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NEURAL MOBILIZATION IN THE MANAGEMENT OF CERVICAL RADICULOPATHY: AN INTEGRATIVE REVIEW

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Trabalho de Conclusão de Curso de Graduação apresentado ao Curso de Fisioterapia da Universidade do Sul de Santa Catarina como requisito parcial à obtenção do título de Bacharel em Fisioterapia.

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Este Trabalho de Conclusão de Curso foi julgado adequado à obtenção do título de Bacharel em Fisioterapia e aprovado em sua forma final pelo Curso de Fisioterapia da Universidade do Sul de Santa Catarina.

Palhoça, 06 de julho de 2021.

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Neural mobilization in the management of cervical radiculopathy: an integrative review

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ABSTRACT

Introduction: Cervical radiculopathy (CR) it is defined as an objective loss of sensorial function and/or motor, due to the impairment of neural conduction on a cervical level. Still, it presents difficult management of its clinical symptoms/signs. Therefore, neural mobilization (NM) has presented beneficial effects in the treatment of neural dysfunctions.
Objective: The present study aimed to verify the effects of neural mobilization in the management of CR.
Design: This study is characterized as an integrative review.
Method: Articles were selected from the following databases: MEDLINE (Medical Literature Analysis and Retrieval System Online /PubMed); PEDro (Phisiotherapy Evidence Database); LILACS (Latin American and Caribbean Literature in Health Sciences), Cochrane Library and Science Direct, in April of 2021. Inclusion criteria were: clinical trials in individuals with CR and treated with NM combined to another treatment or not, restricted to portuguese, english and spanish language, without restriction of publication date. The outcomes evaluated were: pain, functional capacity, range of motion, and handgrip strength. The PEDro scale was used to evaluate methodological quality in the included studies.
Results: 12 articles were included and of these there wasn´t consensus on the best parameters for the management of the outcomes analyzed (pain, functional capacity, range of motion, and handgrip strength). In fact, the articles always used NM combined to others nonpharmacological therapies, without preponderant effect of the associated therapies in the analyzed outcomes. Finally, despite the variability of prescribed doses, the articles presented methodological quality mostly classified as acceptable to good.
Conclusion: The present study verified that NM is an interesting therapeutic tool for pain management, functional capacity, handgrip strength and range of motion in individuals with CR, however it needs better standardization and description of the techniques used in literature.

Keywords: Neurodinamics, nerve, cervical.

1. INTRODUCTION

Cervical radiculopathy (CR) it is defined as an objective loss of sensorial function and/or motor, due to the impairment of neural conduction on a cervical level (FINNERUP et al., 2016). Still, CR presents distinct causes (for instance, acute disc hernia, cervical spondylosis and foraminal narrowing), however they can lead to compression and/or irritation of a cervical nerve root. CR has an annual incidence estimated in 83 cases out of 100.000 individuals, with an increase of its prevalence observed in the fifth decade of life (SAVVA, 2020; THOOMES et al., 2018; RADHAKRISHNAN et al., 1994). Furthermore, cervical nerve roots (C6 and C7) are usually compromised, due to high mobility and range of motion (ROM) that occurs between cervical vertebrae on levels C5-C6 and C6-C7 (SAVVA, 2020; KIM et al., 2016; COREY & COMEAU, 2014).

CR is considered as one of the diseases that most affect cervical spine, some factors such as disc hernia and osteophytes are two of the causes that can lead to this disturb. The compression by cervical disc hernia triggers the inflammation and symptoms in the ipsilateral member to nerve compression (MAGAZONI, 2020; AQUAROLI, et al., 2016). Therefore, the compression of the cervical nerve root causes CR, which promotes irradiated pain to the upper limb. Besides, it can be classified as acute, subacute or chronic, being the acute symptoms the most frequent in the younger population; while the chronic generally occurs in the elderly or young adults (CALDERÓN, 2012; HERKOWITZ, 2000).

Individuals affected by CR generally present a painful (neck) clinical presentation, with irradiation to the arm or numbness in the distribution of a specific nerve root. Radiculate pain usually is accompanied by motor disturbances and/or sensory (HUNGUND et al., 2021; EUBANKS, 2010). Moreover, patients present muscular weakness associated to the myotome correspondent to nerve distribution (MCNEISH et al., 2019) and impaired profound tendinous reflexes (MAGNUS et al., 2020).

Clinical diagnosis of the disfunction is based in the analysis of the complete presentation of symptoms cited above and its associations (ROMEO, 2018; THOOMES, 2012). The main means for this diagnosis are magnetic ressonance and electromyography exams. To evaluate cervical pain and functional capacity, numerous questionnaires are applied, the most commons are: Oswestry Disability Index (ODI), Neck Disability Index (NDI), Back Pain Disability Questionnaire (QBPQ), Short Form 36

Health Survey Questionnaire (SF-36) (MAGAZONI, 2020; FALAVIGNA A. et al., 2011).

Because it has a clinical profile that is refractory to some types of treatments, some nonpharmacological treatments when associated to other therapeutic techniques, have presented interesting effects in the treatment of CR on pain (SAVVA, 2020; KIM, 2017), and gain on ROM (HUNGUND, 2021). Amongst techniques, neural mobilization (NM) presents some beneficial effects in the treatment of neural disfunctions such as: pain, numbness, tingling and weakness; as well as, regaining physiological nerve function, restoring tensioning and mobility, with synchronous movements applied to neural tissue (MAGAZONI, 2020). These maneuvers are applied with slow and rhythmic movements towards the nerves (RAMOS, 2018; BUTLER, 1991).

NM technique assumes that there is some impairment in the mechanic of the nervous system, such as movement, elasticity, conduction and/or axoplasmic flow. Compressive syndromes and adverse neural tension are examples of these disfunctions (DE OLIVERIRA JUNIOR, TEIXEIRA, 2007; BUTLER, JONES, 2003). Studies demonstrated the beneficial effects of NM in the reduction of articular pain in patients with rheumatoid arthritis (LAU, 2018), and in the reduction of pain in cervicobrachialgia (SANZ, 2018). NM demonstrated an excellent prognostic in patients with neuropathic pain, besides presenting low operational costs, easy application and few adverse effects described (RAMOS et al., 2020).

NM is analyzed many times with combined treatment and has demonstrated effects in the reduction of pain and improvement of functional capacity (HUNGUND, 2021; SAVVA, 2020; KIM, 2017; PRABHAKAR, 2011). Nevertheless, presents effects in the increase of ROM (HUNGUND, 2021; SAVVA, 2020; KIM, 2017) and reduction of radicular pain in the upper limb (PRABHAKAR, 2011). In this sense, the present study aimed to verify the effects of NM in the management of CR.

2. MATERIAL AND METHODS

2.1 Characterization of the study and search strategy

This study is characterized as an integrative review. The electronic search of the studies was performed on the databases: MEDLINE (Medical Literature Analysis and Retrieval System Online /PubMed); PEDro (Phisiotherapy Evidence Database); LILACS (Latin American and Caribbean Literature in Health Sciences), Cochrane Library and Science Direct. The search was performed in April of 2021, the study design was restricted to clinical trial, restriction of language (portuguese, english and spanish) was used, and without restriction of publication date.

The search strategies used for the databases were: ((“neural mobilization” OR “mobilização neural” OR “movilización neuronal” OR “nerve mobilization” OR “mobilização do nervo” OR “movilización nerviosa” OR “neural manipulative” OR “manipulação neural” OR “manipulación neuronal” OR “neurodynamic” OR “neurodinâmica” OR “neurodinámica”) AND (“cervical radiculopathy” OR “radiculopatia cervical” OR “radiculopatia cervical”)).

2.2 Eligibility criteria

Article screening was performed initially with the reading of titles and abstracts by two independent reviewers. Stablished eligibility criteria were: pathology (CR); intervention (NM); comparison (compared to other intervention or not; as well as combined treatments to NM); outcomes (pain, functional capacity; ROM; handgrip strength); study design (clinical trial). Articles that did not present the stablished eligibility criteria, and were not free access, as well as duplicates, were excluded from this study.

2.3 Extraction and data analysis

The selected studies were organized systematically in spreadsheets on Microsoft Office Excel® software. Posteriorly, were extracted from the studies the following variables: name of authors; date of publication; groups (characteristics and indication of a existent control group); sample (gender, sample size, mean of age); form of intervention (NM with the number of series, repetitions and descriptions of maneuvers); effects on the outcomes previously stablished (scales used for evaluation); obtained results. The

acquired findings were organized in tables and obtained data from the number of articles included and excluded were presented in the (Figure 1).

2.4 Quality assessment of studies

Study quality was assessed using the PEDro scale by two independent reviewers. The scale has 11 items and the maximum score obtained is up to 10, since item 1 does not score. In this sense, scores between 0 and 4 refer to low quality studies; 4 to 5 acceptable quality; 6 to 8 good quality; and 9 to 10 are studies with excellent methodological quality (Foley et al., 2003; Gonzalez, et al., 2018; Cashin et al., 2020).

3. RESULTS

122 studies were selected according to the descriptors previously established in the MEDLINE databases (Medical Literature Analysis and Retrieval System Online /PubMed); PEDro (Phisiotherapy Evidence Database); LILACS (Latin American and Caribbean Literature in Health Sciences), Cochrane Library and Science Direct. Of these studies, 110 were excluded for not meeting the eligibility criteria previously established. Thus, 12 articles were included in this review (Figure 1).

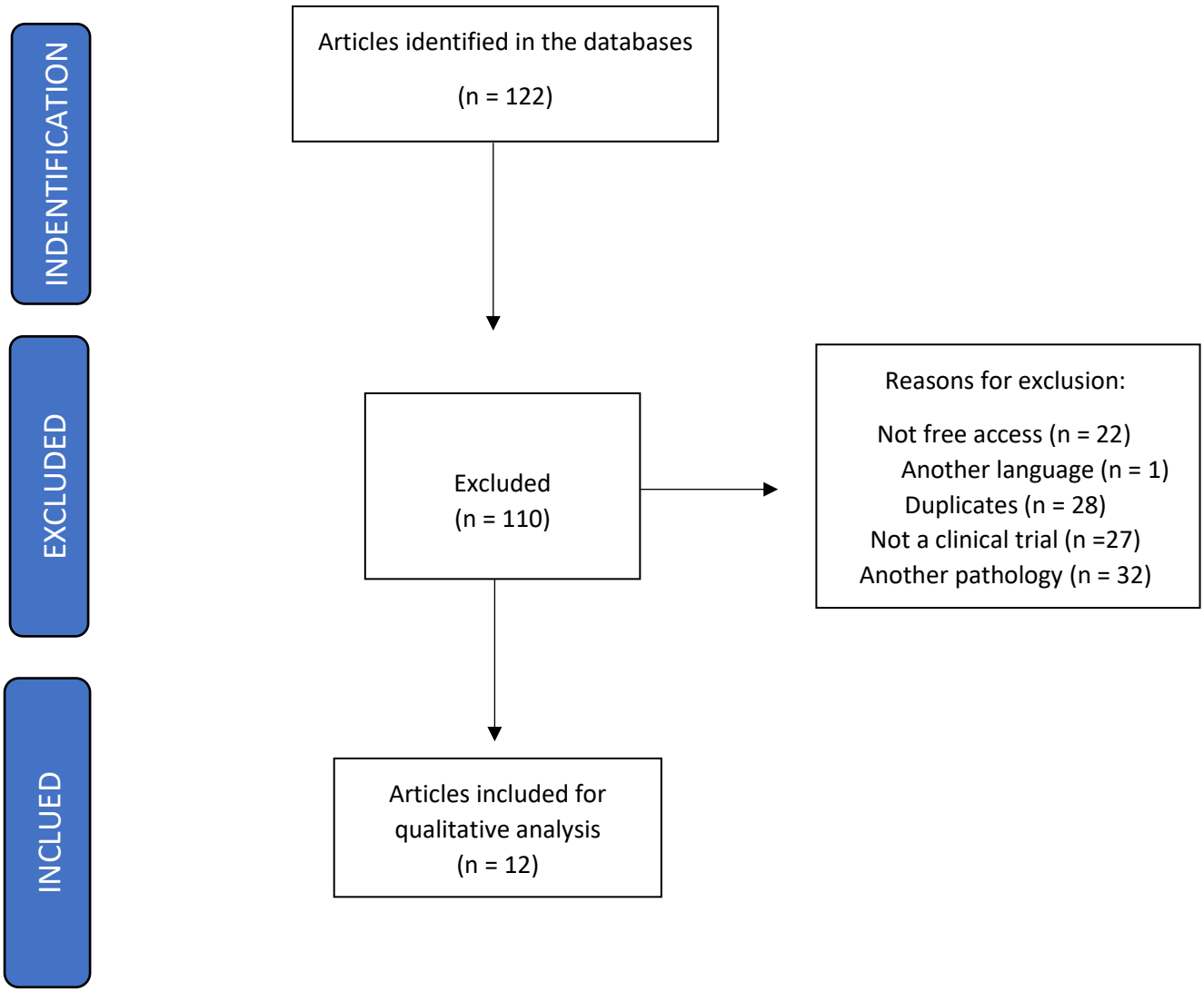

Fig. 1. Flow of studies throughout the review

Table 1 demonstrates the characteristics found in the 12 studies included in the review. Initially, it was possible to verify that most studies participants were women, the mean age of participants was 30 to 60 years, and only two studies did not specify the NM maneuver (ANWAR, 2015; RAJALAXMI, 2020). Among the treatment techniques for CR, the mobilization of the spine with arm movement was observed (HUNGUND, 2021) with sliding, supported by the therapist and the patient performed shoulder flexion abduction and horizontal adduction. While the NM slider (SAVYA, 2020) was performed with repeated passive movements of flexion and extension of the elbow, wrist, and fingers joints of the involved upper limb, performed in a slow and oscillatory manner.

In the slow and smooth segmental mobilization (AYUB et al., 2019) unilateral anterior and posterior glide of the upper limb to be treated was performed, which could be active or passive NM of the upper extremity. In the Mulligan mobilization with arm movement (SHAFIQUE, 2019), a sustained transverse slip is generated. This in turn is kept at the level of the affected spinous process towards the unaffected side while actively performing limited peripheral joint movement. In the study that used neurodynamic treatment (RANGANATH, 2018), the patient was positioned in a neurodynamic test position according to the nerve involved (median, ulnar and radial), the same was performed in the study by KUMAR et al. (2010) (Table 1).

NM with manual cervical traction (KIM et al., 2017) was performed with the patient's wrist and was placed in a neutral position with elbow flexion, posteriorly the patient's wrist and fingers were placed in full extension with arch flexion, and finally, the patient's wrist and fingers were placed fully flexible while the elbow was moved from full flexion to full extension. While the intermittent one (SAVYA, 2016), the glenohumeral joint was placed in different positions according to the objective (neutral at 90° + abduction and lateral rotation; high at 0° of flexion + abduction and lateral rotation and low at 90° of abduction + maximum lateral rotation), while in this position, the elbow was moved from full flexion to full extension, while the patient's wrist and fingers were moved from extension to flexion (Table 1).

Finally, in the NM treatment of median nerve (scapular depression, shoulder abduction and forearm supination, wrist and finger extension, shoulder external rotation and elbow extension), an associated cervical traction was performed (KHATWANI, 2015). While, in mobilization with contralateral cervical inclination associated to dynamic opening (PRABHAKAR, 2011) the patient was positioned in the supine position

and the therapist performed the contralateral inclination movement and posteriorly ipsilateral to the affected side, with oscillatory movements (Table 1).

Table 1 shows that the groups used for comparison were: myofascial release; thermal bag (hot); manual cervical traction; strengthening exercises (isometrics, stabilization); stretches; electrotherapy (TENS, short waves); active movements (flexion, extension, inclination, and cervical rotation).

Study	Participants characteristics	NM intervention	Comparation condition
Hungund et al. (2021)	N = 32 individuals Age = 30 - 50 years Gender = 17 M; 15 F.	**Type of Neural mobilization** = Spine mobilization with arm movement (10 repetitions in one set, 3 sets per session for 6 sessions) **Combined treatments** = Wet warm compress (20 min cervical, 6 sessions); Manual traction (10 sec traction, 5 sec rest for 10 times in 6 sessions); Isometric strengthening of the cervical flexors (10 sec for 10 times, twice a day with 25 sustained repetitions each for 7 sec, and 5 sec rest in 6 sessions).	**Comparison group** = myokinetic stretching technique **Combined treatments** = Wet warm compress (20 min cervical, 6 sessions); Manual traction (10 sec traction, 5 sec rest for 10 times in 6 sessions); Isometric strengthening of the cervical flexors (10 sec for 10 times, twice a day with 25 sustained repetitions each for 7 sec, and 5 sec rest in 6 sessions).
Rajalaxmi et al. (2020)	N = 30 Age = 30-60 years Gender = both sexes (unspecified)	**Type of Neural mobilization** = NM (unspecified maneuvers; in relation to time, were 5 repetitions with one session per day, for 4 days a week, over 12 weeks).	**Comparison group** = Cervical stabilization exercises (5 repetitions with one session per day for 4 days a week, for 12 weeks).
Savva et al. (2020)	N = 66 Age = 48 years Gender = 32M, 34F	**Type of Neural mobilization** = repeated passive movements of flexion and extension of the elbow, wrist, and finger joints of the involved upper limb, and it was given in a slow and oscillatory way (60 sec each series, with a rest period of 30 sec. There were 12 treatments of 15 minutes sessions, being 3 times a week for 4 weeks).	**Comparison group** = Intermittent cervical traction combined with an NM sham technique, which included a sustained position of the cervical spine, shoulder and elbow joints + finger flexion and extension (60 sec each set, with a 30 sec rest period. There were 12 treatments of 15 minutes sessions, being 3 times a week for 4 weeks).

Ayub et al (2019)	N = 44 Age = 30-50 years Gender = 44F	**Type of Neural mobilization** = Active upper extremity NM (6 to 8 repetitions, with 3 sessions per week over 4 weeks) **Combined treatments** = hot compress (10 min); cervical traction (15 min); slow and smooth segmental mobilization (unilateral posteroanterior gliding with 15 to 20 repetitions of 3 sets).	**Comparison group** = Passive NM of the upper extremity. **Combined treatments** = hot compress (10 min); cervical traction (15 min); slow and smooth segmental mobilization (unilateral posteroanterior gliding with 15 to 20 repetitions of 3 sets).
Shafique et al. (2019)	N = 31 Age = 20-60 years Gender = 12M, 19F	**Type of Neural mobilization** = mobilization with arm movement (10 repetitions in the first session, in the other sessions there were 30 repetitions in 3 sets). The protocol was twice a week, over 3 weeks. **Combined treatments** = thermal bag (hot, for 10 min); Active movement (3 sets of 10 reps); isometric exercises (20 sets of 6 to 10 sec); neurodynamics (10 repetitions in each session); manual traction (10 min with sustained traction and 5 sec rest).	**Comparison group** = neurodynamics and manual traction (1 series of 10 repetitions and traction for 10 min with sustained traction and 5 sec rest). The protocol was twice a week, over 3 weeks. **Combined treatments** = thermal bag (hot, for 10 min); Active movement (3 sets of 10 reps); isometric exercises (20 sets of 6 to 10 sec); neurodynamics (10 repetitions in each session); manual traction (10 min with sustained traction and 5 sec rest).
Ranganath et al. (2018)	N = 66 finished Age = 20-50 years Gender = unspecified	**Type of Neural mobilization** = NM according to the nerve involved (ulnar, median, or radial, 3 sets of 15 oscillatory movements. Treatment consisted of 6 times a week for 4 weeks). **Combined treatments** = isometric exercises for cervical and shoulder girdle (10 repetitions, 2 times a day); TENS (15 min, 6 times a week).	**Comparison group** = mobilization with NM movements in the Mulligan method (3 sets of 15 oscillations 6 times a week for 4 weeks). **Combined Treatment** = isometric exercises for cervical and shoulder girdle (10 repetitions, 2 times a day); TENS (15 min, 6 times a week).

Kim et al. (2017)	N = 30 Age = 25-60 years Gender = 11M, 19F	**Type of Neural mobilization** = Sliding neural mobilization of the median nerve simultaneously with manual cervical traction (6 sets of 1 min of traction + 30 sec rest for 10 minutes). Protocol 3 times a week for 8 weeks. **Combined Treatments** = thermal bag (hot, for 20 min); TENS (Frequency 60 Hz, for 15 min).	**Comparison group** = manual cervical traction (6 sets of 1 min of traction + 30 sec rest for 10 min). Protocol 3 times a week for 8 weeks. **Combined Treatments**= thermal bag (hot, for 20 min); TENS (Frequency 60 Hz, for 15 min).
Savva et al. (2016)	N = 42 Age = 28-70 years Gender = 21M, 21F	**Type of Neural mobilization** = NM of the median nerve. **Combined Treatments** = grade II and IV intermittent cervical traction (6 sets of 60 sec and 60 sec rest, during 12 sessions).	**Comparison group** = grade II and IV intermittent cervical traction (6 sets of 60 sec and 60 sec rest, during 12 sessions).
Anwar et al. (2015)	N = 30 Age = não especificou Gender = não especificou	**Type of Neural mobilization** = global NM for upper limbs (1 set of 10 repetitions). **Combined Treatments** = thermal bag (hot, for 10 minutes); cervical isometric exercises (3 sets of 10 repetitions sustained for 5 sec); intermittent cervical traction (3 sets sustained for 20 sec).	**Comparison group** = thermal bag (hot, for 10 minutes); cervical isometric exercises (3 sets of 10 repetitions sustained for 5 sec); intermittent cervical traction (3 sets sustained for 20 sec).
Khatwani et al. (2015)	N = 30 Age = 30-50 years Gender = both sexes	**Type of Neural mobilization** = Median nerve NM, with cervical inclination and with different degrees of oscillation (3 sets of 60 sec and 1 minute of rest at each repetition).	**Comparison group** = lateral cervical slip and manual cervical traction (traction was maintained for 7 sec and performed 3 times).

Prabhakar et al. (2011)	N = 75 Age = 20- 50 years Gender = 36 M; 39 F	**Type of Neural mobilization** = mobilization with contralateral cervical inclination associated with dynamic opening (10 to 15 repetitions, with 1 repetition lasting 5 seconds). **Combined treatments:** thermal bag (hot, in the posterior cervical region for 20 to 25 min); cervical isometric exercises (3 sets of 6 to 8 sec).	**Comparison group (1)** = thermal bag (hot, in the posterior cervical region for 20 to 25 min); cervical isometric exercises (3 sets of 6 to 8 sec); TENS (pulse duration: 50 µs, frequency 100 Hz, time 30 min). **Comparison group (2)** = thermal bag (hot, in the posterior cervical region for 20 to 25 min); cervical isometric exercises (3 sets of 6 to 8 sec).
Kumar et al. (2010)	N = 30 Age = 25 – 68 years Gender = 10M e 20F	**Type of Neural mobilization** = NM of the median or radial or ulnar nerve (it was according to each case in the study, being 3 sets of 20 sec a day, for 10 days). **Combined Treatment** = short wave diathermy and intermittent cervical traction	**Comparison group (1)** = McKenzie methods (exercises / manipulation, with 1 set of 5 to 15 repetitions over 10 days) + combined treatment (not specified). **Comparison group (2)** = short wave diathermy (20 min over 10 days) + intermittent cervical traction (20 min over 10 days) + combined treatment (not specified).

Table 1. Characteristics of the studies

M (Male); F (Female); NM (neural mobilization); TENS (transcutaneous electrical nerve stimulation); Age (equals the age range of the sample); sec (seconds)

Table 2 presents the main findings in the analyzed studies, as well as the outcomes and instruments used for the analyses. For pain outcome, five studies used the Visual Analog Scale (VAS), 10 articles used the Numerical Pain Rating Scale (NPRS), one study used the Pain DETECT Questionnaire, one article used the Neuropathic Pain Scale (NPPS), one study used the Northwick Park Neck Pain Questionnaire (NPNQ), one study used the Mc Gill Short Form Pain Questionnaire (SF-MPQ) and one study used the Result percentage scale.

In the analysis of functional capacity related to activity of daily living and motor function, six studies used the Neck Disability Index (NDI) Questionnaire, two studies used the Patient Specific Functional Scale (PSFS), yet one study used the Korean version of disability of the Neck Index (K-NDI), one study used the DASH Questionnaire of Arm, Shoulder and Hand Disability, one article used the Fear Avoidance Belief Questionnaire. In addition, for the analysis of the outcome related to range of motion, one study used the instrument Performance Attainment Associates, USA, five articles used universal goniometer, one article used the Cranio-Cervical Deep Flexor Resistance Test (CCFT), one study used Scalar Measurement to assess cervical ROM, as well as one research used the upper limb tension test. Finally, in the handgrip strength outcome, three studies that used the dynamometer equipment were observed (Table 2).

Table 2. Effects of neural mobilization

Study	Instruments of evaluation (outcomes)	Main findings
Hungund et al. (2021)	- Visual Analogue Scale – VAS (pain) - Neck Disability Index – NDI (functional capacity) - Cervical ROM with goniometer (ROM) - Handgrip strength with dynamometer (handgrip strength)	There was no statistically significant difference in VAS, NDI, handgrip strength and ROM in relation to cervical flexion, cervical extension, right lateral flexion, left lateral flexion, right rotation, and left rotation between the groups, suggesting that both groups are equally effective in the treatment of CR.
Rajalaxmi et al. (2020)	- Pain DETECT Questionnaire (pain) - DASH Questionnaire of arm, shoulder, and hand disability (functional capacity) - Fear Avoidance Belief Questionnaire and cervical ROM (functional capacity)	In the outcome pain, both groups showed a significant reduction. In the analysis of functional capacity, the group with NM had a better score in the questionnaires when compared to the other groups.
Savva et al. (2020)	- Numeric Pain Rating Scale – NPRS (pain) - Neck Disability Index – NDI (functional capacity) - Patient Specific Functional Scale - PSFS (functional capacity) - Handgrip strength with dynamometer (handgrip strength) - Cervical mobility with goniometer (ROM)	The group with NM showed better clinical response in the analysis of the outcomes: functional capacity, pain, and ROM gain, when compared to the other groups.
Ayub et al, 2019	- Numeric Pain Rating Scale – NPRS (pain) - Neck Disability Index – NDI (functional capacity) - Cervical ROM with goniometer (ROM)	The evaluated groups showed efficacy in pain, global capacity, and ROM.
Shafique et al. (2019)	- Numeric Pain Rating Scale NPRS (pain) - Neck Disability Index – NDI (functional capacity) - Evaluation of ROM - universal goniometer	The group treated with mobilization with arm movement had a better response on pain, functional capacity, and cervical ROM gain, when compared to the neurodynamic group.
Ranganath et al. (2018)	- Neck Disability Index – NDI (functional capacity) - Numeric Pain Rating Scale – NPRS (pain) - Cervical ROM rotations with goniometer (ROM)	There were no significant differences between groups for pain and functional capacity outcomes. While, in cervical ROM (rotation) there was a statistical difference in the MN group treated with the specific nerve (median/ulnar/radial), when compared to the other group.

Kim et al. (2017)	- Korean Version of Neck Deficiency Index - K-NDI (functional capacity) - Numeric Pain Rating Scale – NPRS (pain) - Flexion Test- CCFT (functional capacity) - A cervical ROM instrument - Performance Attainment Associates, USA - (ROM)	The group treated with NM had a better response in the outcome functional capacity, cervical ROM (flexion, extension, and rotation), when compared to the comparison group. However, pain improved significantly in both groups.
Savva et al. (2016)	- Numeric Pain Rating Scale – NPRS (pain) - Neck Deficiency Index - NDI (functional capacity) - Patient-Specific Functional Scale - PSFS (functional capacity) - Handgrip strength with dynamometer (handgrip strength) - Cervical ROM with goniometer (ROM)	The results showed statistically significant differences between measures for pain and functional capacity in the intervention group with NM + traction, when compared to the other group.
Anwar et al. (2015)	- Visual Analogue Scale - VAS (pain) - Neck Deficiency Index - NDI (functional capacity)	All groups had positive effects for the evaluated outcomes (pain/functional capacity).
Khatwani et al. (2015)	- Numeric Pain Rating Scale – NPRS (pain) - Neck Disability Index – NDI (functional capacity)	The result of this study demonstrated that NM with combined treatment is more effective than the treatment with cervical lateral sliding in the outcomes of pain and functional capacity in patients with CR.
Prabhakar et al. (2011)	- Visual Analogue Scale - VAS (pain) - Northwick Park Neck Pain Questionnaire– NPNQ (pain) - Numeric Pain Rating Scale – NPPS (pain) - Mc Gill Short Form Pain Questionnaire - SF-MPQ (pain) - Upper limb tension test (ROM)	There was no significant difference between groups in pain and ROM outcomes. Thus, all showed improvements in the analyzed scores.
Kumar et al. (2010)	- Visual Analog Scale - VAS (pain) - Result percentage scale for Pain Assessment - (ROM)	There was no significant difference between groups in pain and ROM outcomes. Thus, all showed improvements in the analyzed scores.

ROM (range of motion); CT (Cervical Traction); NM (Neural Mobilization); CR (Cervical Radiculopathy);

The results of the methodological quality analysis, using the PEDro scale of the studies included in the review, showed that only two articles had good quality (score 6 to 8), eight studies had acceptable quality (score 4 to 5), and two studies presented quality classified as low (score 0 to 4). Among the items with less contemplation by the analyzed articles were the blinding of participants, therapists, and evaluators (Table 3).

Table 3. PEDro scores of the included studies.

Study (Year)	Randon allocation	Concealed allocation	Groups similar at baseline	Partici-pant blinding	Therapist blinding	Assessor blinding	<15% dropouts	Intention to treat analysis	Between-group difference reported	Point estimate and variability reported	Total (0-10)
Hungund et al. (2021)	Y	Y	Y	N	N	N	Y	N	Y	Y	6
Rajalaxmi et al. (2020)	Y	N	Y	N	N	N	N	N	Y	Y	4
Savva et al. (2020)	Y	N	N	N	N	Y	N	N	Y	Y	4
Ayub et al. (2019)	Y	Y	Y	N	N	N	N	N	Y	Y	5
Shafique et al. (2019)	Y	N	Y	N	N	N	N	N	N	N	2
Ranganath et al. (2018)	Y	Y	Y	N	N	N	N	N	Y	Y	5
Kim et al. (2017)	Y	N	Y	N	N	N	Y	N	Y	Y	5
Savva et al. (2016)	Y	Y	Y	N	N	Y	Y	N	Y	Y	7
Anwar et al. (2015)	Y	N	N	N	N	N	N	N	Y	N	2
Khatwani et al. (2015)	Y	N	Y	N	N	N	Y	N	Y	Y	5
Prabhakar et al. (2011)	Y	N	Y	N	N	Y	N	N	Y	Y	5
Kumar et al. (2010)	Y	N	Y	N	N	N	N	N	Y	Y	4

Y – Yes; N – No.

4. DISCUSSION

This study sought to verify the main therapeutic approaches to NM in CR related to the doses proposed in the interventions (series and repetitions), as well as the instruments used to assess outcomes such as pain and global functional capacity. In the present study, it was possible to identify that the sample profile of the 12 articles included in this review were female participants and the age group was 30 to 60 years old.

In this sense, a study by Radhakrisnan and colleagues (1994) found that the profile of CR presented an annual incidence of 0.1% in men, while 0.06% in women aged 50 years. Corroborating these findings, was observed that the prevalence of CR increases between the ages of 50 to 59 years, due to structural degenerative changes in the spine (SALEMI et al., 1996). Even so, the present study found that the most performed NM maneuver was the median nerve, associated with different therapeutic combinations (hot thermal bag and cervical traction), and the therapeutic doses for the performance were in the majority of three sets with 10 repetitions.

Corroborating the findings observed in this study, Cleland et al. (2005) demonstrated that the use of combined therapies to median nerve NM such as: intermittent cervical traction, thoracic spine manipulation and strengthening exercises for cervical in CR, had analgesic effects, as well, an improvement of the acute and late functional status (after six months). Also in this context, our study found that the main outcomes analyzed were pain with the use of instruments such as visual analogue scale (VAS), numerical pain rating scale (NPRS); as well as the global functional capacity using instruments such as Neck Disability Index (NDI) and the patient-specific functional scale (PSFS). In addition, the cervical ROM was evaluated using the universal goniometer and the handgrip strength using the dynamometer equipment.

In the study by Hungund et al. (2021) they evaluated the effects of NM in individuals with CR, among them there was an association with joint mobilization maneuvers in one of the treated groups. Finally, improvement in ROM and pain reduction were demonstrated. As for the effects on handgrip strength and pain in patients with CR, a study showed in 50 participants with CR treated with NM, when compared to conventional non-pharmacological treatment, that NM was more effective in pain and grip strength when compared to control (conventional treatment) (Mathur et al., 2017).

In this sense, studies have shown effective therapeutic effects of NM associated with different treatments in pain management (Lamba et al., 2012; Khatwani et al., 2015;

Efastathiou et al., 2015; Rajalaxmi et al., 2020); as well as improving global functional capacity (Myrphy et al., 2006; Ranganath et al., 2018; Shafique et al., 2019; Rajalaxmi et al., 2020; Savya et al., 2020) in individuals with CR. In addition, Savya et al. (2016) demonstrated that combination therapies with NM show improvement not only in pain and overall functional capacity; as in handgrip strength and cervical ROM in patients with CR.

Finally, the studies included in this study demonstrate limitations in the methodological quality assessed by the PEDro scale, especially in terms of blinding for participants, therapists, and evaluators. This is a component that prevents biases at various stages of research, but it is not always possible to apply (Buehler et al., 2009). Still, despite the demonstrated limitations, we had 10 articles that demonstrated acceptable to good methodological quality; however, the parameter factors (time of treatment, repetitions and sets, best type of NM) were diverse and discrepant in the literature.

5. CONCLUSION

The present study found that NM is an interesting therapy with beneficial effects for pain management, functional capacity, handgrip strength and ROM in individuals with CR. Even so, there was no consensus on the best parameters for the management of these outcomes, in addition to what was commonly described as three sets of 10 repetitions, and the most described NM was the median nerve, in most of the studies analyzed. In fact, the articles always brought NM combined with other non-pharmacological therapies, with no predominant effect of associated therapies on the evaluated outcomes. Even so, despite the variability of the dose described, the articles presented methodological quality mostly classified as acceptable to good.

Based on the above, clinical trials with a more detailed methodology in the aspects of interventions and comparison groups are suggested, as well as whether there was blinding, and which were the curves and doses (parameters) used to assess the proposed outcomes.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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