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FUNCTIONAL OUTCOME OF THE RESULTS OF PONSETI MANAGEMENT OF CLUB FOOT AFTER WALKING AGE: A STUDY IN SHAHEED ZIAUR RAHMAN MEDICAL COLLEGE HOSPITAL, BOGURA, BANGLADESH

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ABSTRACT
Background: Clubfoot is the commonest congenital deformity in babies. More than 100,000 babies are born worldwide each year with congenital club foot. Around 80% of cases occur in developing nation. **Objective:** To assess the outcomes of congenital clubfoot by Ponseti technique after walking age. **Methods:** This prospective interventional study was conducted in the outpatient department of Shaheed Ziaur Rahman Medical College, Bogura, Bangladesh from January 2018 to December 2019 for duration of two years. All congenital clubfoot patients, age more than 18 months (Walking age group) of both sexes were included in this study. A total number of 30 patients were enrolled in this study as per inclusion and exclusion criteria. Diagnosis of the congenital telipes equinovarus deformity was made by history and clinical examination. Treatment was given according to Ponseti technique and correction of deformity was determined by Dimeglio scoring system. **Results:** 30 patients with 41 clubfeet were treated and followed up for this study. Both rigid and non rigid varieties of club feet were treated irrespective of sex and side of involvement. Dimeglio scoring system was used to evaluate result. Among 30 patients 18(60%) were male and 12(40%) were female .The male patients (60%) were more than female (40%). The mean age in the study group was 23.63 ± 4.75 with a range of $19 - 34$ months. Family history of clubfoot was present in only 4(13.3%) cases and absent in the rest 26(86.7%) cases. Involvement of right foot was in 14 (46.7%) cases followed by bilateral involvement 11 (36.7%) and left foot was in 5(16.7%) cases among 41 feet 32(78%) were rigid and 9(22%) were non rigid. Tenotomy needed in 36(87.8%) cases. Complication was present in 6(14.6%) cases. The mean Dimeglio scoring of deformities of Equinus was 3.22 ± 0.57 and 1.00 ± 0.63 before and after procedure respectively (p<0.001). The mean Dimeglio scoring of deformities of Varus was 3.60 ± 0.49 and 1.37 ± 0.54 before and after procedure respectively (p<0.001). The mean Dimeglio scoring of deformities of Supination was 3.15 ± 0.62 and 1.05 ± 0.68 before and after procedure respectively (p<0.001). The mean Dimeglio scoring of deformities of Adduction was 3.54 ± 0.55 and 0.90 ± 0.50 before and after procedure respectively (p<0.001). The mean Dimeglio scoring of the affected foot was 17.29 ± 1.87 and 4.32 ± 1.82 before and after procedure (p<0.001) respectively. **Conclusion**: This study permits to conclude that Ponseti technique for the treatment of club foot after walking age is safe and effective.

KEYWORDS: Club foot management, Dimeglio scoring, Treatment of club, Sex and side of involvement.

I INTRODUCTION
Clubfoot is a complex deformity in which the foot is completely turned inward at birth. It is the commonest congenital deformity in babies.[1] Clubfoot can occur in an otherwise normal child (idiopathic) or as a part of disorders such as myelomeningocele, or arthrogryphosis. Idiopathic clubfoot occurs worldwide with an incidence varying from 0.39 to 8 per 1000 live births which means that more than 100,000 babies are born worldwide each year with congenital clubfoot.[2] Around 80% of the cases occur in developing countries.[3] Male child are more commonly affected than female child with a ratio of 2:1 and up to 50% of the cases are bilateral.[4] Despite extensive clinical, epidemiological, and basic science research, the etiology and pathogenesis of clubfoot remain unknown.[5] However, clubfoot clusters in families and affects family members across generations, suggesting that genetics may play a role in the causation of this deformity. A positive family history has been reported in up to one-third of patients and twin studies

demonstrate 32.5% concordance for monozygotic twins versus 2.9% for dizygotic twins.[6] The clinical features of clubfoot is the smaller calf muscles and adductus of the forefoot at mid tarsal joint, cavus, varus of the heel and equines of the foot at the ankle joint. Although the most severe deformity occurs in the hind foot, all components of the deformity are interrelated. A normally developing foot becomes a clubfoot during the second trimester of pregnancy. The gene or genes responsible for clubfoot remain active from the 12th to 14th week of fetal life to 4 to 6 years of ages. After this age, relapses are very rare, although the calf atrophy will persist throughout life of the patient.[7] Pathologically, the ligaments of the posterior aspect of the ankle and of the medial and plantar aspects of the foot are shortened and thickened. The muscles and tendons of the gastrocnemius, tibialis posterior, and toe flexors are shortened and are smaller in size. There is an inverse correlation between muscle size and severity of the deformity. In addition, there is an increase in connective tissue rich in collagen that tends to spread into the Achilles tendon and the deep fascia.[8] The goal of treatment is to correct all components of the deformity so that the patient has a pain-free foot with good mobility, without calluses, and without need to wear modified shoes and inserts. Most orthopedists agree that the initial treatment should be non-operative; the preferred methods are manipulation and application of a plaster cast or physiotherapy started soon after birth.[9] The Ponseti technique involves gentle staged correction of the deformities of clubfoot.[10] Weekly manipulations are performed and the foot is cast in plaster of Paris at the maximum correction at the end of every manipulation. The cast is removed before the next manipulation and the correction is slowly increased. In many cases full correction is prevented by a tight Achilles tendon, but this can be released percutaneously as an outpatient procedure under local anaesthetic and most children undergo a tenotomy to complete correction of equinus prior to the application of the last cast. Once full correction of the clubfoot has been achieved (the foot being returned to the plantigrade position, defined as being able to have the sole of the foot flat on the floor when standing) the patient is given a Denis Browne splint to maintain the correction.[11] There are numerous reports of the effectiveness of this method of treatment for clubfoot[12], including the favourable independent thirty-year follow-up of Ponseti's own cases.[13] After a one-year trial period in Blantyre (2002)[14], the technique had dramatically reduced the number of cases being referred for surgery.[15] With adherence to the full treatment regimen, children can obtain complete long-term correction of the condition and join the typical life trajectory. Where treatment is not completed like the foot braces are not worn clubfoot may reoccur.[16]

II OBJECTIVES
General objective
1. To assess the outcomes of congenital clubfoot by Ponseti technique after walking age.

Specific objectives
1. To assess extent of deformity correction by Ponseti method after walking age.
2. To elucidate different complications regarding Ponseti technique
3. To assess post procedure improvement by using Dimeglio Scoring system.

III MATERIALS AND METHODS
Type of Study: This study was a prospective interventional study (Quasi experimental).

Place of Study: This study was taken place in the outpatient department of Shaheed Ziaur Rahman Medical College and Hospital, Bogura, Bangladesh.

Period of Study: This study was conducted from January 2018 to December 2019 for duration of two years.

Study Population: All congenital clubfoot patients, age more than 18 months (Walking age group), of both sexes who attended the outpatient department of the Orthopaedic Surgery at Shaheed Ziaur Rahman Medical College and Hospital, Bogura, Bangladesh included in this study.

Sample Size: Sample size was determined by using the following formula,
$n = 8 \times [r(100-r) + s(100-s)]_{/(r-s)}{}^2$
n = sample size
r = previous success rate of deformity correction
s = expected success rate of deformity correction
Using that formula the sample size was found
So, $n = 8 \times 80(100-80) + 90(100-90)]_{/(80-90)}{}^2$ [r = 80 & s = 90]
= 200

For convenience and short duration of study period a total number of 30 patients were enrolled in this study as per inclusion and exclusion criteria.

Sampling technique: Purposive sampling technique was used.

Selection criteria of subjects.

Inclusion criteria
- Age more than 18 months
- Both sexes
- Unilateral and bilateral clubfeet (Rigid and Non-rigid type)
- Guardians of the patients who gave the consent and were willing to comply with the study procedure.

Exclusion criteria
- Patients below the age of 18 months
- Patients with other congenital deformity
- Relapsed clubfoot
- Neglected clubfoot
- Patients with persistent skin disease

Study procedure: After selection and proper counseling the objectives and the procedure of the study were explained in details to the parents. They were encouraged for voluntary participation and they were allowed to withdraw themselves from the study even after participation whenever they felt. Their written consents were taken in a prescribed form. A questionnaire was prepared by the researcher considering key variables like age, sex, presenting complaints with duration, clinical findings, previous treatment pattern and it was verified by the guide and the data were collected by the researcher himself. Diagnosis of the congenital telipes equino varus deformity was made by history and clinical examination. Treatment was given according to Ponseti technique and correction of deformity was determined by Dimeglio scoring system.

Evaluation of the patients: Evaluation of the patients before and after treatment was done according to Dimeglio scoring system (Dimeglio et al.[17] Calculations of Dimeglio scoring system.

Deformities	points of Dimeglio scoring				
	4	3	2	1	0
Equinus	45–90°pltf	20°–45°pltf	20°pltf – 0°	0° – 20°dorsx	>+20°dorsx
Varus	45–90var	20°–45°var	20°var-0°	0°–20°vlg	>20°vlg
Supination	45–90sup	20°–45sup	20°sup-0°	0°–20°pron	>20°pron
Adduction	45–90°add	20°–45°add	20°add – 0	0°>-<20 abd	>20°abd
Posterior crease				yes	no
Medial crease				yes	no
Cavus				yes	no
Deviant muscle function				yes	no

Total score = 20

Grading of the affected foot by Dimeglio scoring

Grading
Grade-I   (0-5)-----   postural
Grade-II   (6-10)----   moderate
Grade-III (11-15)--- severe
Grade-IV (16-20)--- very severe

Data collection: Data were collected by researcher himself.

Data management: All data were compiled and edited meticulously by thorough checking and rechecking. All omissions and inconsistencies were corrected and were removed methodically.

Data analysis: All data were recorded systematically in preformed data collection form (questionnaire) and quantitative data were expressed as mean and standard deviation and qualitative data were expressed as frequency distribution and percentage. Statistical analysis was performed by using SPSS (Statistical Package of Social Science) for windows version 19. Paired t test was done to select the significance of the test. 95%confidenc limit was taken. Probability value 0.05 was considered as level of significance.

IV RESULTS
Assess the treatment outcomes of congenital clubfoot by Ponseti technique after walking age. This prospective interventional study was conducted in the outpatient department of Shaheed Ziaur Rahman Medical College and Hospital, Bogura, Bangladesh from January 2018 to December 2019 for duration of two years. All congenital clubfoot patients, age more than 18 months (Walking age) in both sexes were included in this study. A total number of 30 patients were enrolled in this study as per inclusion and exclusion criteria. Diagnosis of the congenital telipes equino-varus deformity was made by history and clinical examination. Treatment was given according to Ponseti technique and correction of deformity was determined by Dimeglio scoring system.

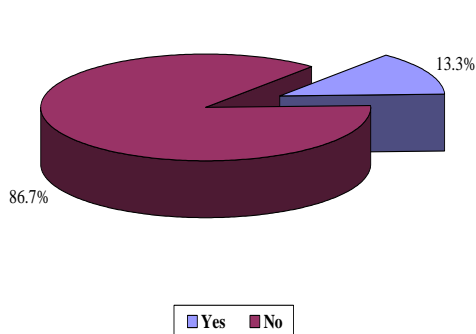**Table 1: Distribution of the patients by age (n=30).**

Age in months	Frequency	Percentage
19 – 22	17	56.7
23 – 26	5	16.7
27 – 30	5	16.7
31 – 34	3	10.0
Total	30	100.0
	Mean ± SD	Range
	23.63 ± 4.75	19 - 34

Among the 30 cases 17(56.7) patients were within age of 19-22 months. Both 23-26 months and 27-30 months groups contained 5(16.7%) patients each. 31-34 months group contained 3 (10%) patients. Mean age of the patients was 23.63 ± 4.75 months [Table-1].

Figure 3: Bar diagram of the patients by involvement of foot.
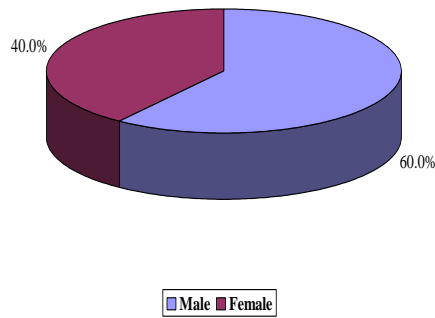
Figure I: Pie chart of the patients by sex.

Pie chart shows the distribution of the study population according to sex. Within 30 cases, the male patients were more than female patients which were 60% and 40% respectively [Figure-1].

Bar diagram shows the distribution of the patients by involvement of foot. Out of 30 patients involvement of right foot was in 14(46.7%) cases followed by bilateral involvement and left foot involvement which was 11(36.7%) cases and 5(16.7%) cases respectively [Figure-3].
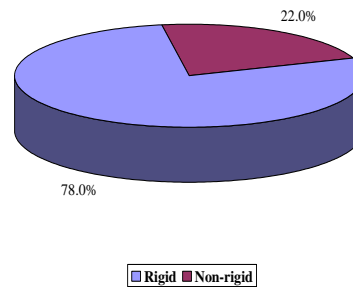
Figure 4: Pie chart of patient by the type of clubfoot.

Pie chart shows the distribution of patients by the type of clubfoot. Majority were rigid type of clubfoot patients which were 32(78.0%) cases and the rest 9(22.0%) cases were non-rigid type of clubfoot [Figure-4].
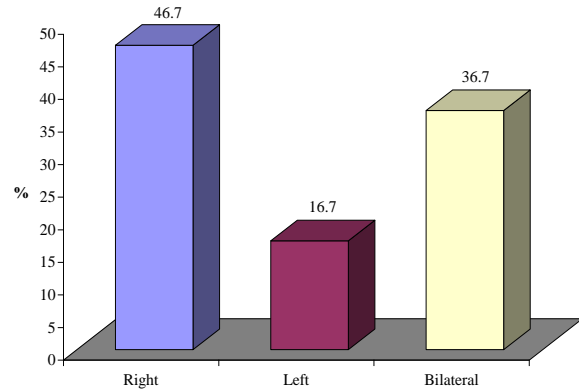
Figure 2: Pie chart of the patients by family history of clubfoot.

Pie chart shows the distribution of the patients by family history of clubfoot. Among 30 patients family history of clubfoot was present in only 4(13.3%) cases [Figure-2].

**Table 2: Distribution of patients by previously received treatment (n=30)**

Previously received treatment	Frequency	Percentage
Yes	7	23.3
No	23	76.7
Total	30	100.0
If yes, nature of treatment		
Ponseti technique	1	14.3
Others	6	85.7

[Table 2] shows the distribution of patients by previously received treatment. Previously received treatment was found in 7(23.3%) cases and 23(76.7%) cases did not get any treatment before. Among the 7 cases of previously received treatment Ponseti technique was used in only 1(14.3%) case and the rest 6(85.7%) cases have received other treatment.

Table 3: Distribution of patients by tenotomy needed (n=41)

Tenotomy needed	Frequency	Percentage
Yes	36	87.8
No	5	12.2
Total	41	100.0

[Table 3] shows the distribution of patients by tenotomy needed. Tenotomy was needed in 36(87.8%) cases and was not needed in 5(12.2%) cases.

Table 4: Distribution of patients by Complications (n=41)

Complications	Frequency	Percentage
Yes	6	14.6
No	35	85.4
Total	41	100.0
If yes, type		
Blister	4	66.7
Skin necrosis	2	33.3

[Table 4] shows the distribution of patients by complications. Complications were present in 6(14.6%) cases. Among 6 cases Blister was found in 4(66.7%) cases and Skin necrosis in 2(33.3%) cases.

Table 5: Distribution of patients by Dimeglio scoring of deformities (n=41)

Deformities	Before procedure Mean ± SD	After procedure Mean ± SD	p value
Equines	3.22 ± 0.57	1.00 ± 0.63	<0.001*
Varus	3.60 ± 0.49	1.37 ± 0.54	<0.001
Supination	3.15 ± 0.62	1.05 ± 0.68	<0.001
Adduction	3.54 ± 0.55	0.90 ± 0.50	<0.001

*Paired t test was done to measure the level of significance.

[Table 5] shows the distribution of patients by Dimeglio scoring of deformities. The mean Dimeglio scoring of deformities of Equinus was 3.22 ± 0.57 and 1.00 ± 0.63 before and after procedure respectively ($p<0.001$). The mean Dimeglio scoring of deformities of Varus was 3.60 ± 0.49 and 1.37 ± 0.54 before and after procedure respectively ($p<0.001$). The mean Dimeglio scoring of deformities of Supination was 3.15 ± 0.62 and 1.05 ± 0.68 in before and after procedure respectively ($p<0.001$). The mean Dimeglio scoring of deformities of Adduction was 3.54 ± 0.55 and 0.90 ± 0.50 before and after procedure respectively ($p<0.001$).

Table 6: Distribution of patients by total scoring of the affected foot (n=41)

Total scoring of the affected foot	Before procedure Mean ± SD	After procedure Mean ± SD	p value
	17.29 ± 1.87	4.32 ± 1.82	<0.001*

*Paired t test was done to measure the level of significance.

[Table 6] shows the distribution of patients by total scoring of the affected foot. The mean score of the affected foot was 17.29 ± 1.87 and 4.32 ± 1.82 before and after procedure respectively ($p<0.001$).

Table 7: Distribution of patients by grading of the affected foot (n=41)

Grading of the affected foot	Before procedure	After procedure
Postural(Grade-I)	0	33 (80.5%)
Moderate(Grade-II)	0	8 (19.5%)
Severe(Grade-III)	9 (22.0%)	0
Very severe(Grade-IV)	32 (78.0%)	0

[Table 7] shows that there were no foot in grade-I (postural) and grade II (moderate) before procedure and the number of foot in those groups after procedure were 33(80.5%) and 8(19.5%) respectively. There were 9 (22.0%) feet in grade-III (severe) and 32(78.0%) feet in grade-IV (very severe) before the procedure. After the procedure no foot was found in grade-III (severe) and grade-IV (very severe).

V DISCUSSION
A total number of 30 clubfoot children were enrolled in this study. The distribution of the study population according to sex was recorded. Among 30 cases, male patients were more than female patients which were 18 (60%) and 12(40%) respectively. Similar finding was also reported by[18], and found that boys were more commonly affected than girls and the ratio was 2:1. American Academy of Orthopaedic Surgeons[19], had reported that boys were affected twice as often as a girl which was consistent with the present study. The

distributions of the patients by age were recorded. The mean age was 23.63 ± 4.75months with a range of 19 – 34 months. Among 30 cases, the highest numbers were in the age group between 19-22 months which was 17 (56.7%). Similar study was done by Yagmurlu et al.[20], and mentioned that they tried to evaluate the efficacy of the Ponseti method in older children who were 20.5 months old on average, which was quite a late age for this kind of clinical study. Similar study was done by Lourenço et al.[21], and reviewed 17 children (24 feet) with congenital idiopathic clubfoot who presented after walking age and had undergone no previous treatment. All were treated with the method described by Ponseti. The mean age at presentation was 3.9 years (1.2 to 9.0) and the mean follow up was 3.1 years (2.1–5.6 years). The distribution of the patients by family history of clubfoot was recorded in this study. Among 30 patients family history of clubfoot was present in only 4(13.3%) cases and absent in the rest 26(86.7%) cases. Similar result was reported by[22], in Japan and he found that a sharp fall in the incidence among the relatives was observed, paralleling the remoteness of the blood relation. This suggests that congenital clubfoot is compatible with the model of multifactorial inheritance. Clubfoot clusters in families and affects family members across generations, suggesting that genetics may play a role in the causation of this deformity. A positive family history has been reported in up to one-third of patients, and twin studies demonstrate 32.5% concordance for monozygotic twins versus 2.9% for dizygotic twins (Dietz 2002). In another stud[23], mentioned that the occurrence rate was 17 times higher in first-degree relatives than in the general population. Wynne-Davies[24], mentioned in another study that unaffected parents with an affected son have one in 40 chances that another son will have clubfoot. Both these two studies are inconsistent with the present study. The distribution of the patients by involvement of foot was recorded. Out of 30 patient involvement of right foot was in 14(46.7%) cases followed by bilateral involvement and left foot involvement which was 11(36.7%) cases and 5(16.7%) cases respectively. Similar result was found by Ponset.[25,26] In Japan found that bilateral and unilateral affected cases were observed in equal numbers.[27] The distribution of patients by the type of clubfoot was recorded. Majority were rigid type of clubfoot patients which was 32(78.0%) cases and the rest 9(22.0%) cases were non-rigid type of clubfoot. The distribution of patient by previously received treatment was recorded. Previously received treatment was found in 7(23.3%) cases and without taking treatment was in 23(76.7%) cases. Among the 7 cases of previously received treatment, Ponseti technique was used in only 1(14.3%) case and the rest 6(85.7%) cases have taken the other treatments. Similarly reviewed 17 children (24 feet) with congenital idiopathic clubfoot who presented after walking age and had undergone no previous treatmen.[27] All were treated with the method described by Ponseti. Four patients (seven feet) had recurrence and failure was observed in five patients (eight feet).[28] The distribution

of patients by need of tenotomy was recorded. Tenotomy was needed in 36(87.8%) cases and was not needed in 5(12.2%) cases. Good or excellent result was achieved in tenotomy patients in which was consistent with the present study. This was achieved without complications.[29] The distribution of patients by complications was recorded. Complications were present in 6(14.6%) cases. Among 6 cases Blister was found in 4(66.7%) cases and Skin necrosis in 2(33.3%) case. Similar result was reported by Lourenço et al.[30] Yagmurlu et al.[31] also published in an article that the complication is less in Ponseti methods using Dimeglio scoring system. The distribution of patients by Dimeglio scoring of deformities was recorded. The mean Dimeglio scoring of deformities of Equinus was 3.22 ± 0.57 and 1.00 ± 0.63 before and after procedure respectively (p<0.001). The mean Dimeglio scoring of deformities of Varus was 3.60 ± 0.49 and 1.37 ± 0.54 before and after procedure respectively (p<0.001). The mean Dimeglio scoring of deformities of Supination was 3.15 ± 0.62 and 1.05 ± 0.68 before and after procedure respectively (p<0.001). The mean Dimeglio scoring of deformities of Adduction was 3.54 ± 0.55 and 0.90 ± 0.50 before and after procedure respectively (p<0.001). Dimeglio classification system for comparison is used for this study as it was one of the most cited instruments and is used both for classification and in follow-up studies.[32] Similar result was reported by Andriesse et al.[33] Dobbs et al.[34], mentioned that noncompliance and the educational level of the parents were significant risk factors for the recurrence of clubfoot deformity after correction with the Ponseti method. The identification of patients who were at risk for recurrence might allow intervention to improve the compliance of the parents with regard to the use of orthotics, and, as a result, improve outcome. Yagmurlu et al.[35], also mentioned that the Ponseti method using Dimeglio scoring system for the club foot patients in walking age is a better procedure.The distribution of patients by grading of the affected foot was recorded. Postural (grade-I) was absent before procedure and after procedure it was 33 (80.5%). Moderate (grade-II) grading of the affected foot was absent before procedure and after procedure it was 8 (19.5%). Severe (grade-III) grading of the affected foot was 9 (22.0%) cases before procedure and after procedure it was absent. Very severe (grade-IV) grading of the affected foot was 32 (78.0%) cases before procedure and after procedure it was absent. The distribution of patient by total Dimeglio scoring of the affected foot was recorded. The mean scoring of the affected foot was found 17.29 ± 1.87 and 4.32 ± 1.82 before and after procedure (p<0.001) respectively. Yagmurlu et al.[36], showed that treatment with the Ponseti method caused significant improvement in all patients, despite their age. The improvement was significant even in the older age group, who were 27.1 months of age on average at the beginning of the therapy. In this study the average follow up period for these patients were 6 months.

VI CONCLUSION

In conclusion, treatment of clubfoot by Ponseti technique is simple, effective, minimally invasive and inexpensive. It can be performed at outpatient department and avoids the complications of surgery in the walking age group children as well as since after birth. It gives a painless, mobile, normal looking, functional foot. From this study it is clear that clubfoot management by Ponseti method is an effective procedure after walking age that is up to 28 months.

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