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Original Article

The effect of proprioceptive neuromuscular facilitation technique on treating cervical radiculopathy

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Abstract
Electronic products such as computers and cell phones have raised the prevalence of cervical radiculopathy (CR). As the sedentary life of the population is increasing as well as the disorders in the cervical region, it is necessary to explore more effective ways of specific physiotherapeutic treatment protocols. This study aims to compare two different physiotherapeutic protocols for CR. This is a prospective nonrandomized research study, conducted in the Center For Physical Therapy and Rehabilitation "Banja Kllokotit", and the private clinic Fizio - Ana in Ferizaj, Kosovo, in 2022. The ethical approval was received by the rehabilitation center (no. 01/22) from the Kosovo Chamber of physiotherapists (no. 169), and the patients also provided informed consent. These are preliminary findings, and thirty patients of ages 20 to 80 were used. In the test group (N = 15), passive mobilizations, proprioceptive neuromuscular facilitation (PNF) contract-relax technique, cupping massage, thermotherapy, and transcutaneous electrical nerve stimulation were applied. The control group (N = 15) combined isometric-strengthening exercises and passive stretching with electrotherapy and hydrotherapy. The visual analog scale was applied on day one, day seven, and day ten, while the Neck Disability Index (NDI) was used before treatment. The experimental group had a decrease in pain on average of 1.73 (p-value = 0.006) in VAS 2. Even in VAS 3, we have the test F = 2.837 (p-value = 0.000). These findings demonstrate substantial variations between groups, while the NDI results revealed moderate disability during daily life activities in the control (3.20±0.77) and experimental groups (3.27±0.79). Passive mobilization combined with PNF technique is an extremely effective physiotherapeutic protocol for patients suffering from CR.
Keywords: Neck pain, passive mobilization, cupping massage, isometric exercise, stretching

Introduction

Cervical radiculopathy (CR) is a clinical condition described as pain in one or both upper extremities, originating from the cervical region. It may be accompanied by cervical pain and stiffness with symptoms in the shoulder girdle and upper extremity, and also by tingling, numbness, or discomfort in the arm, upper back, and upper chest with or without an associated headache (Alshami & Bamhair, 2021; Childress & Becker, 2016).

CR is presented as a disease process because of disc herniation in the cervical intervertebral discs or arthritic degenerations or osteophyte processes compressing the nerve root, which leads to the symptoms produced by the neck and arm of the affected side (Childress & Becker, 2016).

Electronic products such as computers and cell phones have increased the prevalence of this disease. Aside from pain in the neck and arm on the affected side, patients frequently experience loss of sensation, motor function loss, or reflex changes in the affected nerve root distribution (Corey & Comeau, 2014).

The most common examination findings are painful neck movements and muscle spasms. The most common neurologic finding is diminished deep tendon reflexes, particularly of the triceps. To confirm the diagnosis, the Spurling test, shoulder abduction test, and upper limb tension test can be used (Childress & Becker, 2016).

According to the evidence, conservative treatments for CR rehabilitation, including manual therapy, exercise, traction, and epidural steroid injections can help patients with pain relief and improved neurological function (Benditz et al., 2017). Despite the irreplaceable role of surgical treatment, based on the evidence, some secondary implications have been identified such as degeneration of the segment close to the intervention, narrowing of the intervertebral space because of the lowered level of the intervertebral disc, lack of stability for the patient to lead a normal life, etc. (Gutman et al., 2018).

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Numerous studies (Büyükturan et al., 2021; Cox et al., 2020; Domingues et al., 2019; Rampazo et al., 2020; Seyda et al., 2021) has proven that combining regular exercise (Gashi et al., 2020) with other treatments effectively reduces pain and improves the functional status and quality of life of persons suffering from cervical radiculopathy. Some other authors (Calixtre et al., 2019; Cao et al., 2021) have prioritized mechanical and manual traction and passive mobilization for the treatment of patients with chronic pain and have confirmed that this type of technique has been effective in reducing pain but not in improving function and disability. Another author (Ayub et al., 2019) evaluated another method of mobilization called active and passive mobilization, which proved very effective in treating CR.

Based on research by Langevin et al. (2015) an increase in function and mobility in the upper extremities, as well as a reduction in pain, were all observed following the combination of passive cervical mobilizations and active exercises, However, other study has prioritized mechanical and manual traction for the treatment of CR patients and have revealed that this therapeutic approach has been helpful for pain reduction but not for function and disability (Rulleau et al., 2021).

Because there are numerous treatment options that we can use and combine, treating CR is a very challenging problem. The primary challenge is figuring out which combination is the best treatment protocol that we can use. Our goal was to contribute to the science of physiotherapy by demonstrating the PNF's effects on pain, and disability for patients with CR because this gap in evidence-based treatment still needs to be filled.

More studies should be conducted in this area to reduce patients' complaints and improve their quality of life as it appears that the prevalence of CR is constantly rising. This study aims to compare two different physiotherapeutic rehabilitation procedures for CR on pain and disability.

Material and Methods

Participants

This is a prospective nonrandomized research study, conducted in the Center For Physical Therapy and Rehabilitation "Banja Kllokotit", and the private clinic Fizio -Ana in Ferizaj, Kosovo, in 2022. The ethical approval was received by the rehabilitation center (no. 01/22) from the Kosovo Chamber of physiotherapists (no. 169), and patients also provided informed consent. These are preliminary findings, and we used 30 patients, aged 20 to 80, with N=15 in the experimental group and N=15 in the control group. Ten physical therapy sessions were conducted for each patient. Inclusion criteria were patients with neck pain accompanied by pain and numbness of one arm or both and those with periscapular pain with a duration of symptoms more than three months, while the exclusion criteria were patients with mechanical and non-specific neck pain and pain less than three months.

Experimental Procedure

All patients were assessed by a physiatrist, and they were referred for physical therapy. The experimental group was treated with passive mobilizations (Calixtre et al., 2019; Cho et al., 2017) in the cervical region with posterior/ anterior mobilizations (5 min), and PNF contract-relax technique (Maicki et al., 2017) with three repetitions in each neck movement, and a cupping massage(Lauche et al., 2016; Radziejowska et al., 2020) for myofascial release for 5 min including the trapezius region and shoulder muscles, thermotherapy (15–20 min) in the cervical/thoracic region, and transcutaneous electrical nerve stimulation (TENS) for 20 minutes (Martimbianco et al., 2019). While, the control group was treated with the standard physiotherapy protocol applied in the rehabilitation center, which includes passive stretching (10s, 6 repetitions) (Montalvo et al., 2023) and isometric strengthening exercises (8 repetitions) (Ghodrati et al., 2017; Moreno & Garcia, 2022) combined with electrotherapy (interference current for 15 min) and hydrotherapy (20 min).

Measurements

The measurement instruments were the visual analog scale (VAS) (Delgado et al., 2018), which was applied on day one, day seven, and day ten, while the NDI (Rulleau et al., 2021), on the other hand, was used only before treatment.

Statistical Analysis

The data are processed with the statistical package SPSS for Windows Version 22.0 and STATISTICA for Windows Version 10.0, and the data was presented through tables. From the statistical parameters, descriptive statistics, arithmetic averages, standard deviation values and minimum and maximum values were calculated. The statistical significance difference between groups was evaluated through Levene's Test for Equality of Variances, t-test for Equality of means, and 95% Interval Confidence of the Difference. Verification of the tests for the degree of reliability was $P>0.05$.

Results

The total number of patients who participated in the research was 30, of which 25 were female or 83.3% and the other 5 were male or 16.7%. In terms of diagnosis, we see that three patients are with CR, or 10%, 5 others with CR bill, or 16.67%, 11 are with CR lat dex, or 36.67%, and 11 others with CR lat sin, or 36.67% (Table 1).

Table 1. *Demographic Results for Gender and Diagnose*

Gender	N	%
Female	25	83.3
Male	5	16.7
Diagnose	N	%
CR	3	10.0
CR bill	5	16.67
CR lat dex	11	36.67
CR lat sin	11	36.67

Their average age is 51.40 years, with a minimum of 25 years and a maximum is 76 years, while the standard deviation is 13.52 years (Table 2).

Table 2. *Descriptive Statistics for Age*

	N	Minimum	Maximum	Mean	Std. Deviation
Age	30	25	76	51.40	13.528
Valid N (listwise)	30				

In the VAS analysis, we see that we have an overall average of both groups of 7.27 in VAS 1, 4.93 in VAS 2, and 2.73 in VAS 3 (Table 3).

Table 3. *Descriptive Statistics for VAS*

VAS	N	Minimum	Maximum	Mean	Std. Deviation
VAS 1	30	2	10	7.27	1.799
VAS 2	30	2	9	4.93	1.780
VAS 3	30	0	8	2.73	2.243
Valid N (listwise)	30				

Comparative Analysis for VAS

We used the independent sample T-test to compare the control group with the experimental group, and the results show that the control group's VAS 1 average is 7.20 with a standard deviation of 2.17 while the experimental group's average is higher at 7.33 with a standard deviation of 1.39.

We can observe in VAS 2 that the experimental group has a lower average of 4.07 and a standard deviation of 1.28 compared to the control group, which has an average of 5.80 with a standard deviation of 1.82. Similar to VAS3, the control group's mean is 4.27, and its standard deviation is 2.01, as opposed to the experimental group's mean of 1.20 and its standard deviation of 1.14 (Table 4).

Table 4. *Comparative Analysis for VAS between Groups*

	Group	N	Mean	Std. Deviation	Std. Error Mean
vas1	Control	15	7.20	2.178	0.562
	Experimental	15	7.33	1.397	0.361
vas2	Control	15	5.80	1.821	0.470
	Experimental	15	**4.07**	1.280	0.330
vas3	Control	15	4.27	2.017	0.521
	Experimental	15	**1.20**	1.146	0.296

According to the results, we can conclude that VAS 1 has a statistical significance level of F of 2.257, a degree of freedom of DF of 28, and a p-value of 0.844, indicating no statistically significant difference. The average difference between groups is -0.133.

In VAS 2, we have the test F = 1.402, with the degree of freedom DF = 28, while p-value = 0.006 and the average difference between groups is 1.73, indicating that the experimental group has less pain than the control group on average by a margin of 1.73.

Even in VAS 3, we have the test F = 2.837, with the degree of freedom DF = 28, p-value = 0.000, and a high average output between the control and experimental group of the average of 3.067. So even in VAS 3, the experimental group experiences less pain than the control group does, with an average pain level of 3,067, which is a significant difference between the two groups.

Table 5. *Statistical Significance Difference between Groups for VAS*

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
vas1	Equal variances assumed	2.257	0.144	-0.200	28	0.843	-0.133	0.668	-1.502	1.235
	Equal variances not assumed			-0.200	23.856	**0.844**	-0.133	0.668	-1.513	1.246
vas2	Equal variances assumed	1.402	0.246	3.017	28	0.005	1.733	0.575	0.556	2.910
	Equal variances not assumed			3.017	25.122	0.006	1.733	0.575	0.550	2.916
vas3	Equal variances assumed	2.837	0.103	5.120	28	0.000	3.067	0.599	1.840	4.294
	Equal variances not assumed			5 .120	22.193	0.000	3.067	0.599	1.825	4.308

Independent Samples Test

Finally, we can conclude that the differences between groups are considerable, which proves that the experimental group has a decrease in pain in VAS 2 average of 1.73, p-value = 0.006, and in VAS 3 the average difference is 3.067 and p-value = 0.000 (Table 5).

According to the results related to age, the control group has a higher mean value of age with 59.87 with a standard deviation of ±10.63, while the experimental group had 42.93 with a standard deviation of ±10.60.

Table 6. *Neck Disability Index and Age between Groups*

	Age	NDI*	CI 95%
Control group	59.87±10.63	3.20±0.77	2.77-3.63
Experimental group	42.93±10.60	3.27±0.79	2.82-3.71

*Neck Disability Index

From the statistical results regarding the NDI, we can see that the control group has a mean value 3.20 of NDI with a standard deviation of ± 0.77, and interval coefficient ranges from 2.77–3.63, while the experimental group has demonstrated a mean value 3.27 with a standard deviation ±0.79, and interval coefficient ranges from 2.82–3.71, which indicates that both groups presented with moderate disability related to neck radiculopathy (Table 6).

Discussion

This study's objective was to assess the effectiveness of two physiotherapy treatments in the same target population. Patients were separated into two groups and received different physiotherapeutic approaches that compared passive stretching and isometric strengthening exercises with manual techniques such as PNF techniques and passive mobilizations. The outcomes revealed a substantial difference between the control and experimental groups, in VAS2 and VAS3 measurements.

The results of our study can be compared to those of other authors who concluded that inhibitory techniques combined with mobilizations are the best option for the rehabilitation of CR (Lauche et al., 2016; Wong et al., 2016). Additionally, we can confirm that incorporating PNF techniques into the treatment was very effective.

Previous research has shown the value of combining manual therapy and exercises to treat CR. The procedure enhanced function, range of motion, and pain intensity. However, it was impossible to determine which manual therapy techniques were the most effective (Liang et al., 2019)

Another mobilization technique called active and passive mobilization was evaluated by other researchers and found to be very successful in treating CR (Ayub et al., 2019) To reduce pain in muscles around the neck with latent trigger points, another research reported that applying soft tissue release in sternocleidomastoid and suboccipital muscles had a positive effect on the pressure pain threshold (Kim & Lee, 2018). Applying strengthening exercises in the cervical region has a positive impact on reducing pain, and increasing muscular strength. These data are consistent with that from other authors (Lauche et al., 2016; Wong et al., 2016)

Based on our results, passive mobilization proved to be a very effective technique. These data may be comparable to a recent study conducted by Lee and Lee (2017), which evaluated the effect of joint mobilization and therapeutic exercise applied to the cervical spine and upper thoracic spine for functional impairment caused by neck pain. According to their results, both groups improved in VAS, NDI, and range of motion. Despite the lack of research on long-term effects, several writers have found that segmental training for motor control is useful in reducing short-term pain and dysfunction. (Gashi & Azemi, 2022; Price et al., 2021).

These preliminary findings confirmed that passive mobilization combined with PNF techniques is very effective in reducing pain and improving mobility for patients with CR. Furthermore, because these are preliminary results, our study did not have a large sample size, which is a significant limitation. Consequently, a larger sample size could have provided more reliable results, which we will present at the end of our study.

Conclusion

According to the study's findings, we can say that the experimental group showed higher improvement in terms of pain intensity, leading to statistically significant differences between the groups. The NDI results revealed moderate disability during daily life activities. These findings support the assumption that passive mobilization combined with the PNF technique is an extremely effective physiotherapeutic protocol for patients suffering from CR.

The obtained results will guide for all people with neck and arm pain, on how to realize and apply these results in practice. This new evidence will also be very helpful for other physiotherapists when exchanging experiences with other health professionals.

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Conflict of interest

The authors declare that there are no conflicts of interest.

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