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Research Paper

A COMPARATIVE STUDY TO EVALUATE THE OUTCOME OF PONSETI'S TECHNIQUE AND ACCELERATED PONSETI'S TECHNIQUE FOR CORRECTION OF CLUBFOOT

Ashok Vidhyarthi Department Of Orthopaedics, N.S.C.B. Medical College And Hospital, Jabalpur, Madhya Pradesh, India

Rajeev Singh Department Of Orthopaedics, N.S.C.B. Medical College And Hospital, Jabalpur, Madhya Pradesh, India

Rajendra Thakur Department Of Orthopaedics, N.S.C.B. Medical College And Hospital, Jabalpur, Madhya Pradesh, India

Darwinkumar Thakur Department Of Orthopaedics, N.S.C.B. Medical College And Hospital, Jabalpur, Madhya Pradesh, India

ABSTRACT

INTRODUCTION: Clubfoot is a common congenital deformity with incidence of1-6.8/1000 live births.Ponseti method is currently the goldstandard for treatment of clubfoot which conventionally involves weekly plaster changes. A prospective comparative study was carried out at our hospital where we compared one group with weekly plaster change to other group with twice weekly plaster change, using the classical Ponseti protocol of manipulation. **METHODS**: A total 50 feet (36 children), divided into two groups, were randomly allocated to either Group 1 – 25 feet(accelerated Ponseti) or Group 2 – 25 feet (standard Ponseti). Group 2 underwent serial manipulations and casting once a week and Group 1 received manipulations and castings **twice a week**. Pirani score was documented at the time of presentation, after each cast, and at the time of removalof final cast to assess the success of treatment (Pirani score ≤1). **RESULTS**: A total 43 feet (29 patients) underwent the entire course of treatment, while 7 patients discontinued the treatment during the course of the study. 14 patients, i.e, 21 feet were treated with Accelerated Ponseti Protocol (APP),i.e Group -1, and 15 patients, i.e, 22 feet were treated with Standard Ponseti Protocol (SPP), i.e Group-2. Mean duration of treatment from the first cast to tenotomyin the accelerated ponseti protocol group was **20.57 ± 4.5** days (ranging from 12 to 29 days), and in standard ponseti protocol group was **39.66 ± 6.9** days (ranging from 29 to 51 days). **CONCLUSION**: Both the methods proved to be equally efficacious for the management of clubfoot in our study. However, the accelerated method had an overall shorter treatment duration making it convenient for the parents. As the patient is under direct observation of surgeons, complications, in any, are detected early and easily. Overall, the accelerated technique is more practical, beneficial, and equally efficacious as standard ponseti technique, providing a more rapid correction of the deformity.

KEYWORDS

Accelerated Ponseti, clubfoot, standard Ponseti

INTRODUCTION

Clubfoot refers to a group of disorders where the leg, ankle and foot are shaped like a club. While clubfoot is widely understood as a deformity of foot, only few know thattheliteral meaning of club here is –"A heavy stick with a thick end, used as a weapon or for beating drums by tribes of India". It is a complex developmental anomaly, of which the majority of cases are congenital, with a worldwide incidence of 1-6.8/1000 live births.[1] Female to male ratio is of 3:1 and about 40% of the cases are bilateral.

Ponseti described the clubfoot deformity as occurring mostly in the tarsus[2]. The tarsal bones, which are mostly made of cartilage, are in the most extreme positions of flexion, adduction, and inversion at birth. The talus is in severe plantar flexion, its neck is medially and plantarly deflected, and its head is wedge-shaped.Thenavicular is severely medially displaced. In addition, the calcaneus is adducted and inverted under the talus.Excessive collagen synthesis in the ligaments, tendons, and muscles may persist until the child is 3 or 4 years of age and might be a cause of **relapses**[3]. Under the microscope, the bundles of collagen fibers display a wavy appearance known as crimp. This crimp allows the ligaments to be stretched.

In 1932, Dr. Hiram Kiterecognized that forceful manipulation and extensive surgical releases were harmful, and recommended a return to gentle manipulation and cast immobilization for the non-operative treatment of congenital clubfoot[4].

In the 1960s,Dr.IgnacioPonsetidevised his method of conservative treatment of CongenitalTalipesEquinovarus, which started from the age of one day and was based on the fundamentals of kinematics and pathoanatomy of the deformity, and successfully realigning the clubfoot in infants without any extensive and major surgeries. The corrective process utilizing the Ponseti technique can be divided into two phases **The Treatment Phase** during which time the deformity is corrected completely with **Percutaneous surgical Tenotomy if required.The Maintenance Phase** during which time a brace is utilized to prevent recurrence[5].

High Success rate of the Ponseti method has made it themost widely practiced treatment for CTEV in modern era. Classic Ponseti method involves weekly plaster change with gradual abduction of foot. In accelerated Ponseti method, the manipulation method remains the same, but the foot plaster is changed twice a week.This study thus aims to determine the effectiveness of a shorter duration of treatment so that most effective and economical strategies may be adopted in management of these patients[9,101,14].

MATERIALS AND METHODS:

Our study was a prospective study with a totalsample sizeof 50 feet(36 patients), of which 7 patients were lost during the course of the study. At the time of final follow up, 43 feet (29 children), Group 1 (**21 feet, 14 children)** (accelerated Ponseti Protocol group),and Group 2 (**22 feet,15chidren)** (standard Ponseti Protocol group), were included in the study. The study was conducted between December 2018 and August 2020.All idiopathic congenital clubfoot**,** with age less than 6 months, and Pirani score ≥ **4,** were included in the study.Patients withsyndromic, neglected, relapsed,andpostural clubfoot were excluded from the study.

Consent For Participation In Study was taken from the parents of the patients.They were also counseled regarding their disease, stage of lesion , management protocol, and anticipated outcome and probable complication related to the treatment. The study was approved by the institutional ethical commitee. Infants who presented with CTEV were

***CORRESPONDING AUTHOR** Rajeev Singh

Department Of Orthopaedics, N.S.C.B. Medical College And Hospital, Jabalpur, Madhya Pradesh, India.*Corresponding Author Email Id : rajeev200062011@gmail.com

divided into two treatment groups after giving consent for inclusion into the study. Patients were randomly assigned to either group by alternatively allocating successive patients to the control and test group in that order according to their chronological hospital numbers. Both feet were treated by the same method in cases of bilateral CTEV.

The **Standard Ponseti Protocol (SPP)** was taken as the control group (group 2), while the **Accelerated Ponseti Protocol (APP)** was the test group (group 1). Group 2 was managed with the standardPonseti protocol which consisted of serial manipulation and casting which was done once weekly on Friday. The serial manipulation was done according to the technique described by Prof I. Ponseti, with groin to toe casts applied after each manipulation until correction was achieved[6].The test group (group -1) was managed with an accelerated protocol consisting of identical serial manipulation and casting which was however done twice weekly (on Tuesday and Friday) until full correction was achieved .

Detailed personal history was recorded and a thorough general & local examination was carried out and deformity was scored according to pirani severity scoring at time of presentation and at each visit before applying cast. The score was plotted against time interval and the trend of score was noted with reference to effect of manipulations or other interventions on deformity. Pre-casting manipulation is done for two minutes in each cast in both group.

After final cast application, patients with residual equinus deformity were treated withpercutaneoustendoachiliestenotomy. Corrective cast was applied for three weeks after final correction or percutaneous tendoachiliestenotomy. We performed tenotomy under general anesthesia. The patients were started on bracing protocol with Steenbeek type foot abduction brace or Dennis Brown splint till walking age.

All feet were scored using the Pirani method. Successful correction was labeled as Pirani Score <1. Failure was labeled as Pirani Score >1 even after 8 corrective casts. The 'treatment time in plaster' refers to the number of days in plaster prior totenotomy.

Distinct Elements of the Ponseti Method was correction of Cavus deformityby extending the first metatarsal and supinate the forefoot and aligning the forefoot with the hindfoot. Theadduction and Varus deformity are corrected subsequently after the first cast is removed, and the cavus has been corrected.The fulcrum for the correction of deformity is at the HEAD OF TALUS(not the calcaneum).

The foot should never be everted. Dorsiflexion is avoided until 60-70 degree abduction has been achieved, and the talar head is covered, after which dorsiflexion is done. When the tendon is tight, percutaneous tenotomy of the tendon of Achilles is done.

Success of thePirani method requires good casting. Casting with only plaster of Paris is recommended as it is less expensive (supplied by hospital) and more precisely moulded. Before each cast, manipulation of foot is done for about 2 minutes.Only a thin layer of padding is applied for effective moulding and maintenance of foot in maximum corrected position.Firstly, a below knee cast is applied which is subsequently extended to upper thigh.Correction is never forced with plaster and only a little pressure is applied, and care is taken not to use constant pressure. The calcaneus is NEVER touched during the manipulation or casting.Moulding is a dynamic process, with fingers constantly moving to avoid excessive pressure over any single site.Plaster is trimmed so metatarso-phalangeal joints are free dorsally and the plantar surface is supported by the plaster. For subsequent cast applications, thecast is removed in clinic,just prior to the application of new cast, after wetting it.A plastic marker is inserted at the end of each cast roll, at the time of application. This makes removal of cast simple and can be done without causing excessive apprehension in the patient and parents, which can be associated with the use of saws or electric plaster cutters.

The achillestenotomy is an integral part of Ponseti management of clubfoot. Tenotomy is necessary because the Achilles tendon, unlike the ligaments of the foot, is made up of thick, non-stretchable fibers. After the tenotomy, the foot is placed in a final cast in an over-corrected position of maximal abduction and dorsiflexion. The tendon re-grows in this lengthened position, allowing the range of motion needed at the ankle joint. Achilles tenotomy is required in around 80-95% of the patients and should be performed when complete correction of adduction deformity has been achieved but equinus deformity remains.Decision of tenotomy is based on the score for the lateral head of talus is zero, the heel is in valgus and foot is in 60-70 degree abduction[1].

In the usual bracing protocol as described by Ponseti, brace is applied immediately after the last cast is removed, at 3 weeks after tenotomy.For unilateral cases, the brace is set at 60 to 70 degrees of external rotation on the affected side and 30 to 40 degrees of external rotation on the normal side.In bilateral cases, it is set at 70 degrees of external rotation on each side[1]

The first follow-up is done at 2 weeks, to troubleshoot compliance issues. The patient is subsequently followed upevery month for 3 months. After which every 3 month till maximum possible time, but not less than 6 months.

OBSERVATION &RESULTS

Of the 50 feet(36 patients) included in our study, 7 feet(7 patients) discontinued the treatment prior to completion, and hence were excluded from the study. A total of 43 feet(29 patients) were studied, 21 feet(14 patients) in Group-1, and the rest in Group-2.

In Group-2, 60% of the patients were males and 40% females, while in Group-1, 43% of the participants were male, and rest 57% female.A total of 29 children (43 feet) with idiopathic clubfoot were included in the study, 14 (32.5%)of whom were bilateral in my study .When the feet were divided on the basis of the age at first presentation, it was seen that a large proportion of patients seen were 1-3 month old (50%) . The youngest patient included in this study was 7 days old and the eldest was 6 months old. The average age at the time of presentation in Accelerated Ponseti Protocol Group was 63 daysand Standard Ponseti Protocol Group was 70 days. In our study, 16 out of 29 children with clubfoot were first born, out of which 9 (64.3%) underwent correction with Accelerated Ponseti technique, and 7 (46.7%) with Standard Ponsetitechnique. In our study, 3 out of 15 feet (20 %) in the Standard PonsetiGroup, and 3 out of 14 feet (21.6 %) in the accelerated ponseti group, had previous manipulative treatment in other institutions without correcting the deformity components and without Achilles tenotomy.Accelerated Ponseti protocol group patients needed an average of 5.7 plasters per foot for correction where as in standard ponseti protocol group 5.8 plasters per foot were needed.Pirani score before treatment ranged from 4 to 6 in both group. Initial mean Pirani score was 5.071 ± 3.26 in accelerated ponseti group and 5.06 ± 3.28 in Standard ponseti group(p=0.99). Postcast, mean Piraniscore was 0.142 ± 0.31in accelerated group and 0.20 ± 0.38 in standard group(p=0.54). Mean change in pirani score in Accelerated Ponseti Group was 4.929 and Standard PonsetiGroup was 4.86. Mean duration of treatment from the first cast to tenotomy in accelerated ponsetigroup was 20.57 ± 4.5 days (ranging from 12 to 29 days) and in standard ponseti group was 39.66 ± 6.9 days (ranging from 29 to 51 d). Patients not needing tenotomy were provided foot abduction brace at this time. This change was statisticallyanalysed using paired T test and was found to be statistically significant.(t value = 3.39, p value <0.001). Tendoachilles percutaneous tenotomy was required in 71.4 % feet in accelerated ponsetigroup and 72.7 % in standard group.In our study, complication of cast like superficial sores present in 3 (14.4%) children and crowding of toes present in 2 (9.2%) children in Accelerated Ponseti Group while in Standard Ponseti Protocol (SPP) Group superficial sores and crowding of toes present in 2 (9%) children each.All patients underwent a regular follow-up for average of 308 days in Accelerated Ponseti Group and 320 days Standard Ponseti group in my study .In our study, different degrees of recurrence were observed at 6 month follow-ups in the form of relapsed equinus, heel varus and/or forefoot adduction in 22.7% (5 feet of 22) in the Standard Ponsetigroupand 19.2% % (4 feet of 21) in the accelerated Ponseti group(APP). These relapses were remanaged and completely corrected by either Standard or accelerated Ponseti protocol, and percutaneoustenotomy was done for three feet in each group. There were no significant differences in the relapse rate in both group (P = 0.076).

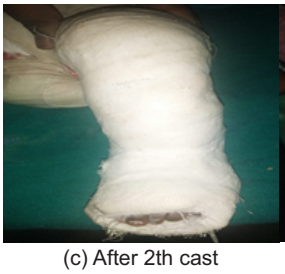
Table 1: Observations at a glance

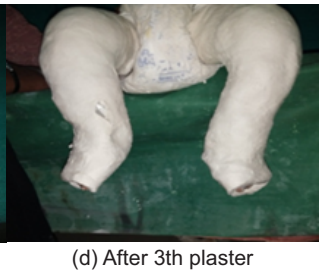
Group	Average age of patients	Average number of plasters per feet	Mean precast Pirani score	Mean Pirani score at 3 months	Mean duration from first cast to tenotomy	Tenotomy	Average follow-up
Accelerated Ponseti Protocol (APP) Group -1	63.73 ±59.66 days	5.7 Cast / Feet	5.07±3.26	0.142±0.31	20.57±4.5 DAYS	71.4 %	308 DAYS

Standard Ponseti Protocol (SPP) Group-2	70.93 ±51.6 3 days	5.8 Cast / Feel	5.06±3 .28	0.20±0.3 8	39.66±6. 9 DAYS	72.7 %	320 DAYS


(a) Accelerated Ponseti method: Preplaster image,


(b) After 1st plaster


(c) After 2th cast


(d) After 3th plaster


(e) After 4rd plaster


(f) After 5th plaster


(g) After 6 th cast


(h) After 7 th plaster


(i) Pretenotomy


(J)PercutaneousTendoachiliesTenotomy


(k) Post tenotomyeqinus correction


(l) Post tenotomy maximum correction cast


(m) After full correction, with splint


(n) 6month followup,

DISCUSSION

Morcuende et al.[7] presented one of the earliest reviewson accelerated Ponseti. They retrospectively reviewed230 patients (319 clubfeet) retrospectively.They compared5 days casting with 7 days casting and concluded that bothgroups had comparable outcomes.

Harnett et al.[8] accelerated the plaster change to 3 times aweek and compared it to weekly plaster change. Their studyincluded 40 patients (61 feet). Initial median Pirani score inaccelerated group was 5.5 and standard group was 5. Piraniscoredecreased number of cast application by an average 4.5 in accelerated group and 4 incontrol group. The authors concluded that triweekly plasterchange was equally effective as weekly plaster change andhad definite advantages. .**Sharma et al.[12]** also did a similar study comparing biweeklyand weekly plaster change in 40 cases (53 feet). Averageduration of treatment in accelerated group was 15 days andstandard group was 35 days. They concluded both protocolsto be equally effective.

G H. Ibraheem.[13] studied 28 patients in two groups and comparedbiweekly with weekly casting. In their study, male patientswere 16 (57%) and females 12 (43%).Unilateral involvementwas seen in 16 cases (57%) and bilateral in 12 (43%).MedianPirani score in their study was 5.2 which improved to below 1in 85% feet. Tenotomy was required in 80% feet

In my study mean duration of treatment from the first cast to tenotomy in accelerated ponseti protocol group was 20.57 ± 4.5 days (ranging from 12 to 29 d) and in standard ponseti protocol group was 39.66 ± 6.9 days (ranging from 29 to 51 d). Patients not needing tenotomy were provided foot abduction brace at this time.Tendoachilles percutaneous tenotomy was required in 71.4 % feet in accelerated ponseti protocol group and 72.7 % in standard group. Rate of tenotomy was slightly higher among accelerated group. Both mean duration and tenotomy rate are approx as same in above study.

CONCLUSION

Our study has demonstrated that faster correction of idiopathic clubfoot deformity can be achieved with an accelerated Ponseti technique (APP) than Standard ponseti protocol group (twice weekly casts).Number of casts required to achieve correction was approxly equal in both group. This modification is time saving, safe and effective for idiopathic clubfoot and helped the parents in less loss of wages.

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