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The Effect of Resting Hand Splint on Hand Pain and Edema among Patients with Stroke

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Abstract: *Stroke patients often decreased upper extremity function that occurred pain and edema. We researched the effects of resting hand splints on hand pain and on edema in patients with stroke in the acute stage. Participants were randomly allocated to the experiment group (n=15) or the control group (n=15). All participants were treated with general rehabilitation treatment for 30 mins / daily, five days / week, for 12 weeks. In addition, participants in the experiment group wore resting hand splints. The data collected for the study were analyzed using SPSS version 18.0. The statistical significance level was set at α=.05. According to the intervention, the changes in the experimental group proved significant differences. By contrast, significant differences were not seen in the control group. In comparing the changes between the groups, significant differences were found in the experiment group in Visual Analogue Scale and in volume of hand, but not in Modified Ashworth Scale. This study researched the effects of resting hand splints on pain and edema in hands of patients in the acute stage of stroke. Significant decreases were found in hand pain and edema in experiment group. Therefore, resting hand splint will in turn contribute to improved upper limb function in stroke patients.*

Keywords: Edema, Pain, Resting hand splint, Spasticity, Stroke.

Introduction

After stroke, patients often experience loss of range of motion (ROM) and decreased upper extremity function due to muscular weakness, spasticity, hypoesthesia, and joint deformations in the upper extremity Pizzi A. *et al* (2005). They can also cause pain, edema, and decrease in range of joint motion, and these complications prevent patients from fully engaging in daily activities, cause depression, and decrease quality of life Boomkamp-Koppen H. *et al* (2005). Therefore, prevention of pain and edema in stroke patients in the acute stage is an important part of rehabilitation therapy Elovic E. *et al* (2005). Resting hand splints used as a part of various treatment intervention methods has in general been considered appropriate for decreasing edema, increasing range of joint motion, and decreasing pain from upper limb hypertonia in adult patients. The method is also reported to be effective in decreasing pain and edema and in improving upper limb function Pizzi A. *et al* (2005), McPherson JJ *et al* (1982) .On the other hand, resting hand splint effects have been evaluated in other systematic review but its effectiveness was not proven. Reports indicate that its effects are disputable over various clinical purposes, splint patterns, various materials, contradictory theoretical backgrounds, and resultant treatment. The basis for objectifying resting hand splint effects is insufficient, and as a result, it is controversial to apply resting hand splints Lannin NA. *et al* (2003).In response, were searched the effects

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of resting hand splints on hand pain and on edema in patients with stroke in the acute stage.

Literature review

In this study, resting hand splint application in patients with stroke in the early stage showed a statistically significant decrease in hand pain. Wilton J C *et al* (1997) reported that pain often occurs in the upper extremity of patients with stroke in the acute stage. Burge E *et al* (2008) reported that resting hand splints are effective in decreasing hand pain. In a report which supports the results of this study, resting hand splints were shown to give patients comfort by minimizing skin friction and irritation, which effectively relieved pain. Pizzi A *et al* (2005) reported that this decrease in hand pain was more common in acute stage stroke patients than in chronic stroke patients. The results of this study were effective because it was conducted with patients experiencing the acute stage of stroke. By contrast, Lanin NA *et al* (2003) reported in a systematic review that resting hand splints were not effective. The results lacked objectivity due to the limitations of a decrease in methodological quality and a lack of cases, as it was a single study case. Lanin NA *et al* (2003) also neglected in a randomized controlled trials (RCTs) study to prove that resting hand splints decrease pain. Resting hand splints can bring about different study results depending on application period, daily wearing hours, and splint shapes Neuhaus B *et al* (1981). Therefore, the negative effects achieved in the short study period of 4 weeks do not seem objective. In our study, positive effects were achieved by applying a sufficient amount of time (12 weeks). Edema-decreasing effects were achieved by applying resting hand splints to patients with post stroke in the early stage. Edema, an excessive accumulation of coelomic fluid, is seen in patients with post stroke in the early phase by spasticity in fingers and wrists, sensory deficits in hands, sweating, and pain with burning sensation Kosir M A *et al* (2001). Hand edema refers to hand swelling in hemiplegic patients caused by venous circulatory disturbance in upper limbs Calliet R *et al* (1980). Gracies JM *et al* (2005) proved edema decreasing effects in their study by applying Lycra hand splints which had a positive effect, working together with changes in wrist position and spasticity decreasing effects in hands. In our study, edema decreases are considered to be affected by spasticity-decreasing effects in wrists. Boomkamp-Koppen H *et al* (2005) also demonstrated the correlation between edema and finger stiffness in their study, which supports our study's results.

Our study had the following limitations: small number of participants, conducted in combination with general rehabilitation treatment, and the possible presence of natural recovery effects appearing in acute stage stroke patients.

Proposed Work

Subjects

This study targeted patients diagnosed with stroke at K University Hospital in Seoul. Thirty patients who met the criteria were selected and agreed voluntarily to participate in the study. The selection criteria are as follows: (1) adults must be over 19 years old, and must voluntarily give consent;(2) participants must have amini-mental status examination (MMSE-K)score of 24 or greater and have no communication problems; (3)participants must have pain and edema in the paralyzed hand; and (4) hemiplegic patients must be diagnosed with stroke in the acute stage between 2 and 6 months.

Materials

Pain was evaluated using a visual analogue scale (VAS), which is evaluated by the participants' subjective judgments, but has high validity and reliability, and is widely used as a pain evaluation scale Price D (1983) Arruda J *et al* (1999). Edema was scaled, using a hand voltmeter

(Preston, A Bissell, and Miami, USA), measuring objective degrees of edema and utilizing moving water. The forearms were measured for both normal and paralyzed sides by submerging them in water up to the mid-point between the wrist and the wrinkles of the inner side of the elbow, and differences were used to indicate degree of edema Burge E *et al* (2008). Stiffness was evaluated using a Modified Ashworth Scale (MAS) while stretching the wrist joint rapidly from the wrist flexion muscles in accordance with the degrees of joint movement ranges at which the person feels resistance, designating rank of stiffness Sloan RL *et al* (1992).

Methods

Participants were randomly allocated to the experiment group (n=15) or the control group (n=15). All participants were treated with general rehabilitation treatment for 30 minutes daily, five days a week, for 12 weeks, together with a general rehabilitation treatment. Participants in the experiment group wore resting hand splints (designed and manufactured to provide comfort with the least amount of stiffness resistance in the joint movement range of wrist extension angles from 10°to30°, which is the wrist functioning position) for a maximum of 10 hours daily. These participants also acquired a general rehabilitation treatment Lannin NA *et al* (2003).The study design is shown in figure 1**.**

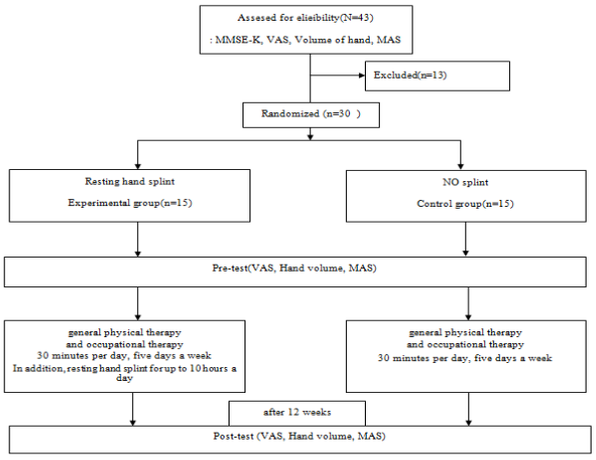

Fig. 1 Trial Profile

Results

The data collected for the study were analyzed using SPSS version 18.0 for Windows. To analyze participants' general characteristics, frequency analysis and chi-squared test were used. An independent sample t-test was conducted to test the homogeneity of the two groups before intervention; a paired sample t-test was conducted to test the changes before and after intervention; an independent samples t-test was conducted to compare the degree of changes between the groups before and after intervention. The statistical significance level was set at α=.05.

Significant differences were not found between the two groups in the homogeneity test before intervention. The general characteristics of the participants are described below in Table 1.

Before and after the intervention, the changes in the experimental group are shown significant differences in VAS, volume of hand, and MAS. By contrast, significant differences were not seen in the control group in VAS, volume of hand, and MAS, either before or after intervention. In comparing the changes between the groups, significant differences were found in the experiment group in VAS and in volume of hand, but not in MAS. (Table 2)

Table 1. Characteristics of participants

Characteristics	Experimental Group (n=15)	Control group (n=15)
Age(year), mean ± SD	62.13±9.81	59.20±11.01
Gender (male/ female)	9/6	8/7
Type of stroke (Hemorrhage/ Infarction)	7/8	5/10
Side of stroke (Right/Left)	6/9	10/5
Time since onset of stroke months, mean ± SD	3.27±1.22	3.87±1.24

SD: standard deviation.

Table 2. Comparison of results between Experimental group and Control group

	Experimental group			Control Group		
	Before treatment	**After treatment**	**Mean difference**	**Before treatment**	**After treatment**	**Mean difference**
VAS	5.07(1.43)	3.53(1.30)*	–1.53(1.24)†	5.40(1.24)	5.13(1.18)	–0.27(0.59)
Volume of hand	571.60(110.14)	547.27(100.98)*	24.33(24.75)†	569.00(100.69)	565.33(100.88)	–3.67(6.93)
MAS	1.33(0.61)	0.60(0.63)*	–0.73(0.59)	1.40(0.63)	1.13(0.64)	–0.40(0.63)

The values are mean ± standard deviation, VAS: Visual AnalogueScale,
MAS:Modified Ashworth Scale
*p<0.05 by Paired *t* test, †p<0.05 by Independent *t* test.

Conclusion

This study researched the effects of resting hand splints on pain and edema in hands of patients in the acute stage of stroke. Significant decreases were found in hand pain and edema in the group that was treated with the combined treatment of general rehabilitation treatment and resting hand splints, but not in the control group that was treated only with general rehabilitation treatment. Therefore, the author expects a positive treatment effect in patients with in the acute stage of stroke in hand pain and edema after applying resting hand splints, which will be in turn contribute to advance upper extremity function and Activities of Daily Living enhancement in post stroke patients.

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