FRCSC

Published online: 30 January 2009
© The Association of Bone and Joint Surgeons 2009

Abstract In 1948, Professor Ignacio Ponseti began a nonoperative management form of treatment for severe talipes equinovarus. This method of manipulative treatment became attractive because long-term outcomes demonstrated the majority of feet were pain-free, plantigrade, and functioning at a high level of activity without evidence of degenerative arthrosis. We retrospectively reviewed the charts of 51 children (31 boys and 20 girls; 72 feet) with idiopathic clubfoot deformity treated with the Ponseti method from January 5, 2002, to January 5, 2007. The median age at treatment was 2 weeks (95% confidence limit, 1–2 weeks); there was no difference in age at presentation between boys and girls. The minimum followup

was 4 months (mean, 19.8 months; range, 4–48 months). A total of 288 casts were applied (mean, 5.5; standard deviation, 0.92). Successful treatment was defined as a plantigrade foot with a normal hindfoot, midfoot, and forefoot on clinical examination. Correction was achieved and maintained in 90% (65 of 72) of the feet; 10% (seven of 72) of the treated feet did not improve and needed subsequent surgery. There was no difference in the proportion of children who had tenotomy or previous treatment among those who presented with residual deformity or recurrence or had surgery. However, patients who tolerated bracing had lower recurrence rates and underwent less surgery.

Level of Evidence: Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

Each author certifies that his or her institution has approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

R. B. Willis (✉), M. Al-Hunaishel, K. Kontio
Division of Pediatric Orthopaedics, Children's Hospital of
Eastern Ontario, Surgery, 401 Smyth Road, Ottawa,
ON K1H 8L1, Canada
e-mail: bwillis@cheo.on.ca

L. Guerra
Department of Surgery, Children's Hospital of Eastern Ontario,
Surgery, University of Ottawa, 401 Smyth Road, Ottawa,
ON K1H 8L1, Canada

L. Guerra
Department of Epidemiology and Community Health, Children's
Hospital of Eastern Ontario, Surgery, University of Ottawa,
401 Smyth Road, Ottawa, ON K1H 8L1, Canada

Introduction

In 1948, Professor Ignacio Ponseti began a nonoperative management form of treatment for severe talipes equinovarus. Despite publication of his excellent results reported in 1963 [12] and 1972 [11] and by Cooper and Dietz [3] in 1995, the Ponseti method of treatment for congenital clubfoot was not widely accepted until the late 1990s. With the publication of his comprehensive treatise, *Congenital Clubfoot: Fundamentals of Treatment* [10], the majority of pediatric orthopaedic surgeons began to reexamine their methods of management of this condition.

The treatment of congenital clubfoot had evolved in the latter half of the 20th century to include surgery in a large majority of patients [1, 6, 8, 14–16]. Treatment would initially involve manipulative correction of the deformity with an attempt to correct all the elements of the deformity

from the initial visit. There was no special attempt to correct the cavus component or pronation deformity of the forefoot by supinating the forefoot with the initial cast. After manipulation, the feet were usually casted in short-leg casts rather than long-leg casts. Failure of manipulative treatment was the norm in the majority of cases with subsequent operative intervention being carried out on children with clubfeet anywhere from 3 months to approximately 12 months of age [1, 5, 16].

The types of surgery varied but in most cases involved posteromedial release as advocated by Turco [15, 16], Carroll [2], and others [1, 4, 6, 8, 14]. This surgical technique was accomplished through a number of surgical approaches but generally involved surgical lengthening of the tendo-Achilles and posterior tibial tendons with possible lengthening of the flexor hallucis longus and flexor digitorum communis tendons. Capsulotomies of the posterior ankle and posterior subtalar joint were routinely used with release of the medial and lateral subtalar joint advocated along with release of the talonavicular joint. Kirschner wire fixation of the talonavicular and/or the subtalar joint was often performed [7]. In our experience the result was often a plantigrade foot but a foot that was stiff and did not tolerate the demands of an active, athletic childhood and adolescence.

With the “discovery” of the Ponseti method of manipulative treatment for congenital clubfoot, pediatric orthopaedists realized this deformity could be successfully treated with nonoperative methods provided the fundamentals and principles as set out by Ponseti were adhered to [3, 10–12]. The Ponseti method of specific manipulative treatment became attractive because long-term outcomes demonstrated the majority of feet were pain-free, plantigrade, and functioning at a high level of activity without evidence of degenerative arthrosis [3, 10–12]. The failure rate of the Ponseti method in the recent literature, as defined by the need for corrective surgery, ranges from 3% to 5% [5, 13]. The senior author (RBW) began his experience with the Ponseti method at Children’s Hospital of New Orleans in January 2001. From January 2001 until June 2004, he personally treated 38 feet in 28 children with a success rate of 95% (unpublished data). Of the 5% failure rate, both feet underwent tibialis anterior transfer to the lateral cuneiform plus open tendo-Achilles lengthening. In some cases, remanipulation as outlined by Ponseti was successful for feet that relapsed.

Our purpose was to (1) confirm the previously reported low percentage of patients who failed treatment and subsequently underwent an extensive surgical procedure, and (2) determine whether age at presentation, gender, tenotomy, previous treatment, and brace tolerance differed in patients without and with residual deformity, recurrence, and comprehensive surgery.

Materials and Methods

We retrospectively reviewed the charts of the children with idiopathic clubfoot deformity who were treated with the Ponseti method at Children’s Hospital of Eastern Ontario from January 5, 2002, to January 5, 2007.

The treatment involved manipulation and casting on a weekly basis and usually percutaneous Achilles tenotomy under local anesthesia in a clinic setting. Five orthopaedic surgeons with training in the specific method of manipulation and casting were involved in the treatment of these patients. The feet were casted for 3 to 4 weeks after an Achilles tenotomy and managed in a Dennis-Browne splint on a full-time basis for 3 months and subsequently on a part-time basis for 2 years. We followed patients every 3 to 6 months during the first 2 years and every 6 to 12 months thereafter.

We computed descriptive statistics for age at presentation. We determined differences in age at presentation, length of followup, and number of casts between boys and girls and between patients without and with residual deformity, recurrences, and comprehensive surgery. The distribution of the variable “age” was skewed while “length of followup” and “number of casts” were normally distributed. Paired t-test and Wilcoxon signed rank test were used for normally and non-normally distributed data, respectively.

We determined if gender, use of tenotomy, previous treatment, and patient tolerance of brace differed in patients without and with residual deformity, recurrences, and comprehensive surgery using Chi square test; Fisher’s exact test was used when the sample sizes were small. All tests were two-sided.

Results

Fifty-one patients (72 feet, 41 right side) were treated using the Ponseti method with a minimum followup of 4 months (mean, 19.8 months; range, 4–48 months) (Table 1). There were 31 boys and 20 girls with a median age of 2 weeks (range, 1–52 weeks). There was no difference between boys and girls in age at presentation ($p = 0.84$) or in mean followup (20 months versus 19.8 months, $p = 0.86$) (Table 1). Five children (seven feet) who had previous treatment had a higher ($p < 0.01$) median age at presentation of 24 weeks (first and third quartiles, 21 and 28 weeks).

Of the 51 patients, 48 had percutaneous Achilles tenotomy as part of the initial treatment. Among the 72 treated feet we applied a total of 288 casts (mean, 5.5; standard deviation, 0.92; range, 4–8). We used a similar ($p = 0.46$) mean number of casts for boys and girls (5.4 ± 0.68 versus 5.6 ± 0.99 , respectively) (Table 1).

Table 1. Demographics and general characteristics

Demographic	Value	p Value
Total number of patients	51	
Total number of feet	72	
Gender (n = 51)	31 male/20 female	
Feet per gender (n = 72)	47 male/25 female	
Age in weeks: median	2 (95% CI, 1–2; range, 1–52)	
Median age by gender (weeks)	Male 2/female 1.5	0.84
Total number of casts	288	
Mean number of casts	5.5 (SD, 0.92)	
Mean number of casts by gender	Male 5.4 (SD, 0.68)/female 5.6 (SD, 0.99)	0.46
Mean followup in months: mean	19.8 (SD, 12.4; range, 4–48)	
Followup by gender (months)	Male 20/female 19.8	0.86
Number of feet that did not improve with Ponseti technique	7/72 (9.7%)	

95% CI = 95% confidence interval; SD = standard deviation.

Table 2. Descriptive analysis of residual deformity and recurrence by feet treated

Variable	Residual deformity			Recurrence		
	Yes (n = 5)	No (n = 67)	p Value	Yes (n = 18)	No (n = 54)	p Value
Median age (weeks)	7 (95% CI, 2–12)	2 (95% CI, 1–2)	< 0.25	1 (95% CI, 1–2)	2 (95% CI, 1–3)	< 0.039
Gender (n = 51)	2 male/3 female	29 male/17 female	< 0.59	4 male/7 female	27 male/13 female	< 0.12
Tenotomy (n/N)	5/5 (100%)	62/67 (93%)	1.0	18/18 (100%)	49/54 (91%)	< 0.45
Previous treatment (n/N)	1/5 (20%)	6/67 (9%)	< 0.68	0/18 (0%)	7/54 (13%)	< 0.24
Patient tolerance of bracing (n/N)	NA	NA		3/18 (17%)	52/54 (96%)	< 0.0001

95% CI = 95% confidence interval; NA = not applicable.

Table 3. Descriptive analysis of patients who needed surgery

Variable	Comprehensive surgery		p Value
	Yes (n = 7)	No (n = 65)	
Median age (weeks)	2 (95% CI, 2–3)	2 (95% CI, 1–2)	0.99
Gender	3 male/2 female	28 male/18 female	1.0
Tenotomy (n/N)	7/7 (100%)	60/65 (92%)	0.98
Previous treatment (n/N)	1/7 (14%)	6/65 (9%)	0.81
Patient tolerance of bracing (n/N)	0/7 (0%)	56/65 (86%)	< 0.0001

95% CI = 95% confidence interval.

Ninety percent (65 of 72 feet) did not require subsequent surgery during the followup time, whereas 10% (seven of 72) did not improve sufficiently and underwent subsequent surgery.

Patients who tolerated bracing had lower recurrence rates (Table 2) and underwent less surgery (Table 3). The age at presentation, gender, and proportion of children who had tenotomy or previous treatment (Table 2) or surgery

(Table 3) were similar among those who presented with residual deformity or recurrence and those who did not, except for patients with recurrence that were slightly younger ($p < 0.039$).

Discussion

Before 2000, the vast majority of children with clubfeet in North America were treated with an attempt at manipulative treatment followed in 3 to 6 months by operative intervention. Long-term outcomes of those patients led pediatric orthopaedists to reexamine these methods. The Ponseti method resulted in a majority of feet that were pain-free, plantigrade, and functioning at a high level of activity without evidence of degenerative arthrosis at long-term followup [3, 10–12]. Our primary purpose was therefore to confirm the previously reported low percentage of patients who failed treatment and underwent an extensive surgical procedure. Our secondary purpose was to determine whether age at presentation, gender, previous treatment, and brace tolerance differed in patients without and with residual deformity, recurrence, and comprehensive surgery.

This is a case series report with some limitations. Data were retrospectively retrieved from the charts and information and selection biases may have been introduced. Our series has short followup and studies with longer-term data will allow for a better analysis of patients who underwent the Ponseti method. Another limitation was lack of an objective scoring system to grade the severity of the deformity.

We had a 10% failure rate with the Ponseti protocol. This observation is in agreement with a previous report comparing the Ponseti technique with traditional casting methods, which showed a high failure rate with the latter [5]. The treating pediatric orthopaedic surgeon must understand the Ponseti method of treatment is a very specific method based on a thorough understanding of the pathology and natural history of talipes equinovarus. The treatment takes advantage of the kinematics of the subtalar joint. Ponseti's concept confirms what was already known: the whole foot moves under the talus. Ponseti uses this principle in his manipulation to simultaneously correct the forefoot and hindfoot by abduction of the foot. The Ponseti method takes advantage of the biologic response of soft tissues to controlled mechanical stress. The manipulations are performed in a specific sequence to enable reduction of the subtalar joint and the talonavicular joint without undue force being applied to the neonate's foot. This concept has been confirmed in an MRI analysis of clubfeet treated by the Ponseti method [9].

With the advent of a treatment program using the Ponseti principles for manipulation of clubfeet, the reported success rate has been excellent [5, 13]. In our institution, the success rate with this method is approximately 90%. Prolonged followup will be required to ascertain if recurrences will be seen, but long-term studies suggest correction will be maintained if patients are able to tolerate a bracing program until 4 years of age.

We observed a 10% failure rate with failure described as the need for subsequent surgery. In most series describing the Ponseti technique, the rate of extensive surgery is less than 5%; extensive surgery being defined as a posteromedial and lateral release [5, 10]. Eventually, up to one-third of patients undergoing the Ponseti technique will require some surgical intervention including tendon transfer, tendon lengthening, or selective release [10]. Our series had a higher initial surgical rate but the total number of patients requiring surgery is similar to other series [5, 10]. The amount of surgery required after the Ponseti technique was considerably less than the original posteromedial and lateral releases described. Although there is no long-term prospective study comparing the Ponseti method to patients

undergoing extensive surgical releases, it seems intuitive that long-term outcomes will be superior in feet treated nonoperatively than in feet treated with extensive surgical release.

The Ponseti method of clubfoot management has revolutionized the treatment of this congenital deformity not only in North America, but around the world. The results of this treatment are superior to surgical management in correction of the deformity, prevention of overcorrection, and, most importantly, markedly improved function of the foot in any ambulatory activity.

References

1. Bensahel H, Csukonyi Z, Desgrippes Y, Chaumien JP. Surgery in residual clubfoot: one-stage medioposterior release 'a la carte.' *J Pediatr Orthop.* 1987;7:145–148.
2. Carroll NC. Controversies in the surgical management of clubfoot. *Instr Course Lect.* 1996;45:331–337.
3. Cooper DM, Dietz FR. Treatment of idiopathic clubfoot: a thirty year follow-up note. *J Bone Joint Surg Am.* 1995;77:1477–1489.
4. Green AD, Lloyd-Roberts GC. The results of early posterior release in resistant clubfeet. *J Bone Joint Surg Br.* 1985;67:588–593.
5. Herzenberg JE, Radler C, Bor N. Ponseti versus traditional methods of casting for idiopathic clubfoot. *J Pediatr Orthop.* 2002;22:517–521.
6. Hutchins PM, Foster BK, Paterson DC, Cole EA. Long-term results of early surgical release in clubfeet. *J Bone Joint Surg Br.* 1985;67:791–799.
7. McKay DW. New concept of and approach to clubfoot treatment. Section II. Correction of the clubfoot. *J Pediatr Orthop.* 1983;3:10–21.
8. Otremski I, Salama R, Khermosh O, Wientroub S. An analysis of the results of modified one stage posteromedial release (Turco operation) for the treatment of clubfeet. *J Pediatr Orthop.* 1987;7:149–151.
9. Pirani S, Zeznik L, Hodges D. Magnetic resonance imaging study of the congenital clubfoot treated with the Ponseti method. *J Pediatr Orthop.* 2001;21:719–726.
10. Ponseti IV. *Congenital Clubfoot: Fundamentals of Treatment.* New York, NY: Oxford University Press; 1996.
11. Ponseti IV, Campos J. Observations on pathogenesis and treatment of congenital clubfoot. *Clin Orthop Relat Res.* 1972;84:50–60.
12. Ponseti IV, Smoley EN. Congenital clubfoot: the results of treatment. *J Bone Joint Surg Am.* 1963;45:261–344.
13. Richards BS, Faulks S. A comparison of two nonoperative methods of idiopathic clubfoot correction: the Ponseti method and the French functional (physiotherapy) method. *J Bone Joint Surg Am.* 2008;90:2313–2321.
14. Simons GW. Complete subtalar release in clubfeet. Part II: Comparison with less extensive procedures. *J Bone Joint Surg Am.* 1985;67:1056–1065.
15. Turco VJ. Resistant congenital clubfoot: one stage posteromedial release with internal fixation. A follow-up report of fifteen years experience. *J Bone Joint Surg Am.* 1979;61:805–814.
16. Turco VJ. Present management of idiopathic clubfoot. *J Pediatr Orthop B.* 1994;3:149–154.