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Dr. Ankush Kumar
Senior Resident, Department of
Orthopedics, Lady Hardinge
Medical College, New Delhi,
India

Dr. Suryakant Singh
Attending Consultant,
Department of Orthopedics
(Joint Replacement), BLK
Superspeciality Hospital,
New Delhi, India

Dr. Neha Chaudhary
Senior Resident, Department of
Community & Family Medicine,
AIIMS, Patna, Bihar, India

Dr. Parimal Bhaskar
Senior Resident, Department of
Orthopedics, Patna Medical
College & Hospital, Patna,
Bihar, India

Dr. Ramesh Kumar
Attending Consultant,
Department of Orthopedics,
PSRI, New Delhi, India

Corresponding Author:
Dr. Suryakant Singh
Attending Consultant,
Department of Orthopedics
(Joint Replacement), BLK
Superspeciality Hospital,
New Delhi, India

Midterm outcome of neglected clubfoot treated by Ponseti method

Dr. Ankush Kumar, Dr. Suryakant Singh, Dr. Neha Chaudhary, Dr. Parimal Bhaskar and Dr. Ramesh Kumar

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Abstract

Background: Mid-term success results by Ponseti method for the treatment of neglected clubfoot can lead to a renewed interest among pediatric orthopedic surgeons. The purpose of this study was to evaluate mid-term effectiveness of Ponseti method for the treatment of neglected congenital idiopathic clubfoot.

Methodology: A total of 49 patients (67 clubfeet) were treated by Ponseti method and were studied prospectively up to July 10 (mean follow up period 5 years, minimum follow-up period of 3 years). Age at the initiation of the treatment, gender, bilaterality, severity of the initial clubfoot deformity measured by Pirani Severity Score System, total numbers of Ponseti casts before the tenotomy, details of tenotomy, compliance with brace and CTEV shoes were examined. Passive range of movements and look of club foot are evaluated with mean 5 years follow-up.

Results: We applied the Ponseti method and found good to excellent results in 44 patients - 89.79% (58 clubfeet - 86.56%) at mean five year of follow up. Parents of 32 patients (65.30%) accepted the look of the clubfoot nearly normal and parents of 12 patients (24.49%) accepted the look of clubfoot as normal. Of the 49 patients who responded to initial Ponseti casting, 14 patients - 28.57% (19 clubfeet - 28.35%) had relapse at varying age; out of which 9 patients - 64.29% (10 clubfeet - 52.63%) were corrected by Ponseti casting method, while 5 patients - 35.71% (9 clubfeet - 47.37%) were resistant to Ponseti method. Poor compliance with the Denis Browne splint was thought to be the main cause of failure in these patients.

Conclusion: Ponseti treatment for neglected CTEV has had encouraging results in terms of attaining a functional and visually acceptable foot and lessening the extent of surgery in cases where full correction is not achieved.

Keywords: Ponseti method, clubfoot

Introduction

With an incidence of 1-2 per 1000 live births ^[1], clubfoot is one of the commonest congenital deformities. It is a complex three dimensional deformity that is difficult to correct, and has a tendency for relapse. Presently, there is nearly universal agreement that the initial treatment of the clubfoot should be non operative regardless of the severity of the deformity. There have been numerous conservative and surgical methods described for the treatment of clubfoot, none of which yield uniformly satisfactory results. Long term studies have led to a decline in the enthusiasm for surgery as it results in a stiff, painful and arthritic foot apart from recurrences and repeat surgeries. For many years, the Kite's method was used for the correction of clubfoot, but it took enormous amount of time for correction and produced excellent results only in the hands of Kite ^[2]. In recent years, the Ponseti method has become the gold standard for correction of clubfoot ^[3, 4]. However, most of the studies on Ponseti method are done in younger children, before the walking age. However, the upper age limit for the Ponseti treatment has not been defined ^[5]. A neglected clubfoot is defined as clubfoot with no initial treatment or perhaps very inadequate and incomplete initial treatment till the walking age ^[6]. The deformity becomes worse at the time the child starts to walk because weight bearing takes place on the side or the dorsum of the foot, exaggerating the abnormal shape and causing further deformation ^[6]. The neglected clubfoot is a social, psychological and physical burden for the patient, his/her family and society. Hence it is imperative to find a solution for the treatment of neglected idiopathic clubfoot which is cost effective and gives long term results.

The current Gold Standard for the management of idiopathic Clubfoot in younger age group is Ponseti method. Till date the textbook treatment protocol for neglected clubfoot has been a surgical correction, which would often result ($\geq 30\%$) in poor results due to scarring, stiffness, and painful feet. However Ponseti or his team did not have any experience on neglected clubfoot as it did not occur in the developed world. After the excellent success of Ponseti method in the younger age group, this method is under review for neglected clubfoot also. The Ponseti method of manipulation and casting to treat neglected clubfoot has been shown to be an effective method of treatment with good short term results [7]. At our institute, we have been treating the neglected clubfoot with Ponseti method since many years with good initial results. The aim of this study was to assess the mid to long term results including the functional outcome of Ponseti method in the correction of neglected clubfoot.

Materials and Methods

This study was conducted in the Department of pediatric Orthopaedics; in a quaternary care centre from November 2015- march 2019. A total of 46 neglected clubfeet in 30 children who were treated by Ponseti method (mean follow up period 3.5 years, minimum follow-up period of 2 years), were included in this cross – sectional observational study, to assess mid to long term outcomes of Ponseti method.

Inclusion criterias

- Subjects treated for neglected clubfoot (typical).
- Presented at minimum of two years after cast correction of foot.

Exclusion criterias

- Patients with syndromic/atypical/neurogenic clubfoot.

- Patients treated with methods other than ponseti manipulation.
- Patients with any prior surgical management for clubfoot.

Methodology

Consents from the parents were taken prior to enrollment in the study after explaining the method of examination in detail. This study was authorized by the local ethical committee of the institute. Detailed history regarding other associated deformities, family history of similar deformity, including treatment history and pre treatment records, and clinical examination of affected foot of the patients was done. Clinical photographs of the patients to assess correction were taken. Patients were called for assessment till a period of minimum two years after cast correction. All previous records and documents which were available were retrieved from CTEV Clinic. The effectiveness of Ponseti method was assessed by comparing pre-treatment and present Pirani score [8], present functional scoring system points [9] and Dimeglio score [10].

Functional assessments included: gait, functional limitation, pain and patient satisfaction. The Ponseti scoring system [6] for functional results was used with 100 points indicating a normal foot. This includes a maximum score of 30 points for amount of pain, 20 points each for level of activity and patient satisfaction, 10 points each for motion of the ankle and foot, position of the heel during stance, and gait. For Satisfaction and Function category, data has been recorded from the patient's parents considering patient as minor. Confidentiality of the records was maintained to the fullest.

Quantification of various components of clubfoot deformity was done using:

1. Pirani score.
2. Dimeglio score.
3. Functional Scoring system. [Table 1]

Table 1: Functional Scoring System According to Dr. Ponseti [9]

Category	Points
Satisfaction (20 points)	
I am...	
1. very satisfied with end results	20
2. satisfied with end results	16
3. neither satisfied nor unsatisfied with end results	12
4. unsatisfied with end results	08
5. very unsatisfied with end results	04
Function (20 Points)	
In my daily living my club foot...	
1. Does not limit my activities	20
2. Occasionally limit my strenuous activities	16
3. Usually limits me in strenuous activities	12
4. Limits me occasionally in routine activities	08
5. Limits me in walking	04
Pain (30 points)	
My club foot...	
1. Is never painful	30
2. Occasionally causes mild pain during strenuous activities	24
3. Usually is painful after strenuous activities only	18
4. Is occasionally painful during routine activities	12
5. Is painful during walking	06
Position of heel when standing (10 points)	
1. Heel varus 0 degree or some heel valgus	10
2. Heel varus 1-5 degree	5
3. Heel varus 6-10 degree	3
4. Heel varus >10 degree	0
Passive motion (10 Points)	
1. Dorsiflexion	1 point per 5 degree (up to 5 points)
2. Total varus-valgus motion of heel	1 point per 10 degree (up to 3 points)

3. Total inversion-eversion of foot	1 point per 50 degree (up to 2 points)
Gait (10 Points)	
1. Normal	6
2. Can toe walk	2
3. Can heel walk	2
4. Limp	-2
5. No heel strike	-2
6. Abnormal toe off	-2

The results were graded as Excellent (90-100 points), Good (80-89 points), Fair (70-79 points) and Poor (less than 70 points). Poor and fair results were considered failures and needed further management for residual or recurrent deformity.

Statistical Analysis

All the data was collected, compiled and statistical analysis was done using SPSS software. Continuous variables were compared using the student t test. All p values were two tailed; $p < 0.05$ was considered statistically significant.

Outcome Measures

The baseline information included age at presentation, sex, bilaterality, previous treatment history, and follow-up time (minimum two years).

Primary

1. Proportion of patients having successful outcome at mid-term follow up, by change in Pirani score, present Dimeglio score and Functional score. A successful outcome was defined as a plantigrade foot with a straight lateral border and normal hindfoot valgus during weight bearing, ability to wear regular shoes comfortably.

Secondary

1. Change in Pirani score.

2. Proportion of patients who relapsed with deformity, once after fully corrected.

Results

A total of 46 feet were included in the study, all subjects aged between three to ten years. The minimum follow up period was 2 years, with mean follow up of 3.5 years. Out of 30 patients, 14 had bilateral clubfeet and 16 had unilateral clubfeet. 22 were male and 08 were female. The mean age of presentation was 5.78 years, ranging between 3 years to 10 years. No relationship had been found with birth order or family history. Individual components of deformities were evaluated clinically using Pirani, Dimeglio, and Functional scoring systems.

The range of pre-treatment pirani scores were from 3.5 to 6, with a mean of 5.29, with a standard deviation of 0.63, and variance of 0.39. The range of Post correction present Pirani score at midterm was 0 to 1.5 with a mean of 0.25, with a standard deviation of 0.39, and a variance of 0.15.

The parameters of pirani scores which had a final score of 0 were MC, PC and EH. For rigid equinus parameter too, final score was 0 except in one foot of age more than 10 yrs who had score of 1. For lateral head of talus, 08 feet had score of 0.5, and 38 had score 0. For curved lateral border, 15 feet had 0.5 score and 31 had 0 score, with a mean of 0.16 and SD 0.24. In our study there was one patient of age more than 10 yrs, who had 0.5 score each for LHT and CLB, and score 1 for RE. [Table 2]

Table 2: Comparison in values of individual components of Pirani score before and after treatment at midterm is as below

	CLB	MC	LHT	RE	EH	PC
Mean of differences	0.823	0.838	0.882	0.970	0.720	0.779
SD of differences	0.272	0.237	0.277	0.171	0.280	0.280
Variance of differences	0.074	0.056	0.076	0.029	0.077	0.078
t value	17.65	20.58	18.58	33.00	14.98	16.20
p value	0.00	0.00	0.00	0.00	0.00	0.00

In all components of Pirani score, Result was significant for 5% level and degree of freedom was 33. So, change in individual components of Pirani score between pre and post

treatment values were found to be statistically significant with p value of 0.00. [Table 3]

Table 3: Changes in Pirani score value before and after treatment at mid term is as below

	Pre-treatment mean	Post treatment mean	Mean of differences	SD of differences	Variance of differences	t value
Pirani score	5.29	0.25	5.04	0.987	0.975	29.78

The change in Pirani score between pre and post treatment values was found to be statistically significant at p value < 0.01 . Result was significant for 5% level. The 95% confidence interval of the differences was from 4.79 to 5.30. The range of Dimeglio score from 1 to 8, with a mean of 2.68,

with a standard deviation of 1.27 and a variance of 1.62. In none of patients was it 0. Out of 46 feet, 42 belonged to benign category, 04 belonged to Moderate category, and none of the feet had score of zero.

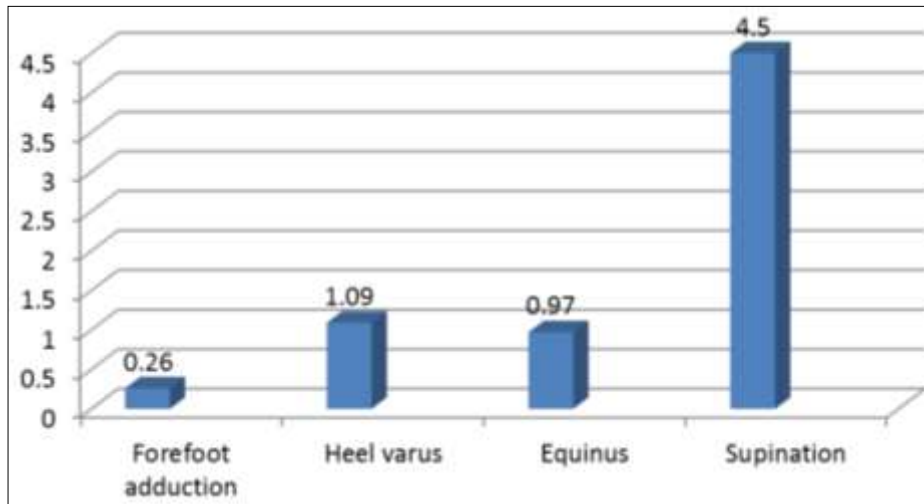


Fig 1: Mean DiMaggio score

The range for functional score was 69 – 96, with a mean of 86.41, with standard deviation of 6.73 and variance 45.40. 39 feet (85%) had shown good to excellent results, hence signifies satisfactory midterm outcome of Ponseti method of treatment. 06 feet had fair and 01 foot had poor results, so

these 07 feet were considered as failures of conservative Ponseti method. The functional score showed a slight decreasing trend with increasing age. The more early the treatment was started for clubfoot according to Ponseti method, better will be the functional outcome expected.

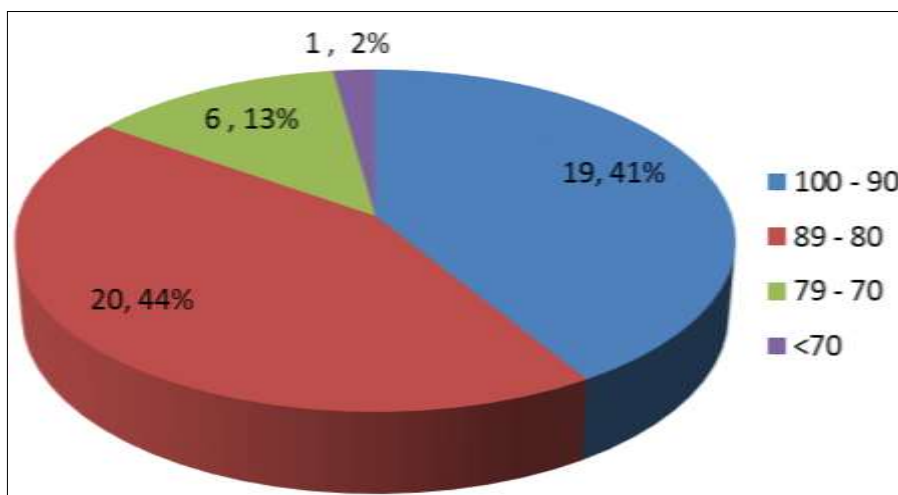


Fig 2: Average functional score

Position of heel on standing was ranged from 10° varus to 12° valgus with a mean of 5.5° valgus and standard deviation of

4.49. Varus position was seen in only 04 feet.

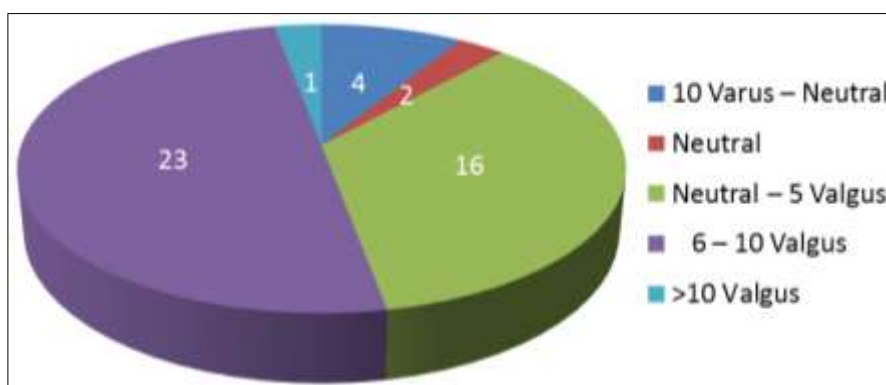


Fig 3: Position of heel distribution

None of the feet had any residual adduction deformity. The range of foot abduction measured in maximum passive

correction was 14 to 38 degree, with a mean of 23.12 degree and standard deviation of 5.77.

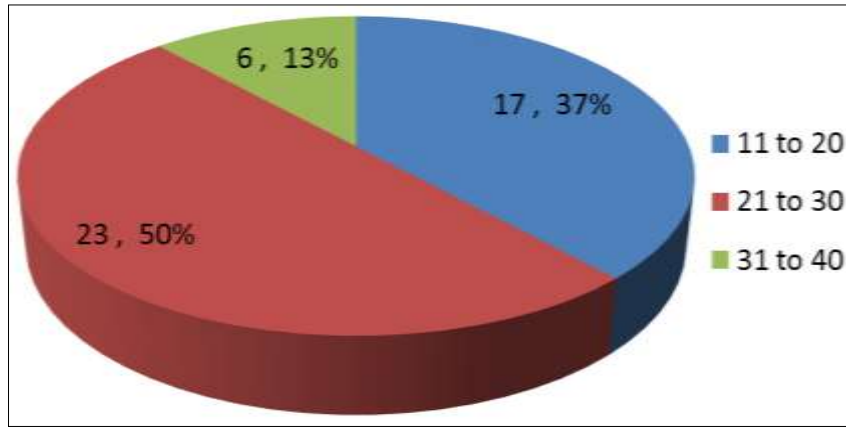


Fig 4: Forefoot abduction

There was only one foot which had not achieved dorsiflexion beyond 0. Passive dorsiflexion of ankle ranged from 3° equinus to 28° dorsiflexion, with a mean of 11.97°

dorsiflexion, and a standard deviation of 5.43 for passive dorsiflexion.



Fig 4: Passive dorsiflexion



Fig 5: Heel Valgus



Fig 6: Heel touching ground on squatting

Table 4: Relapse of deformity

Relapse	No. of feet	Percentage
Dynamic supination	02	4.35%
Cavus	06	13.04%
Equinus	01	2.17%
Varus	04	8.69%

In our study total 07 feet showed relapse of one or other components of the deformity. 06 feet had shown cavus. One foot had relapse of equinus, cavus, and varus deformity simultaneously. This child was aged more than 10 yrs. One

foot had dynamic supination, varus and cavus simultaneously. Another foot showed heel varus positive only, but the functional range of movement was acceptable to the patient and parents too, so no intervention was done for the same.



Fig 7: Right heel varus



Fig 8: Right Heel off the ground

Outcomes

Primary

Out of a total of 46 feet taken, 38 (82%) feet showed a favorable outcome indicated by improvement in post-treatment Pirani score as compared to the pre-treatment Pirani score. Also Dimeglio score variables indicated satisfactory outcomes. 85% subjects demonstrated good to excellent functional score at midterm.

Secondary

1. Favorable changes in Pirani score was observed as mean pre-treatment Pirani score of 5.29 improved to post-treatment Pirani score of 0.25 indicating a mean change of 5.04. The change in Pirani score between pre and post treatment values was found to be statistically significant at p value <0.01. Result is significant for 5% level. The 95% confidence interval of the differences is from 4.79 to 5.30.
2. 07 feet (06 patients including 1 patient with bilateral clubfoot) out of 46 showed relapse at mid-term.

Discussion

The treatment of clubfoot is controversial and continues to be one of the biggest challenges in pediatric orthopaedics. The major concern with the operative treatment of congenital clubfoot is functional outcome. Extensive open surgery like postero-medial release is commonly associated with long-term stiffness and weakness which is avoided by the Ponseti technique. Aronson and Puskarich studied the disability associated with various clubfoot treatment options. Their results showed that patients who underwent casting only and patients who had additional percutaneous heel cord lengthening had the least deformity and disability^[11, 12].

The Ponseti treatment of clubfoot has three phases: the corrective phase involves application of casts, the maintenance phase where splint fitting is emphasized and the transition phase where the splints are discontinued and regular footwear allowed. Problems can occur in any phase due to many causes: incorrect casting technique, improper tenotomy, under-corrected deformity, ill-fitting splints, and lack of understanding and poor compliance of patient's parents due to poor socio-economy can all affect a successful outcome^[12].

Very few studies have been done to assess the effectiveness of Ponseti's method in neglected clubfoot at midterm. Hence the lack of studies on this topic remains to be one of the lacunae in existing knowledge regarding the effectiveness of Ponseti's method at midterm for treatment of neglected clubfoot. Our study was an observational study to evaluate the midterm

results for idiopathic neglected clubfoot treated by Ponseti with satisfactory outcome at mean forty months of follow up. A painless plantigrade foot was obtained and remained corrected with no significant functional impairment in 38 out of 46 feet (82.6%), even at the midterm. Ponseti's method is a convenient, safe, effective and low cost treatment for neglected idiopathic clubfoot. It is a less cumbersome, less troublesome and a convenient method both for the patient and parents with no extra complication. The functional score showed a slight decreasing trend with increasing age. The more early the treatment was started, better will be the functional outcome expected. Cavus was found to be more resistant in older children.

Poor splint compliance was a major issue especially in children coming from low socio-economic strata and where the parents education level was poor. Out of 07 relapses, in 05 patients Denis-Browne splint was used infrequently and it was never used in one patients. We feel that although the foot morphology improves with rigid adherence to the casting technique it is the post-correction phase which needs careful attention and close follow up to ensure a successful outcome.

Conclusion

Ponseti treatment for neglected CTEV has had encouraging results in terms of attaining a functional and visually acceptable foot and lessening the extent of surgery in cases where full correction is not achieved. Thus, neglected CTEV in children presenting at an older age should undergo Ponseti treatment initially, irrespective of the severity of the deformity. Finally, the upper age limit at which successful outcome can be reached, remains uncertain.

Conflicts of Interest

No conflict of interests between authors

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