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Adapting Joshi External Stabilization System for Congenital Talipes Equinovarus Correction: A Practical Solution for Unavailable Distractor Sizes

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Abstract

Congenital talipes equinovarus is a complex foot deformity that is principally corrected by gradual manipulation. The Joshi external stabilization system (JESS) fixator uses this principle of gradual correction by ligamentotaxis. The principal component of the JESS system is the distractor applied at multiple planes to achieve soft-tissue stretching, enabling gradual correction of the deformity. As recommended, the size of the JESS should be at least 2/3rd of the limb to get maximum outcome. However, situations may arise where the exact size of the distractor is unavailable, posing a challenge to achieving optimal correction. This article describes a practical solution involving the use of an additional Z-rod or L-rod, allowing the application of a smaller size distractor. This adaptation ensures continued correction of the deformity, ultimately benefiting patients with optimal outcomes.

Keywords: Clubfoot, Joshi external stabilization system fixator, Distractor, Adaptation, Surgical tip, Children.

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Introduction

Congenital talipes equinovarus (CTEV) is a complex foot deformity that is principally corrected by gradual manipulation. The Ponseti technique of gradual correction by serial casting is a widely used method of correction in most cases of CTEV [1]. In neonates, the deformity can be corrected easily, but correcting late-presenting, neglected, and rigid clubfeet is challenging. Joshi external stabilization system (JESS), developed by Dr. B.B. Joshi, has gained prominence in resource-limited setups as an alternate, minimal invasive method of correcting these difficult cases [2]. The efficacy of JESS in treating challenging cases, including neglected, relapsed, and resistant ones, is well-established and supported by multiple studies [3, 4, 5]. It is employed widely in older children for the correction of CTEV.

JESS includes several components: K-wires, links, straight rods, Z-rods, L-rods, an Allen key, and a distractor (Fig. 1). The distractor is the principal element of JESS, which is used to achieve gradual correction of deformity by ligamentotaxis and soft-tissue lengthening. As recommended by Dr. Joshi [2], the size of the distractor should be at least the same size as the foot for the foot frame and at least 2/3rd of the size of the shin for the tibial frame. In practice, the exact size of the distractor may not be available, and the frame configuration could be suboptimal. The authors propose a surgical tip from their experience to overcome this disadvantage.

Surgical tip

The tibial hold of JESS is decided by the location of the tibial tuberosity, and any distal applications of the proximal K-wires endanger the neurovascular structures passing

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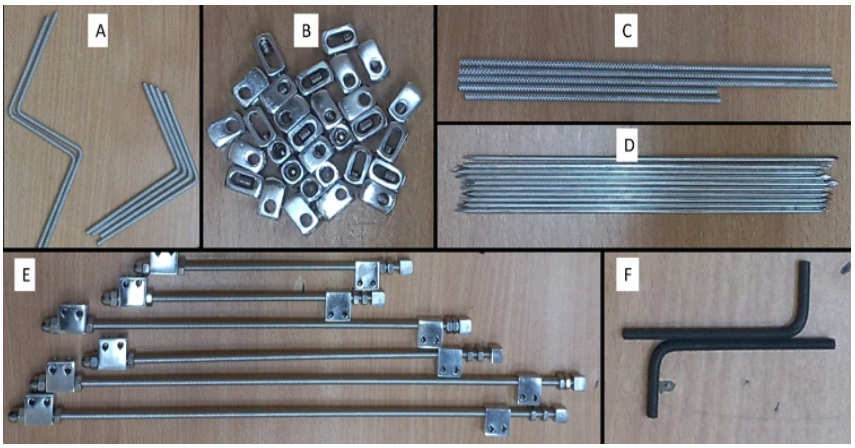

Figure 1: Components of a Joshi external stabilization system fixator; (a) L and Z Rods. (b) Links, (c) Straight rods, (d) K-wires, (e) Distractors, (f) Allen key.

through the mid-section of the leg, so the option remains either to use an appropriate size distractor or to opt for modification or adaptation as described by us in this article.

In situations where the exact size distractor is unavailable, a practical solution involves using an additional Z-rod or L-rod to achieve extension (Fig. 2). By applying these supplementary rods, the surgeon can create sufficient space to accommodate a smaller size distractor. This adaptation enables continued correction of the deformity, ensuring optimal outcomes for patients.

An extra Z-rod/L-rod is attached to the existing rod in the tibial frame with the help of joint links to create extension from the tibial hold (Fig. 3). Now, a horizontal rod is then linked to the extension, and a smaller-sized distractor can be comfortably placed.

Some surgeons prefer to use an additional long anterior rod to maintain the joint distracted anteriorly. In late-presenting cases, however, the long anterior rod required to connect the foot frame to the tibial frame may be too large and is generally not readily available. In such situations, joining two smaller rods using two link clamps provides the necessary length for anterior support (Fig. 4).

Benefits of this approach

The use of additional Z-rod or L-rod with a smaller size distractor offers several benefits, including:

1. Flexibility: This technique provides flexibility in situations where the exact size of the distractor is not readily available.
2. Continued correction: Using a smaller distractor with additional rods, surgeons can maintain the correction process, avoiding delays or compromises in treatment.
3. Multiple smaller rods can be linked using clamps to obtain a longer anterior support frame.

Discussion

The success of JESS correction depends not only on correct wire placement and frame geometry but also critically on the appropriate size and positioning of the distractor. As originally described by Joshi, the distractor length should be at least equal to the size of the foot for the foot frame and approximately two-thirds the length of the tibial segment for the tibial frame [2]. This ensures optimal working length, smooth distraction, and maintenance of mechanical alignment during correction. In many clinical setups – particularly in peripheral hospitals, outreach camps, and low-resource centers – the full range of JESS distractor sizes may not be available. This limitation could compel surgeons to either delay treatment, improvise suboptimal constructs, or abandon frame-based correction altogether. The technique described in this paper addresses this real-world constraint in a simple and reproducible manner by extending the tibial frame using Z-rods, L-rods, or straight

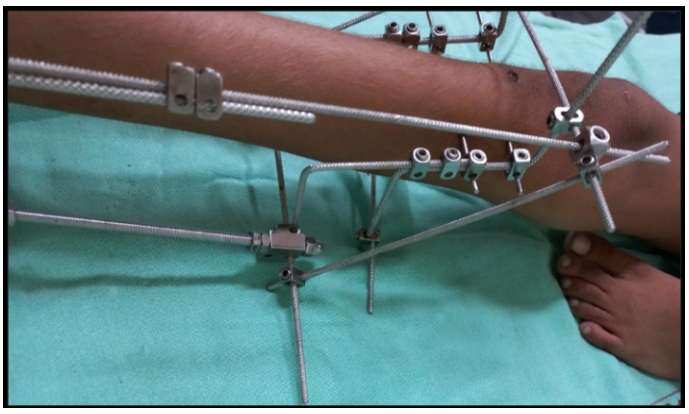

Figure 2: Extension is achieved by attaching two L-rods to the existing tibial frame using link clamps. A straight rod is linked between the tibial frame and the newly made extension to provide additional stability. A smaller-sized distractor is placed over the newly achieved extension.

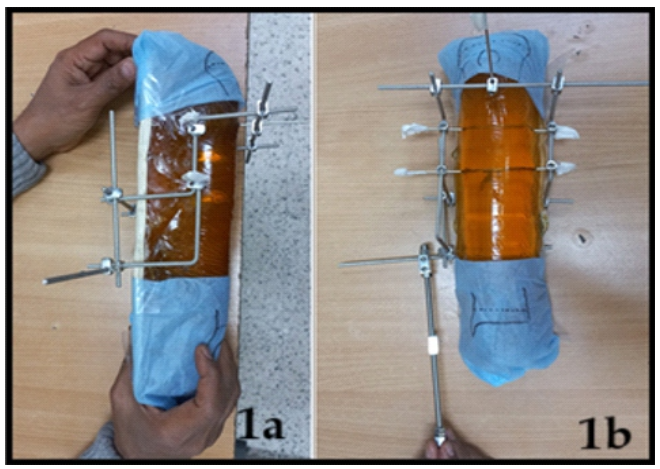

Figure 3: A rubber model analog to leg showing extended tibial frame; (a) Depicts the tibial frame attachment and the placement of an additional L-rod to achieve extension, (b) A smaller distractor can now be easily placed over the extension, as shown.

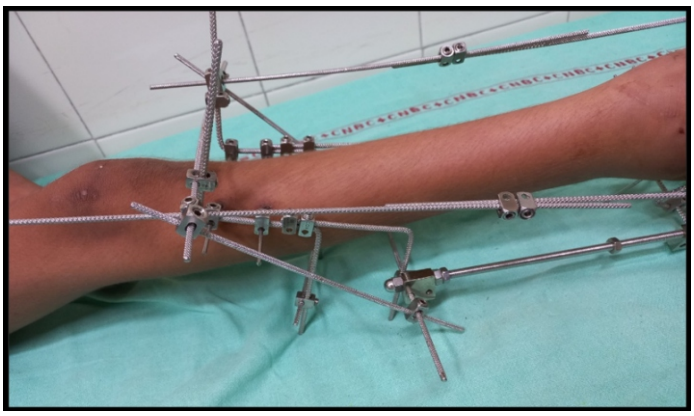

Figure 4: Extension achieved by attaching L rods to the distal tibial pin and the existing Z-rod with the help of links. Note the long extension in the anterior supporting rod achieved by joining two smaller-sized rods using link clamps.

rods, thereby creating sufficient length to mount a smaller distractor without altering the stability of the construct.

From a biomechanical standpoint, the addition of extension rods effectively shifts the point of force application proximally while maintaining the same line of action of the distractor. This preserves the principle of gradual, controlled distraction along the intended axis, which is essential for safe ligamentotaxis. Importantly, the extension does not interfere with wire placement, joint alignment, or soft-tissue envelopes and therefore does not introduce new vectors that might predispose to rotational or translational deformities. The modular nature of the JESS system allows for such adaptations without compromising structural stability, provided that all joints are securely locked and the frame is well balanced.

An additional advantage of this approach is its cost-effectiveness. Most JESS sets already contain multiple Z-rods, L-rods, straight rods, and joint links, which are reusable and do not add a significant financial burden. In contrast, maintaining a full inventory of distractors of all sizes may not be feasible in many centers. By allowing smaller distractors to be used effectively, this technique reduces dependence on an extensive inventory and enhances the practicality of JESS-based correction in real-world settings.

While this is a technical modification rather than a new corrective principle, its clinical implications are important. Ensuring proper distractor positioning and working length helps maintain steady correction rates, reduces the need for frame readjustment, and avoids interruption of the distraction schedule – factors known to influence final outcomes and patient compliance. However, care must be taken to ensure that the extended frame does not become excessively bulky or unbalanced, which could increase the risk of pin loosening, patient discomfort, or accidental frame trauma. Meticulous assembly and regular monitoring remain essential.

Conclusion

Extending the tibial frame using Z-rods, L-rods, or straight rods to accommodate a smaller distractor represents a practical, biomechanically sound, and cost-effective solution when standard distractor sizes are unavailable. This simple modification preserves the principles of ligamentotaxis and gradual correction and allows surgeons to deliver optimal treatment in resource-constrained environments.

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Declaration of patient consent : The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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