A Survey of Rationales For and Against Hand Splinting in Hemiplegia

(spasticity, treatment theory, orthotics)

<table>
<thead>
<tr>
<th>Barbara E. Neuhaus</th>
<th>Mary V. Donohue</th>
<th>Susan R. Goldberg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eileen R. Ascher</td>
<td>Anne Einbond</td>
<td>Valerie L. Takai</td>
</tr>
<tr>
<td>Bridget A. Coullon</td>
<td>Jeanette M. Glover</td>
<td></td>
</tr>
</tbody>
</table>

This study investigated rationales underlying splinting decisions involving patients with hemiplegia. The survey incorporated a limited-choice, multiple-option questionnaire based on the case study of a man with a left hemiparesis at three hypothetical stages of recovery. Ninety-three occupational therapists who answered indicated whether they would or would not recommend a splint at each stage, and selected one or more reasons for their decisions. The respondents fell into three major categories: those who would 1. never splint, 2. always splint, and 3. splint only in the presence of moderate to severe spasticity. Those with longer clinical experience reflected more tendency to splint. The results indicated conflicting practices in splinting and showed the need for further clinical research in this area.

While the advance in knowledge about neurophysiological approaches to treatment increased the possibilities for treating both the spasticity and potential deformities that may occur following a cerebral vascular accident (CVA), it also raised questions about the wisdom of splinting the hemiplegic hand. At the present time, alternative methods of treatment are used with, or in place of, a splint; yet, there is little documentation, either theoretical or empirical, for determining when splinting would or would not be indicated. This further emphasized the need to look at practice as a realistic source of information.

With this consideration in mind,
the study addressed the following questions:

1. Do stages of recovery influence decisions about splinting in hemiplegia?
2. Do years of clinical experience have a bearing on these decisions?

Review of the Literature

A sequential review of hand splinting in hemiplegia indicated changes in treatment theories and techniques between 1856 (3) and the present. An overview of treatment approaches for hemiplegia identified two different directions, which began as early as 1918 (4). For clarification, these approaches will be labeled as the biomechanical approach (4) and the neurophysiological approach.

The biomechanical viewpoint primarily emphasized the prevention of deformity and contracture by mechanical means. The neurophysiological viewpoint, in addition to a focus on prevention of deformity, concentrated on the effects of spasticity and the use of movement and handling techniques to reduce spasticity and facilitate normal patterns of movement.

The literature published between 1911 (6) and 1950 reflected a viewpoint favoring the correction or prevention deformity by a direct mechanical application of splints, towel rolls, and sandbags (3). Proper positioning and passive range of motion were advocated in conjunction with splinting (7-9).

Neurophysiological treatment theories based on the work of Twitchell emerged in the 1950s (3). These theories either did not include splinting in their approach or directly opposed the use of the traditional resting splint (10-12). Although neurophysiological principles were of considerable influence in subsequent writings, the division of opinions on the approach to splinting persists. For example, Blashy and Fuchs (13), using the neurophysiological theories, devised the orthokinetic cuff that incorporated the concepts of facilitation and inhibition.

Three studies on splinting involved the use of neurophysiological theories: Brennan (14) stated that prolonged splinting decreases flexor tone; Kaplan (15) stated that dorsal splinting decreases flexor spasticity; Charait's study on volar versus dorsal splinting reported that dorsal splinting was more effective in decreasing muscle tone (16). This last reference was one of the few reports of empirical studies carried out by an occupational therapist.

Concurrent with the new theories and previously mentioned studies were articles and texts advocating the traditional biomechanical approach (17, 18). Questions regarding palmar versus dorsal splints in hemiplegia continued to be raised (19, 20). Zislis (21) reported reduction of flexor muscle activity when a dorsal splint was replaced by a palmar one; Long (22) supported
2.asha the second and third questions which were:

1. In this case, at the time of initial evaluation in OT, would you provide a splint? A splint, in this context, refers to any individually fabricated rigid orthotic device, which would aid in maintaining the hand in a functional position. Choose either YES or NO, then circle as many as are applicable within that category.

If yes, why?

a. To prevent deformity/contracture
b. To relieve edema
c. To prevent stretch of weak musculature
d. For sensory protection
e. At night only
f. To inhibit further spasticity
g. Distractibility of patients
h. Unilateral neglect
i. Preference for total UE positioning
j. Hand positioning with soft material (i.e., towel roll, foam roll)
k. Possibility of increasing existing edema
l. Possibility of increasing spasticity
m. PROM in place of splint
n. Concurrent intensive use of facilitation

If not, why not?

a. To prevent deformity/contracture
b. To relieve edema
c. To prevent stretch of weak musculature
d. For sensory protection

The same six reasons for and eight reasons for not providing a splint were repeated for the second and third questions which were:

2. After 6 weeks, if minimal spasticity is noted in the patient's finger flexors, and there is still no active motion, would you provide him with a splint? YEA NO

If your answer to number 2 was different from your answer to number 1, which of the following factors influenced your decision to (a) provide a splint, or (b) not provide a splint?

3. If, after 6 weeks from onset, Mr. P. still has no active motion in his left hand, has moderate to severe spasticity in the fingers, and has a partially fisted position of the hand, would you recommend a splint?

YES NO

If your answer to number 3 was different from your answer to numbers 1 and 2, which of the following factors influenced your decision to (a) provide a splint, or (b) not provide a splint?

Therapists were free to select one or more of the rationales for either the Yes or the No response.

Question 4 gave the respondents an opportunity to rank by importance the factors that influenced their decisions with regard to splinting, as indicated in Table 2.

This Caldwell, Wilson, and Braun (23) encouraged splinting of the "neglected spastic flexed wrist" (p 80) in the patient's current position to provide support without pain. These authors discussed the use of concurrent neurophysiological approaches to developing better motor control. Fuchs and Fuchs (24) described in detail a corrective brace made from parts of Erector sets in which they advocated "gentle, continuous pressure...to maintain..." and invidual correction of the fingers "by an outrigger or reverse knuckle bender" (p 88). Two additional authors (25, 26) discussed modifications of the resting splint.

As recently as the 1970s, two physical medicine textbooks (27, 28) continued to maintain the traditional biomechanical approach toward hand splinting in hemiplegia. One of these authors (28) stressed the prevention of painful deformities caused by spasticity as a rationale for hand splinting but did not otherwise address the issue of spasticity. Simultaneously, occupational therapy literature revealed further application of neurophysiological principles to splinting methods, as exemplified by the orthokinetic splint (29). Doubilet and Polkow (30) discussed a trial with the Bobath finger spreader made of nonrigid foam rubber without wrist support that, according to Bobath (31), has a "more dynamic effect" (p 108) than a cock-up splint. Two other earlier authors (32) repeated the biomechanical rationales but added the issues of dorsal/volar and day/night splinting during spasticity. These articles illustrate how several authors adjusted their own treatment approaches between 1969 and 1978 (30, 32).

Most recently, Snook (33) reported preliminary findings on the use of a dorsal spasticity reduction splint as an adjunct to the Bobath approach with two patients.

Trombly and Scott (34) discussed prevention of deformity of the upper extremity of the patient with hemiplegia by correct positioning and splinting "although the latter is controversial" (p 114). In the latest edition of Willard and Spackman's Occupational Therapy, Spencer (35) equally made reference to splinting in hemiplegia as "a controversial subject among physicians, physical therapists and occupational therapists" (p 354). These were the only acknowledgments of the current lack of agreement about indications for or against splinting in hemiplegia.

The variety of approaches identified through a review of the literature increased questions about current practice and provided direction for the subsequent investigation.

Method

Design and Instrument. The study involved a survey design in which data were collected using a branch-
ing survey checklist. The questionnaire, a limited choice, multiple-option format, was field tested in four New York hospitals and further refined before distribution. This questionnaire evolved from one developed by Einbond (36) in her survey of occupational therapists' criteria for hand splinting in hemiplegia, a study submitted in partial fulfillment of the requirement for the Master of Science Degree at Columbia University. Questions used were based on background information provided by a brief case study of a 66-year-old man with a diagnosis of right CVA with left hemiparesis (Figure I).

**Population.** The population selected for the study included 42 facilities in the greater New York area where occupational therapists were treating acute and long-term patients with neurological disorders. Questionnaires were returned by 34 facilities, an 80 percent response. One hundred occupational therapists responded to the mail questionnaire; 7 questionnaires were omitted because of incomplete data. Thus, 93 became the sample population. In the case of a mail questionnaire, the study population is based on self-selection and consists only of individuals who chose to respond (37). The 93 respondents fell into four natural groups according to years of experience, as follows:

Less than one year ............ 20  
One to six years ............. 47  
Six to 15 years ............ 19  
More than 15 years ........... 7  

The question of whether theory determines, or is determined by, practice becomes relevant when theoretical issues are addressed in a practice profession. The lack of a clear theoretical statement to guide practitioners in treatment becomes apparent when seemingly conflicting decisions are made simultaneously concerning a sizeable patient population.

This pilot study was designed to indicate what was occurring in hand splinting in treatment of hemiplegia. The purpose of the study was to determine factors that influenced decisions about splinting: first, at various points of recovery from a cerebral vascular accident, and second, at various levels of clinical experience.

**Statement of the Problem**
In 1976, an estimated 414,000 Americans were hospitalized as a result of a cerebral vascular accident (CVA). With an estimated direct cost for services for these individuals put at $3.26 billion per year (1), this disability will continue to hold a position of prime importance in the national health care picture. The impact of the large number of persons living with the residuals of a CVA was reflected in the employment statistics compiled from AOTA's 1977 Member Data Survey that indicated 27 percent of the total patient population of occupational therapists were persons with CVA/Hemiplegia (2). Questions about the management of spasticity and prevention of deformity, both of

---

### Table 1
Comparison of Therapists' Responses According to Years of Experience by Patterns of Yes/No Responses

<table>
<thead>
<tr>
<th>Yes/No Patterns of Responses</th>
<th>Under 6 Years (n = 67)</th>
<th>6 Years or More (n = 26)</th>
<th>Total (n = 93)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y-Y-Y</td>
<td>9 (13)</td>
<td>5 (19)</td>
<td>14 (15)</td>
</tr>
<tr>
<td>(n = 14)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y-Y-N</td>
<td>2 (3)</td>
<td>1 (4)</td>
<td>3 (3)</td>
</tr>
<tr>
<td>(n = 3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-Y-Y</td>
<td>5 (8)</td>
<td>3 (12)</td>
<td>8 (9)</td>
</tr>
<tr>
<td>(n = 8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-N-Y</td>
<td>33 (49)</td>
<td>13 (50)</td>
<td>46 (56)</td>
</tr>
<tr>
<td>(n = 46)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-N-N</td>
<td>18 (27)</td>
<td>4 (15)</td>
<td>22 (24)</td>
</tr>
<tr>
<td>(n = 22)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total                        | 67 100                   | 26 100                   | 93 100        |

---

Downloaded From: http://ajot.aota.org/ on 10/10/2018 Terms of Use: http://AOTA.org/terms
which influence cost of health care, demanded priority consideration in program planning for these patients.

Results
The analysis of data was based on a sample provided by 93 therapists. The responses to questions 1, 2, and 3 revealed three major patterns: Yes-Yes-Yes (Y-Y-Y) = 14, or those who would splint in all three situations; No-No-No (N-N-N) = 22, or those who would not splint under any of the conditions; and No-No-Yes (N-N-Y) = 46, or those who would splint only if spasticity became moderate-to-severe. Two other patterns with a total of 11 responses (Y-Y-N = 3 and N-Y-Y = 8) were included only in the profile of the total population. Table 1 presents the composite distribution of response patterns according to years of experience. The disproportionate number of respondents who had less than six years of experience corresponded to an approximate ratio of 3 to 1.

The positive relationship between spasticity and splinting is illustrated by Figure 2, indicating the percentages of the more and less experienced respondents to the three questions who would or would not splint. Initially, only 18 percent of the total population splinted; with moderate to severe spasticity, 75 percent splinted. When these subsamples were divided according to experience, 81 percent of the more experienced would splint under at least one of these conditions, while only 70 percent of the less experienced therapists would do so. A chi-square test was performed for each of the three questions. There was no significant difference between those with greater or lesser experience under any of the three conditions.

In order to show more clearly the
Table 2
Rankings Selected for Splinting Rationales

<table>
<thead>
<tr>
<th>Rationales</th>
<th>No Importance</th>
<th>Minor Importance</th>
<th>Moderate Importance</th>
<th>Major Importance</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danger of deformity/contracture</td>
<td>2</td>
<td>6</td>
<td>18</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Extent of edema</td>
<td>4</td>
<td>15</td>
<td>33</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Protective sensation</td>
<td>13</td>
<td>29</td>
<td>30</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Loss of proprioception</td>
<td>22</td>
<td>34</td>
<td>19</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Danger of stretching weak muscles</td>
<td>6</td>
<td>21</td>
<td>34</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Positioning</td>
<td>0</td>
<td>6</td>
<td>10</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>Presence of spasticity</td>
<td>1</td>
<td>7</td>
<td>23</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>Presence of pain</td>
<td>5</td>
<td>17</td>
<td>24</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

variations in rationales for and against splinting with reference to spasticity, only the three major response patterns were further analyzed \((n = 82)\). Frequency distribution of the rationales reflected the progression of spasticity. In the \(Y-Y-Y\) group, the most frequently selected reasons for splinting were for the prevention of edema (78%), fear of stretching weak musculature (78%), and deformity (71%). In the \(N-N-N\) group, passive range of motion was preferred to a splint by 90 percent; total upper extremity positioning by 77 percent and possible increase of spasticity by 72 percent. In the \(N-N-Y\) group, the move toward splinting was made to prevent deformity (91%); to inhibit further spasticity (52%); and by application of a night splint, only 30%). This same group had refused to splint initially for the same two reasons as the \(N-N-N\) group, but 58 percent added the use of concurrent facilitation as their third most important rationale for not splinting. In comparing the \(N-N-N\) and \(N-N-Y\) responses, the only rationale that shifted noticeably was that which dealt with spasticity. This moved from third in \(N-N-N\) to sixth in \(N-N-Y\).

In question 4, which employed an ordinal ranking scale, the respondents ranked by importance the factors that influenced their decisions (see Table 2). In combining the Major and Moderate Importance categories, there is an overwhelming emphasis on positioning (89%), danger of deformity (90%), and spasticity (87%). The two factors that least influenced the splinting decisions of the respondents were loss of proprioception and protective sensation. Twenty-two and 13 percent, respectively, considered these of no importance.

In summary, given the described situation, 14 therapists reported they would always splint, 22 would never splint, whereas 46 would splint only under conditions of moderate to severe spasticity. When the responses of these 82 therapists are compared on questions 1 and 3, a total of 60 (73%) would recommend a splint under the conditions of moderate to severe spasticity, whereas only 22 (17%) did so initially.

Discussion
In discussing the results of the forced-response format used for this study, it must be remembered that the responses are based on a single case study and the conditions set by a questionnaire that allowed only a Yes or No response. Therefore, readers are cautioned about making generalizations from the data presented.

The investigators began the study with two assumptions: first, that the literature would provide guidelines or directives that might explain the origins of prevailing rationales for or against splinting under certain conditions; and second, that there would be a difference in splinting decisions between therapists with greater or lesser experience. The second assumption was partially borne out by the results; the first was not.

Nearly three-fourths of those responding to the questionnaire had six years or less of work experience in occupational therapy; 22 percent had one year or less. Their experience with hemiplegia was therefore
limited, and their decisions about splinting were possibly not based on repeated trials with patients. New therapists may follow the established treatment procedures of the facilities where they are employed, and questions about treatment approaches might not be raised until greater confidence has been established. Nonetheless, a proportionately smaller number of less experienced therapists reported that they always splinted, whereas conversely, a proportionately larger number would never splint.

How many of their responses reflected academic and clinical education and how many were influenced by decisions within each department cannot be determined. Furthermore, a survey inquiry merely gathers data on intent.

Attempts to find explanations in the literature proved disappointing. Information on splinting in hemiplegia is limited not only in quantity but also in scope and depth. Research focuses primarily on the virtues of a particular type of splint, but no studies were located comparing a splinted to a nonsplinted population. Furthermore, since 1968 there has been no documentation of empirical research that compared the effects of two or more types of splints, despite the heightened controversy in practice.

The inconsistencies found in the writings of both therapists and physicians regarding splinting of patients with hemiplegia are reflected in current practice. For example, seemingly conflicting treatment approaches, such as passive range of motion and simultaneous use of facilitation techniques, were reported by a number of respondents. This may have been more a reflection of confused terminology than of conflicting theories. Passive range of motion, which in the earlier writings was used to describe a mechanical intervention, has in addition, come to mean elongation of shortened muscles for inhibition of spasticity, as shown in neurophysiological approach of the Bobaths (31).

Another type of inconsistency, however, is shown when the same reasoning is used to support opposite approaches. The same rationales that led one group of respondents to indicate that they favored splinting under the given condition, led another group to veto splinting. Similarly, of those who had initially chosen not to splint, indicating specifically that they feared the possibility of increasing spasticity through splinting, more than half decided to splint to inhibit further spasticity when the patient’s tone increased to a moderate or severe degree. It was at this point that two prevailing rationales could be compared: the rationale that splinting might increase spasticity versus the rationale that splinting would inhibit further spasticity. Apparently, for these therapists, the inhibition rationale for splinting exerted a stronger influence than their earlier fear that a splint might increase the spasticity.

In spite of revisions and field-testing, the questionnaire ultimately did not provide information on some of the underlying factors influencing the therapists’ decisions. Given the political, administrative, and financial realities of current clinical practice, theoretical principles may not have been the primary consideration.

In view of these limitations, the authors took the stance of investigators attempting to find historical and theoretical explanations for what was reported in the surveyed population. In analyzing the content of the responses, numerous questions arose that clearly point up the need for further clinical research in this area:

1. Politically, who or what determines whether or not a splint is provided? Is this decision based on inter- or intradepartmental policy?

2. Administratively, are there institutional factors that seem to preclude the follow-through of splinting application or of alternative suggestions for positioning of patients?

3. Financially, are time and cost additional considerations?

4. Theoretically, are decisions made on a neurophysiological or biomechanical basis? Within a department, are philosophies eclectic or adhering to one approach?

5. Empirically, which method works? How much, if any, spasticity is desirable to recovery of function? What role should splinting play in this?

Summary and Conclusions
This pilot investigation attempted to find a link between the theoretical foundations of splinting in hemiplegia with currently prevailing rationales for and against splinting as indicated by 93 occupational therapists on a mail questionnaire. Using a case study of a patient with a left hemiplegia, the forced-response survey presented three situations that described the patient’s condition and asked for decisions for and against splinting at that moment. Three major patterns of responses emerged: those who would always splint \( n = 14 \); those who would never splint \( n = 22 \); and those who would splint only under conditions of moderate to severe spasticity \( n = 46 \). The rationales for and against splinting were identified and ranked by frequency. In addition, the study sample was split into two groups according to levels of experience; those
REFERENCES

1. National Institute of Neurological Disorders. Four hundred stroke cases are
Newspaper 33: 2, 3 1979
3. Twitchell T: The restoration of motor function following hemiplegia in man. In
4. Ogden R: Systematic therapeutic exercise in the management of the paralysis
7. Covalt DA: Rehabilitation of the hemiplegic patient. Phys Ther Rev 29: 515,
1949
Am Med Assoc 65: 366, 1915
10. Brunnstrom S: Associated reactions of the upper extremity in adult patients
with hemiplegia—an approach to training. Phys Ther Rev 36: 225-236, 1956
Heinemann Medical Books, Ltd., 1971
12. Rood M: Neurophysiological reactions as a basis for physical therapy. Phys
Ther Rev 34: 444-445, 1954
Occup Ther 13: 226, 1959
Brit Med J 1: 1504-1507, 1959
15. Kaplan N: Effect of splinting on reflex inhibition and sensorimotor stimulation
Assoc 169: 224-229, 1959
19. Licht S: Rehabilitation and Medicine, New Haven: Elizabeth Licht, Publisher,
1966
20. Licht S: Rehabilitation and Medicine, New Haven: Elizabeth Licht, Publisher,
1968
Med Rehabil 45: 41, 1964
New Haven: Elizabeth Licht, Publisher, 1966
23. Caldwell CB, Wilson DJ, Braun RM: Orthopedic management of stroke. In
Clinical Orthopedics and Related Research, WL Nickel, Editor. 63: 80, 1969
26. Jordan RJ: Occupational therapy. In Rehabilitation and Medicine, S. Licht,
Editor. New Haven: Elizabeth Licht, Publisher, 1968
27. Krusten FH, Kottke FJ, Ellwood PM: Handbook of Physical Medicine and
28. Moshman PL: A Problem-Oriented Approach to Stroke Rehabilitation,
Springfield, IL: Charles C Thomas, 1976
29. Farber S, Huss AJ: Sensormotor Evaluation and Treatment Procedure for
Allied Health, Indiana University: Purdue University Press, 1974
30. Doubilet L, Polkow LS: Theory and design of a finger abduction splint for
London: William Heinemann Medical Books Ltd., 1978
32. Wilson DJ, Caldwell C: Central control insufficiency III. Disturbed motor
control and sensation: A treatment approach emphasizing upper extremity
34. Trombly CA, Scott AD: Occupational Therapy for Physical Dysfunction,
354, 1978
the requirement for the degree of Master of Science, available from Columbia
University, New York, New York, 1978

Acknowledgments

The study reported in this paper was supported in part by an Obrock Research Grant from the American Occupational Therapy Foundation.

The authors wish to acknowledge the advice and assistance given by Yasoma Challenor, M.D., Stanley Fisher, Ph.D., and Gordon Williamson, Ph.D., OTR, Joanne Stephan, Sc.D., and Ed Brubaker for editorial help. Sincere appreciation is expressed to the 100 therapists who participated in the study.