

An Alternative Technique for Fabricating Flexor Hinge Hand Orthoses Using Total Contact Molded Plastic Finger Pieces

by Greg Moore, R.T.O.

The flexor hinge hand orthosis is one of the most demanding orthoses for the orthotist to fit properly. The slightest error can result in failure of the orthosis and loss of patient confidence in the orthotist. Presented here is a technique for fabricating the orthosis with increased fitting accuracy and reduction of patient-practitioner contact time. The procedures presented here have been accumulated from the measurement and fabrication techniques of various practitioners (see acknowledgments) and assimilated into this single technique.

HISTORY

The flexor hinge hand splint was originally based on the principle of the flexor hinge hand as described by Nickel, Perry, and Garrett in 1955.¹ In the years that followed, it was developed by them and their co-workers, using the principle of the modified three-jaw chuck, in which the index and middle fingers move together towards the thumb. This is accomplished by immobilizing the thumb in a position of opposition and placing the index and middle fingers in a position of semiflexion at the interphalangeal joints. To prevent slippage of the object grasped, the thumb pad must oppose the pads of the two fingers.

The flexor hinge is that part of the orthosis which hinges at the MP joint and holds the

index and middle fingers in a functional position. The range of motion is from a position of full extension of the MP joints to a point where the finger pads contact the thumb. The orthosis is operated in one direction by internal or external power under voluntary control, and returned to the starting position passively, usually by a spring or gravity.

The orthosis was originally developed to restore upper extremity function of patients with poliomyelitis. As the incidence of poliomyelitis decreased, the orthosis was used with other patients with severe upper-extremity paralysis such as cervical spine injury, hemiplegia, and brachial plexus injury. The results of treatment in these patients indicated that it is the degree of functional loss rather than the diagnosis that is significant. To a large degree, management of upper-extremity paralysis is the same regardless of the cause.²

FABRICATION TECHNIQUE

After the patient has been assessed by the rehabilitation team and the orthotic design has been determined, the patient is seen by the orthotist.

Appropriate measurements are taken and recorded for fabrication of the forearm and/or palmar pieces. Following this initial visit, the orthotist shapes and assembles the pieces ac-

ording to the measurements, with special attention to accurate placement of the MP mounting plate for the flexor hinge finger piece. Temporary straps are also attached to the orthosis to eliminate migration of the orthosis during trial fitting. Other fabrication steps that can be completed at this time are the placement of temporary padding (if used) and the attachment of the adjustable actuating lever kit (Rancho style wrist-driven). The thumb post can be shaped, but should not be attached to the palmar piece until it has been properly fitted to the patient on the second visit.

With the patient's second visit, the forearm and/or the palmar pieces should be fit to the patient and necessary adjustments made to provide for optimal fit and function. The thumb post is fit and attached to the palmar piece in the normal manner at this time. With this accomplished, the orthosis is placed on the patient's hand and secured with the temporary straps.

The index and middle fingers are taped together at the distal phalanges using $\frac{1}{4}$ " masking tape, so as to keep the middle finger slightly longer than the index finger. A position of 35–40° of flexion at the MP joint, 30° of flexion at the proximal interphalangeal joint, and 5–10° of flexion of the distal interphalangeal joint is needed to position the fingers in opposition with the thumb.³ When the positioning of the fingers has been accomplished to the satisfaction of the orthotist, the fingers and thumb are coated with a thin layer of petroleum jelly in preparation for casting.

Four layers of 4" plaster bandage material are measured and cut so that the ends of the bandage extend over the ends of the fingers by $\frac{3}{4}$ " and at the other end over the proximal edge of the MP mounting plate by $\frac{3}{4}$ " (Figure 1). The plaster bandage is then dipped in water and with the fingers held in a position of opposition to the thumb, the plaster bandage is placed over the dorsal aspect of the fingers. The edge of the bandage extends distally so that the tip of the thumb is included in the impression. Proximally, the bandage extends over the MP mounting plate so that an impression of this is included. The bandage should not cover the volar (palmar) side of the fingers. The bandage is rubbed into the fingers, tip of the thumb, and the MP mounting plate to obtain a clear impression, and the edges of the bandage should



Figure 1. Preparation for casting fingers.

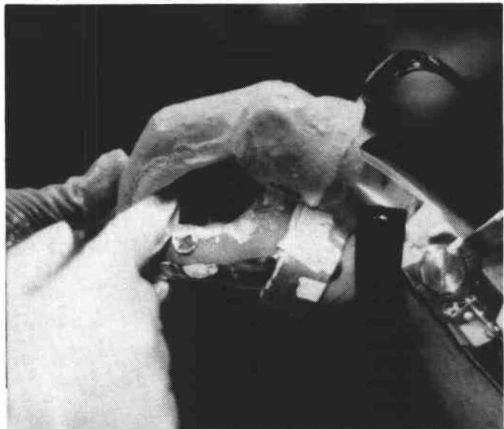


Figure 2. Cast impression incorporating MP joint plate and fingers.



Figure 3. Shows ease of aligning MP joint and finger pieces with MP joint included in the cast.

be folded back approximately $\frac{1}{4}$ " to reinforce the borders (Figure 2). After the bandage has hardened, it can be removed without the use of a cast saw by gently disengaging it from the MP mounting plate area and tilting it up over the fingers.

The proper length of the temporary straps should be marked and the fitted forearm and palmar pieces removed. The patient's hand can now be cleaned, and he/she can be scheduled for a final return visit.

The impression is prepared for filling by enclosing it in plaster bandage and coating the inside with a thin layer of liquid soap. A small mandrel should be contoured to fit the inside of the impression, extending as far distally as the tips of the fingers to prevent fracturing of the positive model (a length of $\frac{1}{2}$ " O.D. aluminum tubing works well for this). The impression is filled with plaster of Paris and stripped, using great care not to fracture the positive model. The model will have good detail, showing the contours of the finger nails, skin lines, and MP mounting plate.

The positive model is prepared for vacuum forming, using a length of nylon stocking as the interface for the $\frac{1}{8}$ " polyethylene. If Surlyn® is used, the Surlyn® is vacuum formed directly over the lightly smoothed impression without an interface. The clarity of Surlyn® facilitates visual assessment of pressure distribution when used with a sensation impaired hand. The plastic should be vacuum formed and not drape formed to insure an exact fit. Once the vacuum forming has been completed, the plastic piece can be removed by using a cast saw and carefully avoiding excessive damage to the impression. The finger piece is now ready to be trimmed using the following general guidelines.

The distal border should be $\frac{1}{8}$ " distal to the proximal edge of the fingernails of the index and middle fingers. The proximal border should be trimmed to the proximal aspect of the proximal phalanges. In the coronal plane, the plastic piece is trimmed along the midline of the fingers. The plastic finger piece is then placed back on the positive impression and a stainless steel superstructure is fabricated using the MP mounting plate impression as the reference for the MP operating lever (Figure 3). This saves an enormous amount of time since the reference between the palmar piece and

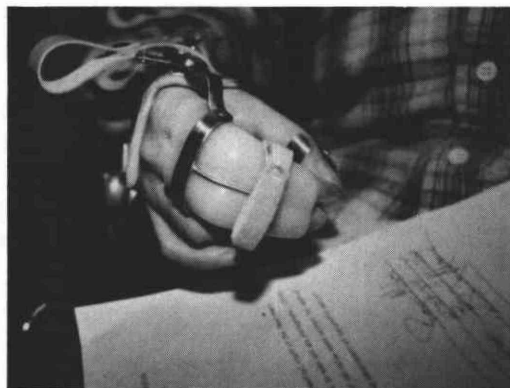


Figure 4. Complete orthosis with polyethylene finger piece.



Figure 5. Orthosis showing use of Surlyn® finger-piece for observation of the skin.

finger piece is part of the positive impression. A regular Jaeco style proximal finger piece is used for the proximal bar of the superstructure, and a $\frac{3}{32}$ " rod connects it to a distal stainless bar located at the middle of the middle phalange. Both of the bars are silver soldered to the $\frac{3}{32}$ " rod and simply bent to the contours of the plastic finger piece.

The proximal finger piece is connected to the MP operating lever in the usual manner. A Velcro® closure can be attached to the distal superstructure bar on a stainless steel closure

and can be fabricated using the bar as the dorsal half of the closure. With the finger piece completed and the remainder of the orthosis finished, the patient can be fitted and the orthosis delivered (Figures 4 and 5). Patient training and minor adjustments are done following regular rehabilitation procedures.

SUMMARY

Fabrication of the intimate fitting flexor hinge component of the flexor hinge wrist hand orthosis can be tedious. The procedure detailed here can facilitate fabrication of a more accurately fitting flexor hinge. The use of a vacuum formed finger section assures a total contact fit resulting in fewer pressure problems on the fingers. The optional use of Surlyn® for fabrication of the plastic finger piece permits direct skin observation when deemed beneficial.

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