Efficacy of Cervical Spine Mobilization Versus Peripheral Nerve Slider Techniques in Cervicobrachial Pain Syndrome– A Randomized Clinical Trial

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**INTRODUCTION**

Neck pain is a common disorder affecting 57\% of the German population\textsuperscript{1}, and, combined with low back pain, it results in costs of nearly 3.3 billion euros\textsuperscript{2}. A number of studies show moderate to good evidence that manual therapy may alleviate neck pain\textsuperscript{3-7}. This analgesic effect may not only be explained by traditional approaches such as the Gate-Control-Theory\textsuperscript{8} and reduced peripheral afferent discharge\textsuperscript{9} but also by the activation of central nervous pain mechanisms such as the periaqueductal gray, which seems to be responsible for pain control and modulation of autonomic functions\textsuperscript{10-12}.

In addition to pain alleviation, the increase in joint range of motion is an intention in manual therapy\textsuperscript{7,12-13}. Furthermore, manual mobilization techniques seem to positively influence neurodynamics\textsuperscript{14-15}. If neck pain radiates into the arm, it is named cervicobrachial pain syndrome and is often associated with neural tissue dysfunctions\textsuperscript{16}. Such dysfunctions are caused by changes in both the physiology and mechanics of

**ABSTRACT**

**Background:** Cervical mobilization and neurodynamic techniques are very common in the treatment of patients with cervicobrachial pain. Experts recommend not treating affected neural tissues until the related mechanical interface influencing the neurodynamics is examined. Although this recommendation is based on expert opinions, it has not been investigated empirically, and scientific evidence supporting this experiential knowledge is still lacking.

**Aim:** The objective of this study was to investigate the expert recommendation that in patients with cervicobrachial pain, an initial mobilization of the mechanical interface is more effective than an initial neurodynamic treatment.

**Methods:** Twenty patients with cervicobrachial pain were randomly assigned to one of two intervention groups to receive once either cervical mobilization at the dysfunctional mechanical interface or peripheral neurodynamic techniques. Pain, active cervical range of motion and neurodynamics were assessed before and after the intervention as well as one week later.

**Results:** Data showed significantly larger effects at follow-up for the cervical mobilization group regarding the extension (improvement of 6.6 vs. -2.4°; \(p=0.050\)), lateral flexion to the non-painful side (7.8 vs. 1.6°; \(p=0.011\)) and for the upper limb neurodynamic test 1 (11.4 vs. -4.7°; \(p=0.015\)).

**Conclusion:** The study supports the expert opinion that in patients with cervicobrachial pain the initial treatment of the mechanical interface through cervical mobilization appears preferable to neurodynamic treatment.

**Key words:** Physical Therapy, Musculoskeletal Manipulations, Neck Pain, Neuromuscular Diseases, Upper Limb Neurodynamic Test.

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the nerves leading to patients’ symptoms and limited range of motion in the upper extremity or cervical spine. Changes in neurodynamics are often influenced by surrounding tissues, called mechanical interfaces. The mechanical interface should be regarded as the most anatomically adjacent tissue to the nervous system that can move independently to the system. For example, a dysfunction of the foramen intervertebrale may affect the corresponding nerve root leading to pathophysiologic changes.

Several researchers have addressed the field of neurodynamic treatment. Results show promising success for symptom relief which is assumed by improved physiology and mechanics of the neural tissues. Butler considered three different ways of treating neurodynamic disorders. First, the selective mobilization of the nervous system; second, the treatment of mechanical interfaces, and third, indirect treatment approaches such as consideration of posture and ergonomics. Furthermore, experts recommend not treating the neural tissues until the related mechanical interface influencing the neurodynamics is considered. Movement of the abnormal neural tissue without movement of its mechanical interfaces should be avoided. If the mechanical interface is not treated, it leads to a stretch effect that should be avoided, especially in irritable conditions of the neural tissues.

Although this recommendation to treat the mechanical interface first is based on expert opinions, it has not been investigated empirically so far. Scientific evidence supporting this experiential knowledge is still lacking.

The objective of the present study was to investigate this recommendation by testing the hypothesis that an initial mobilization of the mechanical interface is more effective than an initial neurodynamic treatment, in patients with cervicobrachial pain.

**MATERIALS AND METHODS**

This study was conducted as a prospective randomized clinical trial according to a pre-defined study protocol in an outpatient rehabilitation centre. The study was approved by the review board of the University of Applied Sciences and Arts, Hildesheim, Germany and was conducted according to the Declaration of Helsinki.

**Patients**

Consecutive patients were recruited between September 2008 and November 2008. Adult patients with neck pain radiating into the upper extremity with limited cervical range of motion, presence of an articular dysfunction at the cervical spine and/or the first rib as well as a positive upper limb neurodynamic test 1 (ULNT 1) and signed informed consent were included. The presence of an articular dysfunction was defined as a reduced range of motion in one direction and or pain and was evaluated by applying passive accessory intervertebral movements. The ULNT 1 was considered positive if the symptoms of the patients occurred during the test, if they could be reinforced by applying contralateral flexion of the cervical spine and if the reactions were different to those of the contralateral arm. Patients were excluded if any of the following criteria were present: a diagnosed central pain syndrome (e.g. fibromyalgia), surgery of the cervical/thoracic spine or of the upper extremity, limitations of the glenohumeral joint, the elbow joint or wrist constraining standard performance of neurodynamic tests, neurological diseases (e.g. stroke, multiple sclerosis), and an inability to communicate in German.

**Measures**

The primary outcome measure was neck pain at rest. Secondary outcomes were arm pain at rest, active cervical range of motion (AROM), and neurodynamics. Current neck and arm pain were quantified using a visual analogue scale (VAS). AROM (flexion, extension, rotation, lateral flexion) were assessed using the Cervical Range of Motion Instrument (CRÖM). Each measurement was performed three times and the median was taken for following analyses. Neurodynamics in the painful arm was evaluated using the ULNT1. The initial position assuring an arm abduction of 90° was controlled by two right-angled laser beams which were projected onto the supine
patient. For calculation of the elbow angle, the length of the arm and forearm was measured by using the bony landmarks (described by the International Society of Biomechanics\textsuperscript{26}) acromion, medial epicondyle, and processus styloideus. These distances were entered into the software mathcad 13 (Mathsoft Engineering & Education Inc. 2005). During the ULNT, the distance between the acromion and processus styloideus ulnae was measured, when the patient signaled the first occurrence of pain. The angle of elbow extension was calculated by means of these three distances which represent a triangle. The ULNT was also performed three times and the median was taken for further calculations. All measures were done by the main author.

**Interventions**

Following the pre-test, the patients were randomly assigned to one of two intervention groups to receive either cervical mobilization or neurodynamic treatment. Randomization was carried out by the main author by blocked one-to-one allocation with the use of envelopes. In both groups, patients were treated by the main author once for approximately 15 minutes depending on the reaction of the patient. Following the treatment, the post-test was performed. Between the treatment and the follow-up one week later, the patients did not receive any further intervention (figure 1). They were instructed not to change medication, if they were taking drugs, in order to avoid the influence of the intake of more or less analgesics.

Cervical mobilization (group C) was performed using accessory and passive physiologic movements on dysfunctional mechanical interfaces located at the cervical spine and/or the first rib. Manipulations were not performed. Analogue to the Maitland concept\textsuperscript{17}, the type of technique and their dosage depended on the physical examination and the reaction of the patient. Side gliding was not used because it influences both joints and thus the mechanical interfaces of the spine as well as neurodynamics\textsuperscript{14, 26}.

The patients of the second treatment group (group N) received peripheral neurodynamic techniques at the upper extremity. Sliders\textsuperscript{29} were applied to all patients. The type of slider was individually chosen according to the most restricted neurodynamic movements. The movements were performed via the shoulder joints, the elbow and wrist. Depending on the reaction of the patients, the cervical spine has been placed in more or less lateral flexion. In this group, for the reasons mentioned above, side gliding of other dynamic movements of the cervical spine was not performed either.

**Data analysis**

Data analysis was performed using SPSS 16.0 (SPSS 2007). Descriptively, the means and corresponding standard deviations were calculated due to the fact that all data were interval-scaled. Analytical statistics were based on non-parametric tests, because most of the data did not follow a normal distribution. To test if there were significant differences between the two intervention groups, the Mann Whitney U test was performed. Significant changes over the investigation period within one treatment group were identified using the Friedman Test. Furthermore, the Wilcoxon signed rank test was carried out to determine if there were significant changes between the pre- and post-test and/or the post-test and follow-up. P ≤0.05 was considered to indicate a statistically significant difference.

**RESULTS**

Twenty consecutive patients have been included and all completed follow-up. At baseline, there were no statistical differences in age, sex, duration of complaints, and days between the pre-test and follow-up (table 1). However, baseline levels for pain, range of motion, and neurodynamics differed significantly. For that reason, the changes between each investigation, and not the absolute values, were calculated.

**Pain**

No significant difference in pain reduction in the neck as well as in the arm between the two groups was revealed (p=.247). However, regarding changes within one group between pre-test and follow-up, only the patients treated with cervical mobilization showed significant pain reduction in the neck (-1.52 points; p=.035) and in the arm (-1.48 points; p=.041).

FIGURE 1. Study design. (n, number of participants; R, randomization)
TABLE 1. Patient-related data of the 20 participants.

<table>
<thead>
<tr>
<th></th>
<th>Group C n=10</th>
<th>Group N n=10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>53.7 (±9.0)</td>
<td>52.6 (±12.5)</td>
</tr>
<tr>
<td>Sex (m/f)</td>
<td>2/8</td>
<td>2/8</td>
</tr>
<tr>
<td>Duration of symptoms (weeks)</td>
<td>215 (±214.2)</td>
<td>323 (±404.1)</td>
</tr>
<tr>
<td>First occurrence of symptoms (yes/no)</td>
<td>1/9</td>
<td>3/7</td>
</tr>
<tr>
<td>Days between post-test and follow-up</td>
<td>7.3 (±2.4)</td>
<td>7.4 (±1.4)</td>
</tr>
</tbody>
</table>

The variables age, duration and days are shown with the mean and standard deviation. For the remaining variables, the absolute value is given.

TABLE 2. Changes in cervical range of motion (degrees). Means and corresponding standard deviations are displayed.

<table>
<thead>
<tr>
<th></th>
<th>Pre ▶ Post</th>
<th>Post ▶ Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>N</td>
</tr>
<tr>
<td>F</td>
<td>0.8 (±5.8)</td>
<td>0.8 (±6.1)</td>
</tr>
<tr>
<td>E</td>
<td>5.2* (±7.2)</td>
<td>1.2 (±7.7)</td>
</tr>
<tr>
<td>Rot ps</td>
<td>7.4* (±8.6)</td>
<td>4.6 (±8.4)</td>
</tr>
<tr>
<td>Rot nps</td>
<td>9.2** (±8.3)</td>
<td>1.6 (±10.2)</td>
</tr>
<tr>
<td>LF ps</td>
<td>4.4** (±5.6)</td>
<td>2.8 (±4.5)</td>
</tr>
<tr>
<td>LF nps</td>
<td>6.2** (±4.4)</td>
<td>3.0* (±3.6)</td>
</tr>
</tbody>
</table>

Abbreviations: F, Flexion; E, Extension; Rot ps, Rotation to painful side; Rot nps, Rotation to non-painful side; LF ps, Lateral flexion to painful side; LF nps, Lateral flexion to non-painful side.

*p≤.05. **p≤.01, ***p≤.001.
Nevertheless, a significant decrease in neck pain was reported in both groups at post-test with -1.18 points (p=.024) for group C and -1.20 points (p=.041) for group N, respectively (figure 2).

**Cervical range of motion**

The increase in cervical range of motion observed between pre-test and follow-up was significantly higher in group C with respect to extension (6.6 vs. -2.4°; p=.050) as well as lateral flexion to the non-painful side (7.8 vs. 1.6°; p=.011), than in group N.

The changes in range of motion within one group between pre- and post-test were greater in the cervical mobilization group (table 2). In this group, the extension, rotation to both sides and lateral flexion to both sides increased significantly, whereas in group N only a significant increase in the lateral flexion to both sides could be observed.

At follow-up, no further significant changes in cervical range of motion in group C could be detected. By contrast, patients receiving neurodynamic treatment even showed significantly reduced rotation as well as lateral flexion to the painful side (table 2).

**Neurodynamics**

The results of the ULNT 1 showed significant different between-group changes between post-test and follow-up in favor of group C (p=.015).

Within the groups, significant improvements over the investigation period (23.3°; p=.003 for group C and 13.0°; p=.015 for group N) as well as between pre- and post-test (figure 3) could be observed for both groups.

The change in elbow angle is noticeable at follow-up. Patients who received cervical mobilization significantly increased their elbow extension by 11.4° (p=.037) whereas those who received a neurodynamic treatment showed a non-significant decrease of 4.7° (p=.260).

**DISCUSSION**

The results revealed significant pain reduction in the neck and in the arm for the patients who received cervical mobilization. Over the investigation period, these patients showed a decrease of 1.53 for the neck and 1.48 points for the arm on the VAS which can be regarded as a clinically relevant change.

To date, the only known study to compare articular with neurodynamic treatment was conducted by Allison et al. Thirty patients with cervicobrachial pain were randomly assigned to one of three groups: neural treatment, articular treatment, and control group. Neural treatment involved mobilization techniques for neural and adjacent tissues, such as cervical lateral glide, shoulder girdle oscillation and muscle re-education. The articular treatment consisted of indirect approaches such as glenohumeral mobilization and thoracic mobilization. No treatment was performed in the third group. Pain was assessed at baseline and after four and eight weeks. The results showed significant pain reduction in both groups.

Furthermore, the between group comparison revealed a significant difference after eight weeks with the patients in the neural treatment groups reporting lower pain on the VAS than those receiving the articular treatment. The authors concluded that both interventions could significantly reduce pain with a potential advantage for the specific neural treatment but mentioned that the articular treatment is a generalized treatment not addressed to actual joint dysfunction. Therefore the effects of the articular treatment approach can be regarded as indirectly supporting the hypothesis that less direct techniques could also affect neural structures. Although comparing a neural with an articular treatment approach, these findings may not be compared to the results in the present study. While Allison et al performed neurodynamic techniques in combination with articular mobilization techniques, for example the cervical lateral glide, which is thought to influence the neural as well as the articular tissues, within one group, these techniques were explicitly separated in the present study.

The analgesic effect of cervical mobilization techniques is supported by other investigations. Schmid et al and Bialosky et al suggested that supraspinal centers are likely to be important in pain modulation. Furthermore, they hypothesized that the periaqueductal grey (PAG) in the midbrain may be involved.
FIGURE 2. Changes in pain between pre-test and post-test as well as between post-test and follow-up.

Changes in pain

The mean decreases/increases on the visual analogue scale of neck and arm pain in both groups are given. * p<0.05

FIGURE 3. Changes in the ULNT 1.

Changes in ULNT 1

The mean increases/decreases of elbow extension in both groups are given. * p<0.05
An analgesic effect through the likely activation of this supraspinal center may explain the pain reduction in regions not directly addressed by the treatment. In the present study, this effect can be seen in the patients who received neurodynamic treatment and experienced decreased neck pain. In the patients who received cervical mobilization, the analgesic effect in the arm may either be explained by the above mentioned supraspinal centers or by an improved functioning of the mechanical interfaces.

Due to the mobilization, the facet joints are supposed to have a better opening and closing function, thereby reducing compression on neural tissues. This reduced compression might contribute to improved physiological and mechanical conditions in the neural tissues, leading to analgesic effects in the upper extremity.

Regarding cervical range of motion, the patients in group C gradually improved more than the patients in group N. A possible reason for this might be that the patients in group C received mobilization techniques directly applied at the cervical spine. These techniques are not only effective for pain reduction but also for increasing range of motion, whereas the primary objective of neurodynamic techniques is not an increase in cervical range of motion but pain reduction as well as an increase in neural mobility.

For these reasons, a greater improvement in the cervical range of motion through the mobilization treatment was expected. Although to a lesser extent, the neurodynamic treatment also led to increases in cervical range of motion. This may be explained by the improved gliding and sliding of neural tissues leading to reduced interference of the cervical motions.

The immediate effects of neurodynamic techniques on the ULNT 1 were investigated by Coppieters et al. Their patients with cervicobrachial pain were treated with a cervical lateral glide technique. Following treatment, the investigators found a mean increase of 19.4° for elbow extension. In the present study, a mean increase of 11.9° (group C) and 17.7° (group N) could be affirmed. The lesser effect of the mobilization treatment compared to that of Coppieters et al may be because the cervical lateral glide is not specific to joints. Concurrently, the joints of the cervical spine as well as neural tissues were addressed. This may lead to a somewhat greater effect than treating the mechanical interface or the neural tissues alone, as was the case in the present study.

The effects of the different treatment approaches examined for a longer period seem to be very interesting. One week after the intervention, the ULNT 1 in group C increased by another 11.4° whereas in group N a slight decrease in elbow extension could be observed. These results indicate that the effect of the neurodynamic treatment only lasts for a short period.
time whereas the mobilization of the mechanical interfaces seems to play an essential role in improving neurodynamics.

**Limitations**

Some shortcomings of the current study have to be taken into account. One limitation is the small sample size: outliers may have had a considerable chance of influencing the data and the statistical analyses might be subject to error. The variance of the data is shown by the large standard deviations in many variables. Furthermore, the small sample size combined with too roughly defined inclusion criteria led to different baseline levels in the groups which made it difficult to compare the effects of the two different interventions. A further issue related to the different baseline level is the duration of complaints. The patients under investigation showed a history of several weeks to several years. As different stages of disease may involve different physiological and pathophysiological processes, the results cannot be generalized. However it is an advantage of the present study that most of the patients had their complaints for some years. Therefore, the possibility of spontaneous remission during the investigation period can be regarded as marginal. Though, the follow-up of one week might be too short to see significant and perpetual clinical changes in these patients.

A further limitation might be the measurement of the ULNT1. The angle of elbow extension was calculated using a mathematical model. This method is easily transferable to the clinical setting, providing the changes in elbow extension after treatment. However, these data do not represent the absolute value of elbow extension but only describe the changes. Therefore, the data of the present study should not be compared to values measured with other methods.

Further studies with a larger sample size, a control group included and blinded investigators are needed to provide stronger evidence. Additionally, long-term effects of both treatment approaches should be evaluated to give clinical recommendations.

**CONCLUSION**

The results of the comparison between the two single interventions indicate that an initial treatment of the mechanical interface is more useful than an initial neurodynamic treatment. For daily practice, we can recommend treatment according to the expert guidelines investigated. However, further research is needed to provide stronger scientific evidence.

**FUNDING SOURCE(S):**

None

**ACKNOWLEDGMENTS**

The authors thank Dr. Harry von Piekartz and members of DVMT for providing the equipment, the Therapy Centre Kirchheim for their support during data collection, patients for their participation, and Kirsten Clift for proof-reading.

**CONFLICTS OF INTEREST**

None identified and/or declared.

**OTHER INFORMATION**


**REFERENCES**


