

Early Predictors of Recurrence and Long-Term Results of Clubfoot Treated by Ponseti Method

Dr Pankaj Kumar Maurya¹, Dr Alok Sahu², Dr Mathew Varghese³,
Dr Abhishek Kaushik⁴

¹Specialist in Orthopaedics, District hospital, Bhadohi, Uttar Pradesh India

²Assistant Professor, Department of Orthopaedics, Govt. Medical College and Hospital, Sundargarh, Odisha, India

³Senior Consultant and HOD, Department of Orthopaedics, St. Stephens's, New Delhi, India

⁴Senior Consultant, Orthopaedics, Accord Super speciality Hospital, Faridabad, India

Corresponding Author: Dr Alok Sahu

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ABSTRACT

Background: Congenital Talipes Equino Varus (CTEV) or Clubfoot is one of the most common congenital deformities of foot. Ponseti cast treatment is considered as the standard method for management of idiopathic club foot with better short term as well as long term outcomes reported. It is important to evaluate the results of Ponseti method in treatment of clubfoot and cause for early recurrence along with long term result of this technique.

Material and methods: Retro-prospective observational study regarding short term as well as long term follow up for result of Ponseti treatment method was done during period of September 2015 to June 2017. Short term results and early predictors of recurrence were assessed with data regarding initial Pirani scores, number of casts needed for correction, need of tenotomy, bracing follow up and treatment of recurrence. Long term outcomes were also noted in children older than 5 years after completion of treatment with performance outcomes like sports activity, squatting, shoe comfort, external rotation of foot, dynamic supination and parent satisfaction scores.

Result: A total of 54 patients (80 club feet) were part of the study. Early recurrence (below 5 years) and late recurrence (after 5 years) was observed in 19% and 10% clubfeet respectively. Poor compliance with the foot abduction brace (Steenbeek brace) was thought to be the main cause of early recurrence. While brace bearing more than 5 hours is essential to prevent recurrence; early Achilles tendon tenotomy was noted to favor long term maintenance of correction and prevent recurrence. Long term result shows that clubfoot treated by Ponseti method had 97% supple feet with ability to squat in most of the patients with better clubfoot Disease Specific Instrument (DSI) score, external rotation and ankle dorsiflexion.

Conclusion: Ponseti treatment method is a safe and satisfactory method for congenital idiopathic clubfoot with long term effectiveness. Recurrences mainly occurred due to non-compliance with foot abduction brace. Recurrences can also be treated by same method.

Keywords: Recurrence in clubfoot, Congenital tali-pes equinovarus (CTEV), Ponseti Treatment, Idiopathic CTEV, Steenbeek brace compliance

INTRODUCTION

Congenital Talipes Equino Varus (CTEV) or Clubfoot is one of the most common congenital deformities of foot. The incidence is approximately 1 in 1,000 births.^[1] and bilaterality is reported in 50% cases.^[2] It is estimated that approximately 1.7×10^5 new cases of clubfoot will be added each year worldwide.^[3] The aim of the treatment of clubfoot is to have a plantigrade, supple foot in minimum possible time. Earlier described modalities of treatment of clubfoot includes bandages in Hippocrates time, serial plaster cast application of Kite's time, surgical treatment; but not a single modality of treatment could be validated as a standalone technique.^[4] According to literature, poor result is observed in surgically treated clubfoot compared to cast and manipulation. with many requiring additional surgical procedures.^[5-7]

Kite (1939) introduced a gentle method of manipulation that primarily involved serial manipulations and casting by abducting foot with applying pressure over calcaneocuboid joint as fulcrum.^[8-9] Kite attempted to correct each component of the clubfoot deformity sequentially instead of simultaneously.^[10] Ignacio Ponseti developed and refined his treatment method for clubfoot in the late 1940s. The method was developed in part as a response to the observation that patients treated with extensive surgeries for clubfoot often developed painful feet with residual deformities over time.^[11] Currently, Ponseti's method is most acceptable method of conservative treatment of clubfoot with several advantages to achieve correction with low cost.^[12] Ponseti's method following initial correction may exhibit relapse of one or more deformity in long term in some cases with the rate of relapse reported by Ponseti's group to be around 10%.^[13] Non-compliance with Ponseti's brace protocol is a major problem associated with most of these relapse.^[14-15] Early relapses can usually be treated with repeat casting regimen followed by the use of the foot

abduction brace (FAB). A repeat tendo-achilles (TA) tenotomy may be required in patients with less than 15 degree of ankle dorsiflexion (DF) following casting.^[14] Ponseti's method was initially described for children less than 2 years of age but this method has been extended to children with higher age group with good results. Ponseti's method, in the last decade has become increasingly popular and is reportedly effective for treating clubfoot in children up to 9 years of age.^[16] Ponseti's method is also being used for treatment of severe non idiopathic clubfoot deformities such as clubfoot occurring with arthrogryposis multiplex congenital (AMC), spinal dysraphism, associated genetic syndrome along with associated neuromuscular disorders.^[17] The method is also being applied to the treatment of complex clubfeet defined by Ponseti^[18] and for clubfeet that have been previously treated with extensive soft tissue release surgery but have suffered a relapse.^[19] Documenting the result of technique and the relapse pattern is thus an important feature to be noted during treatment tenure of each case.

MATERIALS & METHODS

A retro-prospective study was conducted at a tertiary care hospital with a good volume of club foot cases. This study comprised of consecutive cases of clubfoot those were treated by Ponseti method at our institute. All cases of clubfoot treated five years back who were coming for regular follow up were included along with prospective follow up from September 2015 to June 2017. A total of 54 patients were enrolled. 42 patients were boys and 12 patients were girls. 26 patients had bilateral clubfoot, and 28 had unilateral clubfoot. 51 cases were Idiopathic and 3 cases were syndromic (Edward syndrome, Developmental dysplasia of hip and syndactyly each one) which all had been treated 5 years back. In retrospective study we had looked into their medical records for initial Pirani score, number of casts required to correct

deformity, brace compliance and bearing of brace in hours according to parents and early recurrence and their treatment methods.

Also prospectively, all children were followed up once in three months and observed for late recurrences and long-term outcome performance in form of sports activity, shoe comfort, squatting, ankle

dorsiflexion, toe walking and external rotation.

Brace compliance in terms of wearing of braces in hours were recorded and past history of brace compliance was evaluated in these children as reported by their parents/attendants in terms of brace wearing in hours and graded as excellent, good, fine and poor.

Brace compliance	Brace wearing in hours
Excellent	23 hours for first 3 month and night and nap time in maintenance phase
Good	3-4 hours only
Fine	1-2 hours only
Poor	they did not wear brace or discontinue in maintenance phase

Table 1: Brace compliance as per usage in hours

We looked for early recurrences before and after 5 years. Various studies in literature mention signs of early recurrence as early heel rise (assessed when child is walking away from examiner), swing phase dynamic supination (assessed when child is walking towards examiner) and loss of ankle dorsiflexion to less than ten degrees.^[20,21] It occurs due to tibialis anterior over-activity

due to which the foot goes into supination in swing phase while walking. So, we also assessed the dynamic supination of the patients, ankle dorsiflexion and external rotation of foot. We measured parents' satisfaction regarding their children's feet using a 10-item clubfoot Disease Specific Instrument (DSI) as described by Roye et al.^[22]

QUESTIONS		SCORES			
Satisfaction score		1	2	3	4
1	How satisfied are you with the status of your child's foot?	Very satisfied	Somewhat satisfied	Somewhat dissatisfied	Very dissatisfied
2	How satisfied are you with the appearance of your child's foot?	Very satisfied	Somewhat satisfied	Somewhat dissatisfied	Very dissatisfied
3	How often is your child teased because of his or her clubfoot?	Never	Sometimes	Usually,	Always
4	How often does your child have problems finding shoes that fit?	Never	Sometimes	Usually,	Always
5	How often does your child have problems finding shoes that he or she likes?	Never	Sometimes	Usually,	Always
Functional score		1	2	3	4
1	Does your child ever complain of pain in his or her [affected] foot?	No			Yes
2	How limited is your child in his or her ability to walk?	Not at all	Somewhat	Moderately	Severely
3	How limited is your child in his or her ability to run?	Not at all	Somewhat	Moderately	Severely
4	How often does your child complain of pain during heavy exercise?	Never	Sometimes	Usually,	Always
5	How often does your child complain of pain during moderate exercise?	Never	Sometimes	Usually,	Always

Table 2: 10-item clubfoot Disease Specific Instrument (DSI) as described by Roye et al.

Minimum DSI score was 10 which predicts the best outcome and maximum DSI score was 40 which predicts the worst outcome. On the basis of these scores, DSI was graded into four categories

1. **Excellent**- DSI score 10

2. **Good**-DSI score 11-20

3. **Fine**- DSI score 21-30

4. **Poor**-DSI score 31-40

We translated the original DSI into the native language of each family.

We also evaluated performance outcome of these children in terms of sports activity,

shoe comfort, squatting, DF and toe walking.

STATISTICAL ANALYSIS

Data were entered in the excel sheet and analysed with SPSS version 21.0 software. Continuous variables were expressed as mean \pm standard deviation and median. Qualitative variables were expressed as frequencies and percentages. Difference between means were expressed by using 't' test / Mann-Whitney test and Kruskal-Wallis test/ANOVA test (for more than 2 means). A 'p' value less than 0.05 was considered to indicate significance. Sample size was calculated by assuming 95% confidence level, 0.80 probability of success (Power=80%), and a margin of error 10%. The sample size was found to be 54 for the study. So, 54 patients with 80 clubfeet were enrolled in the study.

RESULT AND DISCUSSION

Out of the 54 patients included in this study, 26 children had bilateral (48%) and 28 children had unilateral (52%) clubfoot. In children with unilateral clubfoot, 15 children had Right sided deformity and 13 children had left sided. Literature says that half of the children are known to have bilateral deformity.^[2] So, this finding in our study aligns well with the literature.

Most of the children included in our study were in the age group of 5-14 years. 50% of children were in the age group of 5-6 years and only 4 children (7%) were more than 11 years old child.

Direct questioning of parents on duration of brace wearing revealed that less than 5 hours of brace bearing in continuation phase had statistically higher probability of recurrence with significant p value <0.001 . Literature also confirms that non-compliance with brace protocol is a major problem associated with recurrence. ^[14-15] However, the exact duration required for preventing recurrence is not clear.

Adherent to brace (according to wearing of brace in hours)	Recurrence (No. of feet)		Pearson Chi-Square	P-Value
	Early recurrence	No recurrence		
>5 hours	4	50	31.294	<0.001
3-4 hours	3	15		
1-2 hours	1	0		
<1 hours	7	0		
Total	15	65		

Table 3: Co-relation of Adherence to brace (wearing of brace in hours) and early recurrence.

Although our study shows that start of late casting (>10 weeks) increases chance of recurrence (Pearson chi square 5.451 with p value 0.05), it is not possible to make a valid conclusion as the number of patients in this group studied were small.

Feet having high Pirani score at presentation may correct well and have no direct bearing on recurrence. (T value 0.701 with p value 0.242). This correlation is not statistically significant in our study.

The number of casts applied to achieve correction seems to have a direct correlation with recurrence. Children requiring more than 16 cast seems to have higher recurrence (p = 0.002).

Although syndromic clubfoot is less common, it needs a greater number of casts for correction and have high chance of recurrence.

The overall tendo-achilles Tenotomy rate of patients treated by Ponseti's method in the group evaluated was 90%. 40% of cases that had recurrence did not have TA Tenotomy. Our study showed that both early and late recurrences were more common in non-tenotomy group (Pearson chi square 18.461 with p value <0.001).

Dynamic supination was seen in 7 feet and 3 of them presented with recurrence. Correlation of dynamic supination with recurrence is statistically not significant in our study with p value 0.573 and chi square

0.371. Although, it is a well-known fact that dynamic supination is an early sign of recurrence, the small number in our study could be the reason for the statistically insignificant result. However, the issue of dynamic supination needs to be studied further to know their implication and effect on late recurrence.

Tibialis anterior tendon transfer was done in 5 patients having persistent dynamic supination beyond 5 years age, and patients were kept in short leg cast for 6 weeks post-surgery. Significant improvement in gait were noticed in these children.

Both early and late recurrences were more common in atypical clubfeet. Statistically it is significant with p value of 0.01. (for early recurrence Pearson chi square 6.4735 with p value 0.010 and for late recurrence Pearson chi square 6.5031 with p value 0.010).

As atypical clubfoot seems to have higher probability of early and late recurrence, children who develop atypical clubfeet need to be carefully followed and their bracing protocol should be adhered strictly. To the best of our knowledge there are no reports of long-term result of atypical clubfeet and their recurrence.

Signs of early recurrence are early heel rise, swing phase dynamic supination and loss of ankle dorsiflexion to less than ten degrees.^[20,21] 77 % clubfeet had equinus as component of deformity at recurrence. This may present as combination of cavus with varus, varus alone or equinus alone. This highlights the importance of adequate dorsiflexion and Tendo-achilles Tenotomy for achieving long term correction.

So, public health programs involving management of clubfoot by Ponseti's method of correction should have a goal of maximizing Tenotomy rate. It is also mentioned in literature that the most of the relapses occur in the hind foot, first as equinus and then in the heel as varus.^[23] All cases of early recurrence were treated by Ponseti's method and some of them needed re-do tendo-achilles Tenotomy.

Treatment of 6 late recurrent clubfeet were done by Ponseti methods and 2 late

recurrent clubfeet required Tendo-Achilles lengthening. Most of the recurrent clubfoot can be treated by Ponseti's method only. Majority of recurrence cases were manageable with re-do Ponseti casting without any surgical intervention.

Kinematically Ponseti's method achieve correction by increasing abduction of supinated foot. So, it seems logical to think that the degree of abduction possible would decrease with recurrence of deformity. However, this had not been evaluated in literature. All cases that had recurred had lesser external rotation. Mean external rotation and dorsiflexion achieved in clubfeet treated by Ponseti's method was 16.02 degree and 16.07 degree respectively. The DSI score ^[22] was used to look at the functional outcome and satisfaction in children treated with clubfoot more than 5 years after treatment. The best DSI score was achieved in children treated by Ponseti's method. The Mean DSI score of 11.9 was seen in children treated by Ponseti's method. DSI score also seems to follow closely the degree of correction achieved in terms of dorsiflexion and external rotation possible. Those children with better external rotation and dorsiflexion of foot have better DSI score. Children who are treated by Ponseti's method and followed up for more than 5 years showed best results in terms of their ability to squat (58%) and ability to walk heel to toe, with better degree of suppleness (97%). We also found that 91% children have better shoe compliance and 89% have regular sports activity.

CONCLUSION

Ponseti's treatment method is considered as a standard method for management of idiopathic clubfoot. It has better short term as well as long term outcomes. However, there is limited literature on Ponseti's follow up beyond 5 years. In our study, early recurrence before 5 years was 19 % and late recurrences after 5 years was found to be 10%. Most common reason for recurrence was poor compliance with brace. Brace

wearing for more than 5 hours is essential to prevent recurrence. Most common deformities found in recurrence were equinus and varus and least common was cavus deformity. Children who need more than 10 casts for correction of clubfoot have higher probability of late recurrence. Early Tendo-achilles Tenotomy seems to favour maintenance of correction on a long term and avoid recurrence. Achieving good dorsiflexion by primary or by even re-do tendo-achilles tenotomy is important to prevent late recurrence. The 16 degrees of dorsiflexion at time of bracing seems to correlate well with less probability of recurrence.

Children with atypical clubfeet needs careful follow up and must adhere to brace protocols more diligently. Dynamic supination needs to be evaluated further for its role in late recurrence. Recurrence can easily be managed with Ponseti treatment. DSI score follows up closely with the degree of correction achieved in the foot as measured by degree of dorsiflexion and of external rotation. Long term result of children treated with Ponseti casting shows that their feet remain supple with ability to squat properly.

In a nutshell, Ponseti's method is the best method for treating clubfoot with excellent short term as well as long term result. Issues with brace compliance is a major factor responsible of recurrence of clubfoot.

Declaration by Authors

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