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Research Article

ROLE OF JOSHI'S EXTERNAL STABILIZATION SYSTEM (JESS) IN RECURRENT CTEV ASSOCIATED WITH IRREGULAR FOLLOW-UP

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Abstract: ***Introduction:*** Congenital talipes equinovarus (clubfoot) affects nearly 1 out of every 1000 newborns, with the majority of cases developing without a definite known cause. Abnormal tightening and contracture of the surrounding soft tissues contribute significantly to the deformity and make correction of the affected bones and joint alignment more difficult.**Material and Method:** The present study included children aged between one and two years who presented with recurrent clubfoot deformity. Recurrence was mainly observed in children who had discontinued treatment after achieving initial correction through serial casting, with or without tendo Achillis tenotomy. The objective of this study was to evaluate the effectiveness of the JESS fixator as a treatment option that could help achieve deformity correction while avoiding extensive soft tissue release procedures and corrective osteotomies.**Results:** The treatment goal was to achieve a Pirani score below 4 along with satisfactory clinical correction of the deformity. Once adequate improvement was obtained, the patients were shifted back to serial casting to maintain the corrected position.**Conclusion:** The JESS fixator helps achieve deformity correction without the need for extensive soft tissue release or bony surgical procedures, while also maintaining the natural anatomy of the foot

Keywords: Recurrent CTEV, JESS Fixator, Deformity Correction.

INTRODUCTION

Congenital talipes equinovarus (CTEV), commonly known as clubfoot, occurs in nearly 1 out of every 1000 live births and usually develops sporadically [1]. Although several theories have been proposed to explain its origin, the exact reason for the varying severity seen among affected children is still unclear. One theory suggests that a primary defect in the talus bone causes persistent plantar flexion and inversion of the foot, eventually leading to secondary soft tissue and musculotendinous changes. Another theory quotes that the deformity mainly to abnormalities in the neuromuscular structures, which later produce secondary skeletal deformities [2]. Children with clubfoot often show underdevelopment of the anterior tibial artery and wasting of calf muscles. Alterations in the distribution of type I and type II muscle fibers have also been reported. In many cases, the affected foot is smaller in both length and width compared to the normal foot. Proper management of clubfoot requires understanding of the underlying pathological changes from the beginning of treatment planning. The deformity typically includes equinus, varus, adduction, and cavus components, though the severity may vary between patients. Internal tibial torsion is commonly associated with the condition, and pathological involvement may extend to multiple joints of the midfoot and hindfoot [3].

Soft tissue contractures play a major role in maintaining the deformity and resisting correction. Several ligaments, tendon sheaths, retinacula, and joint capsules around the talocalcaneal, talonavicular, and calcaneocuboid joints contribute to the abnormal positioning of the foot. In long-standing untreated cases, adaptive bony deformities may develop, making correction through manipulation increasingly difficult. Some adults with untreated

clubfoot may even develop joint fusion or degenerative changes due to persistent contractures and abnormal weight-bearing [4,5].

Assessment of clubfoot relies mainly on careful clinical examination along with radiographic evaluation. Standardized radiographic techniques are important for accurate assessment and follow-up. Commonly used clinical grading systems include the Pirani and Dimeglio classifications, both of which are based primarily on physical examination findings. The Pirani scoring system evaluates several clinical parameters, with higher scores indicating more severe deformity. The Dimeglio system assesses reducibility of deformity components such as equinus, varus, derotation, and forefoot adduction using gentle manipulation [6]. Studies comparing these systems have shown good reliability between observers after adequate training.

The first-line treatment for clubfoot is generally nonoperative. Conservative approaches include splinting, taping, manipulation, and serial casting. Treatment usually begins early in life with regular manipulation and casting sessions until satisfactory clinical and radiological correction is achieved [7]. The order of correction is important: forefoot adduction is corrected first, followed by heel varus, and finally hindfoot equinus. Following this sequence helps prevent development of rocker-bottom deformity. Reported success rates of serial casting vary widely in the literature. Among conservative methods, the Ponseti technique has shown excellent outcomes, with successful correction reported in nearly 90–98% of cases. This method can also be effective in older children and in those who failed earlier nonsurgical treatment. In many patients, additional procedures such as percutaneous Achilles tenotomy or anterior tibial tendon transfer may be required to obtain full correction. Studies have shown that children with higher Pirani or Dimeglio scores are more likely to need tenotomy.

The Ponseti protocol includes both treatment and maintenance phases. The treatment phase involves weekly gentle manipulation and casting, ideally beginning within the first week of life. After correction is achieved, the maintenance phase involves the use of a foot abduction brace to maintain the corrected position. The brace is usually worn almost continuously during the first few months and later during sleep for several years to minimize recurrence.

Functional distraction using the Joshi's External Stabilization System (JESS) has emerged as another option for neglected or resistant clubfoot. Differential distraction with external fixation has been reported to provide effective correction while being relatively patient friendly [8]. However, forefoot adduction continues to remain one of the more challenging deformities to correct completely. The Ponseti method offers several advantages over surgical correction, including better functional outcomes and improved patient and parent satisfaction. If recurrent or untreated clubfoot is neglected, it may result in long-term disability and permanent deformity. Therefore, regular follow-up and parental counselling are extremely important throughout the treatment process. Delayed correction, especially after the child starts weight-bearing on an uncorrected foot, can lead to progressive bony deformities and incongruent joint surfaces, making treatment more difficult.

MATERIALS AND METHODS

This study was performed at Department of Orthopaedics, Sree Mookambika Institute of Medical Sciences, Kanyakumari from Feb 2024 - May 2025. The study population comprised of children presenting with clubfoot at different ages from one year to two years of age group. The children presented with recurrent deformity as a result of discontinued treatment after the correction with tenotomy for tendo Achilles or with serial castings alone. This study was performed to evaluate the efficacy JESS fixator an alternative and preventative measure for ostetomies and soft tissue release.

Participants were enrolled in the study based on the following inclusion criteria: (a) children aged between one and two years; (b) a documented history of repeated manipulative correction procedures for the deformity; (c) initiation of independent walking prior to presentation; and (d) persistence of both clinical and radiographic deformities despite undergoing three corrective casting sessions following recurrence. Additionally, only patients with a Pirani score of 6 or higher were considered eligible for inclusion.

The exclusion criteria comprised: (a) deformities associated with other congenital anomalies; (b) a prior history of posteromedial soft tissue release surgery; and (c) the presence of pre-existing callosities accompanied by fissures or suspected infection.

RESULTS

The study included a total of 30 children fulfilling the above inclusion criteria with age distribution and severity score presented in Table 1 and 2 respectively. Among the 30 children included in the study, the majority belonged to the 13–15 months age group (60.0%), followed by 12 months (20.0%). Children aged 16–18 months and 19–24 months each constituted 10.0% of the study population. This indicates that recurrence of CTEV was more commonly observed among children aged 13–15 months. Notably, most children had a Pirani score of 9 (56.7%), indicating severe deformity at presentation. Children with scores 8 and 10 each accounted for 16.7%, while 10.0% had a score of 7. This suggests that the majority of recurrent CTEV cases presented with high severity.

Table 1: Age distribution of study participants (30 cases)

Age	Children (n)
12 months	6
13-15 months	18
16-18 months	3
19-24 months	3
Total	30

Table 2: **Baseline Pirani Severity Score in 30 participants**

Pirani Score	Children (n)
Score 7	3
Score 8	5
Score 9	17
Score 10	5
Total	**30**

The distribution patients according to previous treatment is presented in Table 3. 63.3% had previously received manipulation and casting alone, whereas 36.7% underwent manipulation and casting with tendo Achilles (TA) tenotomy. This indicates that manipulation and casting alone was the more commonly reported previous treatment among recurrent CTEV casesAll children underwent gentle corrective manipulation initially followed by serial casting, and their progress was monitored through changes in the Pirani score. The severity of deformity among the enrolled participants ranged from a minimum score of 7 to a maximum score of 10. Subsequently, the children were assessed for suitability for surgical intervention, and JESS (Joshi's External Stabilization System) fixators were applied under general anesthesia. The fixator was positioned at the maximum achievable corrected alignment while ensuring adequate distal perfusion, confirmed by the absence of delayed blanching in the toes.

A standardized JESS assembly consisting of separate distraction rod systems for the leg and foot was utilized. Kirschner wires were inserted through the region below the tibial tuberosity, the calcaneus, and the first, second, fourth, and fifth metatarsals. The dimensions of the distraction rods were selected carefully to permit gradual overcorrection of the deformity. During the first four postoperative days, patients were closely monitored for pin-tract complications and excessive edema that could arise secondary to procedural trauma.

Treatment	Children (n)
Manipulation and casting alone	19
Manipulation and casting with TA tenotomy	11
Total	**30**

Gradual distraction was carried out on the posterior and medial aspects at a rate of 1 mm per day, while compression on the lateral side was performed at a total rate of 1 mm over four days. During the first postoperative week, the children received oral cefuroxime along with NSAIDs, and regular pin-site dressings were performed. At weekly follow-up visits, the force dissipation rods were adjusted based on the amount of correction obtained. Caregivers were educated about the adjustment procedure and were regularly informed about the progress of treatment whenever modifications to the rods were made. Clinical as well as radiological assessments were performed every two weeks to monitor improvement.

The treatment goal was to reduce the Pirani score to below 4 along with satisfactory clinical correction of the deformity. Once this stage was reached, serial casting was restarted. The fixators were removed after adequate overcorrection had been achieved and maintained for a duration twice as long as the time taken to obtain the correction. Following fixator removal, above-knee casts were reapplied to preserve the corrected position and continued until complete healing of the pin sites. Treatment outcomes were assessed based on the degree of overcorrection achieved. Successful correction was defined by the ability of the plumb line to pass medial to the foot along with attainment of approximately 10–15° of dorsiflexion. These findings generally corresponded to Pirani scores below 4.

The duration required to achieve an overcorrected position varied between 5 and 8 weeks depending on the severity of the initial deformity. Patients presenting with an initial Pirani score of 7 achieved overcorrection within approximately 5 weeks, whereas those with a baseline score of 8 required nearly 6 weeks to reach the desired correction.

DISCUSSION

The present study evaluated 32 participants with a diagnosis of clubfoot deformity at a tertiary centre. The study population consisted mainly of children aged between one and two years presenting to the clinic documenting a history of repeated manipulative correction procedures for the deformity.

The majority of children in this study fell under 13 and 15 months of age, followed by those at 12 months. Similar findings were reported by Sharma and Upadhya (2025) where most children who missed regular follow-

up visits and later returned with recurrence were between 1 and 2 years of age. Moreover, they also found that JESS worked well in these children because it gradually corrected the deformity by slowly stretching the soft tissues, while also avoiding the need for major open surgery [9]. Similarly, Ahmed et al. (2025) studied 50 clubfeet in 33 children with relapsed CTEV under the age of two years and found the mean age at relapse presentation to be 12.5 ± 6.08 months [10], which aligns closely with the 12–15 month peak observed in our study.

The Pirani score which is recognized as the gold standard for measuring sever clubfoot deformity was used in this study. Most children presented with a score of 9, meaning that they has very severe deformity at the time of presentation. These high score was similarly presented by Kumar et al. (2024) who found that the severity of the deformity at presentation was the single most important factor affecting treatment outcomes and the risk of recurrence [11]. Furthermore, Tahririan et al. (2021) also found that in a group of 100 CTEV patients, those who developed recurrence had significantly higher initial Pirani scores [12]. With regard to treatment with JESS, studies have consistently reported that high Pirani scores can be effectively reduced with JESS application. Khan et al. (2023) in a prospective study reports the role of JESS in managing recurrent and neglected CTEV, reporting excellent results in 35.2% and good results in 47.05% of cases [13].

In this study, majority of children had previously received only manipulation and casting (without Achilles tenotomy), while only 36.7% had received manipulation and casting along with Achilles tendon tenotomy. The fact that the majority of children were treated without tenotomy is an important finding because tenotomy is a crucial step in proper CTEV correction. Rangasamy et al. (2022), in a systematic review of Achilles tenotomy outcomes, clearly stated that CTEV cases that underwent Achilles tenotomy had significantly better clinical outcomes compared to those managed with casting alone, with tenotomy being required in 80–90% of all clubfoot cases. This directly explains why the majority of children in the current study who were treated without tenotomy went on to develop severe recurrences requiring JESS.

CONCLUSION

In conclusion, the present study confirms that recurrent CTEV due to irregular follow-up tends to present in the 12–15 month age group with severe deformities (high Pirani scores), often in children who were previously treated without Achilles tenotomy. These findings are well supported by recent published literature. JESS is an appropriate and effective treatment choice for such cases, offering gradual correction without open surgery, which is especially important in young children with very rigid, recurrent deformities.

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