

## THE EFFECTIVENESS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION IN MECHANICAL NECK PAIN: A SYSTEMATIC REVIEW

Made Hendra Satria Nugraha<sup>1</sup> Anak Agung Gede Angga Puspa Negara<sup>2</sup> Ni Komang Ayu Juni Antari<sup>3</sup> Anak Ayu Nyoman Trisna Narta Dewi<sup>4</sup>

<sup>1,2,3,4</sup> Physiotherapy Department, Faculty of Medicine, Udayana University  
Correspondent email: hendra\_satria@unud.ac.id

### ABSTRACT

**Introduction:** Neck pain is a health condition that has a high incidence rate and causes an inability to do daily activities and requires cost in handling it. People with neck pain could be associated with an alteration and deficit of the proprioception of the muscle and neck joint that play a significant role in joint position, postural stability, and motor control of the head and neck. The purpose of this systematic review is to find out the effectiveness of proprioceptive neuromuscular facilitation (PNF) and other recommendation related to application method and dosage of PNF in treating mechanical neck pain. **Method:** The systematic review access to journal databases such as: PubMed Central (PMC) NCBI, Physiotherapy Evidence Database (PEDro), ProQuest, Google Scholar, MEDLINE, and the Cochrane Controlled Trials Register in the Cochrane Library. **Results:** The initial search in 6 databases found a total of 30 articles. Based on inclusion and exclusion criteria 4 articles were used in this systematic review. The application of the muscle energy techniques was applied ranging from 1 time to 8 weeks of intervention. From the 4 reviewed studies concluded that proprioceptive neuromuscular facilitation was effective in improving neck range of motion and function in mechanical neck pain. **Conclusion:** Based on the results of this systematic review it can be concluded that proprioceptive neuromuscular facilitation is effective in improving pain, pain threshold, range of motion, and functional performance in individual with neck pain. The appropriate articles are still limited to 4 studies, but have good to strong qualities. In addition, the application of intervention does not have the same standard.

**Key words:** mechanical neck pain; proprioceptive neuromuscular facilitation; systematic review

### BACKGROUND

Neck pain is a common problem in musculoskeletal condition with an increased disability in 29 million in 2016. Neck pain is ultimately being described as non-specific neck pain because it cannot be assigned a specific cause of the symptoms in majority of patients.<sup>(1)</sup> It becomes a chronic pain, if the duration of symptoms is greater than 12 weeks.<sup>(2)</sup> Neck pain is the third most frequently self-reported in musculoskeletal area in the Netherland. It becomes an important social and health problem affecting up two thirds individual in their lives and make the cost of neck pain become high in primary care.<sup>(3)</sup>

People with neck pain could be associated with an alteration and deficit of the proprioception of the muscle and neck joint that play a significant role in joint position, postural stability, and motor control of the head and neck.<sup>(2)</sup> Evidence is currently inconclusive for the treatment efficacy of sub-acute and chronic neck pain. Many non-pharmacological therapy can be used to treat neck pain, such as electro physical agent, exercise therapy, and manual therapy. A study shown that there is a significant differences in effectiveness and cost-effectiveness in using manual therapy compared to exercise therapy or usual general practitioner care in patients with sub-acute and chronic neck pain.<sup>(3)</sup>

Proprioceptive Neuromuscular Facilitation (PNF) is an example of the application of exercise therapy. PNF applies neurophysiology principles such as sensory/motor system to evaluate or treat of neuromuscular problem. PNF provides an efficient technique to treat neuromuscular and structural dysfunction.<sup>(4)</sup> Several studies have proven that the application of PNF can reduce pain, improve the range of motion, and reduce the degree of neck disability.<sup>(5)(6)(7)(8)</sup> However, the recommendation of application method and dosage have not been widely discussed by some previous studies. Based on that background, the goals to be achieved from this systematic review is to find out the effectiveness of PNF

and other recommendation related to the application method and PNF dosage in treating mechanical neck pain.

## METHOD

### a. Search strategy

This systematic review access to journal database such as: PubMed Central (PMC) NCBI, PEDro, ProQuest, Google Scholar, MEDLINE, and the Cochrane Controlled Trials Register in the Cochrane Library. Search strategy using keywords: ‘proprioceptive neuromuscular facilitation’ and ‘neck pain’.

### b. Inclusion/exclusion criteria

Inclusion criteria include: (1) Journal articles with randomized controlled trial (RCT) research designs, (2) Article must be in English, (3) Articles published in the last 15 years (September 2004 – September 2019). While the exclusion criteria include: (1) If there is the same article, then other articles are excluded, (2) conference proceedings, abstracts, thesis, or case reports.

### c. Study selection

The inclusion and exclusion criteria are independently applied by four reviewers. The full text of each study, then screened by these reviewers to determine if they met criteria. Discussion is used to resolve if there were disagreements in consensus.

### d. Study quality assessment

To assess the quality of the studies, we used The Standard Quality Assessment Criteria for Evaluating Primary Research Paper from a Variety of Fields. This assessment criteria consist of a 14-item assessment checklist in which points were awarded to each criterion (no=0, partial=1, and yes=2). This assessment criteria is a validated standard.<sup>(9)</sup> Article quality assessment was assessed by dividing the total assessment score by 28 then categorized into: limited (<50%), adequate (50% - 69%), good (70% - 80%), or strong (score of >80%). Studied were excluded from this review, if the percentage scores below 50%. Discussion is used to resolve if there were disagreements in consensus.<sup>(10)</sup>

### e. Data extraction

Data were extracted by summarizing data on description of participants, intervention group, control/comparison group, outcome measures, results, and quality rating of the study.

## RESULTS

### a. Study selection

The initial search in 6 databases found a total of 30 articles. Then the selection using inclusion and exclusion criteria obtained 7 articles. The same article was then excluded. The total articles used in this study amounted to 4 articles. Explanation regarding study selection, described in Figure 1.

### b. Methodological quality and risk of bias of included studies

After assessing the quality of the study, there is no article was excluded because they had a score of <50%. The articles obtained have a strong category for 2 and good for 2 studies. Explanation regarding the quality assessment of journals, described in Table 1.

### c. Study characteristics

The 5 included studies had a total of 150 participants. The age of participants ranged between 18-53 years old. The sample sizes of studies ranged from 11 to 22 subjects. The characteristics of the summary of the study results used in this review are summarized in Table 2.

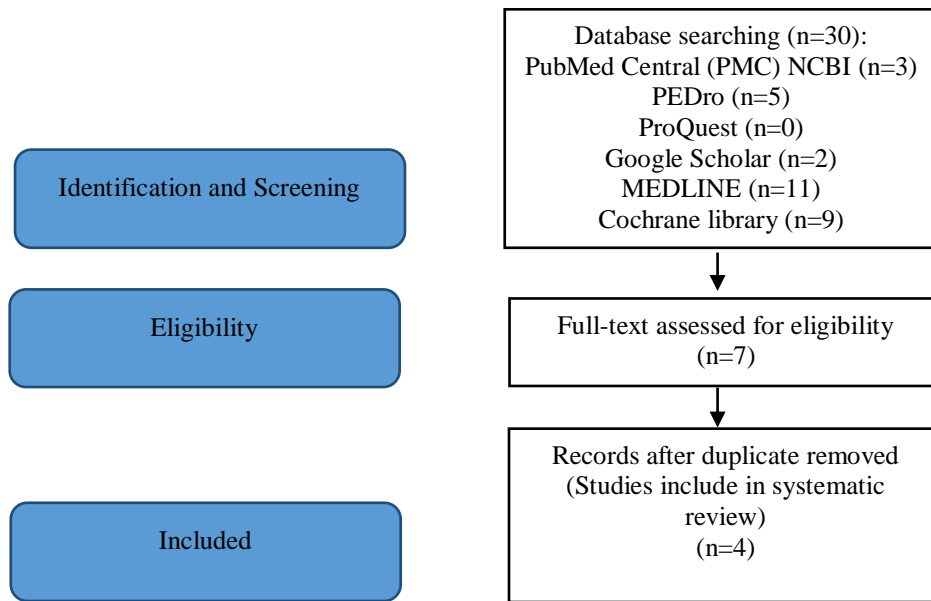


Figure 1. A flow chart of search strategy

Table 1. Methodological quality of included studies

Study	Items on standard quality assessment checklist													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Palmgren et al., 2006 <sup>(5)</sup>	+	+	+	+	±	+	±	+	±	+	±	±	+	+
Jung-Ho et al., 2013 <sup>(6)</sup>	+	+	+	+	±	-	-	+	±	+	±	±	+	+
Jung-Ho and Eun-Yeong, 2013 <sup>(7)</sup>	+	+	+	+	±	-	-	+	±	+	±	±	+	+
Parisa, et al., 2016 <sup>(8)</sup>	+	+	+	+	±	±	±	+	+	+	±	+	+	+

+ = yes; - = no; ± = partial

Table 2. Characteristics of included studies describing the efficacy of muscle energy technique

Author	Sample	Intervention	Control/comp arison	Outcome measures	Results	Quality rating
Palmgren et al., 2006 <sup>(5)</sup>	N = 41 Age range: 18 – 53	Advice and regular exercise + chiropractic therapy (high-velocity and low-amplitude techniques, ischemic compression on myofascial trigger points, and spine-stabilizing exercises or proprioceptive neuromuscular facilitation (PNF) targeted toward hypomobile zygapophyseal joints in the cervical and cervicothoracic region (n=21)	Advice and regular exercise. (n=20)  Dossage: 3 – 5 sessions during a 5-week period.	- Outcome measure was assessed at pre-treatment and the end of 5-week study.  - Neck pain: Visual Analogue Scale (VAS). Cervical range of motion (CROM): goniometer. The ability of the neuroarticulomuscular: head repositioning accuracy (HRA):	The results showed significantly greater improvements in pain and HRA aspects were detected in the intervention group.	Strong 23/28 82,14%
		Dossage: 3 – 5 times for 5 weeks.				

Jung-Ho et al., 2013 <sup>(6)</sup>	N = 32 Age range: ± 47 years old.	General PT technique (hot pack for 20 minutes, ultrasound therapy for five minutes, and transcutaneous electrical nerve stimulation for 20 minutes) and muscle relaxation therapy (hold-relax PNF technique) and shoulder joint stabilizing exercises (3 sets, 5 repetitions, 3 minutes rest) (n=16)	General PT technique (n=16)  Dosage: 1 session.	- Outcome measure was assessed at pre-treatment and after treatment.  - Neck pain: VAS. Pressure pain threshold (PPT): pressure algometer Functional performance: Neck disability index (NDI). Shoulder joint functions: constant-murley scale (CMS).	The results showed significantly greater improvements in postures, internal rotation, and external rotation among the CMS items were detected in the intervention group.	Good 20/28 71,43%
Jung-Ho and Eun-Yeong, 2013 <sup>(7)</sup>	N = 33 Age range: ± 51 years old.	Group 1: Conventional therapy (ultrasound therapy for 5 minutes and hot pack therapy for 20 minutes) + PNF (hold-relax technique). (n=11)  Group 2: Conventional therapy + extracorporeal shockwave therapy (ESWT) (1000 times to the trigger point of the upper trapezius muscle at 5 Hz) (n=11)	Conventional therapy + trigger point injection (TPI) (0.2 mL of 0.3% lidocaine) (n=11)  Dosage: two times per week for 4 weeks.	- Outcome measure was assessed at pre-treatment and the end of 4-week study.  - Neck pain: VAS. Pressure pain threshold (PPT): pressure algometer Functional performance: NDI . Shoulder joint functions: CMS.	The results showed PNF treatment enhanced range of motion in the shoulder joint, neck function, and activities of daily living relative to the other methods; ESWT improved function and reduced degree of pain; TPI treatment reduced pain, but had limited effects in enhancing functional activities.	Good 20/28 71,43%
Parisa, et al., 2016 <sup>(8)</sup>	N = 44 Age range: 22 – 32.	Stabilization exercise (SE) (n=22)  Dosage: 6 times per week and 2 times per day for 8 weeks.	PNF (n=22)  Dosage: 6 times per week and 2 times per day for 8 weeks.	- Outcome measure was assessed at pre-treatment and the end of 8-week study.  - Neck pain: VAS. Functional performance: NDI. Cross-sectional area of deep neck flexor muscles: ultrasonic ultrasonography device.	The results showed that both methods of SE and PNF effective in reduced pain and disability. SE had better effects in increasing the cross-sectional area of deep flexor muscles.	Strong 24/28 85,71%

**DISCUSSION**

The application of the PNF was applied ranging from 1 time to 8 weeks of intervention. From the 4 reviewed articles concluded that proprioceptive neuromuscular facilitation was effective in improving pain, range of motion, pain threshold, and functional performance in individual with neck pain. Table 3 describes the outcome measure used in this study to evaluate the limitations of body function and movement in neck pain based on The International Classification of Functioning, Disability and Health (ICF) criteria.

Table 3. Outcome measure used in the study

Study	Treatment Outcomes					
	Pain	Pain Threshold	Range of motion	Functional performance	The ability of the neuroarticulomuscular	Cross sectional area
Palmgren et al., 2006 <sup>(5)</sup>	x		x		x	
Jung-Ho et al., 2013 <sup>(6)</sup>	x	x		x		
Jung-Ho and Eun-Yeong, 2013 <sup>(7)</sup>	x	x		x		
Parisa, <i>et al.</i> , 2016 <sup>(8)</sup>	x			x		x

Previous research assessed the efficacy of combination of PNF and conventional physiotherapy versus conventional physiotherapy on pain and function in a study of 32 subjects with neck pain. The results showed that the combination of PNF and conventional physiotherapy is significantly better than conventional physiotherapy in improving postures, internal and external rotation movement in individual with neck pain. It can be concluded that PNF technique effective in improving the function of neck pain patients.<sup>(6)</sup>

Another research performed a study on 33 patients with myofascial pain syndrome. They divided patients into 3 groups. All groups received general physiotherapy. First group received PNF using the hold-relax technique. Second group received the shock wave therapy. Third group received injection therapy. The result showed that PNF methods enhanced neck function, range of motion in shoulder joint, and activities daily living compared to the other methods.<sup>(7)</sup>

Another study perform on 44 subjects with chronic non-specific neck pain. The subjects were randomly divided into two groups, into stabilizing exercise and proprioceptive neuromuscular facilitation. The result showed that both methods are in improving neck pain and disability, meanwhile the stabilizing exercise had a better impact in increasing cross-sectional area of the muscle.<sup>(8)</sup>

PNF is a dynamic approach to treat a neuromuscular problem. PNF applies neurophysiology principles such as sensory/motor system to evaluate or treat of neuromuscular problem. PNF provides an efficient technique to treat neuromuscular and structural dysfunction. Structural dysfunctions is defined as a condition that affect the body posture such as the myofascial and articular mobility. Neuromuscular dysfunctions related to the inability efficiently perform a purposeful movement caused by neural irritation or damage. The goal of PNF approach are to facilitate structural and neuromuscular system and reduce the symptoms, improves the distributions of force, and reduce the functional stresses caused by poor neuromuscular control. The basic principle of facilitation that used by the PNF, namely: manual contact, resistance, irradiation and reinforcement, body position and body mechanic, visual stimulation, auditory stimulation (command), traction or approximation, stretch, timing, and patterns.<sup>(4)</sup>

Previous researcher describe the technique which is used on their study as a hold relax technique.<sup>(6)(7)</sup> Hold relax is used to facilitate relaxation and increasing the range of motion. It used an isometric contraction rather than an isotonic contraction. It creates indirect relaxation through irradiation. Hold relax can be divided into two methods, namely: direct and indirect technique. When therapist apply the direct technique, it allows the isometric contraction of the antagonistic muscle to shorten followed by relaxation. In the indirect technique therapist resist the synergists muscle. This technique indicated when the contraction of the restricted muscle is too painful. Other review recommend about the PNF technique which is used to treat the patients. PNF is sufficient to increase the range of motion when apply twice a week, even with single repetition. Static contraction should be held for 3 seconds and using 20% of a maximal static contraction of the target muscle.<sup>(11)</sup>

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**CONCLUSION**

Based on the results of this systematic review it can be concluded that proprioceptive neuromuscular facilitation is effective in improving pain, pain threshold, range of motion, and functional performance in individual with neck pain. The appropriate articles are still limited to 4 studies, but have good to strong qualities. In addition, the application of intervention does not have the same standard.

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