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Effectiveness of neurodynamic techniques in conservative treatment of cervical spine radiculopathy-critical evaluation of the literature

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Abstract:

Cervical radiculopathy is a neurological condition caused by compression and/or a lesion on the nerve roots of the cervical spine, which results in local and radiating pain and many sensory, motor and neurovegetative disorders. In physiotherapy of patients with cervical radiculopathy, neurodynamic techniques are commonly used; however, scientific reports do not clearly confirm the beneficial effects of using these techniques. Therefore, an attempt was made to critically evaluate the studies carried out so far, in which neurodynamic techniques were used in the conservative treatment of cervical radiculopathy. The PUBMED database and Google Scholar were searched for articles. The search terms were combinations of words (in English) containing the full version and abbreviated names of the following expressions: cervical radiculopathy, neuromobilization, neurodynamic techniques and manual therapy. Ten scientific papers met the requirements for inclusion in this article. In most of them, apart from neurodynamic techniques, other therapeutic measures were used, which made it difficult to assess the beneficial effects of neurodynamic techniques. The studies most often evaluated pain, range of motion, subjective symptoms and neck instability. The therapy used both neurodynamic techniques performed passively by a physiotherapist and auto-neuromobilization techniques. 1) Based on the review of previous studies assessing the effectiveness of neurodynamic techniques in the therapy of patients with cervical radiculopathy, it can be concluded that in most of them beneficial effects of therapy were observed. 2) Due to differences in both participants and research methodology, it is difficult to clearly confirm the effectiveness of neurodynamic techniques. 3) Therefore, further research with high scientific value is required to confirm the effectiveness of neurodynamic techniques in the conservative treatment of cervical radiculopathy.

Keywords: cervical radiculopathy, manual therapy, neurodynamic techniques, neuromobilization, physiotherapy

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Introduction

Cervical spine pains are a very significant diagnostic problem in both medical and physiotherapeutic practice. Nowadays, where sedentary lifestyle and constant stress prevail, pains and degenerative processes in the cervical segment are becoming more and more common. One of the consequences of the above-mentioned problems is cervical radiculopathy. It is a neurological condition caused by compression and/or a lesion on the nerve roots of the cervical spine. This compression causes the appearance of typical symptoms of cervical radiculopathy, the most common of which are pain in the neck and upper limbs, feeling of numbness, weakness of muscular strength, paresthesia, and movement deficits, as well as neurovegetative disorders. The aforementioned ailments have a negative impact on both everyday activities and professional life. Emerging pain has both a mechanical component, which is associated with direct compression on a given segment, and an inflammatory component, which is associated with a local increase in the concentration of inflammatory mediators [1-3].

It is assumed that the annual intensity of cervical pain is about 15%, of which in about 0.6% of patients the intensity of pain is so high that it prevents daily functioning. In addition, 11-14% of employees experience activity restrictions associated with neck pain during the year. In contrast, the annual incidence of cervical radiculopathy alone is less frequent and amounts to 107.3 cases per 100,000 in the group of men and 63.5 cases per 100,000 in the group of women (average 83.2/100000) [2,4].

In the treatment of cervical spine radiculopathy, conservative as well as more radical, e.g. surgical treatment is used. Conservative treatment is recommended for mild forms of cervical radiculopathy and may include pharmacotherapy, orthopedic equipment (orthosis), and broadly understood physiotherapy. In physiotherapy, various types of physical procedures are most commonly used, as well as kinesiotherapy, which includes manual therapy involving neurodynamic techniques [1,4].

The scientific literature often mentions nerve entrapment syndrome (e.g. a disorder of normal nerve sliding) [5,6]. Under normal conditions, the nervous system has adaptive mechanisms, by which it is somewhat resistant to the effects of compression and stretching forces, which are present with virtually every movement. If compression of the nerve root occurs and the adaptive mechanisms become exhausted, leading to disorders of normal neuromechanics, it can cause ischemia and hypoxia of the nerve, resulting in numbness in the limb and radiating pain along the innervation area by the given nerve. Such a disorder may lead to impaired nerve slippage, which may result in the formation of pathological tensions within the nerve itself and the structures surrounding the nerve, particularly during limb movement. According to the above considerations, it is justified to use neurodynamic techniques in the therapy of cervical radiculopathy to restore impaired nerve slide [3,6]. A positive therapeutic effect can be observed in various scientific studies in which neurodynamic techniques have been used. Examples are the papers on carpal tunnel syndrome, where neurodynamic techniques were also used as a form of therapy. In these papers, Wolny et al. show that neurodynamic techniques have had beneficial effects in the treatment of carpal tunnel syndrome [3,7-10]. It can therefore be assumed that the same positive effects may occur after the use of neurodynamic techniques in the treatment of cervical radiculopathy.

The use of neurodynamic techniques in the treatment of cervical radiculopathy

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has been introduced relatively recently [12]. Scientific reports do not confirm unequivocally beneficial effects resulting from the use of neurodynamic techniques [3]. Therefore, an attempt was made to critically evaluate the studies conducted so far using neurodynamic techniques in the conservative treatment of cervical radiculopathy.

Materials and Methods

The literature review was carried out in February 2020. The electronic databases PUBMED and Google Scholar were searched to find articles. Searching for articles from databases was based on the use of key phrases in English. The following terms were used in the search: manual therapy, physiotherapy, physical therapy, cervical radiculopathy, neurodynamic techniques, and neuromobilisations.

The analysis included papers meeting the following criteria: 1) cervical radiculopathy was diagnosed in the study participants, and 2) neurodynamic techniques were used in physiotherapy. The year of publication did not matter. However, the focus was only on articles in English.

Titles and abstracts of the papers were analyzed by assessing whether they met the inclusion criteria. Papers that were unrelated to the topic were rejected.

Results

Ten research papers met the requirements for inclusion in this analysis. All of them assessed the impact of neurodynamic techniques on physiotherapy in patients with cervical radiculopathy. A detailed analysis of the mentioned papers is presented in Table 1 (pages 76-78).

Table 1. Characteristics of the papers included in the review

Authors	Project	Participants	Study	Therapy	Results and conclusions
Sambyal S. and Kumar S. [11]	RTC (2 groups)	40 persons Sex: undefined Age: 25-40 years	Pain (VAS)	**Study group (A):** cervical traction, passive neuromobilization **Control group (B):** cervical traction, neck compresses	There was a significant improvement in both groups, but more clinically significant changes were seen in the group in which neuromobilization was used.
Ayub A. et al. [19]	RTC (2 groups)	44 persons Sex: women (44) Age: 30-50 years	Range of motion (ROM)	**Study group A**: active neuromobilization, neck compresses **Study group B:** passive neuromobilization, neck compresses	Both active and passive neuromobilization is effective in the treatment of cervical radiculopathy. No significant differences were observed between the groups.
Kumar S. [12]	RTC (3 groups)	30 persons Sex: women (20) and men (10) Age: 25-68 years	Pain (VAS) ROM (Scalar method)	**Study group (A):** short-wave diathermy, cervical traction, manipulation according to the McKenzie method	In the case of this study, it can be seen that in the group with the use of neuromobilization, the range of motion after therapy is comparable to the other groups, while the pain index after

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Table 1. Cont.

Authors	Project	Participants	Study	Therapy	Results and conclusions
Kumar S. [12]	RTC (3 groups)	30 persons Sex: women (20) and men (10) Age: 25-68 years	Pain (VAS) ROM (Scalar method)	**Study group (B):** short-wave diathermy, cervical traction, passive neuromobilization **Control group (C):** short-wave diathermy, cervical traction	therapy is clearly higher than in the other two groups. In this case, neuromobilization has not proved to be the most effective method.
Chettri P. et al. [13]	RTC (2 groups)	30 persons Sex: women (11) and men (19) Age: average 45,15 years	Neck Disability Index (NDI) ROM (Fluid Bubble inclinometer)	**Study group (II):** passive neuromobilization, strengthening exercises **Control group (I):** cervical traction, strengthening exercises	This study showed a significant improvement in the range of neck motion and a reduction in the rate of neck disability within the two therapeutic interventions. However, comparing the two groups, it cannot be determined which therapeutic approach is better.
Dong-Gyu K. et al. [14]	RTC (2 groups)	30 persons Sex: women and men Age: 25-60 years	Pain (NPRS), Neck Disability Index (K-NDI), Range of motion (ROM)	**Study group:** passive neuromobilization with cervical traction, neck compresses, TENS **Control group**: cervical traction, neck compresses, TENS	After the use of neuromobilization with cervical spine traction and physical procedures, a significantly better therapeutic effect was obtained than using traction alone with physical procedures.
Anwar S. et al. [15]	RTC (2 groups)	30 persons Sex: not specified Age: not specified	Pain (VAS) Neck Disability Index (NDI)	**Study group**: cervical traction, isometric exercises, gentle stretch, neck compresses, passive neuromobilization **Control group:** cervical traction, isometric exercises, gentle stretch, neck compresses	Adding neurodynamic techniques to the multimodal treatment program gave a significantly better therapeutic effect than standard exercises.
Savva Ch. et al. [16]	RTC (2 groups)	42 persons Sex: women and men Age: 28-70 years	Neck Disability Index (NDI) Pain (NPRS) Range of motion. patient-specific functionality scale (PSFS)	**Study group**: cervical traction, passive neuromobilization **Control group**: no therapy	Neuromobilization with simultaneous cervical traction gives a good therapeutic effect in the case of pain reduction and disability index in patients with cervical radiculopathy. The results in the group in which neuromobilization and cervical traction were used are significantly higher.

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Table 1. Cont.

Authors	Project	Participants	Study	Therapy	Results and conclusions
Lamba D. et al. [17]	RTC (2 groups)	40 persons Sex: not specified Age: 25-50 years	Pain (VAS) Passive range of motion (ROM)	**Study group (B):** cervical traction, passive neuromobilization **Control group (A):** cervical traction, warm neck compresses	Studies have shown that neuromobilization in combination with cervical traction gives a better therapeutic effect than cervical traction alone with warm compresses. After the use of neuromobilization, a significant reduction of pain and an increase in the range of motion of the cervical segment was obtained.
Sarfaraj MD and Deepali D. [20]	RTC (2 groups)	30 persons Sex: women and men Age: 30-55 years	Pain (VAS) Range of motion (ROM)	**Group A**: manual cervical traction, passive neuromobilization of the median nerve, warm neck compresses **Group B**: mechanical cervical traction, passive neuromobilization of the median nerve, warm neck compresses	There was no significant difference seen in pain reduction or increase in range of motion between the two groups.
Sarfaraj MD [18]	RTC (3 groups)	60 persons Sex: women and men Age: 45-55 years	Pain (NPRS) Severity of root symptoms (GROC) Neck Disability Index (NDI)	**Group A:** mechanical cervical traction, passive neuromobilization **Group B:** mechanical cervical traction **Group C:** passive neuromobilization	The best statistically significant effect was obtained in the group A, while there is no statistically significant difference between groups B and C. As it can be seen, neuromobilization gives the best effect with the imposition of another technique (in this case mechanical traction).

Eight papers are randomized clinical studies [11-14], and two articles are a clinical study without a control group [19,20]. In eight articles, the study was based on two comparative groups [11,13-17,19,20], and in two articles there were three comparative groups [12,18]. In all papers, participants were examined before and immediately after the therapy. No distant effect of therapy was assessed in any paper.

In all of the papers used in this review, study participants had clinically diagnosed cervical radiculopathy. The number of people participating in the study ranged from 30 to 60 persons. The age of the respondents was determined in nine out of ten papers [11-14,16-20] and ranged from 25 to 70 years. Seven studies involved men and women [12-14,16-18,20], one study involved only women [19], and sex was not specified in two studies [11,15].

Pain was assessed in most studies (8/10) [11,12,14-17,19,20]. The range of motion was examined in seven papers

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[12-14,16,17, 19,20]. Five papers assessed the neck disability index (NDI) [13-16,18]. In one study, the function was evaluated using the patient-specific functionality scale (PSFS) [16], and in one study the severity of root symptoms (GROC) [18].

Neurodynamic techniques enriched with other therapeutic agents were used in all studies included in this review. In each of the 10 papers, neurodynamic techniques were used as passive techniques performed by the therapist, combined with other physiotherapeutic techniques [11-20].

In one paper, in one of the studied groups, neurodynamic techniques were used as an autotherapy program (so-called auto-neuromobilization), but also in combination with other therapeutic means [19]. Other elements of the therapeutic programs used were cervical traction (nine papers) [11-18,20], warm neck compresses (six papers) [11,14,15,17,19,20], streng-thening/isometric exercises (two papers) [13,15], short-wave diathermy (one paper) [12], TENS currents (one paper) [14], manipulation according to the McKenzie method (one paper) [12], and stretching techniques (one paper) [15].

In six out of ten analyzed works, a significantly better therapeutic effect was obtained after using neurodynamic techniques compared to the control group [11,14-18]. In two scientific reports, there was no significant differences between the study group, in which neurodynamic techniques were used, and the control group, in which they were not used in therapy [13,20]. In one study in which neurodynamic techniques were used in both groups, however, using different techniques, no significant differences were observed after the therapeutic cycle [19]. In one article, the therapeutic effect after applying neurodynamic techniques in one of the groups turned out to be worse than in other groups in which neurodynamic techniques were not used [12].

Discussion

Analysis of previous scientific reports assessing the impact of neurodynamic techniques in the conservative treatment of cervical radiculopathy indicates that their use in physiotherapy can have a positive effect on reducing many negative symptoms (e.g. pain or limited range of mobility). In most papers, the authors emphasize the beneficial therapeutic effect after the use of neurodynamic techniques [11,14-18], but in several studies they indicate a weaker or even no effect after the use of neurodynamic techniques [12,13,19,20]. However, both the obtained results and the conclusions drawn on their basis should be viewed critically. Drawing unambiguous conclusions is hindered by the fact that different research methodologies were used in individual papers. In most cases, neurodynamic techniques were only an element of comprehensive therapy, which makes it difficult to draw definite conclusions. Only in one paper were neurodynamic techniques used in patients without other therapeutic elements [18]. Unfortunately, in most works, neurodynamic techniques were combined with other procedures - e.g. cervical traction, warm compresses, various physical procedures (short-wave diathermy, TENS currents) - but also with manipulations, isometric exercises, or strengthening exercises. Of course, it should be emphasized at this point that for causal treatment of cervical radiculopathy, the above-mentioned procedures are of significant importance in the therapeutic process; however, this is not the subject of this review. In these studies, in which several different therapeutic elements were used, it is difficult to assess the actual percentage impact of only one specific element.

In all 10 papers, neurodynamic techniques were performed passively by a physiotherapist, and in each of them these

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techniques were used together with other therapeutic techniques [12-20]. From among the above-mentioned works, auto-neuromobilization was performed in one of the examined groups [19]. In six of the 10 studies, a significant therapeutic effect was obtained after using neurodynamic techniques compared to control groups in which neurodynamic techniques were not used [11,14-18]. In four studies, however, the use of neurodynamic techniques did not significantly improve the patients' condition compared to control groups [12,13,19,20]. Particularly noteworthy is the paper by Sarfaraj, in which the author divided the subjects into three groups [18]. In the first he used mechanical cervical traction with neurodynamic techniques, in the second only mechanical cervical traction, and in the third only neurodynamic techniques. The most significant therapeutic effect (pain reduction, reduction of NDI) was obtained in the group in which cervical traction was used in combination with neurodynamic techniques. There were no statistically significant differences between the other two groups. This is the only study of all included in this review, in which the author used only neurodynamic techniques in the therapy of one of the studied groups. Looking at this scientific report, it can be concluded that the use of neurodynamic techniques alone does not give satisfactory results compared to studies in which cervical spine traction was used. However, this conclusion cannot be considered as final, because it is the only such scientific report. Further studies assessing the effect of neurodynamic techniques on physiotherapy in the treatment of cervical radiculopathy are important, in which only neurodynamic techniques are used without any other additional physiotherapeutic procedures.

In three out of the 10 scientific papers, improvement was achieved after applying each of the therapeutic programs; however, the authors indicate that this was not a significant improvement and that there were no significant differences between the groups after the end of therapy [13,19,20]. In one scientific report, in which there were three comparative groups, in the group in which neurodynamic techniques were used, the pain index was clearly higher than in the other groups, so neurodynamic techniques were not effective [12]. One should wonder why in this case the neurodynamic techniques did not have the desired effect.

The author's conclusion pointed to possible irritation of the nerve roots, which could have had a worse effect than in the other two groups, but maybe the problem lies elsewhere. It is likely that neurodynamic techniques in combination with a thermal factor (short-wave diathermy) have a much worse effect than when using these techniques without any additional physical treatments aimed at localized tissue overheating.

It can be stated that in most of the papers included in this review, the group in which the therapy enriched with neurodynamic techniques was used achieved better therapeutic effects compared to the control group in which another therapeutic program was used. The exception is one study in which Kumar showed that in a group in which neurodynamic techniques were used, the pain index was higher than in control groups, so in this case neurodynamic techniques were not the most effective method [11].

In many papers, different methodologies of therapeutic management (therapy time, number of series, dose) are problematic, which can also impact the effectiveness of therapy based on neurodynamic techniques. In all 10 papers, some reproducible elements of therapy (cervical traction, neurodynamic techniques) were used; however, the other components of the therapy were different

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depending on the study. It should also be noted that each study had a different traction time and the number of repetitions of neurodynamic techniques. The question justified here is whether differences in the parameters of the treatment may affect the results of the therapy. Perhaps the key is the appropriate duration of neurodynamic techniques, not the selection of other components of therapy. Also noteworthy is the fact that the papers included in this review have a discrepancy in both the number and the age of participants in individual studies, which may also affect the final results.

The above considerations regarding the assessment of neurodynamic techniques in the conservative treatment of cervical radiculopathy may indicate the positive effect of the above-mentioned therapeutic techniques; however, no clear conclusions should be drawn yet. Although in most studies beneficial therapeutic effects were obtained, it was only immediately after therapy. It is not known, therefore, whether and how long the effect lasts. From a clinical point of view, the long-term effect is always the most important, because only then we can talk about a beneficial health effect for the patient. The large methodological discrepancies in the studies, which are associated with both the parameters assessed and the use of various therapeutic procedures cannot be the basis for drawing a general conclusion about the effectiveness or ineffectiveness of these techniques. Therefore, further research based on a similar methodology is necessary, in which neurodynamic techniques will be the only element of therapy.

In conclusion, an analysis of previous scientific studies assessing the effect of neurodynamic techniques on cervical radiculopathy has shown that positive final effects of therapy were observed in most of the studies. However, due to differences in both patients and research methodology, it is difficult to make one general conclusion. There is a need for further research aimed at assessing the impact of neurodynamic techniques on conservative treatment of cervical radiculopathy.

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