

ORIGINAL ARTICLE

MANAGEMENT OF IDIOPATHIC CLUBFOOT BY PONSETI METHOD: TIKUR AN-BESSA SPECIALIZED HOSPITAL FIVE YEAR EXPERIENCE

Mengistu G Mengesha, MD^{1*}, Birhanu Ayana, MD², Mengestie M Belay, MD³, Wubalem Zewde, MD⁴, Peter J. , MD⁵

ABSTRACT

Background: Idiopathic clubfoot is one of common congenital musculoskeletal deformity worldwide. More than 80% of idiopathic clubfoot patients live in resource limited countries including Ethiopia. This study is aimed to assess experience of Ponseti treatment for idiopathic clubfoot in Tikur Anbessa Specialized Hospital.

Methods: A five-year retrospective study was conducted. Data analysed with SPSS version 24 and result summarized by texts, tables, and figures. The association between initial Pirani score and number of casts was assessed using the Pearson correlation coefficient with the level of significance set at $P < 0.05$.

Results: A total of 526 patients with mean age at presentation of 15.3 weeks were included. Male account for 387 (73.6%). More than two-third (70.7%) were born in the health facilities. Nearly half of them (47%) had bilateral involvement followed by right side (27.5%). In average, 5.94 corrective casts were needed to correct the deformity. According to Pearson correlation coefficient, a positive correlation was observed among number of casts to correct the deformity with initial pirani score and age at presentation ($r = 0.225, p < 0.001$; $r = 0.178, p < 0.001$). Among 587 feet for which tenotomy performed, only 186 tenotomy (31.7%) was done appropriately according to the criteria (HFCS > 1 and MFCS = 0).

Conclusions: Ponseti method of club foot treatment is effective in treating idiopathic club foot in our setup. Close monitoring of tenotomy decision based on pirani scoring should be made by consultant orthopedic surgeon in order to prevent unnecessary tenotomy.

Key words: Idiopathic Clubfoot, Ponseti treatment, Number of casting, Pirani scoring system

INTRODUCTION

Idiopathic club foot is common condition characterized by poor alignment of foot with involvement of both soft tissue and bony parts in adduction, supination, equinus, and varus(1–7). Worldwide incidence is approximately 1:1000 births and greater than 150,000 children born each year are affected (8–10).

More than 80% of children with idiopathic club foot are living in resource limited set up which makes treatment difficult for them (11,12). The incidence of clubfoot in Ethiopia is estimated to be 3,000-5,000 per year. It is the second most common pediatric condition causing physical disabilities among children in Gondar with estimated prevalence of 13.4% (12,13).

For long time, management of idiopathic clubfoot in Ethiopia was traditional Kite's manipulation and plastering which almost always ended up with a radical surgical posteromedial release which is completely stopped after introduction of Ponseti treatment (13).

Due to the fact that a surgically treated feet become weak, painful, stiff and arthritic that considerably impaired quality of life and high recurrence rate, Ponseti treatment technique become standard of care for clubfoot patients (13–15).

The Ponseti treatment was started at Tikur Anbessa Specialized Hospital (TASH) in 2005 and, in 2006, it is officially adopted as standard of care for all idiopathic clubfoot patients by orthopedic department. Then after, it become standard of management for all clubfoot patients throughout the country (12,13,16).

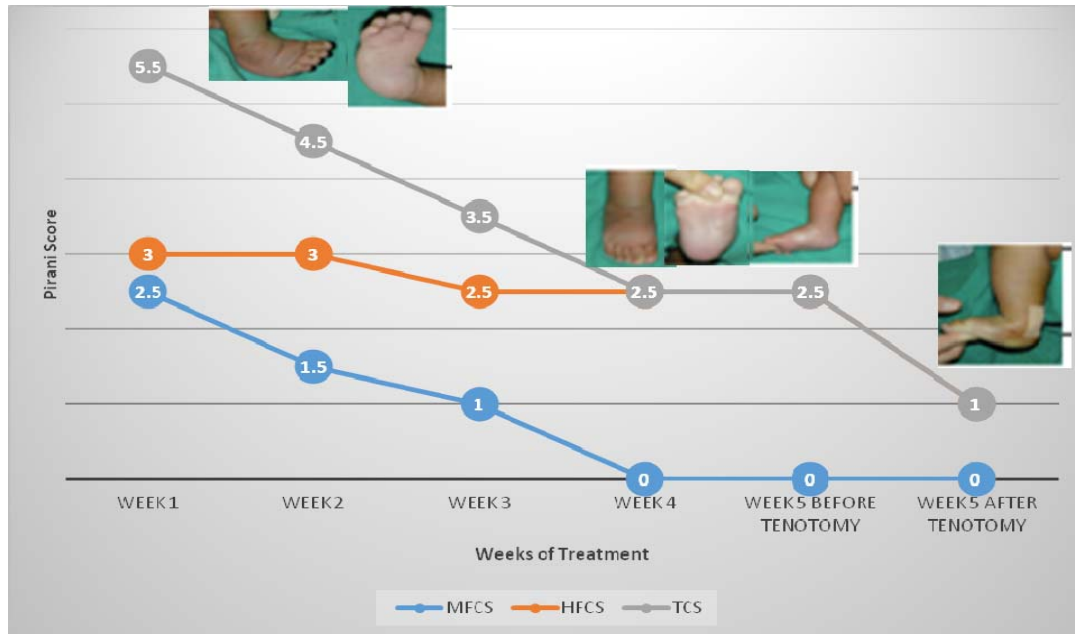
Most clubfoot deformities can be corrected with weekly manipulations and serial casting for 5 weeks followed by percutaneous achilles tenotomy to correct the equines deformity as first phase of treatment (2–4,17,18). Then second phase of treatment will continue with application of an abduction brace until the child age is 4 to 5 years to prevent relapse (3,4,15). Many researches show that Ponseti treatment is successful in up to 95% of the case (4,19,20).

¹Orthopedic surgeon at Hawassa University Comprehensive Specialized Hospital, FCS (ECSA). ²Consultant Orthopedic Surgeon, pediatric Orthopedic sub-specialist at Tikur Anbessa Specialized Hospital. ³Department of Physiotherapy, PhD candidate, Tikur Anbessa Specialized Hospital. ⁴Consultant Orthopedic Surgeon at Tikur Anbessa Specialized Hospital. ⁵Senior Consultant Orthopedics Surgeon, Department of Orthopedics and Traumatology Surgery, Norway.

*Corresponding Author E-mail: mengistugy@gmail.com

Severity of clubfoot deformity and improvement with the Ponseti management is objectively assessed with pirani scoring system which is easy and reliable. Studies show that initial pirani score has positive association with the number of corrective casts, prognosis, indication for tenotomy and outcomes (4,6,9,21,22). In general, based on the Pirani scoring system, at 4th week of the treatment, Mid Foot Contracture Score (MFCS) will be zero, while the Hind Foot Contracture Score (HFCS) will stay more than one.

When MFCS is 0 and the residual equinus is 0.5 or above, percutaneous tenotomy is indicated to speed up the correction of the hind foot equines deformity (**figure 1**). This study is aimed to report our experience at first phase of treatment of clubfoot in our set up even though our data may not completely answer all questions.



(MFCS- Mid Foot Contracture Score, HFCS- Hind Foot Contracture Score, TCS- Total Contracture Score)

Figure 1: Graph showing the correction trend of clubfoot deformities with MFCS, HFCS and TCS with estimated time of correction.

PATIENTS AND METHODS

A five-year retrospective study was conducted at Tikur Anbessa Specialized Hospital (TASH), Addis Ababa, Ethiopia. Four documents for each club foot patients were reviewed: patient medical chart, club foot patients' registry book, Pirani scoring sheet, and tenotomy logbook.

Club foot patients treated with Ponseti method and have completed chart were included in the study. Those patients with incomplete chart, syndromic club foot, neuropathic and late presenting club foot which was previously mentioned as neglected clubfoot (age above 2 years) were excluded.

Chart incompleteness was operationally defined as when one or more than one of the following important variables were missed: sex, age of treatment initiation, place of birth, feet affected, type of club foot, number of visits, Pirani score, and tenotomy status. Data was collected from the 4 documents using structured questionnaires which includes: sociodemographic characteristics, type of club foot, complications, initial and final Pirani score, number of casting, and tenotomy status.

The completed data was collected with Microsoft excel and exported to SPSS version 24 for data cleaning and analysis. Result was summarized by using texts, tables and figures. Pearson correlation coefficient with P-value < 0.05 was used to test the relationship among number of casting, need of percutaneous tenotomy and initial pirani score.

The study was conducted after getting ethical clearance from departmental ethical board.

RESULT

Sociodemographic characteristics:

A total of 1000 club foot patients were managed at TASH during the study period, of those, only 526 patients were idiopathic club foot with completed data and included for further analysis.

Among 526 children, 247 children (47%) were bilateral clubfoot followed by 146 children (27.8%) with right side club foot. Male patient accounts 387 (73.6%) with 2.78:1 male to female ratio. The mean age of the patients at presentation to clubfoot clinic was 15.3 weeks (1 - 92 weeks, SD of 20.53 weeks). More than two third (70.3%) of them were born in health facilities (clinics and hospitals) (**Table 1**).

Table 1: Sociodemographic characteristics of Idiopathic Clubfoot patients at TASH from 2010 to 2015.

Variables		Frequency (n = 526)	Percent (%)
Feet Affected	Right	146	27.8
	Left	133	25.2
	Bilateral	247	47
Sex	Male	387	73.6
	Female	139	26.4
Place of Birth	Home	154	29.3
	Hospital	235	44.7
	Clinic	137	26

Age of Presentation and Place of Birth

Those children with idiopathic club foot and born at home had a mean age of 27.98 weeks (95% CI: 24.14 – 31.82, $P < 0.001$) at time of presentation to clubfoot clinic. Whereas, Children who were born at health facilities had a mean presentation age of 10.22 weeks (95% CI: 8.65 – 11.78, $P < 0.001$). According to Pearson's correlation coefficient, there is association among place of birth with age of presentation to club-foot clinic and number of corrective casting ($r = 0.443$, $p < 0.001$; $r = 0.185$, $p < 0.001$ respectively).

Average Number of Casting, Initial Pirani Score and tenotomy status

The mean number of corrective casts for idiopathic club foot was 5.94 (minimum 3, maximum of 16 with SD of 3.01). For the tenotomy group (for whom tenotomy was done), an average of 5.86 (minimum 3, maximum 16 with SD of 2.98) corrective casting were needed; whereas, non-tenotomy group was corrected

with average of 5.22 (minimum 3, and maximum 7 with SD of 1.05) serial casting and manipulation. The overall mean number of initial pirani score was 4.67 (SD=2.06); which was 4.92 for tenotomy group and 4.1 for non-tenotomy group. According to Pearson correlation coefficient, a positive correlation is observed among initial pirani score and number of casting ($r = 0.225$, $p < 0.001$).

Age Category and Number of Casting

The average number of casting for newborn presented within the first 2 weeks of age was 5.36 (minimum 3, maximum 9, SD= 2.01) and 6.38 (minimum 5 and maximum 16, SD= 2.45) for children with the age of 5 – 24 weeks (**Table 2**). According to Pearson's correlation coefficient, there is association among initial age of presentation and number of corrective casting ($r = 0.178$, $p < 0.001$).

Table 2: Age Category of patient at presentation, Initial Pirani Score and Number of Casting of Idiopathic Club-foot patients at TASH from 2010 to 2015.

Age Group	Number of Children	Average Initial Pirani Score	Average No. of Casting
0–2week	99 (18.8%)	4.84	5.36
3–4weeks	114 (21.7%)	4.68	5.38
5-24weeks	202 (38.4%)	4.59	6.38
25-52weeks	73(13.9%)	4.52	7.12
53-103weeks	38 (7.2%)	4.31	7.81

Tenotomy Appropriateness:

Out of 526 children, 390 (74.1%) children had percutaneous tenotomy under local anesthesia. From 390 children (587 feet) for which tenotomy performed, only 186 tenotomy (31.7%) was done appropriately according to the criteria (HFCS >1 and MFCS = 0). For the rest 421 (68.2%) feet, tenotomy was done without respecting the criteria.

Complications of first phase Ponseti treatment of clubfoot:

The most common complication was recurrence of clubfoot deformity which was documented for 12 children (2.3%) followed by pressure ulcer for 7 (1.3%), rocker bottom deformity for 4 (0.8%) and complex clubfoot for 2 (0.4%) children.

DISCUSSION

Our finding reflected that bilateral involvement (47%) is significantly higher than unilateral involvement which is similar with the previous study done in Bangladesh and our country (13,16,20). It also showed that male (73.6%) were more affected than female with a ratio of 2.8:1. This is similar with a study done in Bangladesh (20), Gondar (13) and Italy (1) which shows predominant occurrence of clubfoot in males.

A two-third of clubfoot children (70.7%) were born at health facilities (clinic and hospital). This indicates they were directly linked to a clubfoot clinic and early treatment was initiated and the outcome was good for them when compared to those delivered at home.

Many Authors showed that Ponseti management is successful up to 95% of clubfeet management (4,22,23). The outcome of Ponseti treatment is dependent on place of birth, pirani score at initial presentation, age at presentation, number of casts to correct the deformity and tenotomy status (4,6,9,17,18,21,24,25). Age of patients at presentation to the clubfoot clinic has a positive correlation with place of birth ($r=0.443$, $p<0.001$). This finding explained by a clubfeet child born at home (mean age of presentation 27.98 weeks) were presented 2.74 times delayed to the clinic than those born at health facilities (mean age of presentation is 10.22 weeks). Late presentation to the clubfoot clinic was seen in our study which may be due to lack of public awareness about clubfoot and its management option and lack of enough trained personnel to manage club foot in each corner of the country. There was an association among place of birth and age of initial presentation with number of corrective casts ($r=0.185$, $p<0.001$, $r=0.178$, $p<0.001$ respectively).

A home delivered clubfoot child needs a higher number of corrective castings than those born at the health facilities which may be due to far from health facilities, or else family's' negative attitude toward modern medicine. In this study, mean number of corrective casts for idiopathic club foot was 5.94 which is nearly consistent with the study done by Pavone *et. al.* (1) estimated that an average 6.6 corrective castings is necessary before performing a tenotomy.

Ignacio Ponseti mentioned that Ponseti treatment of clubfoot should be initiated soon after birth in ideal set up (2,22). In our study, average number of corrective casting for those children presented within 2 weeks was 5.36 which is not significantly different from those come until age of 4 weeks (5.38). But after 4th week of age, there is a significant increase in the number of corrective casting which shows that the earlier the casting, the better the outcome. So, we can start plastering after 2 weeks of birth specifically for those low birth weight, premature, and child who can't breast feed well. There should not be hurry for casting with in the first week of life.

This study showed that a significant positive correlation among initial Pirani score and number of corrective casting ($r=0.225$, $p<0.001$) required to correct the deformity. There are different conflicting ideas in literature regarding the association of initial pirani score and number of corrective casts. Our study is supported by a study conducted in Manchester among 70 clubfeet with HFCS of 2.5 or 3 required higher number of casting (26). Related to this, a research conducted in India showed the more severe the initial deformity, the higher the pirani score, and then it needs a greater number of casts to obtain correction of deformity (9). The average number of corrective casting was higher for the tenotomy group (5.86 casts) than for the non-tenotomy group (5.22), the finding is similar to the study done in India(18). It also showed that 74.1% of the clubfeet children had a percutaneous tenotomy under local anesthesia, this reflects that out of 4 clubfeet children, 3 were having a tenotomy. From the total tenotomy performed in this study, only 31.8% were done when HFCS>1 and MFCS = 1. In 68.2% tenotomy was done even when MFCS is more than or equal to 1. This shows that there is over temptation to do tenotomy before midfoot contracture score is corrected which can lead to other complications. It could be explained that most of the time clubfoot clinic is run by junior orthopedic residents (year 1 and 2) and the decision for tenotomy readiness and final pirani scoring will be done by them.

This may lead for unnecessary tenotomy before the foot is ready. In ideal circumstances, tenotomy should be done when HFCS >1, MFCS= 0, talar head covered inside and ankle dorsiflexion remains less than 10 degrees above neutral position of the ankle (4).

The most common complication in our study was recurrence which is 2.2% followed by pressure ulcer 1.3%, rocker bottom deformity 0.8% and complex clubfoot accounting 0.4%. The recurrence rate finding is similar with a study done by Ford Powell *et. al.* (20) estimated that 2% of patients experienced recurrence. However, Pavone *et. al.* (1) registered recurrence rate among 3.7% of clubfeet patients due to poor compliance of the splint. But we are not able to compare our recurrence rate result with other findings due to the fact that scope of our study was restricted to first phase of clubfoot treatment and doesn't evaluate brace associated complication.

Limitation of the study: since most of patients' chart was having incomplete data, the study may not show the actual picture in our set up. But, in order to get complete data set, we use different data source including Club foot patient's chart (Pirani scoring sheet), club foot patients registry book, patients' medical chart and tenotomy logbook. It was also a single facility-based study which has difficulty to generalize for the whole population in Ethiopia.

Conclusion

This research show that Ponseti treatment is effective in our set up and average number of castings needed to treat the deformity was determined by place of birth, age of presentation, and initial pirani score. These shows that it is important to brought children with club foot earlier to club foot clinic for successful Ponseti treatment outcome with least possible manipulation and casting.

REFERENCE

1. Parone V, Testa G, Costarella L, Pavone G P. Congenital idiopathic talipes equinovarus: an evaluation in infants treated by the Ponseti method. *Eur Rev Med Pharmacol Sci* 2013;17(19):2675–9.
2. Ningthoujam Jungindro Singh, Sanjay Keshkar, Pampa De RK. Management of clubfoot by Ponseti technique-our experience. *IJPMR* 2011;22:12–6.
3. Malhar N Kumar CG. Modified Ponseti method of management of neonatal club feet. *Acta Orthop Belg* 2012;78(2):210–5.
4. Matthew B Dobbs, J R Rudzki, Derek B Purcell, Tim Walton, Kristina R Porter CAG. Factors Predictive of Outcome after Use of the Ponseti Method for the Treatment of Idiopathic Clubfeet. *J Bone Jt Surg* 2004;86-A (1):22–7.
5. Daniel Augusto Carvalhu Maranhão JBV. Congenital clubfoot. *Acta Ortop Bras* 2011;19(3):163–9.
6. Mejabi J O, Esan O, Adegbehingbe O, Orimolade E A, Asuquo J, Badmus H.D. The Pirani Scoring System is Effective in Assessing Severity and Monitoring Treatment of Clubfeet in Children. *Br J Med Med Res* 2016;17 (4):1–9.
7. Sharma Gaurav, Balkrushna Mangukiya, Prasad DV et al. Treatment of Idiopathic Congenital talipes equinovarus deformity by Ponseti technique in rural population. *Int J Med Res Heal Sci* 2013;2(3):363–6.

The Pirani score is good enough to estimate the average number of corrective castings and the need for tenotomy. But it needs strict follow up of residents and other staffs who are involved in deciding and doing tenotomy in order to assure ideal circumstances (MFCS =0 and HFCS >1) are fulfilled in order to prevent unnecessary and less effective percutaneous tenotomy.

Recommendation

Using pirani scoring for clubfoot patients' follow up should be continued and strict criteria should be followed before doing tenotomy to prevent unnecessary tenotomy. If possible, the final scoring should be done in the presence of pediatric orthopedic surgery consultants and decision for tenotomy should be made by consultant. Prospective study is paramount to see the indication for tenotomy.

ACKNOWLEDGMENT

The Authors would like to acknowledge Tikur Anbessa Specialized Hospital Orthopedic department for all support to conduct the study. We are also thankful for Nurses who were working in the clubfoot clinic for their collaboration during the data collection.

Competing of interest: The authors declare that the manuscript was approved by all authors and there are no competing interests. There is no external funding source for the study.

8. Omololu B, Ogunlade T. A. Pattern of congenital orthopedic malformations in an African teaching Hospital. *West Afr J Med* 2005;24(2):92–5.
9. Alok Aggarwal NG. The role of the Pirani scoring system in the management of club foot by the Ponseti method. *Int J Sci Res* 2016;5(6):1284–7.
10. Samantha E Parker, Cara T Mai, Matthew J Strickland et al. Multistate study of the epidemiology of clubfoot. *Birth Defects Res Part A - Clin Mol Teratol* 2009;85(11):897–904.
11. Jose A Morcuende, Lori A Dolan, Frederick R Dietz , Ignacio V Ponseti. Radical Reduction in the Rate of Extensive Corrective Surgery for Clubfoot Using the Ponseti Method. *Pediatrics* 2004;113(2):376–80.
12. Birhanu Ayana, Peter J Klungsoyr. Good results after Ponseti treatment for neglected congenital clubfoot in Ethiopia. *Acta Orthop* 2014;85(6):641–5.
13. Asmare Yitayeh, Berihun Fisseha. Health Condition Associated With Physical Disability Among Children in Ethiopia. *Int J Rehabil Sci* 2015;04(02):19–24.
14. Margaret A Honein, Leonard J Paulozzi CAM. Family history, maternal smoking, and clubfoot: An indication of a gene-environment interaction. *Am J Epidemiol* 2000;152(7):658–65.
15. Ning Lu, Li Zhao, Qing Du, Yakun Liu, Florin I. Oprescu JAM. From cutting to casting: impact and initial barriers to the Ponseti method of clubfoot treatment in China. *Iowa Orthop J* 2010;30:1–6.
16. Biruk L W. Management of Club foot at Tikur Anbessa Hospital; Addis Ababa, Ethiopia. *East Cent African J Surg* 2007;12(1):24–9.
17. Dyer P J, Davis N. The role of the Pirani scoring system in the management of club foot by the Ponseti method. *J Bone Jt Surg - Br* 2006;88(8):1082–4.
18. Anil Agarwal, Neeraj Gupta. Does initial Pirani score and age influence number of Ponseti casts in children? *Int Orthop* 2014;38(3):569–72.
19. Gray K, Pacey V, Gibbons P, Little D, Frost C BJ. Interventions for congenital talipes equinovarus (clubfoot). *Cochrane Database Syst Rev* 2012;(4).
20. Ford-Powell VA, Barker S, Khan MSI, Evans AM, Deitz FR. The Bangladesh clubfoot project: The first 5000 feet. *J Pediatr Orthop* 2013;33(4):40–4.
21. Porecha M, Parmar D. The Predictive Value of Pirani Scoring System in the Management of Idiopathic Club Foot by Ponseti Method. *Internet J Orthop Surg* 2008;11(2).
22. Lynn Staheli. Clubfoot: Ponseti Management. *Global HELP Publications*. 2009. 1–32.
23. Joshua Bridgens, Nigel Kiely. Current management of clubfoot (congenital talipes equinovarus). *BMJ* 2010; 340 (355): 308–312.
24. Mazlina Awang, Abdul Razak Sulaiman, Ismail Munajat MEF. Influence of age, weight, and Pirani score on the number of castings in the early phase of clubfoot treatment using Ponseti method. *Malaysian J Med Sci* 2014;21(2):40–3.
25. Vaishy AK, Arif M, Acharya D, Choudhary R, Seervi PM, Kumar R. Influence of Beginning Time of Casting for Clubfoot Treatment by Ponseti Method in Different Age Group Infants: A Retrospective Study. *Indian J Orthop* 2020;54(1):55–9.
26. Cristina Alves, Carolina Escalde, Pedro Fernandes, Delffin Tavares MC. Ponseti method: Does age at the beginning of treatment make a difference? *Clin Orthop Relat Res* 2009;467(5):1271–7.