

Research Article

Validation of Ponseti method for clubfoot deformity correction

Sanjiv Kumar^{1*}, Sudhir Singh¹, Dharmendra Kumar¹,
Farid Mohammad¹, Tushar Rai¹, Reetu Verma²

¹Department of Orthopaedics, Era's Lucknow Medical College & Hospital, Lucknow, Uttar Pradesh, India

²Department of Anaesthesiology, KGMU, Lucknow, Uttar Pradesh, India

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*Correspondence:

Dr. Sanjiv Kumar,

E-mail: sanjeevkumar98@mail.com

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ABSTRACT

Background: Idiopathic Congenital Talipes Equino-Varus (CTEV) is a complex deformity of foot that is difficult to treat. The goal of treatment is to gain a functional, pain free, plantigrade foot, with good mobility and without callosities. Currently, the most accepted and popular method is the Ponseti method which allows correction of all components of CTEV by manipulation and serial casting without any major surgical intervention. This prospective study was done in a tertiary care centre to statistically assess the efficacy of Ponseti method.

Methods: We treated 150 children (210 feet) with idiopathic clubfoot deformity, using Ponseti technique. The severity of foot deformities were assessed by Pirani scoring system and were also recorded clinically, radiologically and podographically. The changes in the mean Catterall-Pirani scores at different follow ups were evaluated statistically.

Results: The mean number of casts that were applied to obtain correction was 7.86 (range 5 to 11 casts). Percutaneous tendoachilles tenotomy was done in 70% of feet. All children were given foot abduction orthosis after the correction. The results were graded according to Ponseti and Smoley criteria. Good results were obtained in 83% of feet, acceptable results in 7% of feet and poor results in 10% of cases. Statistically significant correction was achieved in manipulation and casting stage which was maintained during bracing phase. The recurrences of the deformity were primarily due to poor compliance in the use of orthosis in post correction phase.

Conclusion: The Ponseti method of correction is a safe and effective treatment for congenital idiopathic clubfoot and radically decreases the need for extensive corrective surgery. Non-compliance with orthotics is the main factor causing relapse of the deformity.

Keywords: Idiopathic clubfoot, Ponseti technique, Catterall & Pirani score, Manipulation and cast application

INTRODUCTION

Idiopathic congenital talipes equino-varus is a complex deformity that is difficult to correct.¹ It is one of the most common congenital deformities. The ratio of male to female is 3:1, and 40% of cases are bilateral.² The prevalence of both immediate and long-term complications in surgically treated clubfoot has generated a renewed interest in nonsurgical treatment.³ The Ponseti method involves serial manipulation, a specific technique

of cast application, and a possible percutaneous tendoachilles tenotomy. It is reported to provide a lower complication rate, less pain and better function as the patient ages as compared to operative treatment.⁴

The method has been reported to have short-term success rates approaching 90% and the long-term results have been equally impressive.¹ Complications occurring as a result of Ponseti technique have not been reported.⁵

Aim of the study

The aim of this study is to report the results of Ponseti method of correction of idiopathic CTEV and to statistically validate the results.

METHODS

We treated 150 children with 210 congenital talipes equinovarus feet using Ponseti technique. The study was cleared by institutional research cell and the ethical committee.

All children who were brought to our outpatient department of orthopaedics with complaints of deformity of foot were screened. Those having congenital talipes equino-varus deformity and age less than one year were included in the study. All children with secondary talipes equino varus, age more than one year and history of previous failed treatment for the same were excluded from the study.

The deformities were assessed and documented clinically according to Catterall-Pirani scoring system, podographic imprints and with radiological assessment.⁶ Clinically the foot was evaluated for medio-lateral border ratio, degree of hind foot equinus, fore foot adduction, heel varus and foot cavus. Podographic imprints were taken on Butter paper and Foot Bimalleolar Angle (FBA) was measured. Radiological evaluation was done on Antero-Posterior view (AP view) and stress dorsiflexion lateral view films of the involved foot. talocalcaneal angle (TaC angle) and tibimetatarsal angle (TM angle) in antero-posterior view and tibiocalcaneal angle (TC angle) and tibiotalar angle (TT angle) in lateral view were measured. These parameters were documented at the start and end of serial casting. All the feet were corrected manually and above knee cast was applied as described by Ponseti without anaesthesia.^{7,8} When the mid-foot score was less <1 and hind-foot score was >1 after manipulation and casting, percutaneous tendoachilles tenotomy was done under local anaesthesia. Once forefoot and hind foot is aligned, then abduction is started progressively and percutaneous tenotomy of Achilles tendon was done if needed.⁸

Final corrective cast for three weeks was given in cases in which tenotomy was done. The cases which showed no or little correction of deformity were treated by surgical intervention.

A foot orthosis was given after removal of the final cast. The orthosis was removed for not more than one hour every day and continued till the child starts walking. Once the child had started walking CTEV shoes were used during daytime and foot orthosis was used during night.

The manipulation and casting was done by one consultant in all cases. The number of casts required to obtain correction was also recorded. Demographic data

including age, sex and laterality of the deformity along with mode of child birth was noted. Children were followed up every week during the manipulation and casting stage and every month for 3 months once the orthosis was applied and subsequently at 6 months, 1 year and 2 years after correction. Parents were advised to strictly adhere to the bracing protocol. The cases which showed relapse were treated again with manipulation and serial casting. Those who did not show correction were treated surgically. The relapsed cases were not included in final assessment.

Various clinical and radiological parameters (Talocalcaneal angle, tibimetatarsal angle, tibiocalcaneal angle, & tibiotalar angle) were recorded before the treatment and after correction and the changes in their values were statistically analysed.

Apart from clinical, podographic and radiological assessment, all children were also assessed according to Catterall-Pirani scoring system (CP Score) and comparison between initial CP score (cpi) and final CP score after casting and tenotomy (if required) at 3 months (cpf1), 6 months (cpf2), 1 year (cpf3) and after 2 years (cpf4) follow up was recorded. All the pre-treatment and post-treatment data of clinical, podographic imprints and radiological parameters were statistically analysed by statistical tool (SPSS software Version 16.0).

RESULTS

There were total of 67680 cases registered in our out-patients department during two year period of study. Out of these 237 cases were of congenital anomaly and 170 children were of congenital talipes equino varus. One hundred and fifty cases of CTEV matching our inclusion criteria were included in the study. There were 114 males (76%) and 36 females (24%). Sixty cases (36 male and 24 female children) had bilateral involvement and 90 children (male & female) had unilateral involvement. Amongst unilateral involvement 54 cases (60%) were right sided and 36 children (40%) were left sided. Mean age of the patients at the time of presenting to us was 06.28 months. One hundred and five children (70%) were born by normal vaginal delivery (12 children by breech presentation) and 45 children (30%) were delivered by low segment caesarean section. Maternal antenatal complications (Oligohydramnios, maternal diabetes and maternal obesity) were not seen in any of our cases.

The pre-treatment and post-treatment data of the various clinical, FBA angle on Podographic imprints and radiological parameters are given in Table 1 & Table 2 respectively. Percutaneous tenotomy was done in 147 feet (70%). No case required extensive surgical procedure. Mean number of plaster casts applied were 7.86.

Out of 210 feet we achieved full/acceptable correction in 189 feet (90%). In 21 feet (10%) we could not achieved acceptable correction and these feet were treated

surgically and were excluded in later calculations. At 6 month follow up (cpf2) we found some degree of loss of correction in 15 feet (7%). These feet were again treated with serial casting with/without tenotomy and good correction was achieved which was maintained till final follow up at 2 years.

The results were graded by Ponseti and Smoley criteria (1963). Good results were seen in 174 feet (83%), acceptable results were seen in 15 feet (7%) and 21 feet (10%) shown poor results in this study. Children having poor results were treated surgically.

Table 1: Showing various clinical parameters before and after serial casting.

		Pre-treatment		Post-treatment		Significance ('P')
		Number	%	Number	%	
M-L Border ratio	<1	178	85	126	60	<0.001
	1-1.19	32	15	84	40	
	>1.2	-	-	-	-	
Equinus (degrees)	<0 ⁰	-	-	189	90	<0.001
	0 ⁰ -20 ⁰	10	5	21	10	
	20 ⁰ -50 ⁰	168	80	-	-	
	>50 ⁰	32	15	-	-	
Adduction (degrees)	<0 ⁰	-	-	191	91	<0.001
	0 ⁰ -10 ⁰	-	-	19	9	
	10 ⁰ -20 ⁰	147	70	-	-	
	20 ⁰ -40 ⁰	63	30	-	-	
Heel varus (degrees)	<0 ⁰	-	-	203	97	<0.001
	<5 ⁰	11	5	7	3	
	5 ⁰ -20 ⁰	168	85	-	-	
	>20 ⁰	31	15	-	-	
Foot cavus (degrees)	Present	147	70	-	-	<0.001
	absent	63	30	210	100	
Podogram (FBA angle) (degrees)	>75 ⁰	-	-	168	80	<0.001
	75 ⁰ -70 ⁰	42	20	36	17	
	70 ⁰ -65 ⁰	151	72	6	3	
	<65 ⁰	17	8	0	-	

Table 2: Showing various radiological parameters before and after serial casting.

		Pre-treatment	Post-treatment	Significance
		Numbers (%)	Numbers (%)	
TaC angle	>30 ⁰	0 (0%)	147 (70%)	<0.001
	25 ⁰ -30 ⁰	168 (80%)	53 (25%)	
	20 ⁰ -25 ⁰	42 (20%)	10 (5%)	
TM angle	>0 ⁰	0 (0%)	189 (90%)	<0.001
	10 ⁰ -30 ⁰	151 (72%)	0 (0%)	
	<10 ⁰	59 (28%)	21 (10%)	
TC angle	>30 ⁰	0 (0%)	178 (85%)	<0.001
	10 ⁰ -30 ⁰	84 (40%)	32 (15%)	
	<20 ⁰	126 (60%)	0 (0%)	
TT angle	50 ⁰ -70 ⁰	147 (70%)	0 (0%)	<0.001
	70 ⁰ -80 ⁰	63 (30%)	21 (10%)	
	>80 ⁰	0 (0%)	189 (90%)	

Table 3: Changes of CP scores at follow-up and the statistical significance.

	Paired differences				t	df	Sig. (2 tailed)
	Difference of mean (Std. deviation)	Std. Error Mean (SEM)	95% Confidence Interval of the df				
			Lower	Upper			
cp i - cp f1	3.05801 (0.81357)	0.06047	2.93869	3.17734	50.569	180	0.000
cp i - cp f2	3.01381 (0.93605)	0.06958	2.87652	3.15110	43.317	180	0.000
cp i - cp f3	3.01381 (0.87469)	0.06502	2.88552	3.14210	46.355	180	0.000
cp i - cp f4	3.05714 (0.86080)	0.06507	2.92871	3.18557	46.982	174	0.000
cp f1 - cp f2	-0.04420 (0.46635)	0.03466	-0.11260	0.02420	-1.275	180	0.204
cp f1 - cp f3	-0.04420 (0.46635)	0.03466	-0.11260	0.02420	-1.275	180	0.204
cp f1 - cp f4	-0.02000 (0.31876)	0.02410	-0.06756	0.02756	-0.830	174	0.408
cp f2 - cp f3	0.00000 (0.47140)	0.03504	-0.06914	0.06914	0.000	180	1.000
cp f2 - cp f4	0.00000 (0.05361)	0.00405	-0.00800	0.00800	0.000	174	1.000
cp f3 - cp f4	0.04000 (0.40627)	0.03071	-0.02061	0.10061	1.302	174	0.194

cp i: Caterral-Pirani score (initial), cp f1: Caterral-Pirani score (final) at 3 months, cp f2 at 6 months, cp f3 at 1 year and cp f4 at 2 year

DISCUSSION

Conservative treatment of CTEV was always believed to be difficult and unsatisfying whereas surgical correction also failed to give useful, supple and plantigrade foot and was associated with complications (long term stiffness, weakness of foot) till last two decades.⁹ But, after re-emergence of Ponseti technique of correction, there many published reports in literature citing the superiority of Ponseti's method over Kite's method.¹⁰⁻¹² The Ponseti technique is an easy, effective and economical method of clubfoot correction when it is applied in idiopathic clubfoot, and patients have better ankle range of motion, both in dorsi-flexion and planter-flexion.¹³ The management of clubfoot deformity is the best if started at very early age as the feet are pliable and response is better as much better remodelling of the small bones of foot occur since they are in cartilaginous phase.^{13,14} After extensive search of published English literature on internet, we did not find any study which has quantified and validated the results of Ponseti's method statistically. We treated 150 children (210 feet) with Ponseti's method and have tried to analyse the results statistically.

A clear male predominance was seen in our study. Male child to female child ratio was 3:1. The male female ratio of our study is higher than other studies which report it to be 2:1.¹⁵⁻¹⁸ There are studies which report a much higher ratio of 4:1.^{16,19} Higher incidence might be a chance finding and may also because male child has much higher social significance in our society. Ponseti found the incidence to be six times higher among males.²⁰ There were 60 cases (40%) with bilateral involvement which corresponds well with others reporting bilaterality between 40%-50%. Amongst unilateral cases predominance of right side involvement was seen which again corresponds with other studies.²¹

Clinical parameters like M-L ratio, foot equinus, foot cavus, heel varus, fore foot adduction and bimalleolar angle all showed statistically significant improvement after serial casting with/without tenotomy after completion of manipulation phase in 189 feet (P <0.001) (Table 1). In 21 feet acceptable corrections in clinical parameters was not observed hence they were taken as poor results and further treated by surgery.

Radiological parameters like TaC angle, TM angle, TC angle and TT angle all showed statistically significant improvement at end of serial casting with or without tenotomy as shown by the changes in degree measured on the radiographic film (P <0.001) (Table 2).

The mean initial Caterral Pirani score (CP i: 3.33) decreased significantly to the time of final correction (CP f1: 0.27) and this change was significant (P <0.001) (Table 3). The mean age of subjects was 6.28 months and most of them were corrected with this technique shows that it is more effective and excellent results can be achieved in a young child. This finding is also endorsed by others¹³. There were 15 cases which showed some loss of correction at 6 month follow up. The scores at 6 month follow up (cp f2) showed some increase in mean CP scores as compared to cp f1 indicating loss of correction in few feet but this difference was not significant (P = 0.204) (Table 3). These cases were successfully treated again with manipulation and casting. The deformities were corrected with average 3 castings and they remained corrected thereafter.¹⁸ There was no loss of correction from 6 months follow up and at 1 year follow up as shown by mean cp f2 and cp f3 values (P = 1.000) (Table 3). Similarly the cp f3 and cp f4 values did not show any significant difference (P = 0.194) (Table 3). This indicates that the corrections are well maintained over long period of follow up.

The average number of casting required before tenotomy was 7.2 in our study. This is in concurrence with other study which reported mean number of casts required as 7.86.⁴ Other authors have reported less number of casts required to achieve the end results.^{18,22} In our study, percutaneous tenotomy was done in 70% feet where as other authors have reported tenotomy in 63.3%-95% cases.^{18,23,24} Serious bleeding complications have been reported following percutaneous tendo-achilles tenotomy.⁵ However, we did not encounter any complication and found it very helpful in obtaining full correction.

In this study we had 83% of good results while acceptable correction was achieved in 7% feet and 10% had poor results as per Ponseti and Smoley criteria (1963). Very good results (>85%) have been reported by most authors.^{4,9,11,12,25} Excellent results (>95%) have been also reported with this technique by some authors.²⁶⁻²⁸ In 21 feet (10%) there was residual equinus and adduction deformity. These patients were treated by surgical procedure and deformity was corrected. The same treatment protocol was followed and acceptable results were obtained by other worker.²⁵

In this study we had 7% of relapse at follow up at 6 months (cp f1-cp f2). On insisting, parents accepted the poor compliance for foot abduction orthosis and it is indicated by change in mean cp f2 at 6 month follow up. This reason has been widely reported to be the main factor causing failure of the technique.^{1,3,9,11,12,14,27} These children were again corrected by casting and strict bracing protocol was advised and correction remained sustained thereafter.

Extensive literature search on internet did not show any study which has validated the usefulness of Ponseti's technique of correction of idiopathic congenital talipes deformity correction in children. This study is the first study to report this. Few authors have compared and shown the superiority of Ponseti's method over traditional method (Kite's method).^{29,30} But the methodology of one of the study is questionable.³¹ Traditional Kite's method has a low success rate (58%), requires longer time to achieve full correction and the need for extensive surgical methods in partially corrected or resistant cases has been the main reasons due to which it has gone in disrepute. Presently subjecting children to Kite's method of treatment seems unethical. Hence we have statistically evaluated Ponseti's method alone.

CONCLUSIONS

The Ponseti method is a safe and effective treatment for congenital idiopathic clubfoot in children less than 2 years of age and radically decreases the need for extensive corrective surgery. Significant clinical corrections are achieved and radically decrease the need for extensive corrective surgery. The corrections are maintained over a long term follow up. Relapse of

deformity can occur specially in early maintenance phase due to improper use of orthosis.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional research cell and ethics committee

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