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Comparative Study Of Deep Cervical Flexion Exercise With Pressure Biofeedback and Muscle Energy Technique for Neck Pain Reduction in Digital Workers

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ABSTRACT

Mechanical neck pain is a common condition among employees who perform static tasks in non-ergonomic postures while using digital devices, potentially leading to pain, disability, and reduced work productivity. The purpose of this study to prove that deep cervical flexion exercise with pressure biofeedback is more effective than muscle energy technique in reducing neck pain and disability in mechanical neck pain conditions of digital creative employees. This study is a true experiment with pre-test and post-test two group design. The subjects of the study were 24 people who were randomly divided into two groups. Group 1 (n=12) received deep cervical flexion exercise with pressure biofeedback, while group 2 (n=12) received muscle energy technique. Pain intensity was measured using the numeric pain rating scale and neck disability was assessed using the neck disability index. The results of the paired sample t-test showed a significant reduction in pain and disability in both groups ($p=0.001$; $p<0.05$). The independent sample t-test confirmed significant differences between the groups ($p<0.05$), with group 1 showing a greater percentage reduction in both pain (68.40%) and disability (55.48%) compared to group 2 (44% and 30.55%). In conclusion, deep cervical flexion exercise with pressure biofeedback showed greater improvement compared to muscle energy technique in reducing neck pain and disability in mechanical neck pain conditions of digital creative employees. Although limited by age differences between groups as a potential confounding factor, the findings remain applicable to workers with prolonged static and non-ergonomic postures.

Keywords: Neck disability; mechanical neck pain; deep cervical flexion exercise; pressure biofeedback; muscle energy technique

INTRODUCTION

Technological advances in the industrial era 4.0 require intensive use of digital devices, especially digital creative sector workers. Activities such as graphic design, digital marketing, and social media management are carried out with computers or laptops for long periods. An unergonomic working posture, such as a head position that is too forward due to a device that is not aligned with the view, is at risk of causing musculoskeletal complaints, namely mechanical neck pain. Mechanical neck pain is pain felt around the superior nuchal line area at the top of the neck and the spinous process of the first thoracic vertebra in the upper back.[1] It is thought to be multifactorial and is triggered by poor posture, neck tension and non-ergonomic physical activity.[2] The underlying cause of this condition is muscle imbalance. This imbalance leads to biomechanical alterations and excessive stress in the cervical region, which ultimately contributes to the development of pain.[3] Lack of muscle activation in the cervical region causes poor control of joint movement, repeated microtrauma, which ultimately causes neck pain and disability.[4]

The prevalence of mechanical neck pain is increasing, particularly among populations who use digital devices for extended periods. A cross-sectional study in Pakistan of 773 office workers who used computers found that 273 (35%) participants experienced mechanical neck pain.[5] This study also correlates with research on Portuguese office workers, 56.1% experienced mechanical neck pain, leading to a 20-43% decrease in work productivity. This highlights how mechanical neck pain hinders employee productivity.[6] These studies show that employees in creative digital agencies, who frequently work in static and non-ergonomic positions, are vulnerable to mechanical neck pain, so it can pose a risk of absenteeism among employees.

Physiotherapy offers various interventions to address mechanical neck pain in employees including deep cervical flexion exercise with pressure biofeedback. This exercise improves neck stability, reduces superficial muscle activity and optimizes deep flexor muscle activity through the use of pressure biofeedback so that muscle activation is more accurate and efficient.[7,8] In addition, muscle energy technique intervention is also commonly used. This method applies isometric contractions followed by relaxation to increase the flexibility of targeted muscles.[9] However, there is literature reporting that the application of muscle energy techniques that are too aggressive can cause discomfort and even injury.[10] Although both interventions have shown clinical benefits, there is a lack of direct comparative studies in populations of creative digital workers, and existing results across other populations remain inconclusive. This represents a clear research gap that no study has yet determined whether deep cervical flexion exercise with pressure biofeedback provides superior outcomes compared to muscle energy technique in reducing pain and disability in this specific workers. Given the rapid expansion of digital-based occupations in Indonesia and globally, targeted and effective interventions are needed to address mechanical neck pain in digital creative employees. This study aims to compare the effectiveness of deep cervical flexion exercise

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with pressure biofeedback and muscle energy technique in reducing pain and disability in the condition of mechanical neck pain in digital creative agency employees so that it is expected to be a guide in choosing the right method for handling mechanical neck pain in digital creative employees. We hypothesize that deep cervical flexion exercise with pressure biofeedback is more effective than muscle energy technique in reducing pain measured by the numeric pain rating scale and disability measured by the neck disability index.

MATERIALS AND METHODS

Methodology

a. Study design
This study is a true experimental study with a pre-test post-test two-group design. Treatment group 1 was given deep cervical flexion exercise with pressure biofeedback while treatment group 2 was given muscle energy technique. Before the patients were recruited, this study had been approved by the Faculty of Medicine, Udayana University/Sanglah General Hospital, Denpasar with an ethical approval number 1021/UN14.2.2.VII.14/LP/2025. An explanation of the procedures and benefits of the study was given to all respondents before the study began.

b. Subjects recruitment
The study was conducted at PT Skena Wahana Kreatif Makassar with a population of digital creative employees who experienced mechanical neck pain. Inclusion criteria: age 20-30 years, working ≥4 hours/day without a break with digital devices, neck pain scale 4-10 (moderate-severe pain) based on the numeric pain rating scale (NPRS), and willing to sign a consent form to be a research sample. To control for other factors, subjects with cervical trauma or surgery in the past 6 months, radiculopathy or myelopathy (Spurling test and Hoffman's sign), systemic or neurological comorbidities, malignancy, regular use of analgesics or participation in exercise outside work, and fever during intervention were excluded. Dropout criteria included withdrawal, absence from more than three sessions, or receiving other therapy outside the program.

c. Sampling technique
Sampling used simple random sampling technique. Of the 33 employees collected, 29 employees met the inclusion and exclusion criteria. Furthermore, random selection was conducted to determine 24 employees as research samples through an website randomizer. Then, the 24 selected people were divided into two groups consisting of 12 people each through random allocation. Group 1 received deep cervical flexion exercise with pressure biofeedback, while group 2 received muscle energy technique.

Materials and procedures

The researcher provided a detailed explanation regarding the objectives, benefits, implementation schedule, and procedures of the study. Then asked for the subject's approval to participate in the study by signing an informed consent. Subject selection was carried out based on inclusion and exclusion criteria through physiotherapy examination (anamnesis, inspection, palpation, and specific tests). Pain was measured with numeric pain rating scale (NPRS) and disability with neck disability index (NDI) as pre-test data. Measurements were carried out single-blind, the assessor conducting baseline and post-test evaluations was blinded to group allocation, while participants were aware of the intervention received.

Group 1 received deep cervical flexion exercise with pressure biofeedback in the supine lying position, the pressure biofeedback unit was placed under the neck. Subjects performed the chin tucked movement starting from a pressure of 20 mmHg then increased progressively to 30 mmHg through 5 pressure targets (22; 24; 26; 28; 30 mmHg). This exercise program consisted of 3 sets, each with 10 repetitions, 10-second contractions, 30-second rest between sets. The exercise was carried out 3 times/week for 6 weeks. Meanwhile, group 2 received muscle energy technique intervention in the form of light isometric contractions against the resistance of the physiotherapist, followed by passive stretching. Each session consists of 5 repetitions, isometric contractions were maintained for 7-10 seconds and stretching for 30 seconds. The exercises were performed 3 times/week for 6 weeks. Compliance was tracked through attendance, and participants missing more than three sessions or receiving outside therapy were considered dropouts. After 6 weeks of intervention, a post-test was conducted to assess changes in neck pain and disability. The data obtained were analyzed using SPSS version 25 software.

Data analysis

Research data analysis was carried out using statistical software SPSS version 25. Descriptive test to describe the characteristics of the research sample based on age, gender, and duration of work using digital devices. The normality test of neck pain and disability data before and after the intervention was analyzed using the Shapiro Wilk test ($p>0.05$, indicates a normal distribution). Homogeneity test to determine data variation using Levene's test ($p>0.05$ indicates homogeneous data). Hypothesis testing using parametric statistical tests, namely paired sample t-test to analyze the differences in pain and disability before and after intervention in each group,

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and independent sample t-test to compare the results between groups after intervention. A difference is considered statistically significant when $p<0.05$.

RESULTS

Characteristics of research subjects

The characteristics of the research subjects including gender, age, duration of work and neck pain and disability scores before treatment in group 1 and 2 are presented in Table 1.

Table 1. *Characteristics of research sampels*

Sample Characteristics	Treatment Group 1	Treatment Group 2	p-value
Gender			
Man	5 (20.8%)	6 (25%)	0.682
Woman	7 (29.2%)	6 (25%)	
Age (years)	23.42±2.53	26.25±1.54	0.004
Working Duration (hours/day)	5.83±0.83	5.75±0.75	0.828
Neck Pain Pre-test	6.33±1.07	6.25±1.13	0.855
Neck Disability Pre-test	16.67±3.33	16.92±3.89	0.868

Based on Table 1. the comparative analysis showed significant differences in age ($p<0.05$), while gender, work duration, pre-test pain and neck disability values showed no significant differences ($p>0.05$). Therefore, the sample characteristics of both groups are generally comparable, except for age.

Covariate analysis (ANCOVA) with age as covariate

Table 2. *Results of ANCOVA with age as covariate*

Dependent Variable	F	p-value	Partial η^2
Neck Pain Post-test	1.007	0.327	0.046
Neck Disability Post-test	0.240	0.629	0.011

Based on Table 2. analysis of covariance (ANCOVA) with age as a covariate revealed that age did not significantly affect neck pain post-test ($F = 1.007$; $p = 0.327$) or neck disability post-test ($F = 0.240$; $p = 0.629$). These findings indicate that the differences in pain and disability reduction were mainly attributable to the type of intervention rather than age, suggesting that age was not a significant confounding factor in this study.

Normality and homogeneity test

Table 3. *Results of data normality test and data homogeneity test*

Research Data	Normality Test[1]		Homogeneity Test[2]
	Treatment Group 1	Treatment Group 2	
Pain:			
NPRS pre-test	0.123	0.064	
NPRS post-test	0.513	0.156	0.460
Neck Disability:			
NDI pre-test	0.804	0.592	
NDI post-test	0.207	0.174	0.082

[1]*Shapiro Wilk test*
[2]*Levene's test*

Based on Table 3. it shows the results of the normality test for data from treatment groups 1 and 2 obtained $p>0.05$, which indicates that the data is normally distributed. The results of the data homogeneity test obtained $p>0.05$, which means that the data from both treatment groups are homogeneous.

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Results of the analysis of the difference in pain and neck disability between before and after the intervention in each group.

Table 4. *Difference Test Results Pre-test and Post-test of Neck Pain in Treatment Groups 1 and 2*

Variable	Group	N	Mean±SD	Percentage Change	p-value
Neck Pain (NPRS)	Pre-test Group 1	12	6.33±1.07	68.40%	0.001
	Post-test Group 1	12	2.00±1.53		
	Pre-test Group 2	12	6.25±1.13	44%	0.001
	Post-test Group 2	12	3.50±1.16		
Neck Disability (NDI)	Pre-test Group 1	12	16.67±3.33	55.48%	0.001
	Post-test Group 1	12	7.42±2.27		
	Pre-test Group 2	12	16.92±3.89	30.55%	0.001
	Post-test Group 2	12	11.75±3.88		

Based on Table 4. the results of the test of the difference in mean values of neck pain and disability before and after the intervention for each group which was analyzed using paired sample t-test showed a significant difference ($p<0.05$).

Results of the analysis of the difference in pain and neck disability after intervention between the two groups.

Table 5. Results of the Test of Mean Differences in Neck Pain and Disability of Groups Treatment 1 and 2

Variable	Group	N	Mean±SD	p-value
Neck Pain (NPRS)	Pre-test Group 1	12	6.33±1.07	0.855
	Pre-test Group 2	12	6.25±1.13	
	Post-test Group 1	12	2.00±1.53	0.013
	Post-test Group 2	12	3.50±1.16	
Neck Disability (NDI)	Pre-test Group 1	12	16.67±3.33	0.868
	Post-test Group 1	12	16.92±3.89	
	Post-test Group 1	12	7.42±2.27	0.003
	Post-test Group 2	12	11.75±3.88	

Based on Table 5. Results of the test showing the difference in mean post-test values of neck pain and disability between the two treatment groups which was analyzed using the independent sample t-test showed significant difference ($p<0.05$). The percentage of pain reduction in groups 1 and 2 was 68.40% and 44% respectively, while the percentage of neck disability reduction after the intervention was respectively 55.48% and 30.55% (Table 4.). Thus, it can be said that deep cervical flexion exercise with pressure biofeedback is more effective than muscle energy technique in reducing neck pain and disability

DISCUSSION

Characteristics of research subjects

Subject characteristics based on gender, show that men and women have the same risk of neck pain. Although a number of studies have shown that women are more susceptible.[10] This is influenced by psychological, biological pressure related to anatomical structure and hormonal differences. Psychologically, women show high levels of anxiety which correlate with an increased risk of neck pain. Anatomical differences related to the size and strength of the lower neck muscles in women cause reduced neck stability. In addition, fluctuations in estrogen hormone levels in women, especially during menstruation, pregnancy or menopause, affect increased pain sensitivity. However, when exposed to similar risks such as long working hours, it is very possible to experience the same complaints.[11]

The age range of the subjects in this study was between 20-30 years, both groups were classified as young productive adults. Previous studies have shown that the percentage of mechanical neck pain is dominated by subjects aged 20-30 years (55.6%). This condition is associated with modern lifestyles, such as prolonged use of computers, especially among office workers.[12] Meanwhile, the average working duration of both groups 1 and 2 was ≥5 hours/day. The long working duration triggers the onset of mechanical neck pain complaints, especially work activities carried out in a static position. This finding is similar to the results of previous studies which stated that there was a significant relationship between working duration and neck pain complaints, with a value ($p=0.021$; $r=0.297$). Working using a computer followed by bad posture for more than 4 hours/day without a break can potentially increase the risk of neck pain and cause neck disability in professional computer workers.[13,14] The

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average pain intensity of treatment groups 1 and 2 was in the moderate category (6.33±1.07 and 6.25±1.13). Also, the average disability value of treatment groups 1 and 2 is classified as moderate disability (16.67±3.33 and 16.92±3.89).

The comparability analysis of the characteristics of the research subjects between the two groups showed significant or non-comparable differences in age data, while data on gender, work duration, pre-test pain and neck disability before the intervention were found to be not significantly different or most of the characteristics of the subjects were declared comparable, so that the differences in results between groups after the intervention can be associated with the effectiveness of the intervention given.

Deep cervical flexion exercise with pressure biofeedback can reduce pain in mechanical neck pain of digital creative agency employees.

Based on the research results, it was stated that deep cervical flexion exercise with pressure biofeedback can reduce pain in mechanical neck pain of digital creative agency employees. From the results of the statistical analysis test, it was obtained ($p=0.001$; $p<0.05$), which indicating that there is a significant difference in reducing pain after being given deep cervical flexion exercise with pressure biofeedback. This study is in line with empirical evidence from previous studies that discuss the efficacy of deep cervical flexor muscle exercise with pressure biofeedback on 60 subjects experiencing mechanical neck pain. This study concluded that deep cervical flexor exercise with visual pressure biofeedback was significantly effective in reducing neck pain compared to the deep cervical flexor exercise group without visual input and the deep cervical flexor exercise group without pressure biofeedback. Subjects were able to control the recruitment of motor units that play a role in increasing muscle strength and endurance through the use of visual pressure biofeedback in deep cervical flexor exercise. Thus, the muscles work more efficiently so that they can reduce muscle fatigue which generally causes pain. This intervention activates and improves muscle performance leading to the restoration of balance between tense superficial muscles and weak deep cervical flexor muscles. Stretching tense muscles and strengthening weak muscles helps achieve optimal muscle strength thereby reducing pain.[15]

Other literature sources also describe that the deep cervical flexor exercise with pressure biofeedback allow for increase in endorphin production, which plays a role in reducing pain. During muscle contraction in the exercise, stretch receptors within the muscles are activated and transmit afferent signals to the central nervous system, subsequently stimulating the release of endorphins. This release contributes to blocking pain signals, both peripheral and central. Based on these findings, deep cervical flexor exercise with pressure biofeedback is considered effective in reducing neck pain.[16]

Deep cervical flexion exercise with pressure biofeedback can reduce disability in mechanical neck pain of digital creative agency employees.

Based on the research results, it states that deep cervical flexion exercise with pressure biofeedback can reduce disability in mechanical neck pain of digital creative agency employees. From the results of the statistical analysis test, it was obtained ($p=0.001$; $p<0.05$) which indicates a significant difference in the reduction of neck disability after being given deep cervical flexion exercise with pressure biofeedback. This study supports previous research on 30 subjects aged 20-40 years, showing a 59.6% NDI reduction after 4 weeks of deep cervical flexion exercise with pressure biofeedback, compared to 55.83% in control group. The improvement correlates with reduced pain intensity.[17]

Individuals with mechanical neck pain experience weakness in the deep cervical muscles including the longus colli, longus capitis and multifidus. Suboptimal activation of these muscles leads to reduced cervical postural control and impaired head position accuracy. This condition often promotes compensation by superficial muscles, such as the sternocleidomastoid, resulting in increased muscle tension and decreased cervical stability, which overall contributes to limitations in performing daily activities.[18]

Deep cervical flexion exercise targets activation of deep cervical muscles, especially longus colli and longus capitis through the use of pressure biofeedback. This activation reduces over compensation in superficial muscles, namely sternocleidomastoid and upper trapezius previously causing an imbalance in neck muscle control.[19] Improving the balance between deep and superficial muscle control has implications for reducing disability, as reflected by the decrease in NDI scores.[20]

Muscle energy technique can reduce pain in mechanical neck pain of digital creative agency employees

Based on the research results, it was stated that muscle energy technique can reduce pain in mechanical neck pain of digital creative agency employees. From the results of the statistical analysis test, it was obtained ($p=0.001$; $p<0.05$), which indicates that there is a significant difference in pain reduction after muscle energy technique. This study is in line with the results of studies that reveal that muscle energy technique is effective in relieving neck pain. The application of this technique has the potential to activate muscle and joint mechanoreceptors, which play a role in inhibiting nociceptive receptor activity, thereby contributing to pain modulation and a reduction in pain perception.[21] The presence of stretching after isometric contraction in the

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application of post isometric relaxation techniques in muscle energy technique can reduce excessive muscle tone through the activation of the golgi tendon of the muscle by sending signals to the central nervous system to induce relaxation of the contracted muscle, increasing relaxation, helps reduce pain associated with muscle tension.[22]

This research supports the results of previous studies on muscle energy techniques which were considered effective in reducing pain compared to conventional therapy.[23] Mechanoreceptors in joints and muscles are stimulated during muscle energy technique that contribute to the regulation of pain modulation. This intervention also affects lymphatic and blood flow, which can change interstitial pressure and increase transcapillary blood flow that helps reduce chemical mediators of pain such as cytokines. This stimulation ultimately reduces the sensation of pain.[10]

Muscle energy technique can reduce disability in mechanical neck pain of digital creative agency employees

Based on the research results, it states that muscle energy technique can reduce neck disability in mechanical neck pain of digital creative agency employees. From the results of the statistical analysis test, it was obtained ($p=0.001$; $p<0.05$), which indicates a significant difference in reducing neck disability after muscle energy technique. This technique utilizes individual muscle strength through mild isometric contractions by activating the inhibition mechanism so that it can help stretch muscles that are experiencing tension. This intervention focuses on stretching muscles to increase the range of motion of the neck. With the increase in the range of motion of the neck, it allows individuals to carry out daily activities optimally which contributes to reducing the level of neck disability.[24] A study proves that muscle energy technique with autogenic and reciprocal inhibition approaches is effective in reducing pain and disability in mechanical neck pain. Of the 80 samples divided into 2 groups and undergoing 12 therapy sessions, both showed significant results in reducing pain and disability.[25] It is further explained that autogenic inhibition is superior in reducing pain, increasing range of motion, and reducing disability in individuals with mechanical neck pain. Based on evidence from previous systematic review studies, it was stated that muscle energy technique are more effective when combined with other conventional therapies.[26]

Individuals with mechanical neck pain generally experience increased muscle tone that triggers spasms. The application of muscle energy technique helps improve muscle mobility by reducing active muscle tone either through autogenic or reciprocal inhibition mechanisms. The decrease in active muscle tone means more sarcomeres function optimally in muscle contraction.[22] The isometric contractions and stretching performed during muscle energy techniques can increase muscle viscoelasticity which contributes to increased muscle flexibility and decreased levels of disability. This decrease in disability is characterized by an increase in the individual's ability to perform daily activities without significant pain.[27]

Deep cervical flexion exercise with pressure biofeedback is more effective than muscle energy technique in reducing pain in mechanical neck pain of digital creative agency employees.

The results of the statistical analysis showed a significant difference between the deep cervical flexion exercise with pressure biofeedback and muscle energy technique groups in reducing pain ($p=0.013$; $p<0.05$). The mean post-test NPRS value of treatment group 1 was smaller than that of treatment group 2, with the percentage of pain reduction after the intervention being 68.40% and 44%, respectively. Based on the mean post-test value and percentage of pain reduction, it shows that deep cervical flexion exercise with pressure biofeedback has better effectiveness in reducing neck pain compared to muscle energy technique.

Deep cervical flexion exercise with pressure biofeedback is designed to improve neuromuscular control of muscles by focusing on the activation of deep cervical flexor muscles, with high muscle spindle density and playing an important role in kinesthetic sense, thus influencing muscle stability and neck posture.[28] This muscle activation helps restore normal movement patterns, reduces mechanical stress on discs and ligaments, and improves cervical posture to prevent recurrent neck pain. It also increases blood and oxygen flow to the muscles, speeding healing and relieving pain.[29] The use of a pressure biofeedback unit aims to help monitor and ensure precise low-load muscle contractions, focused on the deep neck flexors, leading to more optimal deep neck flexor training performance.[30] Pressure biofeedback also motivates individuals to perform better and encourages them to improve their performance in each training session.[31]

Improvements in muscle performance, flexibility of stiff muscles, and increased strength in weak muscles create optimal constant torque throughout training.[8] It is possible that active contraction of the deep cervical muscles during the application of the intervention can stimulate an increase in endorphins through afferent input to the central nervous system by sending signals to the pituitary gland to release beta-endorphins and endogenous opioids. This input is believed to stimulate the neural inhibitory system at various levels in the cervical spinal cord, thereby activating the pain inhibitory pathway.[33] Ergoreceptor activation during exercise increases muscle recruitment and accelerates tissue repair, thereby supporting muscle tissue repair and reducing pain.[3] Thus, the implementation of deep cervical flexion exercise with pressure biofeedback that focuses on deep cervical muscle activation contributes to reducing neck pain.

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This study supports previous research showing that deep cervical flexion exercise with pressure biofeedback is more effective than isometric or stretching exercises for reducing neck pain, especially among professional computer users. Meanwhile, muscle energy technique relies on the activation of autogenic inhibition reflexes through post-isometric relaxation, is less specific in activating deep cervical flexors, making it less effective in improving motor control and endurance needed to address mechanical neck pain in digital creative employees.[34] Muscle energy technique mainly targets superficial muscles with minimal impact on segmental stability and deep cervical muscle activation. Therefore, although muscle energy technique can reduce short-term pain, deep cervical flexion exercise with pressure biofeedback provides better benefits by strengthening deep stabilizer muscles, improving motor and postural control, and thereby significantly reducing pain perception.

Deep cervical flexion exercise with pressure biofeedback is more effective than muscle energy technique in reducing neck disability in mechanical neck pain of digital creative agency employees.

The results of the statistical analysis showed a significant difference between the deep cervical flexion exercise with pressure biofeedback and muscle energy technique intervention groups in reducing neck disability ($p=0.003$; $p<0.05$). The mean post-test NDI value of treatment group 1 was smaller than that of treatment group 2, with the percentage of disability reduction after intervention of 55.48% and 30.55%, respectively. Based on the mean post-test value and the percentage of neck disability reduction, it shows that deep cervical flexion exercise with pressure biofeedback has better effectiveness in reducing neck disability compared to muscle energy technique. Consistent with previous studies, deep cervical flexion exercise with pressure biofeedback effectively reduces neck disability in individuals with mechanical neck pain by targeting deep flexor muscles, such as the longus colli and capitis, which stabilize the cervical spine.[35]

Individuals with mechanical neck pain, experience an imbalance that causes dominant compensation by superficial muscles, while deep flexor muscles weaken and there is decreased endurance. As a result, tissue tension increases, worsening neck posture that contributes to functional disability. Therefore, the implementation of this intervention can improve the balance between cervical posture muscles which effectively helps reduce the level of neck disability.[31] One potential mechanism may involve cortical reorganization in the sensorimotor areas of the neck, which influences the improvement of proprioception through enhanced afferent input from muscle and joint mechanoreceptors in the cervical region to the central nervous system as a result of repeated stimulation during exercise. This adaptation results in improvements in controlling the posture of the head and neck, which is very important in reducing static tension in the neck area. In addition, the application of pressure biofeedback can strengthen muscle endurance through repeated contractions at target pressures, this allows motor activation in deep muscles and improving segmental stability of the cervical spine. Increased muscle endurance encourages a significant decrease in the neck disability index score.[30]

In contrast, muscle energy technique uses submaximal isometric contractions and post-isometric inhibition through soft tissue stretching, which improves flexibility and reduces muscle tone but does not specifically target motor control recovery related to stabilizer muscle activation and postural control, which are primary factors causing dysfunction in mechanical neck pain. Conversely, deep cervical flexion exercise with pressure biofeedback actually retrain specific muscle activation patterns and improve functional movement coordination, making this exercise more effective in reducing disability levels.[36] Thus, deep cervical flexion exercise with pressure biofeedback more effectively addresses the underlying causes of mechanical neck pain and reduces neck disability.

CONCLUSION

Both deep cervical flexion exercise with pressure biofeedback and muscle energy technique reduced neck pain and disability in employees with mechanical neck pain. In this study, deep cervical flexion exercise with pressure biofeedback demonstrated greater reductions in neck pain and disability after 6 weeks compared to muscle energy technique. However, these results should be interpreted cautiously given the relatively small sample size, baseline imbalance in age, and the absence of follow-up to determine long-term effects. Future studies are expected to control potential confounding variables such as age, involve larger sample sizes, include longer follow-up periods, and adopt more robust designs such as randomized controlled trials with blinding to confirm and extend these findings.

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AUTHOR'S CONTRIBUTION STATEMENT

AF conceptualized and designed the study, conducted the research and data analysis, performed data collection and intervention procedures, and prepared as well as edited the draft manuscript. Data analysis and interpretation were carried out under the guidance of the supervisors (SP and W). The supervisors were also involved in designing

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and conceptualizing the research, guiding data interpretation, and providing critical feedback and revisions to the manuscript. All authors approved the final version for submission.

CONFLICT OF INTEREST

The authors affirm no conflict of interest in this study.

REFERENCES

1. Laeto A Bin, Santoso B, Zulissetiana EF, dkk. Hubungan antara Durasi Duduk dengan Kejadian Nyeri Leher pada Mahasiswa Kedokteran Universitas Sriwijaya selama Pembelajaran Daring. *J Ilmu Kesehatan*. 2024;2(2):244–9.
2. Abd-Eltawab AE, Ameer MA. Effect of Kinesio Taping Versus Mechanical Cervical Traction Combined with Physiotherapy Program on Chronic Neck Pain in Young Female University Students. *Hong Kong Physiother J*. 2023;44(1):69–78.
3. Phadke A, Bedekar N, Shyam A, Sancheti P. Effect of muscle energy technique and static stretching on pain and functional disability in patients with mechanical neck pain: A randomized controlled trial. Hong *Kong Physiother J*. 2016;35:5–11. Available from: http://dx.doi.org/10.1016/j.hkpj.2015.12.002
4. Suvarnnato T, Puntumetakul R, Uthaikhup S, Boucaut R. Effect of specific deep cervical muscle exercises on functional disability, pain intensity, craniovertebral angle, and neck-muscle strength in chronic mechanical neck pain: A randomized controlled trial. *J Pain Res*. 2019;12:915–25.
5. Kashif M, Anwar M, Noor H, Iram H, Hassan HMJ. Prevalence of Musculoskeletal Complaints of Arm, Neck and Shoulder and Associated Risk Factors in Computer Office Workers. *Phys Medizin Rehabil Kurortmedizin*. 2020;30(5):299–305.
6. Nunes A, Espanha M, Teles J, Petersen K, Arendt-nielsen L, Carnide F. Neck pain prevalence and associated occupational factors in Portuguese office workers. *Int J Ind Ergon*. 2021;85:1–7. Available from: https://doi.org/10.1016/j.ergon.2021.103172
7. Choi W-H. The effects of the Cervical Deep Muscle Flexion Exercises on Pain and Cervical Function in Patients with Chronic Cervical Pain. *J Korean Soc Neurother*. 2019;23(1):55–9.
8. Jayaseeli P, Scindia GK, Jeyakhar J, Ramya S. Effect of Muscle Energy Technique and Mckenzie Exercise in Improving Disability and Reducing Pain in College Students with Mechanical Neck Pain. *Int J Acad Med Pharm*. 2024;6(3):716–20.
9. Lin LH, Lin TY, Chang KV, Wu WT, Özçakar L. Muscle energy technique to reduce pain and disability in cases of non-specific neck pain: A systematic review and meta-analysis of randomized controlled trials. *Heliyon*. 2023;9(11):1–15.
10. Lo CN, Teo VYE, Manaff NFABA, Seow TCY, Harve KS, Leung BPL. A Cross-Sectional Study Exploring the Relationship between Work-Related, Lifestyle Factors and Non-Specific Neck and Shoulder Pain in a Southeast Asian Population. *Healthc*. 2024;12(18).
11. Zheng B, Zheng L, Li M, Lin J, Zhu Y, Jin L, et al. Sex differences in factors associated with neck pain among undergraduate healthcare students: a cross-sectional survey. *BMC Musculoskelet Disord*. 2022;23(1):1–10. Available from: https://doi.org/10.1186/s12891-022-05782-z
12. Abbas M, Qamar S ul, Habib M, Hanif M, Masood S, Usman H. A Study to Compare the Effectiveness of McKenzie Neck Exercise and Contract Relax Stretching in Mechanical Neck Pain. *J Heal Rehabil Res*. 2024;4(2):1629–33.
13. Khanum F, Khan AR, Khan A, Aafreen A, Khan AA, Ahmad A, et al. Predicting mechanical neck pain intensity in computer professionals using machine learning : identification and correlation of key features. 2024;(March):1–9.
14. Karthi M, Gopalswami AD, Aseer AL. Efficacy of Endurance Training on Deep Cervical Flexor Muscles Using Pressure Feedback in Mechanical Neck Pain. *Int J Physiother*. 2019;6(3):95–101.
15. Rehab NI, Abdallah D, Fahmy EM, Mohamed SS. Effect of Deep Cervical Flexors Training Paradigm on neck pain and functional disability in Patients with Cervicogenic Headache. 2024;3(1):28–40.
16. Ahmed MM, El-Mageed SFA, Hassan KA, Saweeres ESB. Efficacy of Biofeedback Exercise of Deep Neck Flexors on Cervicogenic Headache. *Med J Cairo Univ*. 2019;87(March):967–80.
17. Rahnama L, Saberi M, Kashfi P, Rahnama M, Karimi N, Geil MD. Effects of Two Exercise Programs on Neck Proprioception in Patients with Chronic Neck Pain: A Preliminary Randomized Clinical Trial. *Med Sci (Basel, Switzerland)*. 2023;11(3).
18. Kamayoga IDGA, Adyasputri AAIAF, Putra IPYP, Widnyana M, Utama AAGES. The Efficacy of Deep Cervical Flexor Training with Feedback Reducing Pain and Disability in Individuals with Work-Related Neck Pain. *Phys Ther J Indones*. 2021;2(2):50–3.
19. Rojas Galleguillos F, Clark-Hormazábal C, Méndez-Fuentes E, Guede-Rojas F, Mendoza C, Riveros Valdés A, et al. Exercise-induced hypoalgesia in chronic neck pain: A narrative review. *Sport Med Heal Sci*. 2024;6(1):37–47.

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20. Buttagat V, Muenpan K, Wiriyasakunphan W, Pomsuwan S, Kluayhomthong S, Areeudomwong P. A comparative study of Thai massage and muscle energy technique for chronic neck pain: A single-blinded randomized clinical trial. *J Bodyw Mov Ther*. 2021;27:647–53. Available from: https://doi.org/10.1016/j.jbmt.2021.05.007
21. Osama M. Effects of autogenic and reciprocal inhibition muscle energy techniques on isometric muscle strength in neck pain: A randomized controlled trial. *J Back Musculoskelet Rehabil*. 2021;34(4):555–64.
22. Rana AA, Ahmad A, Gillani SA, Idrees MQ, Awan I. Effects of conventional physical therapy with and without muscle energy techniques for treatment of upper cross syndrome. *Rawal Med J*. 2020;45(1):127–31.
23. Albomahmood KH, Shadmehr A, Hadian MR, Jalaie S, Tahseen J, Fereydounnia S. Efficacy of Extracorporeal Shock Wave Therapy on Active Trigger Point in the Upper Trapezius Muscle. *J Mod Rehabil*. 2022;16(4):298–303.
24. Siddiqui M, Akhter S, Ahmed A, Baig M. Effects of autogenic and reciprocal inhibition techniques with conventional therapy in mechanical neck pain – a randomized control trial. *BMC Musculoskelet Disord*. 2022;23:1–11. Available from: https://doi.org/10.1186/s12891-022-05668-0
25. Sbardella S, La Russa C, Bernetti A, Mangone M, Guarnera A, Pezzi L, et al. Muscle energy technique in the rehabilitative treatment for acute and chronic non-specific neck pain: A systematic review. *Healthc*. 2021;9(6).
26. Joshi R, Poojary N. The Effect of Muscle Energy Technique and Posture Correction Exercises on Pain and Function in Patients with Non-specific Chronic Neck Pain Having Forward Head Posture—a Randomized Controlled Trail. *Int J Ther Massage Bodyw Res Educ Pract*. 2022;15(2):14–21.
27. Amalina N, Setiawati E. Effectiveness of Deep Cervical Flexor (DCF) Exercise on Neck Functional Scores in Helicopter Crew with Mechanical Neck Pain. 2021;3(2):71–6.
28. Matsi AE, Atsidakou N, Christakou A. Effectiveness of Craniocervical Flexion Exercise on Pain , Disability , and Cervical Range of Motion in Patients with Neck Pain. 2020;32(1):39–57.
29. Tsiringakis G, Dimitriadis Z, Triantafylloy E, McLean S. Motor control training of deep neck flexors with pressure biofeedback improves pain and disability in patients with neck pain: A systematic review and meta-analysis. *Musculoskelet Sci*. 2020;50:1–17. Available from: https://doi.org/10.1016/j.msksp.2020.102220
30. Hassan ES, Botla AM, Abdou MY, Attalla AHA, Ali KM, Aboelmaged SR. Effect of stabilizer pressure biofeedback on post-thyroidectomy neck pain in postmenopausal women: a randomized controlled trial. *Physiother Q*. 2024;32(4):35–41.
31. Alghadir AH, Iqbal ZA. Effect of Deep Cervical Flexor Muscle Training Using Pressure Biofeedback on Pain and Forward Head Posture in School Teachers with Neck Pain : An Observational Study. 2021;2021.
32. Tiwari J, Tiwari V, Sharma A, Malik A. The Impact of Deep Cervical Flexibility Training with Pressure Biofeedback on Neck Pain and Disability in Teachers. *UGC Care Gr I List J*. 2023;Vol.13(10):172–82.
33. Nazir S, Arslan HRM, Awan NG, Bilal H. To Compare the Effectiveness of Muscle Energy Technique and Deep Neck Flexors Training on Pain, Range of Motion and Functional Disability in Patients with Mechanical Neck Pain. *Pakistan Biomed J*. 2022;5(1):296–9.
34. Shah I, Kulkarni P, Kumar A. Assessment and Comparison between Cervical Retraction Exercise and Muscle Energy Technique on Cervical Joint Position Sense in Individuals with Forward Head Posture. Int *J Sci Healthc Res*. 2022;7(1):199–208.
35. Ojoawo AO, Ige B, Kunnuji K. Muscle energy technique and static stretching in patients with mechanical neck pain - a randomized study. *Eur J Clin Exp Med*. 2022;20(1):63–9.