International
Journal of Medical and Exercise Science
(Multidisciplinary, Peer Reviewed and Indexed Journal)

ORIGINAL ARTICLE

EFFICACY OF MOTOR CONTROL EXERCISES AND NECK STABILIZATION EXERCISES FOR MECHANICAL NECK PAIN

Search engine:
www.ijmaes.org

Jibi Paul[1*], Adhisha L Shibu[2]

Author:

[1]BPT Student, Faculty of Physiotherapy, Dr. M.G.R. Educational and Research Institute, Vellappanchavadi, Chennai, Tamil Nadu, India

Corresponding Author:

*[2]Professor, Faculty of Physiotherapy, Dr. M.G.R. Educational and Research Institute, Vellapanchavadi, Chennai, Tamil Nadu, India, E-Mail- physiojibi@gmail.com

ABSTRACT

Background of the study: Mechanical neck pain or non- specific neck pain is defined as pain in the anatomical region of the neck and is the most common form of neck pain which can be disabling and also individuals have difficulty with wide range of activities. The study aims to compare the efficacy of motor control exercises and neck stabilization exercises in subjects with mechanical neck pain. **Methodology:** The study was conducted using a quasi-experimental design. Age 18 – 25 years, Gender: Both males and females, Acute pain in the neck lasting less than 4 - 6 weeks, Severity of pain: Moderate, VAS scale 3 and more and NDI score > 25. The study followed a comparative pre-test and post-test type. The study conducted at Outpatient physiotherapy department of Faculty of physiotherapy, DR MGR Educational and Research Institute University. The study included 30 subjects, comprising 14 males and 16 females. The sampling method used in the study was random sampling. The duration of the study was six months. The intervention was administered for 30 minutes/session, 3 days/week for 12 weeks. Outcome measures were Pain intensity and Functional Disability with measuring tools VAS- Visual Analog Scale. The Visual Analog Scale (VAS) is a uni-dimensional (1-D) and numerical rating scale. **Result:** Motor control exercise found more effective over Neck stabilization exercise intervention on NDI and VAS with significance difference in P value 0.028 and 0.002 respectively. **Conclusion:** The result of the study suggested that both Motor control exercise and Neck stabilization exercise are effective but Group A Motor control exercise is found more effective in reducing pain than Group B Neck stabilization exercise

Keywords: Motor control exercise, Neck stabilization exercise, Mechanical neck pain, Visual Analog scale, Neck Disability Index.

Received on 24th July 2025; Revised on 20th August 2025; Accepted on 26th August 2025
DOI:10.36678/IJMAES.2025.V11I03.10

INTRODUCTION

Neck pain is a significant public health issue that impacts both individuals and society, resulting in pain, lost productivity, and increased healthcare costs [(1)]. Mechanical neck pain, also known as non-specific neck pain, is defined by discomfort arising from the physical structures of the cervical spine, such as muscles, ligaments, and joints, with no detectable underlying pathology[1,2].

Mechanical neck pain, which is caused by abnormal movement or positioning of the cervical spine, is characterized by discomfort and stiffness in the neck region, frequently accompanied by limited range of motion and muscular spasm [(2)]. A growing number of people in India are experiencing mechanical neck pain, which is a result of sedentary lifestyles, excessive screen usage, poor posture, and stress from the workplace. According to studies, the Indian population has a notable prevalence of neck discomfort, especially mechanical neck pain[3].

The annual incidence of neck pain ranges from 10.4% to 21.3%, with greater rates found among office and computer workers. Around the world, 203 million people suffered from neck pain in 2020. Neck pain affects 58.3% of undergraduate students in the last year, demonstrating that a significant portion of the Indian population suffers from it. Those with neck problems often find that using a laptop, smartphone, or academic stress exacerbates their pain[4,5].

Neck discomfort is more common in nations with more urbanized cultures or more sedentary work situations possibly as a result of lifestyle variables including increased screen time, bad posture, and prolonged sitting. It was shown that between 30% and 50% of people worldwide may experience neck discomfort at some point in their lives, including mechanical neck pain. More precisely, the global one-year prevalence is estimated to be between 10% and 20% [6,7].

According to estimates from the United States, up to 30% of people experience neck pain at some point during the year, making it a common condition. Studies carried out in Scandinavian nations like Sweden and the UK have also revealed notable prevalence of mechanical neck pain. A thorough analysis found that mechanical neck discomfort is extremely prevalent in these places, with estimates for the general population ranging from 30% to 50% [8].

The widespread ailment known as mechanical neck pain (MNP) is typically brought on by musculoskeletal factors, such as extended periods of poor posture, muscle imbalances and improper ergonomics, which put stress on the neck's muscles causing weakness or tightness [(9)]. Overuse or repetitive motions can strain the neck muscles, causing pain. Ergonomic factors include repetitive heavy lifting or bending that strains the neck muscles and joints, as well as extended computer use with poor ergonomics can cause pain [9,10].

The following characteristics such as deep; aching pain localized to the neck region, stiffness, radiation of pain which can radiate to the shoulders; arms; or head, limited range of motion in the cervical spine, tenderness in the paraspinal muscles especially in the upper trapezius and levator scapulae regions typically define mechanical neck pain's (MNP) clinical presentation Manual therapy, therapeutic

exercises, posture education, and modalities are some of the different treatments for mechanical neck discomfort. The integration of manual therapy with exercise has demonstrated enhanced results. Thoracic spine thrust manipulation may yield short-term enhancement in individuals with acute or subacute mechanical neck discomfort[11, 12.]

Pharmacological interventions are frequently utilized to address mechanical neck discomfort, with the objective of reducing pain and enhancing function and patient satisfaction. Motor control exercises (MCE) and neck stabilization exercises are frequently utilized in the treatment of mechanical neck pain that aim to enhance the function of deep cervical muscles, improve motor control, and provide spinal stability[13]. This study investigates the efficacy of motor control exercise and neck stability exercise as therapies for mechanical neck pain, with an emphasis on reducing pain intensity and functional impairment. Motor control exercises are "exercises that aim to improve the control and coordination of muscles, and to enhance the ability of the nervous system to regulate movement"[14,15].

Motor control exercise (MCE) is to improve deep cervical muscle function and coordination in order to reduce neck pain and increase spinal stability. In order to increase stability and motor control, these workouts concentrate on retraining the deep neck muscles [16]. Motor control exercise (MCE) developed as a result of advances in motor control research, with the goal of improving neuromuscular function in people suffering from musculoskeletal pain. Furthermore, motor control exercise can contribute to short-term benefits in global recovery and activity levels for people with persistent low back pain [17-18].

Neck stabilization exercises aim to improve the stability and control of the neck muscles[19].

Neck stability exercises are intended to improve the strength, endurance, and coordination of the cervical and scapulothoracic muscles. By focusing on neck muscles, these exercises help to reduce pain and improve function. In the middle to late 20th century, neck stabilization exercises gained popularity in the physical therapy and rehabilitation fields in preserving the stability of the cervical spine[)]. This study aims in improving the pain intensity and functional disability by performing motor control and neck stabilization exercises. Outcome measures are evaluated by the tools, Visual Analog Scale (VAS) and Neck Disability Index (NDI [20-22].

Dr Huskisson developed the VAS as a simple and effective way to measure pain intensity[)]. The Visual Analog Scale (VAS) is a one-dimensional (1-D) and numerical rating scale considered to be a highly valid and reliable tool that measures pain intensity (0-10 VAS). The Neck Disability Index (NDI) was developed by Vernon and Mior in 1991. The NDI is a self-report questionnaire that measures the level of disability and pain in patients with neck pain. The Neck Disability Index is a reliable and valid tool for measuring disability of the neck. It is the 10-question questionnaire that examines how neck pain impacts a person's daily life. This study analyses the effectiveness of these therapies to determine how effectively they improve pain and functional disability in people with mechanical neck pain[20].

Aim and Need of the Study

Aim of the study:

The aim of the study is to determine the efficacy of motor control exercises and neck

stabilization exercises on subjects with mechanical neck pain.

Need of the study: Mechanical neck pain or non- specific neck pain is defined as pain in the anatomical region of the neck and is the most common form of neck pain which can be disabling and also individuals have difficulty with wide range of activities. Hence this study was carried out to compare the efficacy of motor control exercises and neck stabilization exercises on reducing pain intensity among patients with mechanical neck pain

METHODOLOGY

On the basis of inclusion and exclusion criteria, 30 subjects were randomly selected and given intervention for 30 minutes/session, 3 days/week for 12 weeks. The study was conducted using a quasi-experimental design. The study followed a comparative pre-test and post-test type. The study conducted at Outpatient physiotherapy department of Faculty of physiotherapy, DR MGR Educational and Research Institute University. The study included 30 subjects, comprising 14 males and 16 females. The sampling method used in the study was random sampling.

The duration of the study was six months. The intervention was administered for 30 minutes/session, 3 days/week for 12 weeks. Inclusion Criteria were Mechanical neck pain, Age 18 – 25 years, Gender: Both males and females, Acute pain in the neck lasting less than 4 - 6 weeks, Severity of pain: Moderate, VAS scale 3 and more and NDI score > 25. Outcome measures were Pain intensity and Functional Disability with measuring tools VAS-Visual Analog Scale. The Visual Analog Scale (VAS) is a uni-dimensional (1-D) and numerical rating scale that measures pain intensity (0-10 VAS) and it was categorized using the following terms: no pain (0), mild (1-3), moderate (4-6), severe (7-9), or worse pain (10).

Outcome Measures

VAS- Visual Analog Scale: The Visual Analog Scale (VAS) is a unidimensional (1-D) and numerical rating scale that measures pain intensity (0-10 VAS) and it was categorized using the following terms: no pain (0), mild (1-3), moderate (4-6), severe (7-9), or worse pain.

NDI- Neck Disability Index: The Neck Disability Index (NDI) has become a standard instrument for measuring self-rated disability due to neck pain. It is the 10-question questionnaire that examines how neck pain impacts a person's daily life**.** The scoring intervals for interpretation, as follows: no disability (0 - 4), mild (5 – 14), moderate (15 - 24), severe (25 – 34), complete (>34).

Procedure: Following ethical approval from the Institutional Review Board of the Faculty of Physiotherapy, Dr. M.G.R. Educational and Research Institute, 30 subjects were selected based on the inclusion and exclusion criteria. The selected subjects included both males and females, aged between 18 and 25 years. Subjects were excluded if they presented with neurological symptoms such as radiculopathy or myelopathy, had a history of cervical spine surgery or trauma, were diagnosed with rheumatic or inflammatory diseases, or exhibited vestibular dysfunction or balance disorders. Based on the specified inclusion criteria, patients with mechanical neck pain were selected. The subjects were fully explained about the benefits of participating in the study and after obtaining consent which is

duly signed assuring confidently of personal details. The subjects were allocated into two groups, group A and group B using simple random sampling method. The subjects in group A were treated with motor control exercise and in group B were treated with neck stabilization exercise. Pre-test and post-test were done by using VAS scale and neck disability index for assessing the pain intensity and functional disability. Pre-test and post-test readings were recorded and noted.

Group A - 15 subjects, Group B - 15 subjects
Test measurement: Motor control exercises and Neck stabilization exercises

Training protocol: Subjects were asked to perform flexion and extension of the neck and neck stretches for 15 repetitions as a warm up exercise and deep breathing as a cool down exercise.

Motor Control Exercises

Intervention for group A included the following techniques: Warm up- neck flexion and extension and neck stretches (3 minutes)

- Motor control exercises
  Craniocervical flexor exercise (3 sets hold for 10 secs followed by 5 sets hold for 10 secs)
  Isometric hold with chin tucks (3 sets hold for 10 secs followed by 5 sets hold for 10 secs)
  Quadruped track exercise (3 sets hold for 10 secs followed by 5 sets hold for 10 secs)
  Co-contraction of the neck flexor and extensor muscles (3 sets hold for 10 secs followed by 5 sets hold for 10 secs)
- Cool down- deep breathing exercise (3 sets hold for 5 secs)

1. **Craniocervical Flexor Exercise**
   Craniocervical exercise, a head lift exercise targets the deep cervical flexors, and this low-load exercise will be performed by the subject by "nodding their heads gently as if they are saying 'yes' holding for few seconds that the individual could accomplish with a slow and controlled craniocervical flexion movement.

2. **Isometric Hold With Chin Tucks**
   In a supine position, perform an isometric hold with chin tucks while keeping the head and neck on the table.

3. **Quadruped Track Exercise**
   A quadruped track with a book on the back of the head and neck, along with arm and leg movements.

4. **Co-Contraction Of The Neck Flexor And Extensor Muscles**
   In a sitting or standing position, gently tuck the chin holding the head with a band in a co-contracted position for 10 seconds, ensuring the movement is slow and controlled.

Neck Stabilization Exercises

Intervention for group B included the following techniques:

- Warm up- neck flexion and extension and neck stretches (3 minutes)
- Neck stabilization exercises
  Chin tucks (2 sets of 15 repetitions followed by 3 sets of 15 repetition)
  Cervical extension (2 sets of 15 repetitions followed by 3 sets of 15 repetition)
  Shoulder shrugs (2 sets of 15 repetitions followed by 3 sets of 15 repetition)

Functional strengthening exercises using Thera band (2 sets, 10 repetition hold for 5 secs)

- Cool down- deep breathing exercise (3 sets hold for 5 secs)

1. **Chin Tuck**
   Chin tuck will be performed in standing position; the participant will be pulled back the chin (as if trying to make a double chin).

2. **Cervical Extension**
   Cervical extension is done in a standing position, the participant grasps the base of the neck, with both hands, while extending the neck as far as possible.

3. **Shoulder Shrug**
   Shoulder shrugs, in a standing position, the participant shrugs his or her shoulders, bringing them up towards the ears.

4. **Strengthening Exercises Using Thera Band**
   During the resistance exercises, 3 distinct colours of Thera-Band tubing (red, green and blue) representing differing resistances were used in a progressive manner by increasing the density of Thera band tubing each week.

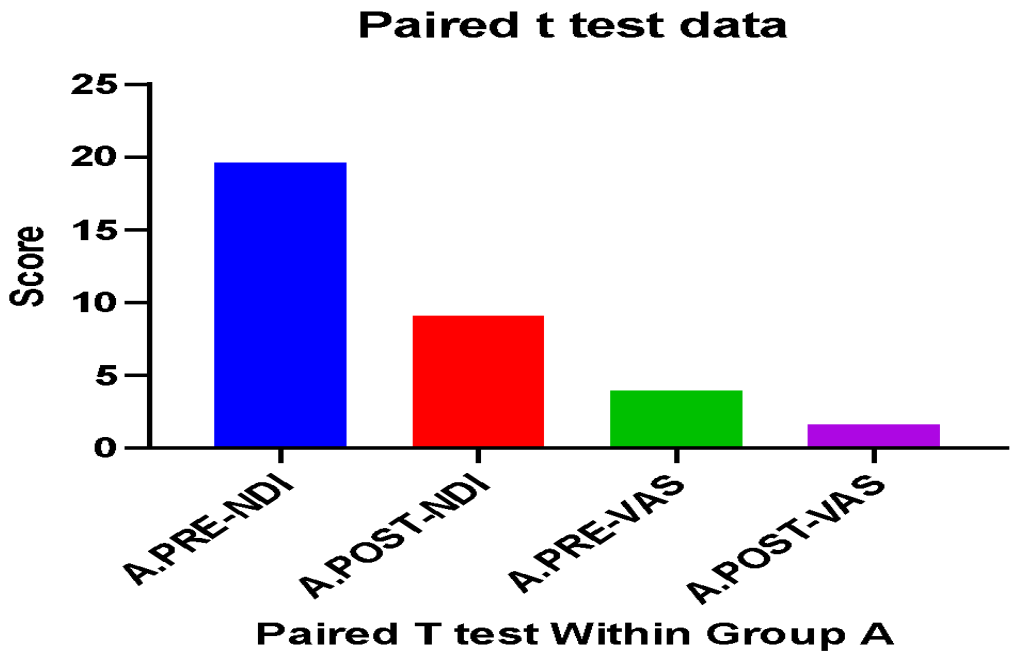
Data analysis: The collected data were tabulated and analysed using both descriptive and inferential statistics. All the parameters were assessed using Graph Prism Pad version 8.4.3, with a significance level of p value less than 0.05 and a 95% confidence interval set for all analysis. The Shapiro Wilk test was used to determine the normality of the data. In this study, Shapiro Wilk test showed that the data was normally distributed on the dependent values at P > 0.05. Hence parametric test was adopted. Paired t-test was adopted to find the statistical difference within the groups & Independent t-test (Student t-Test) was adopted to find statistical difference between the groups.

Group A: Motor Control Exercise

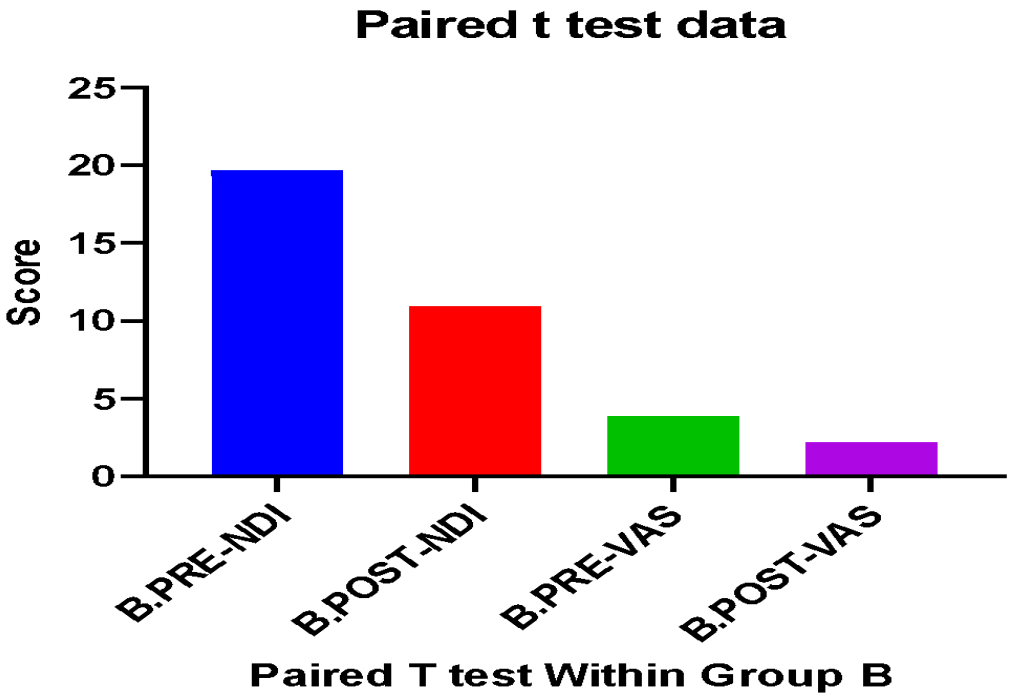
Table 1: Paired t test within Group A on NDI and VAS

Group A	Number of Pairs	Mean Diff.	SD, SEM	df	t	P value	Sig. Diff. (P < 0.05)
NDI	15	10.53	1.767 0.456	14	23.08	<0.0001	****
VAS	15	2.33	2.68 1.99	14	14.64	<0.0001	****

The above table 1 shows significant difference in NDI and VAS within Group A with P value >0.0001.



Graph 1: **Presentation of Presentation of NDI and VAS within Group A**



Graph 2. Presentation of Presentation of NDI and VAS within Group B

Group B: Neck Stabilization Exercise

Table2: Paired t test within Group B on NDI And VAS

Group B	Number of Pairs	Mean Diff.	SD, SEM	df	t	P value	Sig. Diff. (P < 0.05)
NDI	15	8.73	1.534 0.396	14	22.05	<0.0001	****
VAS	15	1.73	0.594 0.153	14	11.31	<0.0001	****

The above table 2 shows significant difference in NDI and VAS within Group B with P value > 0.0001.

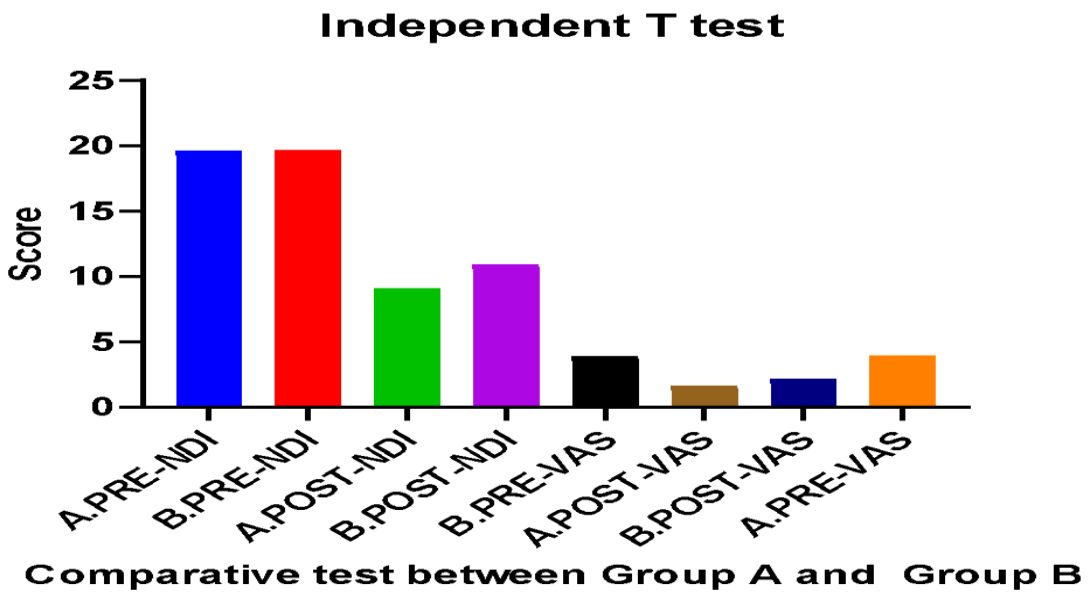
Graph 2: **Presentation of NDI and VAS within Group B**

Comparative Test between Group A (Motor Control Exercise) and Group B (Neck Stabilization Exercise)

Table 3: Independent t test between Group A and Group B

Group A&B		Number of Pairs	Mean Diff. ± SEM	R	DF	t	P value	Sig. Diff. (P < 0.05)
Pre test	**NDI**	30	0.067 0.902	0001	28	0.074	0.941	NS
	VAS	30	0.667 0.264	0.002	28	0.252	0.803	NS
Post test	**NDI**	30	1.867 0.804	0.161	28	2.321	0.028	*
	VAS	30	0.533 0.159	0.285	28	3.347	0.002	**

The above table 3 shows NO significant difference on Pre Test of NDI and VAS between Group A and Group B with P value 0.941 and 0.803, Post Test of NDI and VAS between Group A and Group B, shows significance on P value with 0.028 and 0.002 respectively.



Graph 3: **Presentation of NDI and VAS between Group A and Group B**

RESULTS

Total 30 participants, 14 male and 16 female subjects were included in the study based on specific selection criteria and divided in to 15 samples in each Group A and Group B. Participants were with age group between 18 and 25 years.

Group A- Motor control exercise, found effective on NDI and VAS with mean score difference of 10.53 and 2.33 with significance difference in P value <0.0001.
Group B- Neck stabilization exercise, also found effective on NDI and VAS with mean score difference of 8.73 and 1.73 with significance difference in P value <0.0001.

Motor control exercise found more effective over Neck stabilization exercise intervention on NDI and VAS with significance difference in P value 0.028 and 0.002 respectively.

DISCUSSION

The current study was aimed to compare the effects of motor control exercise (group A) and neck stabilization exercise (group B). The results obtained after 12 weeks of comparison in motor control exercise and neck stabilization exercise. Mechanical neck pain, also known as non-specific neck pain, is defined by discomfort arising from the physical structures of the cervical spine, such as muscles, ligaments, and joints, with no detectable underlying pathology.

This study aimed to evaluate the efficacy of motor control exercises (MCE) versus neck stabilization exercises (NSE) in individuals with mechanical neck pain. MCE specifically targets the activation and coordination of the deep cervical flexor muscles, which are frequently underactive in patients with chronic neck pain. These exercises focus on precision, control, and endurance of cervical movements, effectively correcting postural imbalances and improving neuromuscular function and spinal stability

during daily activities. In contrast, NSE primarily strengthens the superficial cervical musculature, often neglecting the deep muscle system and motor control deficits that contribute to chronicity. Consequently, while NSE may offer short-term symptom relief, it appears less effective in facilitating long-term functional recovery and preventing symptom recurrence [21].

In the present study, It has compared the effectiveness of Motor Control Exercises (MCE) and Neck Stabilization Exercises (NSE) in reducing pain and disability among individuals with mechanical neck pain. Both intervention groups—MCE (Group A) and NSE (Group B)—showed statistically significant improvements in pain and neck disability scores, as measured by the Visual Analog Scale (VAS) and Neck Disability Index (NDI), indicating that both types of exercise can effectively manage mechanical neck pain. However, Group A (MCE) demonstrated superior outcomes compared to Group B (NSE), particularly in terms of mean pain reduction and improvement in functional disability [22].

This observation aligns with evidence from review articles such as Falla et al. (2004), who highlighted the importance of retraining deep cervical muscles for lasting recovery [(33)], Tanvi Tanna et.al., (2016) has concluded that motor control exercises have shown statically and clinically significant improvement in reducing pain and disability when compared to McKenzie exercises among work related low back pain subjects[(32)]. and furthermore, Jull et al. (2008) reported that patients undergoing MCE exhibited significant improvements in neck function and disability compared to those receiving conventional physiotherapy. Tsang et al. (2013) highlighted the importance of motor control and proprioceptive exercises in improving neck joint position sense and reducing cervical symptoms [23].

Motor control exercise has high impact on neck pain and led to marked relief in pain intensity, disability and in improving the endurance of the neck muscle. Endurance training has also showed a statistically significant improvement, however lesser the significant than the motor control exercise group. In contrast, the conventional exercise has found to reduce the pain and disability, although there was no significant improvement in the endurance of the muscle. Carmen Martin-Gomez et.al., (2019) has concluded that motor control interventions for non-specific chronic neck pain patients reduces pain and disability. Motor control seems to be more effective to reduce pain and disability than other treatment[24].

Therefore, on comparing the pretest and posttest of group A and group B Group A intervention motor control exercise found more effective over Group B neck stabilization exercise intervention on NDI and VAS with significance difference in P value 0.028 and 0.002 respectively. Hence both the interventions outcomes and the broader literature suggest that motor control exercises are more effective than neck stabilization exercises in the management of mechanical neck pain, particularly due to their focus on restoring neuromuscular control and promoting long-term rehabilitation. Thus, MCE is more effective than NSE in treating mechanical neck pain. This superiority is attributed to MCE's emphasis on neuromuscular control, proprioception, and deep cervical stability, which are essential for long-term recovery, postural correction, and prevention of recurrence[25].

Neck stabilization exercises, while beneficial, primarily focus on strengthening the superficial cervical musculature such as the sternocleidomastoid, upper trapezius, and levator scapulae. These muscles, although essential for movement and gross stabilization, are often overactive in patients with neck pain, contributing to muscle imbalances and compensatory movement patterns. Therefore, strengthening these muscles without addressing the deep muscle dysfunction might offer only short-term symptomatic relief rather than resolving the root cause of instability [26].

Our results showed significant improvements in both VAS and NDI scores within the NSE group, similar to findings, which confirmed that NSEs could reduce pain and enhance functionality by promoting segmental stability and improving postural endurance. Neck stabilization exercises had a more profound impact on functional improvement and pain relief than stretching, with a statistically significant difference ($p = 0.012$).

Cervical stabilization exercises with feedback not only reduced neck pain but also improved postural alignment and respiratory function, both of which contribute to overall musculoskeletal health. A study reported that both NSE and dynamic exercises were equally effective in improving ROM and functional capacity, with no significant between-group difference.

These mixed results indicate that while NSE can be beneficial, the specificity and neuromuscular retraining focus of MCE make it a more potent option, particularly in the context of young adults with moderate acute mechanical neck pain.

The evidence supports the conclusion that motor control exercises provide a more comprehensive and long-term benefit, addressing both pain and the underlying deficits in neuromuscular coordination that contribute to mechanical neck pain. Thus, in this study both interventions are effective in managing mechanical neck pain; however, Motor Control Exercises appear to offer superior clinical outcomes as it found effective on NDI and VAS with mean score difference of 10.53 and 2.33 with significance difference in P value <0.0001 and neck stabilization exercise, also found effective on NDI and VAS with mean score difference of 8.73 and 1.73 with significance difference in P value <0.0001. Integrating MCE into rehabilitation programs may enhance long-term recovery, while NSE may be beneficial for short-term symptom relief and postural improvement[27].

CONCLUSION

The result of the study suggested that both Motor control exercise and Neck stabilization exercise are effective but Group A Motor control exercise is found more effective in reducing pain than Group B Neck stabilization exercise.

Motor control exercises offer greater benefits due to their targeted activation of deep cervical muscles, enhancement of neuromuscular control, and superior improvements in pain and disability scores. This focused approach not only addresses the symptoms but also corrects the underlying dysfunctions, resulting in more sustained and long-term recovery.

In conclusion, while neck stabilization exercises have demonstrated effectiveness in reducing pain and improving function, they are not superior to motor control exercises.

REFERENCE

1. Rajalaxmi V, Jibi Paul, M. Manoj Abraham, M. Sasirekha, Efficacy of Motor Control and Endurance Exercises in Neck Pain: A Pilot Study Volume 12, Issue 1, January-March 2019, Pages 19-24 .
2. Kumar A, Kishor J, Laisram N et al. Prevalence of Musculoskeletal Disorders amongst Adult Population of India. Epidemiology Int 2019; 4(3): 22-26.
3. Lucas, J., van Doorn, P., Hegedus, E. et al. A systematic review of the global prevalence and incidence of shoulder pain. BMC Musculoskeletal Disorders 23, 1073 (2022).
4. Somaye Kazeminasab , Seyed Aria Nejadghaderi , Parastoo Amiri , Hojjat Pourfathi , Mostafa Araj-Khodaei , Mark J M Sullman , Ali-Asghar Kolahi , Saeid Safiri BMC Musculoskeletal Disorders Neck pain: global epidemiology, trends and risk factors 2022 Jan 3;23:26.
5. Hush, J.M., Maher, C.G. & Refshauge, K.M. Risk factors for neck pain in office workers: a prospective study. BMC Musculoskeletal Disorder 7, 81 (2006), 2474-7-81.
6. Bart N Green A literature review of neck pain associated with computer use: public health implications 2008 Aug; 52(3):161–167.
7. Marc A. Childress, MD, And Samantha Jayne Stuek, MD Neck Pain: Initial Evaluation and Management 2020; 102(3):150-156
8. Hector Beltran-Alacreu, Ibai López-de-Uralde-Villanueva, César Calvo-Lobo, Josué Fernández-Carnero, Roy La Touche Clinical features of patients with chronic non-specific neck pain per disability level: A novel observational study 2018 Aug; 64(8): 700-709.
9. Brandon C. Williams, Scott W. Lowe, Ryan C. McConnella , Joshua A. Subialka An overview of systematic reviews investigating clinical features for diagnosing neck pain and its associated disorders, 2024 Dec 13:1-13.
10. Megan M Heintz , Eric J Hegedus Multimodal Management of Mechanical Neck Pain Using a Treatment Based Classification System 2008; 16(4):217-24.
11. Philadelphia Panel, Evidence-based clinical practice guidelines on selected rehabilitation interventions for neck pain PMID: 11589644, 2001 Oct;81(10):1701-17.
12. Kevin M. Cross, PT, PhD, ATC, Chris Kuenze, MA, ATC, Terry Grindstaff, PT, PhD, Jay Hertel Ph D ATC Thoracic Spine Thrust Manipulation Improves Pain, Range of Motion, and Self-Reported Function in Patients With Mechanical Neck Pain: A Systematic Review 2011 Sep;41(9):633-42.
13. Carmen Martin-Gomez, Rebeca Sestelo-Diaz, Victor Carrillo-Sanjuan, Marcos Jose Navarro-Santana, Judit Bardon-Romero, Gustavo Plaza-Manzano Motor control using cranio-cervical flexion exercises versus other treatments for non-specific chronic neck pain: A systematic review and meta-analysis 2019 Jul:42:52-59.
14. Asma Batool, Rabail Rani Soomro & Aftab Ahmed Mirza Baig Comparing the effects of neck stabilization exercises versus dynamic exercises among patients having nonspecific neck pain with forward head posture: a randomized clinical trial 2024 Sep 4;25(1):707.
15. Bruno T Saragiotto, Christopher G Maher, Tiê P Yamato, Leonardo O P Costa, Luciola C Menezes Costa, Raymond W J G Ostelo, Luciana G Macedo Motor control exercise for chronic non-specific low-back pain 2016 Jan 8;2016(1):CD012004,
16. Mark L Latash, Evolution of Motor Control:

From Reflexes and Motor Programs to the Equilibrium-Point Hypothesis June 2008 19(19):3-24 doi: 10.2478/v10078-008-0001

17. Yi-Liang Kuo , Tsung-Han Lee , Yi-Ju Tsai Evaluation of a Cervical Stabilization Exercise Program for Pain, Disability, and Physical Impairments in University Violinists with Nonspecific Neck Pain 020 Jul 28;17(15):5430, doi: 10.3390/ijerph17155430
18. Validation of Digital Visual Analog Scale Pain Scoring with a Traditional Paper-based Visual Analog Scale in Adults, 2018 Mar 23;2(3):e088, doi: 10.5435/JAAOSGlobal-D-17-00088
19. Ms. Rabea Begum, Mohammad Anwar Hossain Validity and reliability of visual analogue Scale (vas) for pain measurement JMCRR 02 (11), 394-402 (2018) ISSN (O) 2589-8655 | (P) 2589-8647
20. H Vernon , S Mior The Neck Disability Index: a study of reliability and validity 1991 Sep;14(7):409-15.
21. M JH McCarthy , M P Grevitt, P Silcocks , G Hobbs The reliability of the Vernon and Mior neck disability index, and its validity compared with the short form-36 health survey questionnaire 2011 Aug 4;21(1):93–100.
22. G A Jull , D Falla, B Vicenzino, P W Hodges The effect of therapeutic exercise on activation of the deep cervical flexor muscles in people with chronic neck pain,2009, 14(6):696-701.
23. Jordan Miller , Anita Gross, Jonathan D'Sylva, Stephen J Burnie, Charles H Goldsmith, Nadine Graham, Ted Haines, Gert Brønfort, Jan L Hoving Manual therapy and exercise for neck pain: a systematic review,2010, 14(6):696-701.
24. Tanvi Tanna, Senthilkumar Thiyagarajan, Prabhu Chinna Gounder Comparing the Effectiveness of Motor Control Exercises versus Mckenzie Exercises for Work Related Back Pain, 2016, 04(03):178-185.
25. Falla D, Jull G, Hodges P. (2004). Patients with neck pain demonstrate reduced electromyographic activity of the deep cervical flexor muscles during performance of the craniocervical flexion test. Spine, 2004, 29(19):2108-14, DOI: 10.1097/01.brs.0000141170.89317.0e
26. Sarig Bahat H et al. (2009). Rehabilitation of patients with chronic neck pain: A review of the literature J Back Musculoskeletal Rehabilitation, 2009, 22(1):17-20, DOI:10.3233/BMR-2009-0210
27. Tsang SMH, Szeto GPY, Lee RYW. (2013) Motor control training and proprioception exercise for chronic neck pain: A systematic review. Manual Therapy, 2013, 18(6):556–562.

Jibi Paul, Adhisha L Shibu (2025). Efficacy of Motor Control Exercises And Neck Stabilization Exercises For Mechanical Neck Pain , ijmaes; 11(3); 2449-2461.