A Plastic Tenodesis Splint*

Preliminary Evaluation of a Functional Brace for a Paralyzed Hand With Effective Wrist Extensors

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A paralyzed hand with some power in the wrist can be made functional by stabilizing the proximal and distal interphalangeal joints of the index and long fingers and the joints of the thumb in the position of function so that the fingers, when flexed at their metacarpophalangeal joints, meet the abducted and partially opposed thumb. The fingers, of course, must be

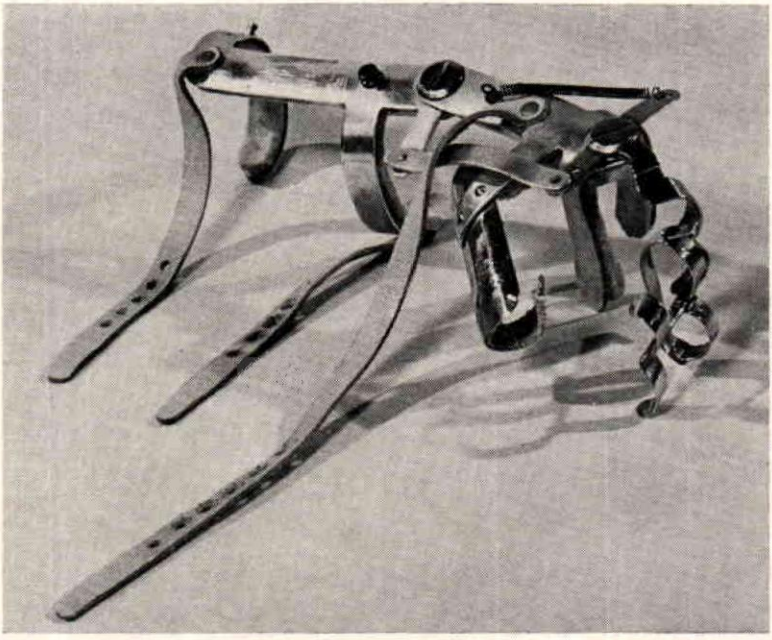

FIGURE 1

Flexor-hinge splint developed at Rancho Los Amigos, Downey, California.

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made to flex toward the thumb by some connecting device or tendon that extends from the fingers past the mobile wrist joint to some anchor point on the forearm.

In the conventional metal tenodesis brace, the flexor-hinge splint, the fingers are pulled toward the thumb by a connecting lever arm, which is attached to steel finger rings and extends past the wrist to be attached to the side of the forearm brace (Fig. 1). There are four joints in this type of device. When the patient extends his wrist, a three-jaw-chuck type of finger flexion occurs.[2] This brace must be custom-fitted by an experienced orthotist, since the fit of the finger rings is critical. For patients who have anesthetic hands, as in quadriplegia, the pressure of these rings can cause pressure sores when the patients attempt to wear the device for extended periods.

The weight of the splint, although only about four ounces, may tire the marginally functional wrist extensors of some quadriplegic patients and this, together with the resistance offered by the joints in the splint, may prevent movement. The splint is also difficult for patients to apply and, in our experience, its appearance is difficult for some patients to accept.

TABLE I

Patient's Reaction to Characteristics of the Splint

Characteristics	Satisfied (No. of Patients)	Indifferent or No Answer (No. of Patients)	Dissatisfied (No. of Patients)
Weight	25	5	0
Pinch or three-jaw-chuck grasp	24	5	1
Ease of application	23	5	2
Appearance	22	7	1
Fit	21	5	4
Washability	21	5	4
Size of finger opening	18	5	7

TABLE II

Results of Pinch-Meter Test on Seven Patients

Case No.	Muscle Grade	Three-Jaw Pinch without Splint (Ounces)	Three-Jaw Pinch with Splint (Ounces)	Gain (Ounces)
1	Fair plus	7	17	10
2	Fair plus	13	24	11
3	Fair plus	10	23	13
4	Good minus	5	22	17
5	Good minus	11	32	21
6	Good plus	8	128	120
7	Good plus	14	112	98

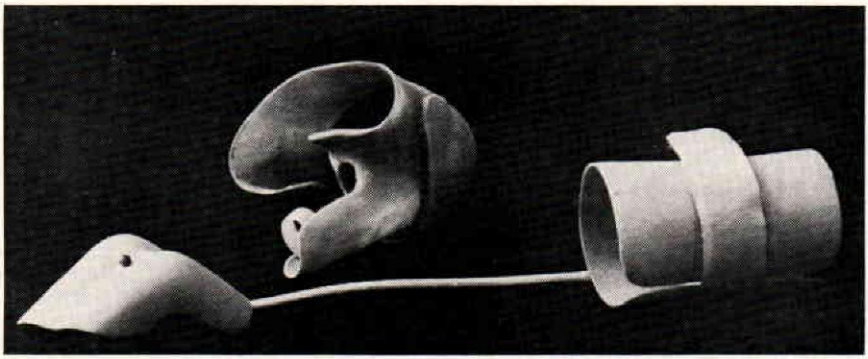

FIGURE 2

The R.I.C. plastic tenodesis splint showing the finger shell, thumb post, and wrist cuff.

FIGURE 3

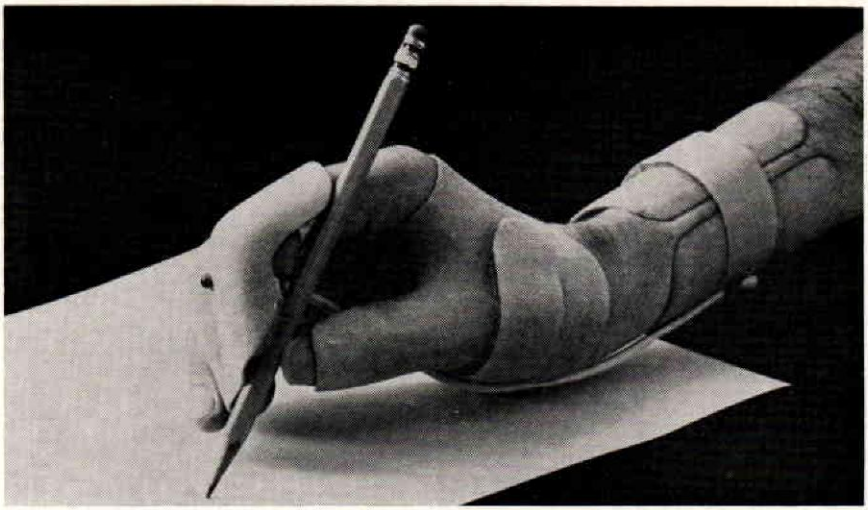

FIGURE 4

Figs. 3 and 4: Writing and holding a glass with the R.I.C. plastic tenodesis splint.

Five years ago, a splint was developed in the Orthotics Research Laboratory of the Rehabilitation Institute of Chicago through the combined efforts of the rehabilitation team. This device is now known as the R.I.C. plastic tenodesis splint.[1] The purpose of this report is to present a preliminary evaluation of this device, based on thirty patients with post-traumatic quadriplegia fitted in the Upper Extremity Disability Clinic at the Rehabilitation Institute of Chicago.

The device provides a three-jaw-chuck type of grasp, using the tenodesis principle in a simplified manner. All mechanical joints are eliminated and the patient's own joints are used (Fig. 2). The splint consists of three laminated plastic parts: (1) the finger shell, which stabilizes the middle and distal phalangeal joints of the index and long fingers; (2) the thumb post, which holds the thumb in abduction and opposition so that the pulps of the thumb and the index and long fingers meet as the fingers flex; and (3) the wrist cuff, which is the anchor point above the mobile wrist joint. The tendon connection is a round nylon lacer, three-sixteenths of an inch, which fastens distally to the volar surface of the finger shell between the fingers and just distal to the interphalangeal joints. Proximally the lacer is secured above the wrist joint on the volar surface of the wrist cuff. The thumb post and forearm cuff are kept closed by Velcro straps and can be adjusted by the patient. All parts of the splint are formed over a cast of the patient's hand and forearm so that a critical fit is ensured. The splint may be constructed by a prosthetist or any person familiar with standard lamination techniques. Its total weight is approximately one and one-half ounces, compared with the four-ounce weight of the flexor-hinge splint.*

In the Upper Extremity Disability Clinic at the Rehabilitation Institute of Chicago, during a four-year period, thirty patients with post-traumatic quadriplegia characterized by paralysis of the hands and wrist extensors with fair plus strength or better were fitted with the R.I.C. plastic tenodesis splint. The following results were obtained:

Of the thirty patients fitted, twenty-six continued to wear the splint after discharge from the hospital. These twenty-six used the splint for writing (Fig. 3), eating or drinking (Fig. 4), table games, typing, shaving, applying makeup, and smoking. The splint was also used for cooking, brushing teeth, combing hair, and washing the face.

The patient's reaction to various characteristics of the splint is listed in Table I.

When wearing the brace, pinch was improved to the extent that all thirty patients could grasp heavier objects with the brace than without it.

Of the four patients who did not continue to wear the splint, two rejected it for psychological reasons and two had reconstructive hand surgery.

* The device is kept from sliding down for several reasons: (1) The finger shell does not slide because the fingers are held in the shell by elastic straps; (2) the 45-degree angle of the shell at the proximal interphalangeal joints tends to lock the fingers firmly in place; (3) the harder the patient extends his wrist, the more the interphalangeal joints are pressed, by pressure of the object grasped, against the distal wall of the shell; (4) the thumb post is quite stable and, if well molded to the contour of the thumb, will not move; and (5) the wrist cuff is kept from sliding distally by being certain during fabrication that it is molded carefully behind the ulnar styloid process and by tightening the Velcro closure so that a clamping action is provided. In patients who have a minimum ulnar styloid process and much fatty tissue in the wrist and forearm (rare in our experience), a longer wrist cuff will provide the necessary clamping action to provide a stable attachment point for the nylon tendon cord. Lining the cuff with Silastic RTV 502 during fabrication will also reduce sliding tendencies, although this is not necessary in the large majority of cases.