

## Ideas and Innovations

# A modular tension-adjusting splint for tendon transfer in reconstructive surgeries of extremities

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### ABSTRACT

Optimal tension during tendon transfer is the most important surgeon-controlled factor, which determines the final outcome of surgery. To attain optimal tension, the joints have to be maintained in proper position during the final attachment of the transferred tendon. Maintaining this desired position requires one extra assistant and is difficult. We herein describe a modular splint designed by us, which can be used for most of the commonly done tendon transfers in practice. It is very versatile as it can be used for all the age groups and for both right and left sides. A single splint, which is autoclavable and can be used for most commonly done tendon transfers, makes it user-friendly.

### KEY WORDS

Modular, single splint for commonly done tendon transfers, tension-adjusting splint, versatile splint

### INTRODUCTION

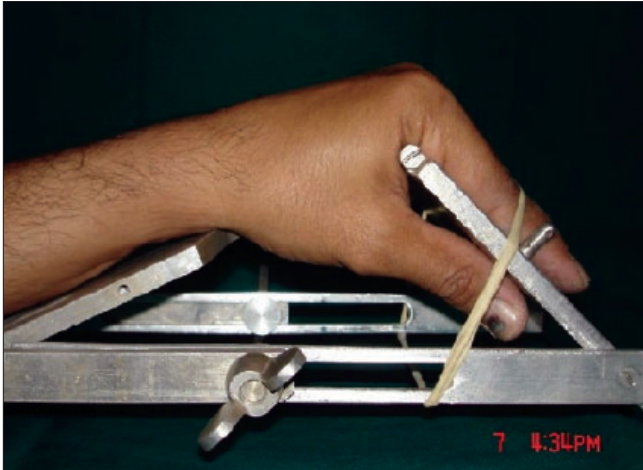
The role of proper positioning of the joints and optimizing the tension during final attachment of the tendon is very crucial in any tendon transfer.

The margin of error between overcorrection and undercorrection is very precarious and can easily tilt the final outcome into fair or poor even in the best of the hands. Robert Jones<sup>[1]</sup> who is considered the father of modern orthopedics and a pioneer in tendon transfers, in his earlier recommendations (1908 version) had emphasized on a slight overcorrection during tendon transfer and maintenance of the hyper-corrected position to secure uninterrupted continuity of the overcorrection. He had also suggested certain adjuvant procedures like dermodesis and partial tenotomies of relatively overacting antagonists to achieve mild overcorrection in tendon transfer. This overcorrection led to loss of opposite movement and compromised the final

outcome. Hence the practice of over-correction was criticized and the surgeons were recommended to suture the tendons in an optimal tension with joints kept in optimal position.

The optimal position of the joints during routine tendon transfer in the extremities is well known and accepted<sup>[2]</sup> [Figures 1-4].

To achieve these positions at various joints during final tendon attachments in tendon transfer is not only difficult but also demands one extra assistant. The existing tension-adjusting splints to maintain the joint position during tendon transfer are rigid, inflexible and applicable for only one transfer e.g., - Fritschi and Thangarajan;<sup>[3]</sup> Thangarajan<sup>[4]</sup> improvised the Fritschi<sup>[5]</sup> splint which maintains metacarpal arch during tendon suturing and Salafia's<sup>[6]</sup> tension equalizer splint for claw hand correction. Sane *et al.*<sup>[7]</sup> have addressed the same problem



**Figure 1:** Showing commonly used intra-operative position during dynamic claw corrective tendon transfer for intrinsic minus deformity where the motor slip is attached to the lateral band, wherein the wrist is at zero degree, MCP joints in 70 degree flexion and IP joint straight. Also note, with the help of rubber band, IP joints can be held in absolute neutral position during the final attachment of donor tendon slip

by measuring the tension required to correct clawing using a spring balance for each finger preoperatively and applying the same tension by using the same spring balance intra-operatively.

The authors have been using a specially fabricated modular intra-operative splint, which suits the purpose in many of the commonly performed tendon transfers in peripheral orthopedic reconstructive surgeries.

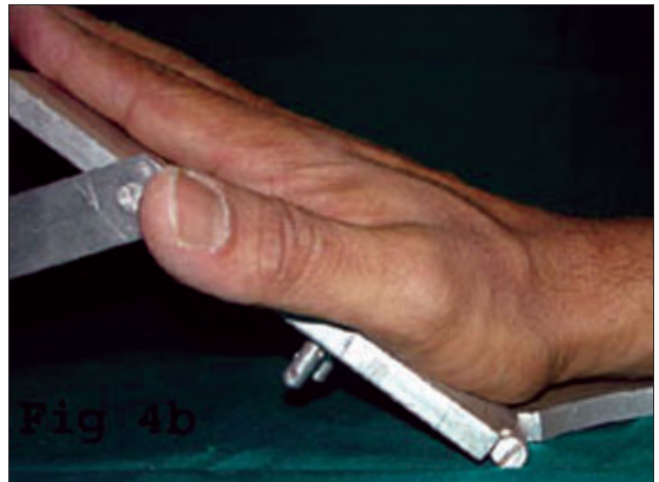
**Method: Description of the splint: [Figure 5]**

The splint is made up of aluminum and has two pieces, one longer for the forearm and another shorter for the hand connected to each other with a swivel, which can rotate up to 250°. These two pieces can be locked in any desired angle with the help of two detachable latches and hand-operated nuts. The hand piece has a provision for the thumb to be kept in a plane at 90° to the rest of the metacarpals. The forearm piece has a telescopic attachment at one end allowing it to be lengthened to suit any age group [Figure 6]. The hand piece can also be lengthened with an extra attachment to facilitate proper positioning of the joints during tendon transfer in foot drop as shown in the diagram [Figure 5]. The entire splint weighs 400 g and is autoclavable. Because of the 250° swivel, the splint can be used on both the left and the right side. The expandable forearm piece makes the splint versatile for any age group [Figures 5 and 6].

This splint also incorporates lateral knobs, which can



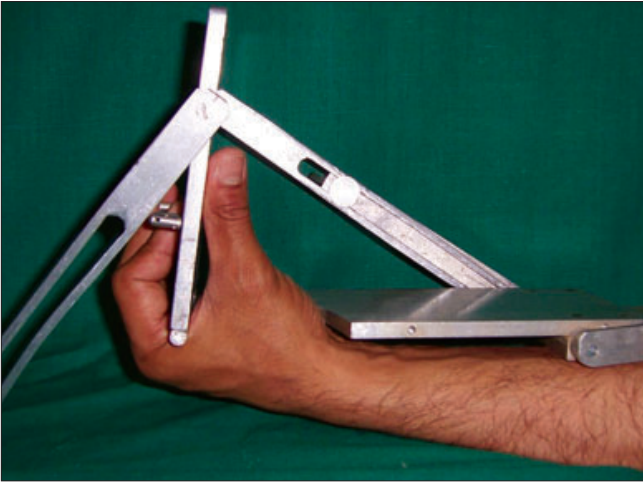
**Figure 2a:** Showing commonly used position during flexor carpi ulnaris to extensor digitorum communis transfer and palmaris longus to extensor pollicis longus transfer, wherein the wrist, MCP joints and IP joints are all in neutral position and thumb in as much radial abduction as possible



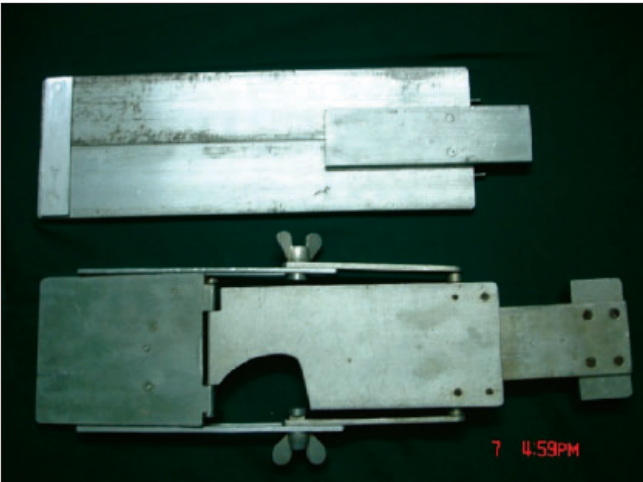
**Figure 2b:** Showing the position for pronator teres to extensor carpi radialis brevis transfer wherein the wrist is kept in 45° flexion and other joints in neutral position



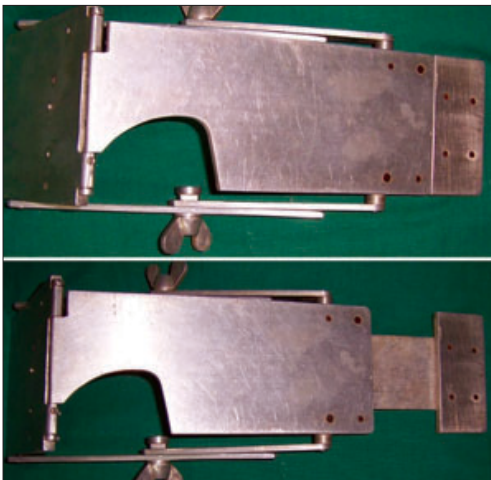
**Figure 3:** Showing ideal position of thumb during opponensplasty with the wrist in neutral and thumb in as much palmar abduction as possible and IP joints in neutral position



**Figure 4:** Showing the position required for tendon transfers in foot drop. The ankle is maintained in 20° with knee flexed. Note: The extension piece is attached to the hand piece and the forearm piece supports the foot. If required this piece can be extended by using the forearm extension piece



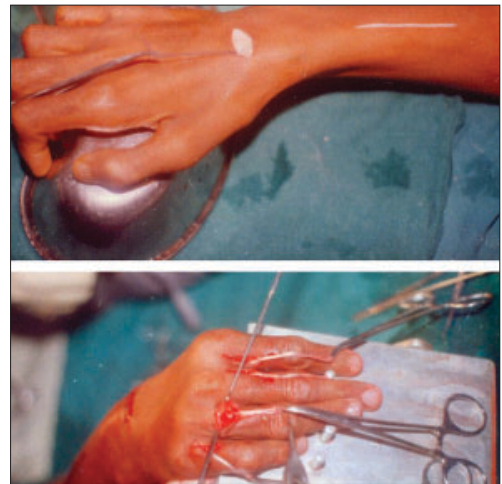
**Figure 5:** Showing the hand and forearm pieces with the forearm extension piece attached. The forearm piece on one side has a notch to allow placing of thumb in full abduction with wrist in neutral. The frame when turned upside down allows it to be used for both left and right side, making it modular for any side and any age group



**Figure 6:** Shows the telescopic mechanism at the forearm piece, which allows it to be lengthened to suit any age group

be used to fasten the forearm, hand or the fingers in the proper position using rubber bands obtained from the proximal end of surgical gloves. Similar knobs on the hand piece of the splint can help the fingers to be kept apart for easy exploration and suturing of the motor slips into the lateral slip of the extensor expansion during dynamic claw correction as shown in Figure 1.

**Fabrication** - M/S Technical Graft Intel Mangalore, fabricated this tension-adjusting splint on a “made to order” basis. It has taken us two to three versions of this splint to finally come out with the present modular



**Figure 7:** Intra-operative picture showing the use of splint for claw hand correction



**Figure 8:** Intra-operative picture showing the use of splint for simultaneous claw hand correction and opponensplasty

system. The initial version needed one each for the left and right side. Once our requirements are put forward, technical people with a fair amount of interest in experimentation should not find it difficult to fabricate a user-friendly and simple gadget like the one described by us.

**Material used** - Any material can be used to fabricate the splint, as long it is autoclavable, strong, durable, cheap and light. We have used aluminum for the latter two reasons. We have been using this splint since a few years without any problem related to the usage.

**Cost** - One piece of this aluminum splint cost us about Rs. 2000-2500 a few years ago.

## DISCUSSION

This simple intra-operative splint makes the surgeon's task much easier with one assistant less in obtaining the proper joint position and proper tension during tendon attachment. This will also allow the surgeon to fine tune the tension and position the joint according to the need in certain cases of hypermobile joints, where the tension required can be less than the usual .

Using this handy splint we have performed claw corrections, isolated [Figure 7] and in combination with

opponensplasty [Figure 8] in total claw hand due to low median and ulnar nerve palsies, as intra-operative positions of the joints can be achieved easily for both the transfers using the splint. With a small additional extension piece attached to the splint, one can also use it during Barr's or Ober's procedure of tendon transfer for foot drop [Figure 4].

## CONCLUSION

The authors describe a handy, surgeon-friendly intra-operative splint, which can be used during tendon transfer surgeries for median, ulnar, radial and lateral popliteal nerve injuries, which constitute a majority of the indications for tendon transfers.

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