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ORIGINAL RESEARCH

COMPARATIVE ANALYSIS BETWEEN CONVENTIONAL AND ACCELERATED PONSETI TECHNIQUE FOR TREATMENT OF IDIOPATHIC CONGENITAL TALIPES EQUINO-VARUS

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Abstract

Introduction: Clubfoot is a common congenital deformity and expected to affect 1.2 out of every 1000 live births in India. This is a huge number of instances, and their management necessitates special attention. The Conventional Ponseti techniques currently the gold standard approach to treat clubfoot which entails changing the plaster every week and gradually abducting the foot. Modification of the Ponseti method, The accelerated Ponseti method, the manipulation method remains the same, but plaster is changed two or three times a week, which can shorten the time immobilized in plaster with increased parents compliance. In this study comparison between conventional and accelerated ponseti technique in management of Clubfoot and effect of initial pirani scoring on final outcome were assessed.

Materials and Methods: A prospective study was done in 50 feet (39 patients), who were randomly allotted with 25 feet in conventional group and 25 feet in accelerated group. In conventional group, manipulation and casting were done at weekly intervals, whereas in accelerated group, the same was done at 3 days interval. The initial and final Pirani score, number of casts required, duration of casting and relapse after treatment were recorded for all cases in both the groups and the results were analyzed.

Results: The mean Pirani score difference between the first and last cast of the conventional method was 5.00±0.00 while the Pirani score difference of the accelerated method was 4.96±0.14. No significant difference was found in the mean Pirani score difference between the two groups ($p=0.136$). The mean total number of casts of the conventional method was 6.58±0.89 while the total number of casts of the accelerated method was 9.90±0.63. So the mean total number of casts in the conventional method was found to be significantly less than the accelerated method ($p<0.001$). The mean total duration from 1st cast to tenotomy of the conventional method was 39.05±6.23 days while the mean total duration from 1st cast to tenotomy of the accelerated method was 26.70±1.90 days.

Conclusion: The result of this study shows that the Accelerated ponseti method is equally effective as Standard Ponseti method in treatment of idiopathic CTEV with the benefit of reduction in treatment time and it will also help to improve compliance among parents.

Key words: Accelerated Ponseti, Congenital talipes equino-varus (CTEV), Clubfoot, Pirani score, Conventional Ponseti

1. INTRODUCTION

Congenital talipus equinovarus (CTEV), commonly called club foot, is a congenital condition with the deformity of food and consist of four components midfoot cavus, forefoot adductus, heel/hindfoot varus, hindfoot equinus [1]. Idiopathic clubfoot is the commonest orthopedic congenital condition that has been

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treated since the times of Hippocrates. However, as information regarding the aetiology and pathoanatomy of the club foot has grown over the decades, the outcomes have improved. Over the years, the therapeutic approaches have also evolved. In the 50s Ignacio V. Ponsetí developed an innovative method for the treatment of congenital clubfoot pathology which is a proponent of conservative management pointed out to the errors in kites' method of correction. Presently High success rate of the ponseti method of manipulation and casting methods is followed all over as early treatment for club foot [5], resuming surgery only for resistant cases, recurrences and delayed presented cases. Long term followup has shown 78% results with Ponseti's method [6, 7]. The traditional Ponseti approach entails changing the plaster every week and gradually abducting the foot. The accelerated Ponseti method, the manipulation method remains the same, but plaster is changed two [5, 8] or three times [9] a week. Achilles tenotomy in the majority of cases to address residual equinus, and maintenance of correction in a Foot Abduction Orthosis (FAO). For effective treatment of the condition, weekly hospital visits during the corrective phase and frequent hospital visits during the maintenance phase are essential. Because CTEV was considered a non-urgent condition during the COVID-19 pandemic's lockdown, surgeons and hospitals postponed corrective casting and subsequent therapy. However, the delay was not consistent across countries, and only a few doctors and hospitals continued to treat clubfoot. As a result, the amount to which clubfoot management has changed is unknown and has yet to be determined. The purpose of this survey was to investigate the same.

HISTORICAL REVIEW

Initial Period of Serial Manipulations and Immobilization:

Clubfoot was originally represented in ancient Egyptian tomb art, and treatment dates back to 1000 B.C. in India. Hippocrates (approximately 400 B.C.) gave us the first documented account of clubfoot, believing that mechanical pressure was the cause. He described manipulative corrective approaches that are similar to modern nonoperative methods. The next mention of repetitive stretching came from Arcaeus, who described his stretching technique as well as two mechanical devices for sustaining the correction in a chapter on the treatment of clubfoot published in 1658. Cheselden, at St. Thomas' Hospital in the mid-eighteenth century, treated clubfeet with repeated stretching and tape to keep the improved position. From this point onwards, until 1803, The problem was seemingly disregarded when Scarpa wrote his historical Memoir on Congenital Club-foot of Children [7]. Timothy Sheldrake wrote an essay called Distortions of the Legs and Feet of Children [11] in 1806. Sheldrake, like Hippocrates, applied bandages to his patients and claimed that the majority of them were healed. Delpech performed subcutaneous Achilles tendon tenotomy in two individuals with acquired talipes equinovarus in 1823. Both patients developed sepsis, and he decided not to perform the procedure again. Stromeyer separated the tendoAchillis subcutaneously in numerous patients with no fever or other evidence of infection in 1831. W.J. Little was a young British surgeon who suffered from poliomyelitis and had an equinovarus deformity.

He went to Hanover to see Stromeyer, who successfully operated on him. Little was taught how to conduct the treatment by Stromeyer, who also authorized Little to operate on a few of the patients that visited his clinic. Little subsequently returned to England, where he successfully introduced the treatment. In the United States, Rogers and Dickson were the first to conduct subcutaneous tenotomy for clubfoot in 1834 and 1835, respectively. Adams was the first surgeon to point out the folly of separating the Achilles tendon as the initial stage of deformity repair in 1866. M. Guerin documented the use of plaster-ofParis in the treatment of congenital clubfoot in 1838, and it is believed that he was the first to do so. Phelps performed a medial release of all soft tissues, elongation of the tibialis posterior, division of the medial ligament of the ankle joint and plantar fascia, abductor hallucis, flexor hallucis longus, all the short flexors, and finally osteotomy of the neck of the talus and wedge resection of the calcaneus in 1891[12].

Serial Manipulations and Immobilization:

Hugh Owen Thomas (1834-1891) developed the Thomas wrench, a device used to forcibly correct clubfoot. Denis Browne (1892-1967), the father of pediatric surgery and best known in orthopaedics for

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his Denis Browne bar used to correct clubfoot; a similar abduction orthosis is still used today to maintain correction of the deformity. Michael Hoke (1874-1944) was advocating manipulative treatment for clubfoot and holding the correction with plaster casts. In the early and mid-1900s Kite continued the meticulous clubfoot cast application and molding that he had learned from Johns Hopkins and succeeded Michael Hoke as medical director. He recommended abducting the foot at the midtarsal joint and pressing the thumb "on the lateral side of the foot near the calcaneocuboid joint" to get "complete repair." [13] Ponseti treatment was first introduced in the UK in the late 1990s, and NHS physiotherapist Steve Wildon popularized it across the country. The French method of clubfoot treatment is a conservative, non-operative approach that includes daily physical therapy.

French method:

The French method of clubfoot treatment is a non-operative, conservative approach. Daily physical therapy for the first two months, then thriceweekly physical therapy for the next four months, with continuous home exercises once official physical therapy is completed. The feet are massaged, stretched, and taped during each physical therapy session to maintain any range of motion gains. Strengthening the peroneal muscles, which is regarded to contribute to long-term correction, may be the focus of exercises. After the child has been in physical therapy for two months, the number of sessions can be reduced to three times a week instead of days until the child has been in therapy for six months. To ensure long-term correction, caregivers must continue completing exercises at home and splinting at night after the physical therapy program is completed.

Kite's and Lovell's manipulative correction:. This procedure involves correcting abnormalities in the following order: adduction of the forefoot, inversion at the subtalar joint, varus at the heel, and equines at the ankle. The procedure begins with longitudinal traction given to the foot, which stretches the foot. Over the head of the talus, a thumb is positioned laterally in the sinus tarsi. The index finger is softly pressed against the head of the talus. After the talonavicular joint has been minimized, a slipper cast is applied. The foot is molded on Plexiglas as the cast dries, with the heel pushed out of varus and the foot flattened to prevent cavus. As the slipper cast dries, you can correct forefoot adduction by abducting the forefoot on the hindfoot. A finger is positioned laterally across the distal end of the calcaneus (calcaneocuboidal joint) to act as a fulcrum during this procedure. From beneath the talus, this slipper cast is used to externally rotate the calcaneus and forefoot as a unit. After that, the cast is extended to the thigh and the foot is rotated externally. Because attempting to cure equinus before correcting the other deformities results in a rocker-bottom deformity, There is no attempt to correct equinus until the forefoot adduction and heel varus are corrected. When equinus could not be repaired after the forefoot adduction and heel varus were corrected, Kite and Lovell recommended wedging the cast.

Kite's errors: kites considered that the forefoot is in absolute adduction and emphasized that lateral deviation (abduction) of the forefoot by putting pressure on calcaneocuboid joint laterally holding the heel will correct adduction deformity (kites error- this prevented abduction of calcaneum which is in adduction). However, the entire foot is in adduction, with the forefoot adducted more than the hindfoot. Also,heel varus does not correct by everting calcaneum- he did not realize that calcaneum will not Evert if not laterally rotated

2. MATERIALS AND METHODS

The Prospective Study was conducted in the Department of Orthopaedics of Hind Institute of Medical Sciences, Safedabad, Barabanki, Uttar Pradesh, India. from 1st July 2020 to 30 June 2021. 39 patients with total 50 clubfeet who met the inclusion criteria were included: Age less than one year, unilateral or bilateral idiopathic CTEV, patients of either sex, and parents of the child giving consent to take part in the study. Age more than one year, earlier treated with plaster cast application or any other method, earlier operated for clubfoot, atypical, syndromic or secondary clubfoot were excluded from the study. The convenience and purposive sampling techniques done for collecting sample units, 25 patients were treated

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with once weekly casting and 25 patients were treated with twice weekly casting on fixed days. The cases were treated on an out patient basis. All cases were clinically assessed using Pirani scoring system at initial presentation and subsequent visits. Ponseti method of casting was followed in both Conventional and Accelerated Ponseti groups.

2.1 PONSETI METHOD OF CORRECTION

A thorough general examination of the child was done so as to detect any associated congenital anomalies. A complete clinical assessment of all feet made precast and postcast. Parents were educated about the precautions to be observed for children with casts. The aim of treatment was to achieve a functional, pliable, gentle manipulation of foot for at least one minute was done. Before application of cast, Cavus was first corrected by supinating the forefoot, to bring it in line with the hindfoot, and dorsiflexion of the first metatarsal. The cast was applied in two stages: first, a short leg cast was applied to just below the knee and then it was extended above upto groin to convert it into toe-to-groin cast. The knee was held in 90 degree of flexion. Gentle moulding was done. The toes were exposed to look for any signs of ischemia. In next subsequent visits, manipulation and casting was continued to abduct the foot gradually with the lateral part of head of talus as fulcrum. We used Pirani score proposed by Dr. Shafique Pirani, Clubfoot Clinic of Royal Columbian Hospital, Canada, for the assessment of initial severity and progress of treatment. This score is easily done at presentation and at each plaster change and has shown good interobserver variability. The score is based on observation of six parameters each having score 0, 0.5, or 1. A child's total score can be between 0 and 6. Pirani score at final follow‐up was used to assess the success of treatment in both groups with results being graded as excellent (Pirani score <1), good (score 1–2), and poor (score >2). When hind foot score was one or more, mid foot score of less than one and lateral part of head of talus not palpable, decision to perform percutaneous tenotomy was taken. 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.[7]

Dennis Brown abduction brace was used in all patients after the correction of deformity. For unilateral cases, the brace was set at 60°–70° of external rotation and 30°–40° of external rotation on the normal side. In bilateral cases, it was set at 70° of external rotation on each side. These children were followed up at 2 weeks to troubleshoot compliance issues, every month till 3 months and then every 3 months till maximum possible time, but not <6 months. The brace was worn for 23 hours a day for first 3 months after casting and then during night and nap time for 12 hours in a day for 3 years. Statistical analysis was done to compare: age and sex distribution, laterality of foot, initial and final Pirani score, number of casts required and treatment time till tenotomy or correction of equinus without tenotomy, rate of tenotomy and relapse of deformity in the Conventional and Accelerated Ponseti groups.

3. RESULTS

A total of 39 cases (50 feet's) cases were assigned randomly to two study methods conventional and accelerated. So total of 25 feet's were distributed in conventional groups and the rest of 25 feet's were distributed to an accelerated group using the block randomization method. Out of 39 cases, the majority 23 (59%) were males and the rest 16 (41%) were females. Hence the approx. female – male ratio was 1 : 1.4. the majority 20 (51.3%) cases had laterality of the right side while 8 (20.5%) had laterality of the left side. Rest 11 (28.2%) had a bilateral type of laterality. Out of 39 cases, 3 cases were not observed after tenotomy due to loss to follow-up. The mean age of cases of the conventional method was 3.74±2.13 months while the mean age of the accelerated method was 3.20±1.61 months. No significant difference was found in mean ages between the two groups (p=0.206). The mean Pirani score difference between the first and last cast of the conventional method was 5.00±0.00 while the Pirani score difference of the accelerated method was 4.96±0.14. No significant difference was found in the mean Pirani score difference between the two groups (p=0.136). In all these cases, the mean Pirani scores of the conventional method were significantly less than the accelerated method. Mean Pirani score was 0.00±0.00 after 3 wks of tenotomy and after 3 months and 6 months of using DB splint. The mean total number of casts of the conventional method was 6.58±0.89 while the total number of casts of the

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accelerated method was 9.90±0.63. So the mean total number of casts in the conventional method was found to be significantly less than the accelerated method (p<0.001). The mean total duration from 1st cast to tenotomy of the conventional method was 39.05±6.23 days while the mean total duration from 1st cast to tenotomy of the accelerated method was 26.70±1.90 days. So the mean total duration from 1st cast to tenotomy in the conventional method was found to be significantly more than the accelerated method (p<0.001). Delay in the cast was observed in 2 (10.5%) patients of the conventional method and 1 (5%) patient of the accelerated method. So delay in the cast was found in total 3 (7.7%) patients. No significant difference was found in a proportion of delay in cast between the two methods (p=0.517). Slippage of the cast was observed in 1 (5.3%) patient of the conventional method and 1 (5%) patient of the accelerated method. So slippage of the cast was found in a total 2 (5.1%) patients. No significant difference was found in a proportion of slippage of the cast between the two methods (p=0.970).

4. DISCUSSION

The Ponseti method, which highlights manipulation of the foot with serial casting and tenotomy of the tendo Achillis, is presently the method of choice for conservative treatment of clubfoot as has already been proven by many studies.[38] The conventional Ponseti method involves serial plaster changes at weekly intervals. In a country like India where parents are required to travel long distances to bring their children for corrective casting, there are several financial and social issues.[66] Many of these children are not capable to complete their treatment and are lost to follow‐up which is one of the most significant reasons for the failure of treatment. Few previous studies have assessed corrective casting two or three times a week instead of once a week with the patient admitted to the hospital.[5] This method has noticeable advantages such as the parents do not need to travel again and again, and the complete treatment duration is shortened. With this context, we conducted this study to compare the efficacy of the accelerated Ponseti method with the conventional method and effect of initial pirani scoring on final outcome were assessed.

Ahirwar R et al. revealed through their study that males were twice (65%) likely affected and (53.5%) clubfoot cases had both feet affected [67].

Vaishy AK et al. also observed that the male and female ratio was 2.9:1 with 149 males and 51 females [68].

Pulak S et al. also observed 80.0% males and 20.0% females in her study [69].

Kumar R et al. observed through his study that among 35 children, 22 (62.86%) were male and 13 (37.14%) were female [70].

In our study Out of 39 cases, the majority of 20 (51.3%) cases had laterality of the right side while 8 (20.5%) had laterality of the left side. Rest 11 (28.2%) had a bilateral type of laterality. So the overall cases under study were 50 Feet (11 Bilateral Sides + 8 Left side + 20 Right side) which were randomly assigned to two treatment groups conventional and accelerated.

Harnett et al. also observed that the Pirani score before treatment initial median Pirani score was 5.5 (95% confidence interval 4.5 to 6.0) in the accelerated group and 5.0 (95% confidence interval 4.0 to 5.0) in the standard control group. The scores decreased by an average of 4.5 in the accelerated group and 4.0 in the control group. There was no significant difference in the final Pirani score between the two groups (chi-squared test, p = 0.308) [35].

Elgohary HS et al. also observed that Pirani score before treatment ranged from 4 to 6 in both the traditional Ponseti and the accelerated Ponseti groups with mean values of 5.17 ± 0.62 and 5.13 ± 0.61, respectively (P = 0.75), whereas the final Pirani score ranged from 0 to 1 in both groups, with mean values of 0.49 ± 0.42 and 0.52 ± 0.38, respectively (P = 0.89) [27].

In our study Before the first cast, the mean Pirani score of the conventional group was 6.00±0.00, which was reduced to 5.20±0.25 after 1st cast and this reduction was statistically significant (p<0.001), then it was further reduced to 4.70±0.25 after 2ndcast and this reduction was statistically significant (p<0.001) After 3rd cast the mean Pirani score was 4.16±0.31 with a statistically significant reduction (p<0.001). Statistically, significant reduction too observed after the 4th cast and onwards. Most of the cases completed their treatment after the 6th cast, so only 11 cases remain for treatment after the 7th cast with

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overall mean Pirani score of 1.41±0.58 and 4 cases remain after the 8th cast with the mean Pirani score of 1.00±0.00. Whereas; before the first cast, the mean Pirani score of the accelerated group was 6.00±0.00, which was reduced to 5.46±0.25 after 1st cast and this reduction was statistically significant ($p<0.001$), then it was further reduced to 5.04±0.25 after 2nd cast and this reduction. was statistically significant ($p<0.001$) After 3rd cast the mean Pirani score was 4.52±0.27 with a statistically significant reduction ($p<0.001$). Statistically, significant reduction too observed after 4th cast and onwards. Most of the cases completed their treatment after the 9th cast, so only 18 cases remain for treatment after the 10th cast with overall mean Pirani score of 1.08±0.19 and 5 cases remain after the 11th cast with a mean Pirani score of 1.00±0.00. The mean Pirani score difference between the first and last cast of the conventional method was 5.00±0.00 while the Pirani score difference of the accelerated method was 4.96±0.14. No significant difference was found in a mean Pirani score difference between the two groups ($p=0.136$).

Islam MS et al. observed that the average number of casts required to correct all the deformities was 6.3 ± 1.2 in the standard group and 6.1 ± 1.4 in the accelerated group ($p = 0.45$). The average time spent in cast was 58.2 ± 8.3 days in the standard group and 39.5 ± 5.2 days in the accelerated group ($p < 0.001$) [18]. Pulak et al. observed that The number of casts per feet in her study was three to ten (average 4.9) [69]. In a series by Ponseti et al, the number of cast per feet was five to ten (average 7.6) [69]. In another study by Laaveg et al, the mean number of casts during their treatment was seven [77].

Morcuende et al. reported that 90.0% of the patients required five or fewer casts[36], In our study, The mean total duration from 1st cast to tenotomy of the conventional method was 39.05±6.23 days while the mean total duration from 1st cast to tenotomy of the accelerated method was 26.70±1.90 days. So the mean total duration from 1st cast to tenotomy in the conventional method was found to be significantly more than the accelerated method ($p<0.001$). Morcuende et al. performed serial manipulations and casting every 3–4 days and found that the children were uncomfortable and the feet developed oedema [36]. They concluded that changing the casts every 5 days is probably the fastest way to obtain a successful correction with minimal side effects. The mean age of cases of the conventional method was 3.74±2.13 months while the mean age of the accelerated method was 3.20±1.61 months. No significant difference was found in mean ages between the two groups ($p=0.206$).

5. CONCLUSION

Standard Ponseti method has been accepted as the gold standard for correction of CTEV. Accelerated Ponseti method of correction has been started recently. In developing country like India, this technique is a very safe, easy, result-oriented, and economical cheaper method of clubfoot management. Parents who have to travel a long distance for treatment of the child will get benefited by shortening the duration of treatment by the accelerated method, and it will also help to improve compliance among parents. The maintenance of plaster will be of lesser concern for the parents. The twice weekly casting will also reduce the time of immobilized foot in plaster. There will be lesser chance of slippage of plaster, and advantageous for the baby in terms of reduced skin sore issues, easier bathing, normal motor development and possibly lessens the risk of osteopenia. The Limitations of our study were limited number of patients and short duration of follow‐up. We conclude that the Accelerated ponseti method is equally effective as Standard Ponseti method in treatment of idiopathic CTEV with the benefit of reduction in treatment time. The study shows that the number of patient lost to follow up as compare to the conventional method reduced significantly, because of the proper cancelling and short treatment time. Proper motivation and persuading the parents to accept long-term brace treatment helps maintain the correction over a longer period time and prevents relapse.

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