BRIEF OR NEW

A Dynamic Traction Splint for the Management of Extrinsic Tendon Tightness

Sam Dovelle, Patricia Kulis Heeter, Paul D. Phillips

Key Words: equipment design, splints • hand injuries, therapy • splints, finger

The management of extrinsic extensor tendon tightness associated with upper extremity soft tissue and brachial plexus injuries is a recurring problem encountered by occupational therapists specializing in hand therapy. Many dynamic splints designed to increase the active and passive range of motion of the metacarpalphalangeal (MCP) and interphalangeal (IP) joints are described in the literature; yet none specifically addresses the resolution of extrinsic extensor tendon tightness. Extrinsic extensor tendon tightness may be caused by scar adhesions in the forearm, wrist, or hand/or by a shortening of the muscle or tendon due to disuse or denervation. To test for extrinsic tightness, the IP joints of the involved digits are passively flexed, first with the MCP joint extended and then with the MCP joint flexed. If extrinsic tightness is present, an increased resistance in the passive flexion of the IP joint is noted when the MCP joint is fully flexed (Hunter, 1984). To manage the problem of extrinsic tendon tightness, the occupational therapists at Walter Reed Army Medical Center designed a dynamic pulley traction splint and used it successfully for the past 2 years. The purpose of the splint is to provide (a) maximum passive flexion of all joints of the involved digit(s), (b) a pulley system that approximates the digits' anatomical pulley, and (c) a mechanism for controlled tension of the involved digit(s). The splint consists of two separate traction apparatuses (see Figures 1 and 2).
Figure 2
Interplay of the Two Traction Components

Materials
The following materials are used for the construction of the splint:

- Volar wrist splint with straps
- Thermoplastic splinting material, self-adhering, 1.9 cm × 5.08 cm (¾ in. × 2 in.)
- Monofilament line, 10 lb test
- Rubber bands, 2 @ size 11
- Leather strip, 2.54 cm (1 in.) wide
- Hole punch
- Eyelets, 0.48 cm (⅛ in.) diameter
- Eyelet fastener
- Clothing hooks
- Cyanoacrylate adhesive (Super Glue)

Construction
The first step is to make a volar wrist splint that will stabilize the wrist in the neutral position and provide a support base for the traction apparatus. Any standard volar splint can be used, providing the MCP joint of the involved digit(s) is able to achieve complete unrestricted flexion. After the volar wrist splint has been constructed and applied to the forearm, wrist, and hand straps, a small thermoplastic hook is molded and attached to the splint at the most proximal border (see Figure 3). For ease of attachment, a self-adhering thermoplastic material is used for both the splint and the hook.

A traction guide is made by cutting a strip of thermoplastic material, 1.9 cm × 5.08 cm (¾ in. × 2 in.), and placing a small, metal eyelet at one end, 0.48 cm (⅛ in.). The traction guide is subsequently attached to the volar splint at wrist level in alignment with the involved digit’s line of pull. This attachment prevents the monofilament line and rubber bands of the traction systems from rubbing against the splint.

A leather loop, 2.54 cm (1 in.) wide, is placed around the proximal phalanx of the involved digit. An eyelet measuring 0.48 cm (⅛ in.) is fastened to join both ends of the leather to form a loop. Relief cuts are made on the leather strap at the points where the loop interferes with the achievement of maximum flexion of the digit’s IP joints. Figure 4 illustrates the placement of the eyelet and the desired relief cuts in relation to the size of the involved digit. One end of a monofilament line is secured to the eyelet of the finger loop. The other end is tied in a small loop through which a rubber band is then attached. This line is made long enough to prevent the rubber band from interfering with the eyelet on the wrist traction guide when the digit is passively flexed.

A small clothing hook is fastened to the fingernail of the involved digit(s) with cyanoacrylate adhesive (Super Glue). A second monofilament line with a small loop tied on each end is made. One end of the monofilament line is fastened to the clothing hook, and the other end (which has a rubber band attached) is passed through the eyelet of the finger loop and wrist traction guide and attached to the thermoplastic hook at the base of the splint. It is important that the monofilament line is long enough to prevent the rubber band from interfering with the wrist traction guide during passive finger flexion.

After it has been fabricated, the dynamic splint is assembled in the following manner:

1. Strap the patient’s forearm, wrist, and hand into the volar wrist splint.
2. Place the finger loop around the proximal phalanx of the involved digit. Pass the rubber band attached to the loop’s monofilament line through the wrist traction guide. Attach the rubber band to the thermoplastic hook at the base of the splint.
3. Attach the loop on the free end of the second traction system’s monofilament line to the fingernail hook. Pass the rubber band, which is fastened to the monofilament line, through the eyelet of the finger loop. Then pass it through the eyelet of the wrist

Figure 3
The Traction Components Attached to the Wrist Traction Guide and Thermoplastic Hook of the Volar Wrist Splint
traction guide and attach the rubber band to the thermoplastic hook at the base of the splint.

4 Adjust the tension of the two rubber band or traction systems as required to achieve maximum, simultaneous flexion of the MCP and IP joints. The tension in both traction systems is increased as the patient develops a tolerance to the splint.

Splint Application Parameters and Precautions
Initially the dynamic splint is worn for 20- to 30-minute intervals, 4 to 5 times a day. As the patient’s tolerance to the splint increases, wearing times are increased up to but not exceeding 1-hour intervals. Both traction systems can be adjusted independently to allow the therapist maximum control in monitoring tension.

The therapist should educate the patient in the precautions of dynamic splint wear. As with any dynamic splint designed to influence living tissues, splint wear is discontinued or modified if the patient exhibits signs of sensory impairment, skin maceration, or pathological joint changes. The attending hand surgeon or physician is notified about any changes in the patient’s status.

The dynamic splint is no longer necessary once the patient achieves and maintains a full active and passive range of motion through a prescribed exercise program.

Summary
The dynamic traction splint designed by therapists at Walter Reed Army Medical Center is used for the management of extrinsic extensor tendon tightness commonly seen in brachial plexus injuries and traumatic soft tissue injuries of the upper extremity. The two components of the splint allow for simultaneous maximum flexion of the MCP and IP joints. This simple and economical splint provides an additional modality to any occupational therapy service involved in the management of upper extremity disorders.

Reference

Related Readings