

Early Outcome of Ponseti Method for Treatment of Talipes Equinovarus

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Abstract

Background: The most widely recognized congenital deformity of musculoskeletal abnormalities at birth is clubfoot, with pain and disability if left untreated. The Ponseti technique has become popular due to its short and long-term success rate published worldwide. Unfortunately, in our country, families have no good interest in it due to several casting and follow-ups, which are essential to the ponseti method. The study's objective was to evaluate our locality's early ponseti method outcome in clubfoot management. Also, to analyze the early recurrence rate and the characteristics of patient and family which predict the recurrence? **Methods** We studied 50 infants with 77 idiopathic club feet at Erbil teaching hospital between the periods of November 2018 to November 2019. Clubfoot cases were evaluated using the Pirani score at the first presentation, and scores were recorded with a consequent visit, manipulation, and serial casting until correction of deformity was done. Minimal corrective surgery (percutaneous Achilles tenotomy) was performed on the greater part of the idiopathic club feet and preceded with a foot abduction brace; more extensive surgery (posteromedial release) was performed only for resistant cases. Recurrence was analyzed concerning age, gender, parent education, family history, and the family's compliance with bracing- foot abduction brace. **Results:** 77 feet of 50 babies were managed, 31 were males, and 19 were females. Twenty-seven patients with bilateral clubfeet, the mean Pirani score was (4.623) range (1.5 -6) at presentation. Clubfoot correction was obtained in all but 7 feet (4 cases), about (90, 9%). Among 46 cases (70 feet) the mean cast was 5.49 ranges (3-8) and was required for correction. The normal time for deformity correction was (6.94 weeks, range (of 3-10) for complete deformity correction. Tenotomy was performed on 51 feet (66.2%) with an idiopathic club foot. Early relapse was 14 cases (30, 4%); among them, 12 cases (80%) were due to non-compliance of parents with foot abduction brace. **Conclusion:** The Ponseti method for clubfoot treatment is safe, successful, and non-invasive. Economical with excellent outcomes, minimize the need for corrective surgery. Relapse is related to noncompliance of the family with bracing.

Keywords: Outcome. Clubfoot, Ponseti method,

1. Introduction

Clubfoot is a congenital deformity found in 1 in each 1000 live birth; 50% of cases are bilateral. The deformity has four components: Ankle equines, metatarsal adducts, cavus, and hindfoot varus.¹

The cause of clubfoot is multifactorial, by malformed bones, muscles, and joints or abnormal ligaments and tendons. Or maybe result from external forces that put the foot or feet in a defective position during an embryo,² or due to neurogenic disorders in neuromuscular balance or gene variations.³

Clubfoot that is available during childbirth might be either congenital or positional. In positional talipes, the foot that is normal but has been held in an abnormal position in the uterus, that is correctable, its incidence is five times more common than congenital type, ⁴ Congenital talipes is a fixed condition that can be idiopathic or tautological, and the idiopathic type is usually an isolated skeletal deformity, often bilateral.⁴

If the conservative treatment failed, clubfoot

could be treated conservatively or by surgical intervention. The Ponseti method is mainly conservative. Hippocrates introduced the first preservationist method in 400 BC when he suggested gentle manipulation accompanied by splinting.⁵

Ponseti Method, which was developed by Dr. Ponseti, in 1963, is safer and more efficient than surgery.⁶⁻⁷ Another procedure is the French technique (Functional method), developed by Masse and Bensahel in France in 1970 ⁸. It requires daily manipulation of the foot by the physiotherapist for 30 min. This was followed by muscle stimulation around the foot, especially the peroneal muscles; for the reduction to be maintained then, adhesive strapping was applied.⁹

The study aims to evaluate the Ponseti Method's outcome in managing congenital idiopathic club foot in children and also to study recurrence rate about the age of presentations, sex, family history, severity at presentation, and compliance of parents with a brace.

2. Patients and Method

This is a prospective study done in Erbil teaching hospital on 50 patients (77 feet) using the ponseti technique between November 2018 and November 2019. Thirty-one patients (62%) were male, and nineteen (38%) were female. Twenty-seven patients (54%) were bilateral and twenty-three (46%) were unilateral, their main age was 3.9 months (ranging from 2weeks to 11months) 27 patients (54%) were less than 5 months, and 23 patients (46%) were more than 5 months.

Preliminary explanation to parents regarding the treatment technique, visit complication, outcome, and compliance are done, and their consent was taken. Patient and examination information was collected, and data were recorded; the information included pregnancy, birth history, birth weight, family history, and educational level of the parent.

Examination findings included side involved, the severity of clubfoot graded by use of Pirani score, and other skeletal examination like the spine, hip, extremities, and neurological assessment.

3. Ponseti Technique

This method is divided into two-stage; the Casting stage, during which gentle Manipulation, sequential Casting, and tenotomy, and the Maintenance stage, which uses a foot abduction Brace to prevent a relapse of deformity 11.

The clubfoot components must be corrected in the sequence. We start with Cavus, Adduct, Varus, and finally Equinus. All parts of the deformity are corrected simultaneously, except for the ankle equinus. Firstly, cavus correction is undertaken. This is by elevating the first ray to have a normal longitudinal arch.

The foot is maintained in the maximum corrected position by holding counter pressure applied against the talus head. The Varus of the heel does not need to be effectively corrected because A corrects automatically as the forefoot adduction is corrected. Correction of the equinus component can be undertaken too. Gentle dorsiflexion (gradual stretching) can be tried. But in most cases, it requires a percutaneous heel cord tenotomy. Tenotomy can be done, and Cast padding is then applied, then trailed by the above-knee cast with the foot in fifteen-degree dorsiflexion and seventy degrees of abduction for three weeks.

The maintenance phase can be started once the last cast is removed to prevent a recurrence. The brace must be worn full-time in the first three months, then only during naps and at night for 3-4 years. The brace, known as the foot abduction brace,

After we start with a proper schedule of follow-up follows 2 days (to check for brace fitness) 2 weeks (to troubleshoot compliance issues), and 6 weeks (to detect early recurrence)—3 months (to start with night and nap protocol), and lastly every 3 months. Until the age of 4 years during follow-up, the

recurrence is identified so the reapplication of casts with the ponseti method was done.11

4. Statistical Analysis

The information was converted using a particular coding sheet into the codes, and the data was then transformed into computerized data. Statistical analysis SPSS version 22 (Social Science Statistical Package) used the chi-square test of association to compare proportions. The exact test of Fisher's was used when the expected number of table cells of more than 20% was less than 5. A one-way variance analysis (ANOVA) was used to evaluate three ways. To compare the means of each group. A post-shoe test (L SD) was used. Statistically significance p-value were kept $p < 0.05$.

5. Result

According to Pirani scoring,¹² we categorized the severity of deformity of feet at presentation including mild (1.5-2.5), moderate (3-4.5), and severe (5-6) categories. So, according to the response of cases to manipulation and casting, we classified into 3 patterns as shown in (Tab.1). With the sequence of manipulation and casting, whenever mid-foot score and hindfoot scores are improved and the total score is (< 1). Only casting will be the treatment. When the midfoot score is improved (< 1), and the hindfoot score remains high (> 1). Percutaneous Achilles, Tenotomy has been done. Extended poster-medial soft tissue release is the treatment when both midfoot and hindfoot score remains high.

Pattern of management	No	%
Casting	19	24.7
Percutaneous tenotomy	51	66.2
Postero-medial release	7	9.1
Total	77	100

All the cases treated were idiopathic clubfoot; others were excluded from this study. The total number of patients was 50 (77 feet), out of which 31 (62%) were male and 19 (38%) were female. 27 cases (54%) were bilateral, and 23 cases (46%) were unilateral. At the application of the first cast, the mean age was (3.9 months) range (0.5-11 months).

The overall mean Pirani score at presentation in 77 feet was (4,623) range (1.5-6). Only 4 cases (7feet) were referred to perform extended posteromedial soft tissue release because they were rigid, and the desired position could not be achieved by the ponseti method.

Among 70 feet (46 cases) the total no. of cast required to correct the deformity was 5.49 cast. Range (3-8). We have 10 feet (7 cases) out of 77 feet have a complication in the form of an erythema, abrasions, and toes swellings were treated by padding the site, and removal of the cast until the swelling subsides then recasting was done.

Duration of the cast in weeks

Among 70 feet (46 cases), the average time that was

required until correction of deformity was 6.94 weeks, (range 3-10). For 13 feet of severity-mild according to Pirani scoring, required 3.54 weeks, for 12 feet of severity-moderate required 6.92 weeks, for 45 feet of severity-severe required 7.93 weeks. (Table-2).

severity	No	Mean	SD	P- Value (LSD)
mild	13	3.54	0.776	<0.001
moderate	12	6.92	1,193	<0.001
severe	45	7.93	1,176	,023
total	70	6.94	2.139	

Early outcome

70 feet undergo the ponseti method with a good result, while 7feet are referred to perform extended posteromedial soft tissue release. so, the early outcome was excellent 90.9%

Early outcome	Frequency	Percent	mild	Moderate	severe
success	70	90.9	13	12	45
Failure	7	9.1	0	0	7
Total	77	100			

Early recurrence rate

Follow up the duration of the cases (46 cases) involved in the study was 5.3 months (range 1-9months), and the recurrence rate was 30.4% (14 cases). Among the recurrent cases, the parent of 12 patients (80%) was non-compliant with the brace, and among non-recurrent cases, parents of only 3 cases (20%) were non-compliant. Among the recurrent feet, only 4 feet were treated with percutaneous tenotomy, and the remaining feet were cast.

Ratio and relation of variables to recurrence

There is a strict relation between recurrence and the family's compliance with using the brace, where the p-Value was significant <0.001. The family's educational level directly affects the compliance; therefore, the recurrence, P-Value <0.001. The remaining variables include age, gender, and education of parents: residency, family history, pattern management. Severity and compliance and their relation to recurrence with P-Value are shown in (table 4).

	recurrent		Non-recurrent		Total		P-Value
	NO.	%	No	%	No	%	
Compliance	2	6,5%	29	93,5%	31	100%	<0.001
Noncompliance	12	80%	3	20%	15	100%	
Age <=5	5	18,5%	22	81,5%	27	100%	.036
Age 5months 5	9	47,4%	10	52,6%	19	100%	
Positive family history	2	28,6%	5	71,4%	7	100%	1.000
Negative family history	12	30,8%	27	69,2%	39	100%	
Male	10	34,5%	19	65,5%	29	100%	0.436
Female	4	23,5%	13	76,5%	17	100%	
Total	32	69.6%	14	30.4%	46	100%	

Variable	Recurrence		Non-Recurrence		Total		P-value
	No	%	No	%	No	%	
Severity Mild	3	23.1%	10	79.96%	13	100%	414
Moderate	6	50.0%	6	50.0%	12	100%	
Severe	16	35.6%	29	64.3%	45	100%	
Total	25	35.7%	45	64.3%	70	100%	

6. Discussion

In our study, 90.9% of feet had good to excellent outcomes by sequential casting alone. With or without tenotomy. Our result was higher than that of Boret et al., whose study (117 clubfeet) with a rate of 89.2% with a mean follow-up duration of (6.3 years), although lower than the study of Bansal R. et al. on 111 children (166 clubfeet) after three years of follow-up duration. 13-14

In our study, at the initial presentation, the mean age was (3.9) months (range 0.5- 1 1) which was near the age incidence observed by Dobbs et al.15, which was 12 weeks (range 1-60). Presenting age at initial presentation directly affects the quality (mobility) of the foot, Pirani score, the need for tenotomy, and final results. A similar finding was reported by Lehman et al.16 and Morcuende et al.17 Where, they have stressed the importance of initiating treatment at an early age. Our study's age incidence was less than 12 months because the previous relapse was

our exclusion criteria.

The mean Pirani score: 70 feet was 4.49 range (1.5-6). 13 clubfeet (18.57%) had a Pirani score of 2.077, 12 clubfeet (17.14%) had a Pirani score of 3.87 and 45 (64.28%) with scores of 5.35, which was lower in both Pirani severity scoring and many foot in comparing the study of Bansal R et al., mean Pirani score was 5.5 range (4-6). 120 (72.29%) clubfeet had Pirani score of 6 and 46 (27.71%) with scores of <6.49

In the present study, the mean number of casts required to correct the deformity was (5.49) cast, range (3-8), which was near the study of Ban et al., 14 where average number of casts per foot was (5.7) casts. The number the cast that is required also depends on the methods of application, and experience and experienced clinicians require fewer castes. 18

The tenotomy was done whenever dorsiflexion was less than 10 degrees above neutral.¹⁹ Achilles tendon tenotomy was an integral part of the Ponseti technique. 20-21, while we preferred to do it under local anesthesia. This was the same done by Mercuende et al.,¹⁷ and Herzberg et al.,²² who prefer that the Achilles tenotomy be done in the clinic with topical or local anesthesia.

Percutaneous Achilles tenotomy for 51 feet (66.2%) out of 77 clubfeet was done, and that was lower as observed in the study of Dobbs A al. 28 74 (86%) of the 86 clubfeet. After completing the casting regimen, the feet were placed in an afoot abduction brace to maintain the correction in the present study. 14 case (30.4%) of 46 cases reported relapses after initially successful treatment; these relapses were significantly associated with noncompliance with the FAB. The relapse rate of 80% in patients non-compliant with the FAB and relapse rate of 6.5% in compliant patients. This was near the result of Ponseti.²³ who has reported a relapse rate of 78% in patients non-compliant with the FAB and 7% in compliant patients. Higher than the study of Dobbs et al., 15 on 51 patients, among the noncompliance group (21 patients) only five cases (24%) had no recurrence. Among compliance group, there were no recurrent cases, in which bracing compliance was found to be a significant predictor of recurrence.¹⁵

Depending on the result and statistical analyses of this study which emphasized the strict relationship between recurrence and compliance of the family with a brace (P-Value: 0.001). Among the compliance group (31 patients), were only 2 cases (6.5%) recurrent, and among the noncompliance group (15 patients), were 12 cases (80%) recurrent. In our locality there are so many people either illiterate or with low educational level and with low socioeconomically status, so it indirectly affects the recurrence rate, so the relationship between recurrence and education of parent (P-Value: <0.001), among 33 educated cases were only 4 cases (12.1%) recurrent, and among 13 illiterate cases were 10 cases (76.9%) recurrent. In our study, relapse rates were near the relapse rate of Dobbs et al.¹⁵ studies

on 51 patients (86 feet), where 16 patients (31%) relapsed for 6 months mean follow-up duration.¹⁵ And lower than the study of Haft GP et al., 21 patients (41%) relapsed in their study on 51 patients because of the difference in the rate of brace compliance.

So, applying the ponseti method in every case of club foot is important because it at least delays operation even if the family is not in compliance with a brace. Regarding the treatment of recurrence cases, most recurrences are detected early, all minor recurrent, and treated by weekly changed casting (1-3 cast) with tenotomy in 4 feet. This is proved by Haft GP t al; 9 recurrent cases, all treated conservatively 24 in recent years, studies have indicated that the rate of surgical procedures is reduced by earlier identification of relapse and repeat application of casts. And improved compliance with abduction bracing. 15-22

Statistically, there is no significant relationship between age, gender, residency, family history, and severity of clubfeet at presentation with the rate of relapse after an initial successful trial of serial casting, which was also proved by Dobbs el al and Haft et al. 15-24 previous studies have shown the rates of noncompliance with bracing ranging from 10% to 41%. And this wide range of compliance of the family with the bracing protocol is related to these families' economic and educational standards.¹⁵⁻¹⁷

7. Conclusions and Recommendation

1. The ponseti is a good and reliable treatment for CTEV correction that fundamentally reduces the required surgical correction.
2. Compliance and maintenance are important to prevent the recurrence of a clubfoot treated with the ponseti method.
3. There is no significant relationship between ages and sex. Family history and severity of clubfoot at presentation, and the rate of relapse after a successful trial of serial casting.
- 4- Meticulous Cast Application, preferably personally by the treating orthopedist, calls for better cooperation and compliance by family and affects the treatment outcome.
- 5- Arrangement of follow-up sessions with cast sessions in groups encourages compliance and confidence among families.
- 6-. Further study includes a larger no. of patient and for a longer duration of follow up

References

1. Ponseti IV. Idiopathic congenital talipes equinovarus. In: Ponseti IV, eds. *Congenital Clubfoot Fundamentals of Treatment*. 1st ed. New York: Oxford University Press Inc. 1996;1(2):448-54.
- 2-Ponseti IV, Campos J (1972) The classic: observations on pathogenesis and treatment of congenital clubfoot. *Clin Orthop Relat Res* 467(5):1124--1132
- 3-Bor N, Coplan JA, Herzenberg JE (2009) Ponseti

- treatment for idiopathic clubfoot: minimum 5-year follow-up. *Clin Orthop Relat Res* 467(5):1263-1270
4. Huntley JS; Optimising the management of congenital talipes. *Practitioner*. 2013 Oct;257(1765):15-8, 2.
- 5-Withington ET. Hippocrates: Loeb classical Library. Vol. 3. London: Heinemann:1927.
- 6-. He JP, Shao JF, Hao Y. Comparison of different conservative treatments for idiopathic clubfoot: Ponseti's versus non-Ponseti's methods. *J Int Med Res*, 2017; 45(3): 1190-1199
- 7-. Besselaar A T, Sakkers R JB, Schuppers H A, Witbreuk M MEH, Zeegers E VC M, Visser J D, Boekstijn R A, Margés S D, Van der Steen MC M, Burger K N J. Guideline on the diagnosis and treatment of primary idiopathic clubfoot. *Acta Orthop* 2017;88(3): 305-9.
- 8-. Seringe R, Atia R. Idiopathic congenital clubfoot: Results of functional treatment 69 Feet. *Rev Chir Orthop Reparatrice Appar Mot*. 1990; 76:490-501.
- 9-. Dimeglio A, Bonnet F, Mazeau P, DeRosa V. Orthopaedic treatment and passive motion machine: Consequences for the surgical treatment of clubfoot. *J Pediatr Orthop B*. 1996;5:173-80.
- 10-. Radler, C., 2013. The Ponseti method for the treatment of congenital club foot: Review of the current literature and treatment recommendations. *International Orthopaedics*, 37, pp.1747-1753.
- 11-. Staheli. L.. 2003. Clubfoot: Ponseti Management. GlobalHELP Publications, pp.9
- 12-. View Image [Internet]. Ijonline.com. 2017 [cited 13 December 2017]. Available from: http://www.ijonline.com/viewimage.asp?img-IndianJOrthop-2017-51-1-_81_197551_b1.jpg
- 13-. Noam Bor, Julie A. Coplan, John E. Herzenberg, Ponseti Treatment for Idiopathic Clubfoot: Minimum 5-year Follow up. *Clin Orthop Relat Res*. 2009 May; 467(5): 1263- 1270. Published online 2009 Jan 7. DOI: 10.1007/s11999-008-0683-8.
- 14-. Bansal R, Jolly A, Farook PBM, Kamran I, Wahaj S, Hanasoge V. Management of congenital talipes equino varus using Ponseti method: 3-year follow-up in 166 club feet. *Int J Res Orthop* 2017;3:775-80.
- 15- Dobbs MB, Rudzki JR, Purcell DB, Walton T, Porter KR, Gurnett CA. Factors predictive of outcome after use of the Ponseti method for the treatment of idiopathic clubfeet. *J Bone Joint Surg Am*. 2004; 86:22-27
- 16-. Lehman WB, Mohaideen A, Madan S, Scher DM, Van Bosse. HJ, Iannacone M, et al... technique for the treatment of idiopathic clubfoot. *J Pediatr Orthop B* 2003; 12: 133-
- 17-. Morcuende JA, Dolan LA, Dietz FR, Ponseti IV. Radical reduction in the rate of extensive corrective surgery for clubfoot... *J Pediatr Orthop* 2003; 23:780-7.
- 18-. Roye BD, Vitale MG, Gelijns AC, Roye DP Jr. Patient-based outcomes after clubfoot surgery. *J Pediatr Orthop*. 2001 Jan-Feb;21(1):42-9.
- 19-. Congenital Club Foot: The Results of Treatment. Ignacio V. Ponseti, MD and Eugene N. Smoley, MD. *J Bone Joint Surg Am*. 1963;45:261-344.
- 20-, *J Bone Joint Surg Am*. 1980 Jan;62(1):23-31. Long-term results of treatment of congenital club foot. Laaveg SJ, Ponseti IV.
- 21- *J Bone Joint Surg Am*. 1992 Mar;74(3):448-54. of congenital clubfoot. Ponseti IV.
- 22-. Herzenberg JE, Radler C, Bor N. Ponseti Versus Traditional Methods of Casting for Idiopathic Clubfoot. *J Pediatr Orthop*, 2002; 22(4): 517-21.
- 23-. Ponseti IV. Relapsing clubfoot: causes, prevention, and treatment. *Iowa Orthop J*. 2002; 22:55-56 1888384.
- 24-Soran A. Ramadhan 2010 Early result of ponseti method in the treatment of clubfoot.
- 24-. Haft GE. Walker CG. Crawford HA. Early clubfoot recurrence uses of the Ponseti method in a New Zealand population. *J Bone Joint Surg Am* 2007;89:487-493.