

Functional Hand Assist

RANDOLPH N. WITT, Certified Orthotist

and

ODON F. VON WERSSOWETZ, M.D., FACP

Gonzales Warm Springs Foundation

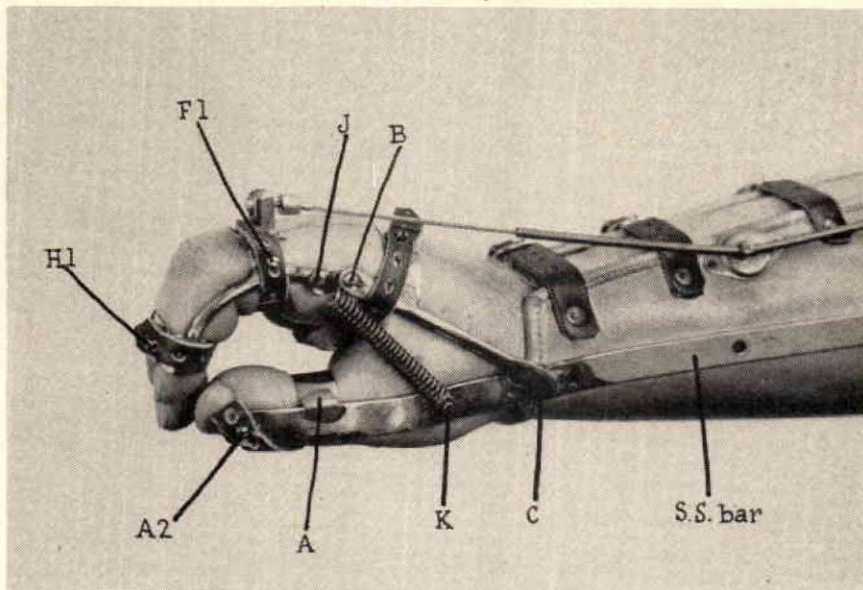


Fig. 1. Functional Hand Assist, radial view

In the rehabilitation of neuromuscular disorders, there is a great need for some type of mechanical hand assist for patients with severe involvement or flail hands. Such a device was developed at the Gonzales Warm Springs Foundation Hospital.

In constructing such a device, it is mandatory to utilize all the prehensive and kinesthetic senses that remain in the involved bodily segment as this will result in better utilization of the appliances. In general, this device is constructed of three parts,—that is, the terminal device, the supporting unit, and the transmission mechanism.

The steps in construction of this appliance are as follows:

1. Make plaster shell of forearm and wrist.
2. Pour mold and dry thoroughly, trim and dress.

3. Make molded leather cuff.
4. Place stainless steel bar ($\frac{1}{2} \times \frac{3}{32}$) on cuff in line with thumb in position of opposition. (Fig. 1).
5. Place hook "A" (Fig. 1) on stainless steel bar at center of 1st phalanx of thumb. Hook "A" is made of .040x $\frac{1}{2}$ " spring temper stainless steel and is silver soldered on to $\frac{1}{2} \times \frac{3}{32}$ " stainless steel bar. Apply $\frac{3}{8}$ " leather strap on hook at "A-1", (Fig. 2) anchoring to stud at "A-2" (Fig. 1).
6. Form out of Monel Wire (Wire drill gauge size 18) the metacarpal joint "B" (Fig. 1) and the angle of the index finger.
7. Silver solder the #18 wire at point "C" (Fig. 1) at wrist on the radial side, being extremely careful that metacarpal joint "B" (Fig. 1) is in alignment with metacarpal joint of index finger. This is very important.
8. Apply metacarpal bar (.040x $\frac{1}{2}$ " stainless spring temper steel bar) with silver solder at point "D" (Fig. 3) allowing enough clearance for extension of index and middle finger. This bar runs across the metacarpals and curves around the 5th metacarpal.
9. Apply leather strap, $\frac{3}{8}$ " at point "E" (Fig. 2) crossing palm of hand and anchor at stud "D-1". (Fig. 3)

10. Apply bar (.040x $\frac{1}{2}$ " stainless steel spring temper) at center of 1st phalanx of index and middle finger at point "F". (Fig. 3) Put leather strap, 3/8" at point "G" (Fig. 2) to anchor at stud "F" (Fig. 1). This strap passes under the fingers.
11. Next apply bar (.040x $\frac{1}{2}$ " stainless steel spring temper) to distal end of 2nd phalanx of index and middle finger at point "H" (Fig. 3). Put 3/8" leather strap, at point "I", (Fig. 2) pass under fingers and anchor to stud "H-I" (Fig. 1).
12. At this point stop and check all parts for proper fit. Be sure metacarpal joint "B" is in line with 2nd metacarpal. You should have at least 1 $\frac{1}{2}$ inches opening between thumb and two fingers when in open position. Slowly close fingers, check apparatus for freedom of range and motion. When closed, thumb should be in center of first two fingers to give desired pinch.
13. Now we are ready to apply the spring or elastic for closing the fingers. Any desired amount of tension may be obtained by winding different sizes of springs. The spring should be anchored at point "J" (Fig. 1), just forward of the metacarpal joint of index finger, and just back of the metacarpal joint of the thumb at point "K". (Fig. 1) This should be done in this manner so as to leave the web between the thumb and index finger free for grasping larger objects.
14. The post for the cable pull is applied next. This should be put on top of 1st phalanx band at point "L" (Fig. 3). Then the first keeper for cable housing attached to arm cuff, at a point where cable is in direct line of pull. This point is determined by the type of harnessing that is going to be used on the patient.

The harnessing may be on either shoulder, as it is used in the below the elbow prosthesis, or may be from one of the lower extremities, if the shoulders are flail. In such cases, especially in patients confined to wheelchair, the motive force may be derived from the foot, using dorsi and plantar flexors, or from the thigh using adductors and abductors.

The appliance usually should fix the wrist in 20-30 degrees of dorsiflexion, in the position of function of hand. However, the degree of dorsiflexion should be adjusted individually to permit optimal position to obtain the greatest amount of activity. The stabilized thumb is so arranged in opposition that it meets the index and long finger, which are bound together in a plane of 15 degrees angle

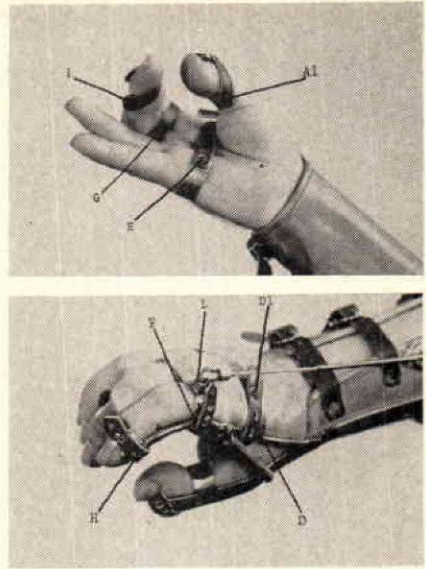


Fig. 2 and 3. Functional Hand Assist.
Top: palmar view
Bottom: dorsal view

to the longitudinal axis of the hand. This prehensile position gives the patient the most comprehensive and universal approach to objects of various shapes and sizes, yet provides as secure grip as possible. The exposed palmar pads of fingers and thumb permit the utilization of the tactile and kinesthetic senses that the patient may have.

This device has been used successfully in patients having flail hands as the result of poliomyelitis or traumatic quadriplegia. It facilitates a greater degree of rehabilitation, as the patients are able to feed themselves, write, brush their teeth, and do other light activities. These activities, though small in themselves, are of utmost importance to the patient in giving him a feeling of independence.

This appliance will not meet the needs of all hand involvements, however, if used where applicable it has proved to be a practical functional assist. It has to be fitted individually and modified to each degree of disability.