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Original Article

ROLE OF ABDUCTOR HALLUCIS RELEASE WITH PONSETI METHOD FOR TREATING FOREFOOT ADDUCTION IN IDIOPATHIC CONGENITAL TALIPES EQUINOVARUS

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Abstract

***Objectives**: The study's aim is to assess the benefit of abductor hallucis tenotomy (AHT) in idiopathic talipes equinovarus as a treatment of adduction deformity of forefoot during serial casting. **Methods**: A study of fifty cases (50) children (72 feet) history of idiopathic clubfeet had been treated prospectively in (Abo El Reesh pediatric hospital-Kasr Al Ainy) between February 2017 and August 2018 (18 months). Fifty 50 cases (72 feet) managed with abductor hallucis tenotomy added to serial casting for treating forefoot adduction with Ponseti method. **Results and conclusion**: 50 cases (72 feet) managed abductor hallucis tenotomy added to Ponseti and, followed up 9 months. 97% success rate, mean Pirani score was 0.4, the abductor hallucis tenotomy reduces the length and number of casts, as well as the expense and likelihood of leg atrophy and relapse.*

Keywords: *Clubfoot, Abductor hallucis, Ponseti, forefoot adduction, Abo El Reesh pediatric hospital- Kasr Al Ainy, Sohag university hospital.*

1. Introduction

The prevalence of congenital talipes equinovarus is around 1.24 per 1000 live births, making it one of the most frequent congenital orthopaedic anomalies [1]. Bilateral cases account for 50% of all cases, and boys account for 70% of all cases [2]. The true etiology of idiopathic type of congenital talipes equinovarus is unknown but there are Several theories that proposed regarding the cause of clubfoot to: anomalies in development of leg muscle [3], genetic defect in connective tissue [4], The anterior portion of the talus has a cartilaginous anlage defect [5], compression inside the uterus [6], talonavicular joint dislocation [7], peroneal muscle innervation anomalies [8], myofibrosis [9], Abnormal insertion of the tendon [10], development is halted [11], tight deltoid ligament [12]. The aim of congenital clubfoot treatment is to achieve a pain-free, functional, normal-looking, plantigrade foot with good mobility that does not require special foot-wear [1,13]. Nonoperative treatment for congenital talipes equinovarus begins in the first few

days of life, and few researchers have identified their casting technique in precision. Kite [14], Shaw [15], Vessely [16], Ikeda et al [17], Bensahel et al [18]. Serial weekly long leg casting, preceded by manipulations to gradually correct deformity with counter-pressure on the taler neck till forefoot abduction is obtained 60 to 70 degrees, was identified by Ponseti. If any residual equinus still presents after 4-8 weeks of casting and the foot has been abducted to 60 degrees, an Achilles tenotomy should be conducted and the foot should be casted in maximal dorsiflexion. After removal of last cast orthotic talipes splints used in all children [19,20]. The ponseti technique success rate was 85%-90% of cases, while other methods of conservation, have success rates that ranges from 11% to 58% [1]. Relapse patterns following ponseti were categorized into five categories by Bhaskar A and Patni P: Reduced ankle dorsiflexion from 15 ° to neutral in grade IA. Grade IB indicates dynamic forefoot adduction or supination, Grade IIA indicates rigid equinus, Grade IIB indicates rigid adduction of the forefoot/midfoot complex, and Grade III indicates a combination of two or more abnormalities: Fixed equinus, varus and forefoot adduction [21]. The aim of this work is assessing the results of Ponseti method with abductor hallucis tenotomy (AHT) in idiopathic talipes equinovarus as a treatment of forefoot adduction deformity with serial casting

2. Materials and Methods

Patients included in the study are Idiopathic talipes equinovarus with forefoot adduction, relapsing idiopathic talipes equinovarus after Ponseti method, Infants age above three months and less than two years old. With exclusion of patients with secondary talipes equinovarus, postural talipes equinovarus, previously extensive soft tissue surgery and Infants age less than three months old or children more than two years old. Study of 50 cases (72 feet) history of idiopathic clubfeet had been treated prospectively in multicenters (Abo El Reesh pediatric hospital and Sohag university hospital) between Febr. 2017 and Aug. 2018 (18 months). All cases were managed with abductor hallucis tenotomy added to serial casting for treating forefoot adduction with Ponseti method. Aged from 3 months up to 2 years. Each clubfoot scoring with Pirani system was rated [22]. There are six various com-ponents of the clubfoot that could be recorded. The hindfoot components are the posterior crease, empty heel, and rigid equinus, while the midfoot components are the medial crease, curvature of the lateral border of the foot, and the location of the talus head. A cumulative score ranging from 0 to 6, with 6 being the most extreme deformity. For achieving our aim, all feet were assessed by the same orthopedic surgeon according to Pirani scoring system at the time of presentation. In comparison to a normal foot, there are six clinical symptoms of clubfoot: Three indicators assess midfoot contracture and three indicators assess hind-foot contracture. Each sign is given a rating of 0 for no abnormality, 0.5 for moderate abnormality, and 1 for extreme abnormality. A higher score means that the deformity is more extreme. Throughout treatment and follow-up, scoring was done at each visit Before applying the cast, gentle manipulation of the foot is done, followed by above knee plaster casts with the knee flexed 90 degrees. The casts have been changed every week. Clubfeet was managed with the Ponseti technique and doing abductor hallucis tenotomy (AHT) for forefoot adduction during serial casting. Seventy-two feet

(65 relapsed after Ponseti, 2 relapsed postsurgical release and 5 neglected). Under general anesthesia (GA), it was performed in the operation room. Foot, leg, and knee, after preparation and draping. A small 1/2 cm incision is made on the medial aspect of the base of the big toe the tendenious portion of the muscle is identified, and the muscle is sharply dissected, while an assistant holds the foot abducted, (defined and hanged on right-angle clamp then cut) after the tenotomy skin closure was not indicated in most cases, just the incision was sealed with a small piece of sterile gauze and a sterilized soft roll and casting for two weeks. Then completing the same sequence of casting series to correct other deformity components as prescribed by Ponseti. All patients were routinely scheduled follow up at clinic monthly for follow up for at least 9 months. Post AHT protocol of follow up is: patient stays for six hours for foot assessment, above knee cast with foot abduction from 60 to 70 degrees for two weeks, revaluation of foot edema on the second day. After 2 weeks, the cast is started changing, and the serial casting sequence is completed to correct other deformity components. Following the removal of the last cast, the Dennis-Brown splint was added. With follow-up, the infected foot is set in 70 degrees external rotation, and then progressively reduced. For the first three months following the removal of the last cast, the parents have been informed that the splint would be worn for (22-24 h)/day. Following that, the child did wear the splint for 12 hours at night until the age of 2-4 years. Following the removal of the last cast, all patients were followed up on for an average of nine months. Every month, supervisory follow-up was carried out. The findings were reported and clinically assessed. The hindfoot and forefoot were assessed clinically. Based on the Pirani et al criterion [22], the findings were divided into three categories: good, bad, and failed. When the Pirani score reached 1.5, it was deemed good when it reached 1.5 to <5 , it was deemed bad and when it reached 5 to 6, it was deemed failed.

3. Results

The overall sample population had an average age of 12.5 months. At the first presentation visit, the mean total Pirani score was 5.4, while the final score at the conclusion of the last casting was 0.46 and 0.67 at the end follow up after nine months. Mean Midfoot score (MFCs) was 2.5 at first presentation, 0.168 after first cast removal. The P-value in the final Pirani score is <0.001 at the conclusion of the last casting and end of follow up for at least 9 months, also MFCs after first casting in comparing both groups, tab. (1). That shows the differences between Pirani score in Immediate MFCs was 0.0 in group of patients, final total Pirani from 0.0-0.5 and end follow up Pirani score ranged from 0.0-0.5 in group of patients. Comparing Pirani score between at first visit with final and end follow up also MFCs at first visit and immediately after first cast removal.

Table (1) Patients group.

Variables	Group (No. = 72)	P-value
	Mean ± SD/Count (%)	
Male gender	39 (54.2%)	0.195
Right side	33 (45.8%)	0.349
Age in months	12.67 ± 5.958	0.807
First visit total pirani score	5.424 ±0.5481	0.668
First visit MFCs	2.583 ± 0.4111	0.475
Immediate MFCs	0.056 ± 0.1582	<0.001**
Final total pirani	0.292 ± 0.2751	<0.001**
End follow up total pirani	0.368 ± 0.3249	<0.001**

P. value differences were 0.004 at final cast removal, < 0.001 at end of follow up and 0.001 MFCs, tab. (2). Mean Pirani score changes was -5.1319 at final Pirani

and first visit Pirani, -5.0556 at end follow up Pirani and first visit Pirani and -2.5278 post AHT MFCs and first visit MFCs in. was -4.8000 at final Pirani and first visit Pirani, -4.4308 at end follow up Pirani and first visit Pirani and -2.2077 after cast removal MFCs and first visit MFCs. This study success rate was 97.3% good results and 2.7% relapsed in patients managed with conventional Ponseti and AHT (abductor hallucis tenotomy), owing to poor parental adherence to regular, close follow up and splinting.

Table (2) Changes in Pirani score.

Variable	Patients	P. value
	Mean ± SD	
Post AHT or first cast MFCs and First visit MFCs	-2.5278 ± 0.41016	0.001**
Final Pirani and First Visit Pirani	-5.1319 ± 0.56912	0.004**
End FU Pirani and First visit Pirani	-5.0556 ± 0.59075	< 0.001**

5. Discussion

Congenital clubfoot affects one to three out of every thousand live births. It could be unilateral or bilateral. Bilateral deformities affect 50% of patients [2]. The preliminary therapy of idiopathic congenital clubfoot starts with sequential and soft manipulation to overcome and stretch the contractures, followed by sequential casting (Ponseti method), casting, or strapping to preserve the corrected position achieved by stretching, according to most orthopedic surgeons [23,24]. Operative therapy must only be regarded when manipulation and a plaster cast have started to fail to correct the problem within a pre-scribed time frame, which must not exceed 3 months. Long term results of the conventional Ponseti technique have been confirmed to be satisfactory in 85-90% of feet when applied correctly. Other nonsurgical therapy manipulation and casting methods, such as Kite's and French methods had a lower success rate and were linked with more problems, like cavus foot deformity, wrong repair with breakage of mid-tarsal joints and rocker-bottom deformity, talar dome flattening, ulcers from cast strain, and fracturing caused by undue force throughout manipulations [25, 26]. The rate of success to obtain a full correction in this study was 97.3% and 2.7% relapsed in patients managed with Ponseti and AHT (abductor hallucis tenotomy), owing to weak parent adherence with routine follow- up and splinting. This is consistent with the findings of those who used the same approach, Abdullah el SA [27], registered 30 children (45 feet) with idiopathic clubfoot, ranging in age from one day to 6 months. After serial casting, patients were handled utilizing the conventional Ponseti method with abductor hallucis tenotomy; 43/45 feet became good (95 %), and 2/45 feet became bad (5%), on comparing this study with Abdullah el SA, study included more patients number also it is randomized controlled study comparing Ponseti method with or without abductor hallucis tenotomy as a therapy for chronic forefoot adduction in idiopathic clubfoot by using the Ponseti serial casting process. Michael and Matthew confirmed that the Ponseti method was used in the treatment of 34 infants (57 clubfeet), and that 54 of the 57 (95 %) clubfeet were effectively corrected, while only two patients were ineffective (5 %). Due to noncompliance with the Dennis-Browne splint, three clubfeet needed surgery [27]. Herzenberg and colleagues have commented on their findings in the first 27 patients treated with the Ponseti procedure, finding a 97 % success rate and just one failure (3%) [28]. In a short-term follow-up, Lehman and colleagues had a 92 % rate of success in their initial series of 50 feet [29]. At their institution, Segev and colleagues recorded a 94 % success rate for manipulative therapy that use the Ponseti method, relative to just 43 % for the other group managed with the modified Kite method [30]. Elshenawy and associates [31] prospectively evaluated the Ponseti method's findings in the therapy

of congenital idiopathic clubfoot, assessing the factors which affected the findings and reporting any complications. Correction has been achieved in 43 cases (95.5%) with two to ten casts and limited complications. To summarize, the Ponseti technique is an effective and safe remedy for clubfeet that significantly reduces the requirement for comprehensive surgery. In this research, the number of casts changed weekly on average between four and six times in children managed with (AHT with Ponseti), after that TAT tenotomy was done and the feet were cast in a dorsiflexion position for one month. Abductor hallucis tenotomy, which permitted appropriate forefoot abduction, was responsible for the lower cast number prior to tendon Achilles tenotomy (TAT). This abduction enabled dorsiflexion of the foot to be done safely without smashing the talus among the calcaneus and tibia. Ponseti and Smoley [31] indicated that casts lasted 5-12 weeks (average, 9.5 weeks). The average length was 8.6 weeks in another research by Regarding tendon achilles tenotomy (TAT), Scher and colleagues [33] conducted a research with the aim of predicting the requirement for tenotomy at the start of the Ponseti therapy. The Pirani scoring systems were used to rate 50 clubfeet (35 patients). Tenotomies were needed in 36 of the 50 feet (72%). Tenotomy patients received a higher number of casts. In a study of 27 feet with Pirani ratings of around 5.0, (85.2 %) needed a tenotomy and (14.8 %) did not follow to the removing of the last cast. According to this, there was no significant difference among those who had a tenotomy and those who did not. In this study of 72 feet TAT done in most cases in 68 feet (94%) and only 8 feet (6%) not required, all feet were fairly well corrected at the conclusion of casting, regardless of if a tenotomy was required (TAT). there was no obvious leg muscle atrophy or disparity in leg/foot size or length, which was due to the AHT method, which reduced the period of the casts needed to correct the forefoot adduction. In this research, 3 feet (4%) infected wound of released abductor hallucis due to bad hygiene and managed with daily dressing and local debridement over a week then recasting series continued. 2 feet (2.7%) relapsed during follow up in mild forefoot adduction, varus and equinus, this was partly attributable to the brace being applied inappropriately at homes as parents removed it for bathing, and partly attributable to a shortage of frequent follow-up and non-compliance with the brace, managed by recasting in two casts with weekly interval. 2 casts (2.7%) slipped managed with recasting longer casts. Stringent guidance for brace use, motivation from committed personnel, and more regular follow-up have resulted in improved patient compliance with the brace and initial detection of any relapse. Morcuende and colleagues [34] found that compliant patients had a 6% relapse rate and non-compliant patients had an 80% relapse rate. The root cause of the compliant group's relapse was foot muscle imbalance and ligament stiffness. Cavus as well as forefoot adduction were initially seen as a result of brace non-compliance, however with routine follow-up and stringent brace compliance instructions, such relapse modes were lessened. During serial casting, two feet developed superficial cast ulcers, which were managed with a betadine dressing underneath the cast a patient with skin breakdown due to cast complications was handled by Morcuende and associates [34] by delaying the cast for a few days and using a topical antibiotics. In concluding, this study yielded satisfactory results in treating CTEV using

the Ponseti method with a very low rate of complications in both groups and a superior functional outcome when adding abductor hallucis tenotomy (AHT), mostly due to decreased number of necessary casting that helps in early regaining the normal activity and avoiding atrophy of the calf muscles. This technique, although new, has proven to be simple, easy, reliable and relatively inexpensive.

6. Conclusion

While initial clubfoot deformity correction could be reliably accomplished, the real challenge in successfully using the Ponseti technique is avoiding relapse and managing possible complications during and after follow up. To avoid a recurrence, regular follow-up and helpful parents are critical. The Ponseti method plus abductor hallucis tenotomy (AHT) reduces the period of casts needed to correct forefoot adduction, as well as the costs and risk of foot and leg muscle atrophy. The key to maintaining initial foot correction is to educate and encourage parents to use the post-corrective brace properly. Finally it is recommended from this study that Abductor hallucis tenotomy (AHT) with Ponseti method is better in relapsed, neglected and persistent forefoot adduction in idiopathic clubfeet from age of three months up to two years old, while conventional Ponseti method is fairly sufficient in younger than 3 months infants.

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