A STUDENT'S VIEW OF FUNCTIONAL ARM BRACING

By STEPHEN HALL,, C.O.

Institute for the Crippled and Disabled, New York City

Editor's Note: Stephen Hall was one of the skilled orthotists selected for the first course in Functional Arm Bracing given at the University of California at Los Angeles. His comments on the subject matter will be of interest to other orthotists who wish to apply for admission to one of the four classes now scheduled.

After the usual greetings and orientation by the staff of UCLA, we started with *Functional Anatomy of the Hand* given by Dr. J. Perry of Rancho Los Amigos. The anatomical functions of the parts of the hand, including the wrist, forearm, fingers and thumb were discussed in detail with the necessary muscles used by joints and their action produced in function. Such actions as flexion, extension, abduction and adduction of the fingers were discussed.

Uses of the Hand

A. Percussion—when used as a club to pound the desk with the wrist and forearm acting as a lever.

B. Prehension or grasp—the act of picking up objects.

Types of Prehension.

a. Three Point palmar
b. Two Point palmar
c. Side Pinch
d. Nail Tip Grasp
e. Hook grasp for carrying only
f. Cylindrical as large round handle
g. Spherical as ball

Dr. Perry explained how the three point palmar or chuck type grasp was the most generally used type of prehension. We use this type about 50% of the time for picking up objects and about 88% of the time for holding objects. We next went into types of bracing such as:

1. *Polio.* The chief problems are atrophy of muscles and the hyperextension of joints.
2. *Injuries from Trauma.* The need usually is for progressive bracing over a long period of time.
3. *Nerve Injuries.*
    1. Median nerve controls flexor side of hand Palmar.
    2. Ulnar nerve.
    3. Radial nerve controls the extensor side of hand—Dorsal wrist and thumb.
4. *Rhumatoid Arthritis*—Two problems:
    1. Bad position of hands. 2. Deformities—typical swans neck fingers.
5. *Spastic Hemiplegia*—Two problems: 1. Limitation of extension. 2. Coordination Loss.

First Splint made was the Basic hand splint which is used to maintain the thumb in functional position and support palmar arch. This splint is the foundation for a great number of other types of splint by using attachments.

Second Attachment made was the swivel thumb-spreader bar and spring types. Function of this spring swivel thumb was to dynamically hold thumb in abduction. Spring tension can be overcome to allow grasping of smaller objects. To use this splint the patient must have thumb flexion to operate the swivel. Hand should be free of deformity and fairly flexible.

Third Attachment made was the First Dorsal Interrosseus Assist. The function of this attachment is to abduct first finger to assist prehension. The spring on the attachment can also be adjusted to assist flexion to the first finger.

Fourth attachment made was the lumbrical bar. The function of the lumbrical bar is to prevent hyperextension of proximal phalanges, allowing the extensor digitorum communis to extend distal phalanges. The lumbrical bar is usually used to hold the fingers in 15 degrees flexion so that full extension can be obtained at the distal phalanges.

Second Splint made was the Dynamic finger flexion assist, used to assist finger flexion. To use this splint the patient must have fair to good finger extensors.

Third Splint. After adding the long forearm piece to a new Basic hand splint to form the Long Opponens hand splint we added a C Bar to the splint. The function of the "C" Bar is to hold the thumb in opposition and *Abduction.* The "C" Bar is used on all splints except when the Swivel thumb is used. Also used with the "C" Bar is the Thumb IP Extension Assist. It is a spring and stop added to an oppones hand splint to dynamically extend the thumb at the IP Joint providing better grasp position.

Fourth Splint made was the Action Wrist with Dorsiflexion Assist. Hinge joint allows free volar and dorsiflexion and partially prevents radial or ulnar deviation with the Dorsiflexion assist added it assists wrist dorsiflexion. The splint is used when wrist extensors are in the poor to fair range. May be used with a stop to prevent too much dorsiflexion or prevent volar flexion.

Fifth Attachment made was the hand splint prop, used at night or period of rest for the patient so that the weight of the splint and hand are not put onto the patient's hand. This has been found to help prevent bed sores on the hands.

Fifth Splint made was the flexor hinge splint which can be with finger, wrist or shoulder harness drive to give prehensive grasp to the patient. It can also be harnessed to the artificial muscle to provide power. An interesting addition to the flexor hinge splint when used with the shoulder harness is the pressure relief control. The fact that the fingers are under constant pressure from the spring to close the fingers a patient would have serious difficulties unless he could relax his grasp once in a while. The relief control allows him to relax his fingers until he wants to use them for grasp.

At this point in the program we left hand splinting and went to the Rehabilitation Center at Rancho Los Amigos to see patients. These, we fitted with splints which we had made in class from measurements given to us by our instructors. The results were quite good and we next went into *Ball Bearing Feeders* that attach to the patients' wheelchairs.

The feeders tied in with the lecture on Biomechanics of Functional Hand splints and arm Bracing. The apparent good that the feeders accomplished for the severely handicapped wheelchair patients was clearly shown. We also viewed the Flying saucer feeder, the suspension-type feeder and the quadriplegic feeder that is automatic. At the same time that the Feeder lecture was in progress we went into the special assistive devices that can be made for the Polio and Paralyzed patient. Most of these devices have been made by all the people in the Orthopedic business at one time or another but it was a good chance to exchange ideas from many parts of the country on the different types of aids that are available.

Second Half of the Course

Principles of Operations and Application of Functional Arm Braces. Basic Anatomy of the Arm and Shoulder was discussed by Mr. John Bray of the UCLA Staff. Muscles discussed were: Trapezius, Levator, Rhomboid, Serratus Anterior, Pectoralis Minor and Subclavius, which are all Fixator Muscles. The Prime Mover muscles discussed were, Pectoralis Major, Latissimus Dorsi, and Deltoid. The need for this anatomy was soon apparent when we started to harness some of the polio patients' hands, arms and shoulders.

Handi Hook was the first type of assistive devise discussed and made in the laboratory. The basic indication for the use of the hook is that the patient would have no sensation in the hand. Quadriplegics are the most likely users. The hook is made of Stainless Steel handpiece. It has a position of function friction lock built into the wrist unit. The Hook may be activated by 1. Scapular elevation, 2. Humeral flexion, 3. Shoulder elevation, 4. Leg loop or perineal strap on either side of patient, 5. By attachment to wheelchair if patient uses one. Position of Hook is according to patient's needs and type of activity to the patient can best be trained for.

If patient has immobility of the finger joint and lack of sensitivity of the fingers, and also paralysis of the muscles of the wrist the patient would be fitted with the Handi-Hook plus the addition of the Dorsal or Volar wrist splint. The wrist splint holds the hand in a functional position. The hook is available in three sizes with either the left hand or right hand position. With cable controlled hook the cable can be attached to either foot by a simple shoe and brace arrangement to provide additional opening power if needed.

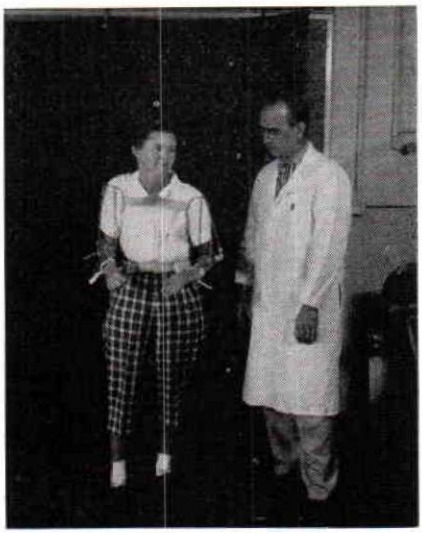
Straight Shoulder Suspension Hoop: The shoulder suspension Hoop provides a stable foundation for the attachment of various combinations of rubber bands, cables, levers and joints designed to assist the patient to obtain useful function of his shoulder and elbow joint. The Hoop consists of a well padded waist band shaped to fit the body contour over the crest of the illium. It is held in place by chest straps and waist straps.

A "U" shaped hoop of stainless steel wire goes over the shoulder and inserts into tubing attached to the waist band and locked with set screws. No weight is borne on the shoulders but all the weight of the arm is carried through the attachment to the waist band resting on the illium.

The hoop and waist band can be shaped to the contour of the body by bending irons or by hand. The straight shoulder hoop is usually used with a forearm cuff to give the patient elbow flexion assist. The patient should have elbow extensors and the hoop will help flexion. Without extensors some other source of power such as a leg reciprocator should be used. This type of brace is theraputic and with it a weak triceps muscle can be built up in strength. The balancing of the arm with the rubber band tension and the position of the hooks on the cuff are the most critical concern of the fitter when using all of the suspension apparatus in the course.

The axillary shoulder suspension hoop may be used instead of the straight hoop and offers certain advantages to the patient. The axillary hoop is worn under the clothing and usually does not include a shoulder saddle. It would not be used if there was a presence of sensitivity in the axillary region or the chest wall.

The By-Pass shoulder Hoop is used most generally for the attachment of the various types of shoulder and forearm flexion units. The hoop is shaped around the top of the shoulder at the point of the acromium and the first



Stephen Hall checks out the bilateral functional arm brace fitting he did for Mrs. Betty Wickstrom, one of the patients who served as teaching aides in the Pilot Class.

She is wearing a By-Pass Shoulder Suspension Hoops with Fore Arm and Elbow Flexion Assists. On each side of the braces is a manually operated locking device activated by a lanyard. The units also include internal and external rotation and pronation Assists Springs, which help the patient to pronate the hands.

The braces allowed the patient the use of her hands at table top level in a functional position, and the ability to reach out and grasp objects.

assistive device added was the shoulder flexion assist. This consists of the lever arm which is activated by a series of rubber bands running from the front of the hoop to the distal end of the arm cuff. To this shoulder assist can easily be added the forearm cuff and the necessary rubber bands to give forearm flexion. The By-Pass hoop is also fitted with the shoulder stabilizer and elbow locking joint which is activated by a lanyard and the use of the other hand to attain the locked position. The bar that contains the locking device can be placed either on the lateral or medial side of the arm. A pronator or supinator spring can be incorporated into this unit to give either pronation or supination. If a leg reciprocator is used with the By-Pass hoop the elbow unit should be a free unit because the cable hand and foot could be locked in a flexed position if the elbow was not free.

Leg Reciprocators are used where the patient has weak shoulder and elbow muscles as in the flail arm. If finger function exists at all a reciprocator will bring the forearm into a functional position. The cable rewind mechanism is attached to the shoe and is activated by a bale across the instep of the shoe coming in contact with the calf of the other leg. This action shortens the cable and when the foot is again placed on the floor the cable lifts the forearm cuff of the patient. The cable is anchored to the waist band with cable housing retainer. To allow the arm to extend the bale is released by downward pressure on the instep of the foot using the heel of the opposite leg.

The final brace shown and assembled was the *shoulder supported functional arm brace.* This brace has no waist band and is hung from the shoulder girdle. The patient would necessarily need good shoulder muscle tone to allow the fitting of the upper arm support. The elbow locking unit is activated by the opposite hand and has seven locking positions. The unit may also include a pronation and supination assist. The most critical concern of the technician in the fitting of this brace is the shaping and contouring of the metal shoulder saddle to the arm and chest wall surfaces. The placing of bands will allow the brace to be positioned with the mechanical joint in line with the anatomical joint.

All the functional arm brace parts are now being manufactured by the Hosmer Corporation of California.