



Determination of Relationship Between Ponseti Method of Clubfoot Management and Age of Treatment Onset

Tochukwu Nze Ugorji*, Ada Jovita Daniel, Kachisicho Theresa Anoliefo, Darlington Chimaobi Onyido and Dowell Oluchukwu Mbanu-Jackson

Department of Prosthetics and Orthotics, Federal University of Technology Owerri, Nigeria

*Corresponding author: Tochukwu Nze Ugorji, Department of Prosthetics and Orthotics, Federal University of Technology Owerri, Nigeria.

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Abstract

Background: Clubfoot, also called Congenital Talipes Equinovarus (CTEV) is a congenital abnormality of the foot. The deformities involved could be unilateral or bilateral. Ponseti intervention, developed by Ignacio Ponseti is a manipulative technique that corrects congenital clubfoot without invasive surgery.

Aim: The aim of this study is to quantitatively and qualitatively analyze the effectiveness of Ponseti intervention among children of different ages that presented for clubfoot treatment to ascertain the ideal age to begin treatment of clubfoot.

Objective: The study objectives include deducing the relationship between the effectiveness of Ponseti and age at treatment onset, to know the best time to begin clubfoot treatment, to analyze quantitatively and qualitatively the results from clubfoot treatment with a mean follow-up of 0-2 years.

Significance: The findings of this study will add to the existing knowledge of clubfoot treatment using Ponseti method, as well as reveal the effectiveness of Ponseti method in clubfoot treatment at various ages of treatment onset of clubfoot patients to discover the ideal time to begin treatment in order to promote a shorter treatment period and effectiveness clubfoot treatment.

Method: The study was carried out because of the need to determine the ideal time to begin clubfoot treatment, reducing relapse rate and promoting shorter duration of maximum treatment. It was retrospectively carried out in an Orthopedic Hospital in Eastern part of Nigeria with a study population of patients who presented for treatment of clubfoot within the age bracket of 0-2 years and have been treated using the Ponseti method. Medical records were reviewed with the aid of a data collection form designed by the researcher through which the data collected was used for comparison and statistical analysis.

Result: 21 patients were reviewed in Group one while 27 patients were reviewed in Group two. There are a total number of 36 clubfeet reviewed in Group one of which 8 patients had unilateral clubfeet and 14 patients had bilateral clubfeet, while 40 clubfeet were reviewed in Group two, of which 12 patients had unilateral clubfeet and 14 patients had bilateral clubfeet. The mean age at treatment onset in Group one was 63.52 days that is about 2 months 7 days old, while the mean age at treatment onset for Group two was 489.59 days that is about 17 months, 13 days. The mean age at the end of treatment in Group one was 114.7 days that is 4 months, 2 days old, while the mean age at the end of treatment was 624.3 days that is, 22 months, and 8 days old. 9.5% of patients had relapse in Group one, while 11.1% of patients had relapse in Group two. A mean value of 4.286 plaster castings were needed by patients in Group one, while a mean value of 6.44 plaster castings were needed by patients in group two.

Conclusion: Results gotten after the analysis showed a significant relationship between the effectiveness of Ponseti management and the age at onset of treatment, recommending that clubfoot is ideally treated within the age bracket of 0-6 months to prevent relapse, increased duration of treatment and too much serial casting and also promote a society with reduced rate of clubfoot deformity, thereby reducing need for future bone correction surgery, and reduced direct effects of late management of clubfoot on the child's family.

Keywords: Clubfoot, Treatment, Effectiveness, Age, Musculoskeletal birth defects, Bilateral

Introduction

Clubfoot is one of the most common congenital musculoskeletal birth defects. Untreated it leads to physical impairment and deformity, resulting in loss of mobility and function. The cause in most cases is unknown [1]. Club foot is a common congenital deformity affecting 150000-2000000 children every year. Untreated patients end up walking with the side or back of the affected foot, with severe social and economic consequences [2]. It presents with calf muscle atrophy (smaller calf muscle; the soleus muscle), adducts of the fore foot, caves, Varus of the heel and equines of the foot, which can be unilateral or bilateral. In most cases, clubfoot is discovered after the baby is born by physical assessment or visual inspection of the foot or an X-ray of the foot. It can also be discovered in utero during an ultrasound, after which nothing can be done to correct until the child is born [3]. The aim of medical therapy for clubfoot is to correct the deformities early and fully, and to maintain the correction until growth stops.

Clubfoot treatment has been a challenge to health professionals. The first treatment, known to have come from the 19th century, uses devices for forced manipulation [4]. In the 1980s and 1990s, soft tissue posterior-medial release surgeries were performed. This procedure yielded poor outcomes, with stiffness, pain and functional impairment of the foot. In recent times however, Clubfoot can be treated either operatively or non-operatively. Surgical method, which is an operative form of treatment, involves incisions and release of soft tissues of the plantar, medial, posterior, lateral structures of the foot. Long term follow-up showing clubfoot treated by extensive surgery led to a worse quality of life in adulthood because of repeated soft tissue releases causing stiffness, pain and arthritic foot [4]. Whereas the French method developed by Frederique Bonnet involves daily manipulations and taping [5].

In the last decade, Ponseti method has become increasingly popular and is effective in treating CTEV in children up to 9 years of age. Ponseti method, developed by Ignacio Ponseti is widespread worldwide and it consists of series of manipulations and immobilizations with casting, as well as percutaneous Achilles tenotomy to correct the deformities. When correction is deemed to have been achieved, an orthosis is used to maintain the correction obtained [6]. It was developed by Dr. Ignacio Ponseti of the University of Iowa hospital and clinics. It is a conservative method of treating clubfoot that was developed in response to the complications and poor outcomes that came with surgical management of clubfoot [7,8]. Ponseti in the year 1963 described a very effective conservative method of treating clubfoot with very few recurrence rates.

Dr. Ponseti was convinced there was a more efficient and effective way of treating clubfoot, this resulted in him studying extensively functional and patho-anatomy of the normal foot and the one presented with clubfoot [8,9]. The Ponseti Method

has earned a place of high esteem among other interventions in clubfoot treatment because of its better outcomes. Its use has spread worldwide with evidence shown in 113 out of 193 united nations member countries [10]. The Ponseti method consists of 2 equally important phases: the corrective phase; which consists of manipulation, casting and tenotomy and the maintenance phase; which is the use of Foot Abduction Brace to prevent relapse or recurrence [8,11].

In comparison, French method and Ponseti method require highly trained personnel, but the effectiveness of the French method is more critically dependent on the quality of the professional training and it is definitely preferable that the entire treatment be carried out by only a few therapists if too many hands are involved, it is not possible to ensure that the foot development will be properly followed. The goal of clubfoot treatment is to achieve a functional, pain-free, plantigrade foot with good mobility and without calluses and been able to fit into regular shoes. [12] The proposal that congenital clubfoot should be treated soon after birth has been widely accepted [12]. Ponseti also suggest that initial treatment should begin in the first weeks of life to take advantage of the more favorable viscoelastic properties of the connective tissues in the newborn.

The upper limit age for onset method management is unclear. Several authors have reported that neglected clubfoot cases or patients presenting at an older age could also be managed successfully by Ponseti method [13]. Ponseti method can be used to treat clubfoot at different ages of onset of treatment but the effectiveness of its use at different ages is important to be established so as to determine the ideal time to start the treatment of clubfoot to reduce relapse and promote a shorter duration of maximum treatment. The findings of this study will add to the existing knowledge of Ponseti method as well as reveal its effectiveness at various ages of treatment onset to discover the ideal time to begin treatment in order to promote a shorter and effective duration of clubfoot treatment. This study aims at quantitatively and qualitatively analyzing the effectiveness of Ponseti intervention among different ages of subjects that presented for clubfoot treatment in the hospital used for the study, to know the ideal age to begin the treatment of clubfoot for a better outcome.

Research objectives include; to qualitatively and quantitatively analyze the results from treatment of congenital clubfoot with a mean follow-up of 0-2 years, to deduce if there is a relationship between the effectiveness of Ponseti management and the age of onset of treatment, to know when is the best time to begin treatment of clubfoot, to investigate relapse pattern, to establish number of plaster cast applied on various ages of children during treatment. The goal of the Ponseti method is to reduce if not eliminate all elements of the clubfoot deformity, leaving a functional, pain free, normal looking, plantigrade, mobile foot. Clubfoot can be treated in

infancy in about 6-8 weeks with the proper gentle manipulations and plaster casts. The treatment is based on a sound understanding of the functional anatomy of the foot and of the biological response of muscles, ligaments and bone to corrective position changes gradually obtained by manipulation and casting [11].

Method

Research Design

The study is a retrospective study with focus on patients who have been treated for congenital clubfoot deformity at an orthopedic Hospital in South-East part of Nigeria.

Population of Study

This research was conducted at an orthopedic Hospital in South-East part of Nigeria. The study population includes patients who presented for treatment of clubfoot within the age bracket of 0-2 years and have been treated using the Ponseti method between the years (2014-2017). The study excludes children for the following reasons: syndrome, postural and neurological clubfeet, previous treatment before referral, those lost to follow-up before the 5 years follow-up years and lost or incomplete data.

Data Collection

Medical records was reviewed with the aid of a form used to collect the needed information and such information needed are; the gestational age and presentation age of the patient, sex, the initial Pirani as well as the final Pirani score, number of serial casting, age at onset of orthotic shoe use, age at relapse (if any), age at the end of treatment, clubfoot laterality and follow up age. The data was divided into two groups according to the age at treatment onset, Group one (0-6 months) and Group two (6 months- 24 months).

Ethical Consideration

Ethical Approval for this research was requested and granted by the Ethical board of the Orthopedic Hospital, before the data was collected at the Medical Records department.

Sample Size and Sampling Technique

The patients whose data are being used were born between the years 2014 and 2015. A total of 60 data were collected, 12 being exempted because the cases were those of acquired clubfoot, clubfoot with neurological cause and incomplete data. A total of 48 children were reviewed, which includes 22 females and 26 males. A total of 76 feet were reviewed; 20 unilateral clubfoot (of which 13 involved the right foot and 7 involved the left foot), and 28 bilateral clubfoot. 7patients were referred from another hospital for expert

care at the study institution; they had not begun treatment at their initial hospitals.

All patients were given orthotic shoe for final correction of the deformity according to Ponseti standards as well as serial casting at the initial correction stage. Plaster of Paris was used for serial casting. Families were asked to soak the casts in warm water for ease of removal, preventing plaster cutter injuries. The foot was considered corrected when it was clinically possible to achieve at least 15 degrees dorsiflexion, 70 degrees abduction, slight valgus heel, straight lateral foot border and a final Pirani score of 0.

Data Presentation and Analysis Techniques

The data collected for this study were presented using frequency tables and percentages for comparison. From the above table, 21 patients were reviewed in Group one while 27 patients were reviewed in Group two. There are a total number of 36 clubfeet reviewed in Group one of which 8 patients had unilateral clubfeet and 14 patients had bilateral clubfeet, while 40 clubfeet were reviewed in Group two, of which 12 patients had unilateral clubfeet and 14 patients had bilateral clubfeet. The mean age at treatment onset in Group one was 63.52 days that is about 2 months 7 days old, while the mean age at treatment onset for Group two was 489.59 days that is about 17 months, 13 days.

The mean age at the end of treatment in Group one was 114.7 days that is 4months, 2 days old, while the mean age at the end of treatment was 624.3 days that is, 22 months, and 8 days old. 9.5% of patients had relapse in Group one, while 11.1% of patients had relapse in Group two. A mean value of 4.286 plaster castings were needed by patients in Group one, while a mean value of 6.44 plaster castings were needed by patients in group two.

Results

From the (Table 1 & 2), 43.75% of the patients reviewed (i.e. 21 patients) were between the ages of 0-6 months with a mean age of 63.52 days (i.e. about 2 months, 7 days) and 56.25% of the patients reviewed (i.e. 27 patients) were between the ages of 7-24 months with a mean age of 489.59 days (i.e.17 months, 13 days). From the (Table 3), there were a total of 28 bilateral feet and 20 unilateral feet. 45.8% feet were in Group 1(i.e. 36 feet) and 54.2% feet were in Group 2 (i.e. 40 feet). From the (Table 4), the mean number of plaster casts for Group 1 was 4.29 casts and for Group 2 was 6.44 casts. From the (Table 5), two patients had relapse in group 2. This was due to poor compliance of bracing. In group two, 3 patients had relapse for the same reasons. From the (Table 6), 21 patients were reviewed in Group one while 27 patients were reviewed in Group two.

Table 1: Age distribution of patients.

S/N	Group One	Age at Beginning of Treatment	S/N	Group Two	Age at Beginning of Treatment
1	Patient 1	168days	1	Patient1	365days
2	Patient 2	9days	2	Patient2	252days

3	Patient 3	56days	3	Patient3	224days
4	Patient 4	21days	4	Patient4	730days
5	Patient 5	140days	5	Patient5	252days
6	Patient 6	1day	6	Patient6	280days
7	Patient 7	12days	7	Patient7	730days
8	Patient 8	21days	8	Patient8	730days
9	Patient 9	49days	9	Patient9	368days
10	Patient 10	42days	10	Patient10	730days
11	Patient 11	168days	11	Patient11	363days
12	Patient 12	140days	12	Patient12	733days
13	Patient13	112days	13	Patient13	367days
14	Patient14	168days	14	Patient14	727days
15	Patient15	14days	15	Patient15	339days
16	Patient16	3days	16	Patient16	421days
17	Patient17	56days	17	Patient17	733days
18	Patient18	14days	18	Patient18	727days
19	Patient19	58days	19	Patient19	720days
20	Patient20	56days	20	Patient20	740days
21	Patient21	28days	21	Patient21	730days
			22	Patient22	350days
			23	Patient23	436days
			24	Patient24	730days
			25	Patient25	533days
			26	Patient26	421days
			27	Patient27	224days
	Mean Age	63.52days		Mean Age	489.59days

Table 2: Frequency and percentage distribution of patients.

Groups	Mean Age	Frequency	Percentage
Group 1 (0 months-6 months)	Mean: 63.52 days (range: 1-168 days)	21	43.75%
Group 2 (7 months-24 months)	Mean: 489.59 days (range: 224-730 days)	27	56.25%

Table 3: Laterality distribution of clubfoot.

Options	Bilateral Clubfoot Frequency	Unilateral Clubfoot Frequency	Percentage%
Group 1	14	8	45.80%
Group 2	14	12	54.20%
Total	28	20	100%

Table 4: Frequency distribution of plaster cast applied on patients.

Group 1	Number of Plaster Casts	Group 2	Number of Plaster Casts
1	7	1	3
2	3	2	4
3	4	3	3
4	3	4	11
5	4	5	3
6	2	6	14
7	5	7	6

8	4	8	8
9	9	9	11
10	6	10	1
11	6	11	4
12	5	12	3
13	6	13	22
14	4	14	10
15	10	15	7
16	3	16	4
17	5	17	3
18	9	18	7
19	3	19	3
20	3	20	3
21	6	21	4
		22	7
		23	9
		24	5
		25	4
		26	11
		27	4
Total no. of Plaster cast	107 cast		174 cast
Mean of Plaster cast	4.29 cast		6.44 cast

Table 5: Frequency and Percentage distribution of relapses.

Options	Frequency	Percentage (%)
Group 1	2	9.50%
Group 2	3	11.10%
Total	5	10.40%

Table 6: Data presentation for comparison.

Variable	Group 1 (0-6 months)	Group 2 (7-24 months)
Number of patients	21	27
Unilateral: Bilateral clubfoot	8:14	12:14
Number of club foot	36	40
Age at beginning of treatment	Mean: 63.52 days i.e. 2 months, 7 days (range: 1-168 days)	Mean: 489.59 months, 13 days (range: 224-730 days)
Age at end of treatment	Mean: 114.7 days i.e. 4 months, 2 days (range: 56-280 days)	Mean: 624.3 days i.e. 22 months, 8 days (range: 308-840 days)
Ratio of female to male	9:12	12:15
% Relapse	9.50%	11.10%
Number of plaster casts	Mean:4.29 casts (range: 2-10 cast)	Mean:6.44 casts (range: 1-22 cast)

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Conclusion

From the result findings, Group one patients were treated within the mean time frame of 2months, while group two patients were treated within the mean time frame of 4months. Group one patients also had lesser relapse rate than Group two patients. Group one patients had to go through lesser plaster casting than Group two patients. The results also showed that the effectiveness of Ponseti can be measured by the age at end of treatment. Because this study was retrospective, Groups 1 and 2 were not matched in terms of previous treatment; they were not classified according to the severity of the clubfoot at the beginning of treatment. Such absence of classification of the clubfoot at treatment onset may be a limitation. However, it has been suggested that initial classification of severity is not related to success of the treatment, because different foot responds to different manipulation [14].

Here, the number of plaster casting was used as proxy for severity of the deformities. From the result findings, there is a relationship between Ponseti management of clubfoot and age at treatment onset. Therefore, early presentation of children for treatment is advised for caregivers to avoid prolonged period of treatment and other issues that may arise from late presentation. Also, from the research, it was discovered that parents were less compliant to Ponseti procedures at the later age. This caused a significant increase in relapse and this is due to increased non-chalant attitude as the child is growing. This study proves this existing fact as indeed clubfoot was ideally treated at the earlier group (i.e. group one). The findings of this study is line with a study carried out in 1996 by Ponseti which suggested that initial treatment should begin in the first weeks of life to take advantage of the more favorable viscoelastic properties of the connective tissues in the new born [13,14].

Conflict of Interest: There was no conflict of Interest.

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