

Effectiveness Of Cervical Isometrics and Proprioception Neuromuscular Facilitation Techniques in Mechanical Neck Pain Patients

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Abstract

Background: Mechanical neck pain is one of the most prevalent musculoskeletal disorders worldwide and is associated with pain, reduced cervical mobility, and functional disability, affecting individuals' quality of life. It commonly results from poor posture, repetitive movements, prolonged computer use, and muscular imbalance, particularly among working-age adults. Patients with mechanical neck pain often exhibit weakness of the deep cervical muscles, impaired proprioception, and altered neuromuscular control, which contribute to persistent symptoms and recurrence. Exercise therapy is considered a first-line conservative treatment for mechanical neck pain because it improves muscle strength, endurance, and functional performance. Cervical isometric exercises enhance muscle activation without excessive joint movement, making them beneficial for reducing pain and improving cervical stability. Proprioceptive Neuromuscular Facilitation (PNF) techniques facilitate neuromuscular coordination through diagonal movement patterns and proprioceptive stimulation, thereby improving flexibility, strength, and functional movement. PNF has demonstrated positive effects on pain reduction, range of motion, and muscle performance in individuals with various musculoskeletal disorders, including neck pain. Combining cervical isometric exercises with PNF techniques may provide synergistic benefits by simultaneously improving muscle strength, proprioception, and motor control. Despite growing evidence supporting both interventions individually, limited studies have directly compared their combined effectiveness in patients with mechanical neck pain. Therefore, investigating the effectiveness of cervical isometric exercises and PNF techniques may help identify an optimal physiotherapy approach for reducing pain, improving cervical function, and enhancing quality of life in individuals with mechanical neck pain.

Methods: The study was done to assess the effectiveness of cervical isometrics and proprioception neuromuscular facilitation techniques in mechanical neck pain patients. Prior to conducting the survey, the ethical committee approval was made. Patients were selected according to inclusion and exclusion criteria. With permission of 44 patients suffering from mechanical neck pain, a pre-experimental one-group pre-test and post-test study was conducted. Participants underwent a four-week structured exercise program consisting of cervical isometric exercises and cervical PNF techniques. Outcome measures included the Numerical Pain Rating Scale (NPRS), NDI scale, Cervical ROM. Assessments were performed before and after the intervention. Data were analyzed using descriptive statistics and paired t-tests.

Keywords: Mechanical neck pain, poor posture, restricted neck ROM, Neck disability index.

Introduction

Mechanical neck pain (MNP) is one of the most common musculoskeletal disorders affecting people across all age groups and is a leading cause of pain, disability, and healthcare utilisation worldwide. It is defined as pain originating from the cervical spine and its surrounding soft tissues without evidence of serious pathological conditions such as fractures, infection, inflammatory disease, or neurological compromise (Blanpied et al., 2017). The increasing prevalence of sedentary lifestyles, prolonged computer and smartphone use, poor workplace ergonomics, and sustained static postures has contributed significantly to the growing burden of mechanical neck pain, particularly among working-age adults (Côté et al., 2019). The Global Burden of Disease study has consistently identified neck pain as one of the leading causes of years lived with disability worldwide, highlighting its substantial socioeconomic impact (Vos et al., 2020).

Mechanical neck pain is characterised by pain, muscle tightness, reduced cervical range of motion, impaired proprioception, and functional limitations that interfere with activities of daily living and occupational performance (Blanpied et al., 2017). Patients frequently experience stiffness, tenderness of cervical musculature, headache, and decreased endurance of the deep cervical flexor and extensor muscles. These impairments often result in altered movement patterns, reduced cervical stability, and

persistent symptoms if not managed appropriately (Falla et al., 2017). Chronic mechanical neck pain has also been associated with deficits in sensorimotor control and cervical joint position sense, suggesting that proprioceptive dysfunction plays an important role in the persistence and recurrence of symptoms (Treleaven, 2008).

Conservative physiotherapy management remains the first-line treatment for mechanical neck pain because of its effectiveness, safety, and cost-efficiency. Current clinical practice guidelines recommend therapeutic exercise, manual therapy, patient education, and postural correction as primary interventions for reducing pain and improving function (Blanpied et al., 2017). Among these approaches, exercise therapy has demonstrated moderate to strong evidence for improving pain intensity, cervical muscle endurance, mobility, and quality of life. Therapeutic exercises target muscular weakness, impaired motor control, and reduced endurance, thereby restoring normal cervical biomechanics and preventing recurrence (Gross et al., 2015).

Cervical isometric exercises are widely used in physiotherapy rehabilitation programmes for patients with mechanical neck pain. These exercises involve static muscle contractions without producing visible joint movement, allowing activation of cervical musculature while minimizing stress on cervical joints and painful structures. Isometric exercises improve muscle strength, endurance, neuromuscular activation, and cervical stability by enhancing recruitment of both superficial and deep cervical muscles (Kisner et al., 2022). They are particularly beneficial during the early stages of rehabilitation because they can be performed with minimal pain and without aggravating symptoms. Several studies have reported significant reductions in pain intensity and disability following cervical isometric exercise programmes, emphasising their role in restoring cervical function (Gross et al., 2015).

Another important rehabilitation approach is Proprioceptive Neuromuscular Facilitation (PNF), which is a therapeutic technique designed to improve neuromuscular function through specific movement patterns, proprioceptive stimulation, and manual resistance. Developed by Kabat, Knott, and Voss, PNF facilitates coordinated muscular activity by stimulating proprioceptors and enhancing motor learning (Adler et al., 2014). The technique incorporates diagonal and spiral movement patterns combined with stretching, resistance, approximation, traction, and verbal cues to improve flexibility, muscle strength, coordination, balance, and functional movement. In patients with musculoskeletal disorders, including neck pain, PNF has demonstrated beneficial effects on pain reduction, increased cervical range of motion, improved muscular performance, and enhanced functional outcomes (Hindle et al., 2012).

Proprioception plays a critical role in maintaining cervical stability and coordinated head movements. The cervical spine contains a high density of mechanoreceptors within muscles, ligaments, and joint capsules that provide continuous sensory feedback regarding head position and movement. Dysfunction of these proprioceptors due to pain or muscle fatigue may impair cervical joint position sense and neuromuscular control, thereby contributing to recurrent episodes of neck pain (Treleaven, 2008). PNF techniques specifically target these proprioceptive deficits by improving sensory feedback and facilitating more efficient muscle activation patterns. Consequently, combining strengthening exercises with proprioceptive training may provide superior rehabilitation outcomes compared with strengthening alone.

The deep cervical flexor and extensor muscles have an essential role in maintaining cervical posture and segmental stability. Patients with mechanical neck pain commonly exhibit reduced activation of these stabilising muscles together with overactivity of superficial cervical musculature, resulting in abnormal movement patterns and increased mechanical stress on cervical structures (Falla et al., 2017). Cervical isometric exercises primarily enhance muscular strength and endurance, whereas PNF techniques focus on improving neuromuscular coordination, proprioception, and movement efficiency. Therefore, integrating these interventions may address multiple components of cervical dysfunction simultaneously and facilitate more comprehensive rehabilitation.

Previous research has independently investigated the effectiveness of cervical strengthening exercises and PNF techniques for neck pain management. Systematic reviews have shown that exercise therapy significantly reduces pain and disability in individuals with mechanical neck disorders (Gross et al., 2015). Similarly, PNF interventions have demonstrated improvements in flexibility, muscle performance, and functional movement across a variety of musculoskeletal conditions (Hindle et al., 2012). However, relatively few clinical studies have specifically evaluated the combined effectiveness of cervical isometric exercises and PNF techniques in patients with mechanical neck pain. Furthermore, limited evidence exists regarding whether the addition of PNF to conventional cervical isometric exercise programmes provides greater improvements in pain, cervical range of motion, proprioception, and functional disability.

Given the increasing prevalence of mechanical neck pain and its impact on physical function, work productivity, and quality of life, identifying effective physiotherapy interventions remains an important clinical priority. Understanding the comparative and combined effectiveness of cervical isometric exercises and PNF techniques may assist physiotherapists in designing evidence-based rehabilitation programmes that optimise patient outcomes. Improved pain control, restoration of cervical muscle function, enhancement of proprioception, and reduction of disability may ultimately decrease recurrence rates and improve long-term quality of life for individuals affected by mechanical neck pain.

Therefore, the present study aims to evaluate the effectiveness of cervical isometric exercises and proprioceptive neuromuscular facilitation techniques in patients with mechanical neck pain. The findings of this study may contribute to the existing body of evidence and provide clinicians with practical guidance for selecting appropriate therapeutic interventions to improve pain, cervical function, and overall rehabilitation outcomes.

Materials and Methods:

Participants:

The study was conducted after obtaining informed consent from all participants. Mechanical neck pain patients aged between 18 and 45 years. Participants were required to provide written informed consent prior to enrollment. The inclusion criteria included Age 18 - 45 years, Both males and females, Duration of pain at least 3 months, NPRS score between 5 to 8 cm, Neck disability index score more than 10 points on 0-50 scales. Exclusion criteria includes History of neck surgery in the past 12 months. Diagnosed cases of central cervical canal stenosis, torticollis, and scoliosis, Neck pain with radiation to the arm and upper extremity, History of cervical degenerative joint disease.

Procedure:

The present study was conducted to determine the effectiveness of cervical isometric exercises and cervical proprioceptive neuromuscular facilitation (PNF) techniques in patients with mechanical neck pain. The study was carried out in Karad city after obtaining approval from the Institutional Ethical Committee. A total of 44 subjects with mechanical neck pain who fulfilled the predetermined inclusion and exclusion criteria were selected for the study.

Initially, potential participants were screened according to the inclusion and exclusion criteria. The purpose, procedure, potential benefits, and possible risks of the study were explained to each participant. Written informed consent was obtained from all eligible participants before their inclusion in the study. After obtaining informed consent, 44 eligible subjects were included in the study. The participants were randomly allocated into two groups, with 22 subjects in each group.

Group A (n=22): Subjects received the prescribed baseline treatment along with cervical isometric exercises and cervical PNF techniques. Cervical isometric exercises were performed according to the prescribed protocol, targeting the major cervical muscle groups without producing cervical movement. Cervical PNF techniques were administered using appropriate PNF patterns and techniques under the supervision of the investigator. The intervention was performed according to the predetermined treatment protocol.

Group B (n=22): Subjects received baseline treatment alone according to the study protocol. The intervention was administered for the predetermined duration and frequency. The outcome measures selected for the study were assessed according to the study protocol, and the findings were recorded systematically. All participants were instructed to report any discomfort experienced during the intervention, and the treatment was performed under appropriate supervision. After completion of the intervention, the collected data from both groups were compiled and entered into a Microsoft Excel sheet. The data were subsequently subjected to appropriate statistical analysis to determine the effectiveness of cervical isometric exercises and cervical PNF techniques in patients with mechanical neck pain. The results obtained from the statistical analysis were interpreted and compared between the two groups. Based on the findings, the study conclusion was drawn regarding the effectiveness of the combined intervention in patients with mechanical neck pain.

Ethical approval and participation consent:

The ethical approval for undertaking the suggested studies has been obtained from the Institutional Committee of Ethics of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India, dated January 22, 2026. Every participant provided their informed permission in writing after being given the assurances of confidentiality and the freedom to discontinue participation at any moment.

Results:

Table no.1 Age variable:-

Variable	Category	Group A		Group B	
		(n=22))	%	(n=22))	%
Ages	18-25 (years)	5	22.7%	2	9%

	26-35 (years)	8	36.3%	11	50%
	36-45 (years)	9	41%	9	41%

Interpretation:

The age distribution of participants in both groups showed that the majority belonged to the 26–35 years and 36–45 years age categories. In Group A (n=22), 5 participants (22.7%) were aged 18–25 years, 8 (36.3%) were aged 26–35 years, and 9 (41.0%) were aged 36–45 years. In Group B (n=22), 2 participants (9.0%) were aged 18–25 years, 11 (50.0%) were aged 26–35 years, and 9 (41.0%) were aged 36–45 years.

Table no. 2 Gender Variable:-

Variable	Category	Group A		Group B	
		(n=22)	%	(n=22)	%
Gender	Male	11	50%	12	54.5%
	Female	11	50%	10	45.5%

Interpretation:

Therefore, there is no statistically significant difference in gender distribution between Group A and Group B ($p > 0.05$).

Table no.3 NPRS Analysis:-

Outcome Measure		Pre NPRS, Mean $\pm$ SD	Post NPRS, Mean $\pm$ SD	t-value	p-value
NPRS	Group A(n=22)	6.41 $\pm$ 2.81	2.68 $\pm$ 1.29	5.65	<0.001
	Group B(n=22)	6.45 $\pm$ 2.25	5.36 $\pm$ 2.13	1.65	0.106

Interpretation:

Group A: NPRS decreased from 6.41 $\pm$ 2.81 before treatment to 2.68 $\pm$ 1.29 after treatment. The estimated reduction was 3.73 points, indicating a statistically significant improvement ($t = 5.65$, $p < 0.001$, approximate independent-samples calculation). Group B: NPRS decreased from 6.45 $\pm$ 2.25 to 5.36 $\pm$ 2.13, an estimated reduction of 1.09 points. This was not statistically significant ($t = 1.65$, $p = 0.106$, approximate calculation).

Table no. 4 NDI Analysis:-

Outcome Measure		Pre NPRS, Mean $\pm$ SD	Post NPRS, Mean $\pm$ SD	t-value	p-value
NDI	Group A(n=22)	32.77 $\pm$ 4.56	12.05 $\pm$ 8.52	10.07	<0.001
	Group B(n=22)	30.95 $\pm$ 5.10	24.09 $\pm$ 10.46	2.77	$\approx$ 0.009

Interpretation:

The mean NDI score in Group A decreased from 32.77 $\pm$ 4.56 at baseline to 12.05 $\pm$ 8.52 post-intervention, representing a mean reduction of 20.73 points. In Group B, the mean NDI score decreased from 30.95 $\pm$ 5.10 to 24.09 $\pm$ 10.46, representing a mean reduction of 6.86 points. The estimated pre–post comparison was statistically significant in both Group A ($t = 10.07$, $p < 0.001$) and Group B ($t = 2.77$, $p \approx 0.009$). Between-group comparison showed no significant difference at baseline ($t = 1.25$, $p = 0.219$), but a significant difference at post-intervention ($t = -4.20$, $p < 0.001$).

Table no. 5 ROM Analysis:-

Outcome Measure	Group A Pre Mean $\pm$ SD	Group A Post Mean $\pm$ SD	t Value	p Value	Group B Pre Mean $\pm$ SD	Group B Post Mean $\pm$ SD	t Value	P Value
Flexion	35.50 $\pm$ 5.24°	Not valid*	—	—	31.91 $\pm$ 21.87°	36.32 $\pm$ 19.66°	-0.70	0.49
Extension	39.73 $\pm$ 5.96°	51.64 $\pm$ 8.67°	-5.31	<0.001	41.09 $\pm$ 6.84°	47.36 $\pm$ 12.42°	-2.08	$\approx$ 0.044
Rotation Left	49.50 $\pm$ 0.00°	70.80 $\pm$ 12.43°	-8.03	<0.001	49.50 $\pm$ 0.00°	60.09 $\pm$ 16.59°	-3.00	$\approx$ 0.005
Rotation Right	51.32 $\pm$ 5.89°	69.80 $\pm$ 8.52°	-8.37	<0.001	50.41 $\pm$ 4.37°	60.09 $\pm$ 16.59°	-2.64	$\approx$ 0.012
Side Flexion Left	28.52 $\pm$ 4.66°	37.73 $\pm$ 4.38°	-6.75	<0.001	25.89 $\pm$ 6.23°	29.77 $\pm$ 8.52°	-1.73	$\approx$ 0.091
Side Flexion Right	28.52 $\pm$ 4.66°	38.18 $\pm$ 4.07°	-7.32	<0.001	27.30 $\pm$ 4.13°	30.86 $\pm$ 7.32°	-1.99	$\approx$ 0.053

Interpretation:

Cervical ROM demonstrated improvement following intervention in both groups. Group A showed significant improvements in extension, left rotation, right rotation, left side flexion, and right side flexion (all $p < 0.001$). Group B demonstrated significant improvements in extension ($p \approx 0.044$), left rotation ($p \approx 0.005$), and right rotation ($p \approx 0.012$). Changes in left side flexion ($p \approx 0.091$) and right side flexion ($p \approx 0.053$) in Group B were not statistically significant.

Final Interpretation For Result Section:-

The present study was conducted to evaluate the effectiveness of cervical isometric exercises combined with cervical PNF techniques (Group A) compared with baseline treatment (Group B) in patients with mechanical neck pain over a 4-week treatment period.

The demographic characteristics of both groups were relatively comparable with respect to age and gender. Regarding pain intensity, Group A showed a greater reduction in NPRS scores, from 6.41 ± 2.81 to 2.68 ± 1.29 , compared with Group B, where the score decreased from 6.45 ± 2.25 to 5.36 ± 2.13 . The improvement in Group A was statistically significant ($p < 0.001$), whereas the improvement in Group B was not statistically significant ($p = 0.106$).

Similarly, a greater improvement in neck disability was observed in Group A. The NDI score decreased from 32.77 ± 4.56 to 12.05 ± 8.52 in Group A, compared with 30.95 ± 5.10 to 24.09 ± 10.46 in Group B. Both groups showed statistically significant within-group improvement; however, the magnitude of improvement was considerably greater in Group A. The post-intervention between-group comparison was also statistically significant ($p < 0.001$).

Cervical range of motion also improved following treatment. Group A demonstrated statistically significant improvements in cervical extension, left rotation, right rotation, left side flexion, and right side flexion ($p < 0.001$). Group B showed significant improvement in extension, left rotation, and right rotation, while changes in left and right side flexion were not statistically significant.

Therefore, cervical isometric exercises combined with cervical PNF techniques appear to be more effective than baseline treatment in reducing pain and disability and improving cervical range of motion in patients with mechanical neck pain over a 4-week treatment period. Hence, the study supports the effectiveness of cervical isometric and PNF techniques as an effective physiotherapy intervention for mechanical neck pain.

Discussion:

The present study was conducted to determine the effectiveness of cervical isometric exercises and cervical proprioceptive neuromuscular facilitation (PNF) techniques in patients with mechanical neck pain. A total of 44 subjects fulfilling the inclusion and exclusion criteria were included and randomly allocated into two groups. Group A received cervical isometric exercises and cervical PNF techniques along with baseline treatment, whereas Group B received baseline treatment alone. The outcomes

obtained after the intervention were compared between the two groups.

The findings of the present study can be explained by the role of exercise therapy in improving cervical muscle function and reducing pain and disability. Mechanical neck pain is commonly associated with altered cervical muscle performance, reduced muscle endurance, impaired cervical movement and functional limitations. Therapeutic exercises directed toward the cervical musculature may therefore help restore muscular control and improve functional capacity.

The use of cervical isometric exercises in the present study is supported by previous research. Alpayci and İler reported that cervical extensor isometric exercises produced significant reductions in neck pain and improvements in cervical lordosis compared with the control condition. Similarly, a randomized study comparing isometric and isotonic neck strengthening found that both exercise approaches significantly improved pain, disability, cervical range of motion and muscle strength in patients with chronic mechanical neck pain. These findings support the use of cervical isometric exercise as an important component of rehabilitation for mechanical neck pain.

The possible mechanism behind the improvement following isometric exercise may be related to improved cervical muscle strength and endurance, enhanced muscular stability and better control of cervical movements. Isometric contraction allows strengthening of the cervical muscles while minimizing excessive movement of the cervical spine. Improved muscular support may reduce mechanical stress during daily activities and consequently contribute to reduction in pain and functional disability.

The addition of cervical PNF techniques in Group A may have provided further benefits by stimulating proprioceptive input and improving neuromuscular control. PNF techniques are designed to facilitate coordinated muscular activity and improve movement patterns. A randomized clinical trial involving patients with chronic mechanical neck pain reported that PNF treatment significantly improved pain, Neck Disability Index scores and active cervical range of motion after four weeks of treatment. The authors concluded that PNF was beneficial and produced results comparable to craniocervical flexor training.

Further evidence comes from a randomized controlled trial comparing PNF with passive vertebral mobilization in patients with mechanical neck pain. The study found significant improvements in neck disability across the treatment groups and demonstrated that PNF combined with routine physiotherapy could be beneficial in the management of mechanical neck pain. This is consistent with the rationale for incorporating PNF into the intervention used in the present study.

The combined use of cervical isometric exercises and PNF may therefore have a complementary effect. While isometric exercises primarily provide strengthening and stabilization of the cervical musculature, PNF may contribute to proprioceptive stimulation, neuromuscular coordination and improved movement control. The combination may consequently provide greater improvement than baseline treatment alone. Previous research also supports the value of combining exercise with conventional physiotherapy in mechanical neck pain. A randomized clinical trial found that an exercise-based intervention produced significant improvements in pain and disability compared with minimal intervention.

Recent evidence further supports cervical strengthening as part of management for mechanical neck pain. A 2024 randomized comparative trial reported significant improvements in pain, cervical range of motion and disability following cervical isometric exercise-based treatment, with additional exercise producing further benefits. Another randomized trial found that specific deep cervical muscle training improved pain, disability, cervical posture and neck-muscle strength compared with usual care.

Overall, the findings of the present study suggest that cervical isometric exercises combined with cervical PNF techniques, when added to baseline treatment, may be an effective physiotherapy approach for patients with mechanical neck pain. The improvement may be attributed to enhanced cervical muscle strength, endurance, proprioception, neuromuscular coordination and functional cervical control. However, the interpretation of the findings should take into consideration the sample size of 44 participants, the recruitment of subjects from Karad city and the limited follow-up period. Further studies with larger sample sizes, longer follow-up periods and standardized treatment protocols are recommended to establish the long-term effectiveness of this combined intervention.

Limitations:

The present study had a relatively small sample size of 44 participants and was conducted in a limited geographical area (Karad city), which may restrict the generalizability of the findings. Variations in participants' age, occupation, posture, physical activity, and treatment compliance may also have influenced the outcomes. Furthermore, participants' daily activities and postural habits could not be completely controlled throughout the study.

1. Conclusion:

The present study was conducted to determine the effectiveness of cervical isometric exercises combined with cervical PNF techniques in patients with mechanical neck pain over a 4-week treatment period. The results demonstrated that Group A, which received cervical isometric exercises and cervical PNF techniques, showed greater improvement than Group B, which received baseline treatment. Group A demonstrated a significant reduction in pain intensity (NPRS) and neck disability (NDI), along with

significant improvements in most measures of cervical range of motion. Although Group B also showed some improvement, the magnitude of improvement was comparatively lower. Therefore, it can be concluded that cervical isometric exercises combined with cervical PNF techniques are more effective than baseline treatment in reducing pain and disability and improving cervical range of motion in patients with mechanical neck pain. Thus, the study supports the use of combined cervical isometric and PNF techniques as an effective physiotherapy intervention for the management of mechanical neck pain.

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Ethical Approval:

Ethical approval for the present study was obtained from the Institutional Ethics Committee of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India, dated January 21, 2026.

Conflicts of Interest:

We claim that there are no conflicts of interest in the content of this study

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