*Critically Appraised Topic Template*

Title: There is limited evidence supporting the use of resting hand splints to reduce spasticity in the upper extremity in adults post-CVA when compared to therapy alone.

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CLINICAL SCENARIO –

Condition/Problem: A cerebrovascular accident (CVA) occurs when there is an interruption of blood supply to the brain resulting in a lack of oxygen and nutrients, ultimately causing cell death. CVA's can result from a blocked artery (ischemic stroke) or from leakage of a blood vessel (hemorrhagic stroke). Depending on the part of the brain that is affected, a CVA may cause: paralysis, abnormal muscle tone, spasticity, weakness, numbness, aphasia, dysphagia, cognitive limitations, emotional problems, depression, pain, and inability to perform self-care activities. Spasticity as a result of CVA can lead to muscle shortening, contracture formation, pain from muscle spasms, edema, loss of function, poor hygiene, and impaired body image (Basaran et al,. 2012).

Incidence/Prevalence: CVA is the fifth leading cause of death in America, with approximately 185,000 people dying from a CVA each year (National Stroke Association). CVA is also the leading cause of serious long-term disability ("Stroke Facts," 2015). Currently, there are approximately 7 million living CVA survivors. Of those that survive a CVA, nearly 2/3 require rehabilitation (National Stroke Association).

Impact of the problem on Occupational Problems Individuals who have increased spasticity as a result of a CVA often experience difficulties in completing occupations, especially those that require bilateral upper extremity use. Patients with spasticity may have difficulties with upper and lower body dressing, self-care activities and grooming, meal preparation, toileting, leisure activities, driving, and other IADL tasks. The fact that spasticity occurs in conjunction with other factors such as decreased muscle strength, decreased sensation, and cognitive problems, leads to further decreased function and participation.

Following CVA, depression is common and can affect motivation and persistence to complete ADLs, IADLs, work, and leisure activities. The client's roles that they once had (caregiver, worker, or family member) may change following the CVA, leading to a decreased sense of self-worth or self-image. Relationships with others may be negatively affected as the person has increased dependence on others to complete ADL/IADL tasks. In addition, limited function may mean decreased social participation, which may also negatively affect relationships. Common cognitive problems following a CVA include difficulties with problem-solving, new learning, and sequencing, along impaired judgment and memory problems, all of which can lead to impaired occupational performance (Raju, Sarma, & Pandian, 2010).

Intervention: Following a CVA, it is typical for a patient to experience motor deficits, including spasticity. One intervention used to treat spasticity is resting hand splints. Resting hand splints provide a slow and prolonged stretch to the muscles and ligaments in the upper extremity. The intended purpose of this stretch is to reduce spasticity, prevent contractures, and increase function of

the upper extremity. These splints are meant to be worn for long periods of time, typically at night. Resting hand splints can be created to be worn on either the volar or dorsal side of the patient's upper extremity.

In the research articles included in our research synthesis, the intervention groups in Basaran et al. (2012) and Lanin et al. (2006) wore the splint for 9-12 hours per night for 4-5 weeks whereas Pizzi, et al., (2005) required the splint to be worn 90 minutes per day for 3 months.

OT theoretical basis: The frame of reference that splinting is based off of is the biomechanical frame of reference. The biomechanical frame of reference focuses on remediating client factors such as strength, range of motion, endurance or balance in order to increase function and occupational performance. This is often done through exercise and/or positioning. Splinting is a form of positioning, which aims to increase range of motion by reducing spasticity, thus remediating a client factor.
The main goal of utilizing splinting to reduce spasticity is to position clients in a way that provides a stretch to connective tissues (Basaran et al., 2012).

Science behind the intervention: The mechanism of change behind using resting hand splints to reduce spasticity is biomechanical and neurophysiological. The biomechanical mechanism of change occurs with a slow and prolonged stretch that leads to increased elasticity of the connective tissues (Basaran et al., 2012). The neurophysiological mechanism of change involves the inhibition of the reflexive synergistic contraction of muscles. Splinting is thought to reduce spasticity through these mechanisms in order to improve joint activity, provide joint integrity, reduce pain, and prevent contractures. Ultimately, the result is intended to be improved function and occupational performance (Lannin & Ada, 2011).

Why the intervention is appropriate for OT: Although other professionals may construct or prescribe splints for their patients, splinting is within an occupational therapist's scope of practice. Specifically, splinting is included in the occupational therapy framework as a preparatory method. Splinting prepares the upper extremity to perform occupations by decreasing spasticity, preventing contractures, and increasing range of motion.

FOCUSED CLINICAL QUESTION:

Are resting hand splints, when compared to therapy alone, effective at decreasing spasticity in the upper extremity for adults post cerebrovascular accident?

SEARCH SUMMARY

The databases we used to find our articles included google scholar, Murphy library, PEDro, National Rehabilitation Information Center, and Cochrane (5 total data bases). The total number of relevant articles located was 5 with varying strengths. One article was rated as strong, two were rated as moderate, two were rated as limited, and one was rated as no evidence. We chose the three articles to critique based off of their strength, rigor, and the year they were published. We did not chose the systematic review because it contained almost all of our other articles we had found. The literature of this intervention was limited because it is a fairly new idea that resting hand splints

| Search Terms | Inclusion and Exclusion Criteria |
|---|---|
| Spasticity<br>Post Stroke<br>CVA<br>Splinting<br>Resting Hand Splint<br>Therapy techniques | Inclusion: measuring spasticity, post CVA patient, using splint as intervention<br><br>Exclusion: articles prior to the last ten years, non-English |

may not be as effective at reducing spasticity as the profession once believed. Due to the limited amount of research on this topic, we had to use one research study with low rigor.

CLINICAL BOTTOM LINE:

There is limited evidence supporting the use of resting hand splints to reduce spasticity in the upper extremity in adults post-CVA when compared to therapy alone.

Limitation of this CAT: This critically appraised paper (or topic) has been reviewed by occupational therapy graduate students and the course instructor.

TABLE 1: SEARCH STRATEGY

TABLE 2: SUMMARY OF STUDY DESIGNS OF ARTICLES RETRIEVED

| Level | Study Design/ Methodology of Articles Retrieved | Total Number Located | Citation (Name, Year) |
|---|---|---|---|
| 1a | Systematic Reviews or Meta-analysis of Randomized Control Trials | 1 | Lannin, N.A., Herbert, R. D., (2003) |
| 1b | Individualized Randomized Control Trials | 2 | • Basaran, A., Emre, U., Karabavut, K. I., Balbaloglu, O., Bulmus, N. (2012)<br>• Lannin, N., Cusick, A., McCluskey, A., & Robert, H.D. (2006) |
| 2a | Systematic reviews of cohort studies | | |
| 2b | Individualized cohort studies and low quality RCT's (PEDro ≤4) | 2 | • Pizzi, A., Carlucci, G., Falsini, C., Verdesca, S., Grippo, A. (2005)<br>• Langlois, S., Pederson, L., & Mackinnon, J. R. (1991) |
| 3a | Systematic review of case-control studies | | |
| 3b | Case-control studies and non-randomized controlled trials (quasi experimental or clinical trials) | | |

| | | | |
|---|---|---|---|
| 4 | Case-series and poor quality cohort and case-control studies | | |
| 5 | Expert Opinion | 1 | Lannin, N. & Ada L. (2011) |

STUDIES INCLUDED

| | Study 1<br>Pizzi, Carlucci, Falsini, Verdesca, Grippo | Study 2<br>Lannin, Cusick, McCluskey, Herbert | Study 3<br>Basaran, Emre, Karadavut, Balbaloglu, Nercivan |
|---|---|---|---|
| Design | Pretest-postest Quasi Experimental design | Randomized control trial | Single-blind, randomized control trial, pre-post study |
| Level of Evidence | Limited, 2B | Moderate, 1B | Moderate, 1B |
| Rigor Score | 4 | 10 | 8 |
| Population | 40 patients with hemiplegia and upper-limb spasticity, with a score >1, after CVA at least 4 months before with no functional movements | 63 patients who experienced a CVA within 8 weeks of the study and had no active wrist extension | 36 patients with a history of a single CVA averaging about 39 months prior to the study and a wrist MAS score >+1 |
| Intervention Investigated | Resting hand splint<br>Type of splint:<br>Custom-fitted volar splints in a functional resting position with wrist in 30 degrees of extension, normal transverse arch thumb in abduction and opposition with the pads of the 4 fingers, and metacarpal and proximal interphalangeal joints in 45 degrees of flexion | Resting hand splint with therapy<br>Types of splint:<br>-resting position group (hand splint positioned in 0-10 degrees of extension)<br>-extension group (hand splint with wrist at comfortable end-range position) | Resting hand splint with therapy<br>Type of Splint:<br>Volar or dorsal splint at a comfortable end-range position |
| Comparison Intervention | No comparison intervention (no control group) | Therapy alone with no splinting | Therapy alone with no splinting |
| Dependent Variables | -Spasticity at the elbow and wrist (clinically)<br>-Joint mobility<br>-Pain<br>-Spasticity (physiologically)<br>-Spasms | -Wrist extensibility<br>-UE function<br>-UE spasticity<br>-Self-reported disability/symptoms | -Spasticity of FCR muscles (clinically)<br>-Spasticity of FCR muscles (physiologically)<br>-Joint mobility (wrist extension) |
| Outcome Measures | -Modified Ashworth Scale (MAS)<br>-PROM<br>-Visual analog scale<br>-H-reflex/Mmax ration (measures spasticity) | -Wrist extension ROM with MCP and IP joints extended<br>-Motor Assessment scale<br>-Tardieu scale | -Motor assessment scale (MAS)<br>-H latency & Hmax: Mmax ratio<br>-PROM<br>Duration of use |

| | | | |
|---|---|---|---|
| | -Comfort and time of splint application | -Disabilities of the arm, shoulder and hand (DASH) | |
| Results | There was a significant p value of <.002 for elbow spasticity, but no other statistical significant results for any other measurements of spasticity. | No statistical significant results were found for any measurement of spasticity in any joint. | No statistical significant results were found for any measurement of spasticity in any joint. |
| Effect Size | For elbow spasticity: -.52 | Not calculated | Not calculated |
| Conclusion | There was a decrease in elbow spasticity with the use of splinting, but due to the poor strength of the study, we cannot make any conclusions. | There was no decrease in UE spasticity with the use of splinting and therapy. | There was no decrease in UE spasticity with the use of splinting and therapy. |

SYNTHESIS SECTION:

PICO Question: Are resting hand splints, when compared to therapy alone, effective at decreasing spasticity in the upper extremity for adults post-CVA?

Overall Conclusions:

Terms:
Spasticity is a motor disorder that is defined by an increased stretch reflex within the muscle that is velocity-dependent classified as an upper motor neuron syndrome (Lannin & Ada, 2011).
Chronic CVA: participants that were 8 or more weeks post-CVA at time of the study.
Acute CVA: participants that were less than 8 weeks post-CVA at time of the study.

Wearing Schedule: Basaran, et al. (2012), and Lannin, et al. (2006), required the splint to be worn 9-12 hours per night for 4-5 weeks whereas Pizzi, et al., (2005) required the splint to be worn 90 minutes per day for 3 months.

Point in recovery post-CVA: On average participants experienced a CVA 17 months prior to the study (Pizzi, et al., 2005), 27.6 days prior to the study (Lannin, et al., 2006), and 37.9 months prior to the study (Basaran, et al., 2012).

Type of Splint: In Pizzi et al. (2005), participants wore custom-fitted volar splints in a functional resting position with wrist in 30 degrees of extension. In Lannin et al. (2006), participants wore custom-fitted static volar splints in either 0-10 degrees of extension (resting position) or greater than 45 degrees of wrist extension (comfortable end-range position). In Basaran et al. (2012), participants wore either volar or dorsal splints at a comfortable end-range position.

Treatments used in Combination with Splint: In addition to splinting, participants in Basaran, et al., received a home based exercise program that included motor training and stretching (2012). In

Lannin, et al, participants received "typical rehab services" which included stretching in addition to splinting (2006). Pizzi, et al. used no other treatment aside from splinting (2005).

Outcome Measures: In Pizzi et al. (2005), the following outcome measures were used: Modified Ashworth Scale (MAS-measures clinical spasticity), PROM using goniometers (measures joint mobility), visual analog scale (measures pain), H-reflex/Mmax ratio (measures physiological spasticity), and Penn Spasm Frequency Score (measures spasms). In Lannin et al. (2006), the following outcome measures were used: wrist extension ROM with MCP and IP joints extended (measures joint mobility), Motor Assessment Scale (measures UE function), Tardieu scale (measures spasticity), and the DASH (measures self-reported disability/symptoms). In Basaran et al., (2012) the following outcome measures were used: Modified Ashworth Scale, (measures clinical spasticity), H latency and Hmax/Mmax ratio (measures physiologic spasticity), PROM (measures joint mobility), and duration of use.

**When looking at variables that could have impacted the splinting intervention, it cannot be concluded that a specific wearing schedule, time after CVA, treatments used in combination with splinting, or outcome measures had a direct effect on the results of this study.*

Similar Result Findings:
All three studies measured the effects of splinting on spasticity post-CVA. Two of the three studies, Lannin et al., (2006) and Basaran et al., (2012), found no statistically significant difference in spasticity following splinting intervention. Both of these two studies had high rigor, with Lannin et al. (2006) having a PEDro Score of 10 and Basaran et al. (2012) having a PEDro Score of 8.

Different Result Findings:
Pizzi did find statistically significant results in reduction of spasticity of the elbow, but like Lannin et al. (2006) and Basaran et al. (2012), did not find a reduction of spasticity at the wrist. However, Pizzi did not have a control group which resulted in low rigor and a PEDro Score of 4.

There is limited evidence supporting the use of resting hand splints to reduce spasticity in the upper extremity in adults post-CVA when compared to therapy alone.

Boundaries:

There were a total of 142 participants ages 18-81 (mean age 63) in these three studies. Participants were post-CVA and demonstrated spasticity of the upper extremity. The amount of time post-CVA ranged from 25 days to 168 months. On average participants experienced a CVA 17 months prior to the study (Pizzi, et al., 2005), 27.6 days prior to the study (Lannin, et al., 2006), and 37.9 months prior to the study (Basaran, et al., 2012). Basaran, et al. (2012) and Lannin, et al. (2006), required the splint to be worn 9-12 hours per night for 4-5 weeks, whereas Pizzi, et al., (2005) required the splint to be worn 90 minutes per day for 3 months.
Each study had different inclusion requirements related to the level of spasticity. Participants in Pizzi, et al. (2005) required a MAS score of >1 and Basaran, et al. (2012) required a MAS score of >1+, meaning that Pizzi, et al. (2005) accepted participants with lesser amounts of spasticity. Lannin, et al. (2006) did not specify a specific MAS score for inclusion criteria.

Implications for Practice:
The results of the synthesis of these three studies does not support the use of resting hand splints to decrease spasticity in post-CVA patients. However, spasticity did not get any worse, suggesting that resting hand splints, when used in conjunction with other therapy, may maintain spasticity with this population. Because none of these three studies looked at the effect of splinting alone compared to a control group, we cannot conclude that splinting had a direct effect on maintaining spasticity. Therefore, future research needs to be conducted in order to conclude whether resting hand splints alone can be used to maintain spasticity.

REFERENCES

Critiqued Articles

Basaran, A., Emre, U., Karadavut, K.I., Balbaloglu, O., & Bulmus, N. (2012). Hand splinting for poststroke spasticity: A randomized controlled trial. *Topics in Stroke Rehabilitation*, *19(*4), 329-337.

Lannin, N. A., Cusick, A., McCluskey, A., Herbert, R. D. (2006). Effects of splinting on wrist contracture after stroke. *Stroke*, *38,*111-116.

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Related Articles (Not Individually Appraised)

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Other Related Information

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