

# The Effects of Bracing in Reduction of Contractures and Improvement of Function in Long Standing Cases of Hemiplegia\*

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Function improvement in long-standing cases of hemiplegia has traditionally been considered unlikely. At the point of patient discharge to home care, or to vocational rehabilitation centers, gains in physical function are usually considered maximal. Perhaps this implicit assumption is an unfortunate generalization. It is to this problem that this paper addresses itself.

Considerable progress in development of both static and functional upper extremity braces has been made on the West Coast during recent years. Pioneering work of the Orthotics Section of Rancho Los Amigos Hospital of Los Angeles County, and the Upper Extremities Clinics of the Medical Center of the University of California at Los Angeles has opened new questions regarding the possibilities of bracing to prevent deformity and to increase function with a wide variety of spastic and flaccid paralysis cases. In some of these, quite dramatic results have been obtained (1).

Typically, such cases are under the direct supervision of Physical Medicine and Rehabilitation Departments of the hospitals, and are at the peak of function through the work of therapists. In cases which have not had such services available, or in cases of long-standing dysfunction long after hospital discharge, very little has been attempted.

In the course of a research program to determine the industrial employment potential of hemiplegics (3), conducted under Office of Vocational Rehabilitation sponsorship, evaluation of hemiplegic clients for transitional workshop training at Community Rehabilitation Industries, Inc., included the evaluation of these clients in terms of potential functional restoration through bracing and prosthetics application. Eight cases have thus far been sufficiently followed to permit report.

## Evaluation Procedure for Bracing Hemiplegics

Following entry to the workshop training program, and within thirty days of the time of entry, each subject was evaluated by an orthopedist. This evaluation had, as a primary purpose, the determination of potential effect of bracing, particularly as it might increase function of the paralyzed or paretic side. Prior medical information regarding range of motion, flexion, spasticity and type and extent of prior treatment, as well as an adult modification of Katz' "Survey of Physical Capacities," (4) was also evaluated.

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For those cases considered capable of potential benefit, prescription for braces was written, and the appliances secured. Those showing severe and unreduced contractures, flail arm, wrist drops and other hemiplegic residuals from damage to the central nervous system were fitted with various types of braces.

Reevaluation of the cases was done at/or before six months' intervals, both to describe effect and to modify prescriptions. In cases where muscle size changes and flexion shifts required, adjustments and services were obtained from qualified orthotists.

#### Case Descriptions and Results Obtained

**Case I** *Anamnesis*: Male, Negro, age 43, former stevedore, ten years post onset from CVA, right hemiplegic. Residuals: forearm 118° elbow flexion, wrist 135° pronation, fingers tightly clenched, definite edema of wrist and hand at entry. Systems review essentially negative except CNS and musculo-skeletal.

*Prescription*: Long opponens splint with metacarpophalangeal extension stop and interphalangeal extensor assists. Brace applied July, 1958.

*Six Months' Reevaluation*: Nearly complete elimination of forearm flexion contracture, partial reduction of wrist drop, fist opened sufficiently to admit 1" diameter tube when brace removed. Finger spasticity much reduced although still carried in flexion when not wearing brace. Edema much reduced.

*One Year Reevaluation*: Additional gains to above. Subject can use right hand to hold objects up to 2" diameter with or without brace. No evidence of edema.



Case I. Drill Inspector Al Johnson

**Case II** *Anamnesis*: Female, Caucasian, age 47, housewife, fifteen years post onset of left hemiplegia sequela to cranial surgery. Forearm 120° elbow flexion, drop wrist with slight radial deviation. Fingers in such tight flexion that nails must be cut short to avoid lacerating palmar surface. Systems review negative except CNS and musculo-skeletal. Finger stretch reflex grossly hyperactive.

*Prescription*: Long opponens brace with metacarpophalangeal extension assist. Brace fitted September, 1959.

*Six Months' Evaluation*: Current appliance of questionable value. Difficult for subject to apply due to hyperactive stretch reflex of left hand. Flexor intensity breaks down plastic finger slings of extension assists. Tolerance for appliance 2-4 hours daily because of severe pain. Suggests possible use of night splint to reduce contracture prior to second attempt to use long opponens brace. Progress is difficult to evaluate at this time.

**Case III** *Anamnesis*: Female, Caucasian, age 28, ceramics decorator, 5 years post onset of right hemiplegia from CVA, 160° elbow flexion, tremor, range of motion restricted, wrist 150° pronation, some spastic flexion of fingers. Capable of finger extension (three extension-flexions prior

to tetanus), but unable to grasp objects in right hand. Some muscle atrophy.

*Prescription:* Long opponens, metacarpophalangeal extension stop and interphalangeal extensor assist. Brace applied June, 1958.

*Six Months' Reevaluation:* Muscle development such that three expansive adjustments have been made. Wrist no longer in flexion, tremor reduced and finger extension markedly improved. Can now grasp, lift and hold objects in involved hand. Finger extensions prior to tetanus 85 in rapid succession.

*One Year Evaluation:* Small but definite improvement over ratings of six months in all categories. Tremor now infrequent and minor, and involved hand customarily used in assists and routine work activities.

Case IV *Anamnesis:* Female, Caucasian, age 49, teacher, right hemiplegia subsequent to CVA at age 45, arm primarily flail with contractures in forearm and hand muscle groups. Elbow 150° flexion, wrist drop, fingers in deep flexion. Hand cannot admit small diameter tube without forcing fingers open.

*Prescription:* Long opponens brace, finger extension assists, metacarpophalangeal extension stop. Brace applied January, 1959.

*Six Months' Reevaluation:* Contracture reduction, wrist drop aided, still unable to use involved hand as other than a holding fixture.

*One Year Reevaluation:* Now able to pick up small, light objects with involved hand. Wrist drop appears to have been eliminated.

Case V *Anamnesis:* Male, Caucasian, age 21, student, left hemiplegia subsequent to traumatic injury of right cerebral cortex at age 17. Immature and quarrelsome. Wrist flexion to 100° radial deviation, digital deviation, non-uniform finger flexions.

*Prescription:* Long opponens, metacarpophalangeal stop and thumb positioner, tension plate for finger positioning. Brace fitted May, 1959.

*Six Months' Reevaluation:* Little or no change noted. Subject uses the brace only rarely and after pressuring by family and workshop staff. Complains of pain in using appliance, and fails to keep appointments for adjustments or refitting. Subject left training and has not been followed—now in unknown status and cannot be located.

Case VI *Anamnesis:* Male, Caucasian, age 45, former army officer. Right hemiplegia subsequent to shell fragment penetration of left motor cortex at age 37. Shoulder dislocation, some active wrist flexion, fingers in flexion, no contractures, anesthesia of entire upper extremity.

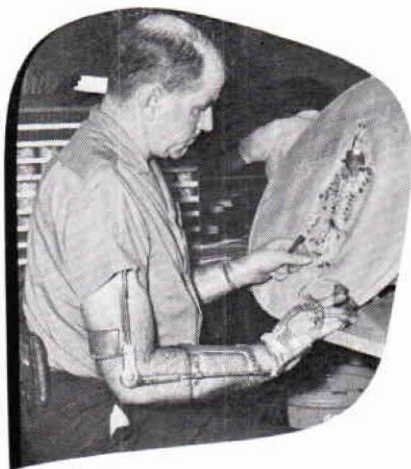
*Prescription:* Shoulder cap, manual elbow hinge with scapular abduction lock, contralateral, flexion wrist with extensor assist and interphalangeal assists on fingers. Brace applied June, 1959.

*Six Months' Reevaluation:* Shoulder stabilized, elbow can be locked in functional position, with some use of hand as a helping or holding device. Considerable reduction of shoulder pain. Can tolerate brace for about six hours.

*One Year Reevaluation:* Continued reduction of shoulder pain. Now able to close thumb and forefingers to grasp small light objects. Brace tolerance 12 hours per day.

Case VII *Anamnesis:* Male, Caucasian, age 32, precision grinder, right hemiplegia subsequent to CVA at age 28, with osteomyelitic complication following surgery, considerable aphasia. Elbow 135° flexion, drop wrist, and finger flexion, mild edema one year post CVA.

*Prescription:* Long opponens, with metacarpophalangeal tensor assist and strong outrigger finger assists. Brace fitted August, 1958.



Case VI. Former Army Captain J. E. Warrell, now supervisory foreman, electronics division.

*Six Months' Reevaluation:* Some contracture reduction, with finger extension aided and wrist position improved. Subject can use hand only as a clumsy holding fixture while wearing brace, and no coordination is noted in attempts to use the non-involved hand when involved hand is holding anything—this appears to be reduced when the distance between hands is increased and the subject does not then “ape” the motion of the uninvolved hand with the braced member.

*One Year Reevaluation:* Wrist positioning now can be accomplished without wearing brace, although there is some residual finger flexion without brace. Independent operation of hand is still quite poor, although dysfunction of coordination is reduced. Subject has had several adjustments to accommodate increased muscle size, but no longer tolerates brace as he did during the first period. Attitudinal shifts and a motivation decline seem to be slowing progress of function improvement.

*Eighteen Months' Reevaluation:* While contractures have been markedly reduced and some gross control in hand use has been achieved, the primary gain has been in prevention of deformity for this subject. Brace is now used only a few hours daily, and subject claims fatigue and discomfort in its use. It is possible that a prescription change to a more functional appliance is indicated.

Case VIII *Anamnesis:* Male, Caucasian, age 43, naval architect. Right hemiplegia with aphasia residuals well compensated subsequent to CVA at age 40. Intensive PT treatment at Rancho Los Amigos managed to greatly reduce spasticity. Shoulder and elbow function good, elbow flexion slight ( $160^{\circ}$ ), drop wrist severe and finger flexion strong with thumb disarticulation. Some tremor in use of shoulder and elbow to lift arm. Subject's expectancies for return of physical and mental functioning ability are rated as unrealistically high.

*Prescription:* Finger driven flexor hinge splint, metacarpophalangeal stop. Brace fitted October, 1958.

*Six Months' Reevaluation:* Wrist position greatly improved, and some active finger extension return. Thumb disarticulation still a problem. Change of prescription to include ID extension assists and swivel thumb unit.

*One Year Evaluation:* Slight but continuing progress in use of involved arm, hand and wrist. Thumb swivel effective, and subject can now use hand to grasp objects, although fatigue tolerance in fingers is low, and continual use of fingers is not yet within subject capabilities.

*Eighteen Months' Reevaluation:* Little or no further change, some additional resistance to fatigue. Subject continues to wear brace many hours daily, but has not accepted reality of ultimate residual limitation.

### Discussion

One of the most significant points, in the opinion of the writers, to be developed in this study, was the high proportion of positive responses to bracing in these long-standing cases. The average duration of conditions sufficient to warrant bracing was more than six years, and in several of the cases more than ten years. Within such a time span, losses in the opposing muscle systems were quite severe, but *were not* total atrophies. It is, of course, impossible to specify whether or not a greater return might have been achieved if bracing had not been so long delayed, although the impression gained by comparing these cases on a time since disablement basis is that a high degree of function could have been more easily secured without the delay.

From our examination and follow-up of these cases, the salient point appears to be that reduction of deformity and contractures has had a functional, as well as cosmetic and psychological effect, on the hemiplegic cases. It is, however, a reciprocal effect, especially from a rehabilitation standpoint; with the psychologically difficult cases, response to bracing seemed not only a function of the hours of application, but also of the subject's total concept of himself as a handicapped person, a finding concurring with those of others who have developed prosthetic devices and mechanical appliances of all types for the meeting of physical limitations. (2)

### Implications

Perhaps only two aspects of the same conviction are implied in this set of observations. The first implication is that hemiplegic cases should be evaluated for the potential value of functional braces to reduce contractures, prevent deformity of members, and aid function. The second implication is that all hospitals, agencies, and indeed practitioners of all specialties should be aware of the potential contribution of bracing techniques to the management of hemiplegic residuals.

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