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Effectiveness of Modified Scapular Exercise and Stretching Exercise on Pressure Pain and Neck Disability in Architecture Students with Mechanical Neck Pain in Denpasar

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ABSTRACT

This study aimed to prove the difference in the effectiveness of modified scapular exercise compared to stretching exercise in pressure pain and neck disability in architecture students with mechanical neck pain in Denpasar. This research is experimental research with pre and post-test two-group design. The research sample consisted of 16 people who were divided into two groups by simple random sampling. Group 1 with the modified scapular exercise intervention and group 2 with the stretching exercise intervention. Both groups received treatment 3 times a week for 6 weeks. Measurements were made before and after treatment. Pressure pain was measured with a pressure algometer and neck disability were measured with the Indonesian version of the neck disability index questionnaire. Based on the paired sample t-test on modified scapular exercise and stretching exercise, the results obtained were right and left pressure pain with a value of $p<0.001$ and neck disability with $p<0.001$, which means that there was a significant difference in the decrease of pressure pain and neck disability before and after the intervention, in each group. For the independent sample t-test, the value of right pressure pain was $p<0.05$, left pressure pain was $p<0.05$, and neck disability was $p<0.001$, which showed significant differences in the decrease of pressure pain and neck disability in the two groups. In conclusion, modified scapular and stretching exercises can decrease pressure pain and neck disability in architecture students with mechanical neck pain in Denpasar. However, based on the analysis of the results of the intervention, modified scapular exercise was more effective in decreasing pressure pain and neck disability in architecture students with mechanical neck pain compared to stretching exercise.

Keywords: Mechanical neck pain, Pressure pain, Neck disability, Modified scapular exercise, Stretching exercise

1. INTRODUCTION

Nowadays, laptops are one of the mandatory items owned by students. The use of laptops in students is generally due to practicality and the demands of coursework that must be done. Lecture assignments are generally carried out for a long period of time so that they can cause static postures. Static postures that are carried out by students continuously can cause musculoskeletal complaints, one of which is mechanical neck pain.

Mechanical neck pain is pain with mechanical characteristics such as signs and symptoms that arise when the position is static for a long time, limited joint range of motion, muscle spasms to disability in the neck that interferes with daily activities. One study states that mechanical neck pain can cause a decrease in neck muscle strength and endurance, especially in the deep cervical neck muscles [1]. Mechanical neck pain can be caused by

static posture of the neck, whereas using a laptop for a long duration of time can cause static posture of the neck. When using a laptop for a long period of time or exceeding the maximum duration of 2 hours/day, it can cause the energy used to be greater, the posture becomes abnormal and the body position becomes static, causing complaints in the skeletal muscles where these complaints are generally felt ranging from very mild to very painful [2].

The 66% prevalence of neck pain occurs at the age of 20-30 years which is triggered by intense use of a laptop or computer for a period of more than 4 hours/day [3]. Another study also states that the age of 18-50 years is the age that most often experiences neck pain, because at this age the increase in the incidence of neck pain is caused by a static sitting position with the head forward while studying and working in front of the [4].

Research conducted by Dzuria, 2021 [5] states that as many as 85.2% of students experience neck pain with the risk factors that most influence the onset of neck pain, namely postures that tend to be static and not ergonomic and the use of laptops for a long duration of time. Prolonged use of a laptop in this position can also result in abnormal muscle work, where using electronic devices with a forward head posture causes greater pain in the upper trapezius muscle and induces increased upper extremity muscle activity [6]. This neck pain can result in decreased work productivity and interfere with daily activities in a person [7].

Architecture students are students who use laptops relatively long in a day. This is due to the design studio course, which takes up a lot of time for architecture students to be in front of a laptop. This course has assignments that require a high level of concentration, where students are required to design spaces and their surrounding elements to look aesthetic but still in accordance with their functions. The time period for collecting assignments in this course is done weekly for 1 semester. This causes architecture students to be in front of a laptop for more than 8 hours a day and complete assignments for up to 3-4 days. The duration of using a laptop for more than 8 hours a day with a static posture of the neck can increase the risk of pain or complaints in the neck of architecture students [8].

Pain and discomfort in the neck when doing daily activities can be treated by providing physiotherapy interventions in the form of exercise. The recommended exercise program including stretching, strengthening, and endurance is an effective treatment for individuals who have neck pain [9]. Stretching is one of the important factors in individuals with mechanical neck pain. This is due to the shortening of the postural muscles of the neck, causing limited neck mobility and causing pain or discomfort in the neck [10]. Previous studies have said that giving stretching exercises to people with neck pain can help reduce the pain [11]. Giving this stretching exercise caused as many as 95% of subjects with neck pain to experience decreased pain [12].

Providing a series of strengthening and resistance exercises such as scapular stabilization exercises is also said to reduce neck pain [13]. Stability training can increase flexibility, relieve discomfort, and reduce re-injury risk [14]. Previous studies state that scapular stabilization exercises given to subjects with chronic mechanical neck pain can reduce pain and disability in the neck [15]. The study of Mey, et al. (2012) [16] also stated that giving scapular exercises after 4 weeks can reduce pain in all research subjects. Scapular stabilization exercise programs for neck pain are still very varied and not specific to the upper trapezius, rhomboid, and serratus anterior muscles in gadget users such as smartphones and laptops [9].

The scapula stabilization exercise program modified by Chuanchan, et al. (2021) on laptop users using this muscle function and mobility technique has been shown to treat complaints of neck pain and disability. Modified scapular exercise can affect more than one direction and facilitate multiple muscle work during exercise. This exercise is a combination of stretching, functional exercise and strengthening exercises using body weight [9].

Based on previous studies which state that data on the effectiveness of scapular stabilization exercises on neck and functional pain are still limited [13], the researchers conducted further research by comparing exercises that are commonly used to reduce pressure pain and disability in the neck and scapular exercises which are still little studied, entitled "the effectiveness of modified scapular exercise and stretching exercise on pressure pain and neck disability in architecture students with mechanical neck pain".

2. METHODS

This research design is experimental with pre and post-test group control design. The research was conducted at the Faculty of Engineering and Planning, Warmadewa University, Denpasar. The research sample was 16 architecture students with the inclusion criteria of students aged 18-24 years who experienced neck pain ≥ 1 month (sub-acute-chronic), NDI score> 5 and duration of laptop use> 2 hours a day. Students who had a history of trauma, neuromuscular disorders in the neck and serious pathology were excluded from this study.

The research sample will be divided into 2 groups where group 1 is given modified scapular exercise intervention and group 2 is given stretching exercise intervention [9]. Modified scapular exercise is a modified exercise that uses a combination of muscle function and mobility techniques, where the exercise consists of stretching, functional exercise, and strengthening using body weight. The exercise movement techniques are rise up with retract scapula, rise arm with trunk twist, push on elbow, quadruped with arm press, trunk twist with shoulder abduction, trunk twist, rise hand with rotate trunk, upper back stretch, and neck and trunk rotate. Stretching exercise is one of the exercises with movement techniques that are done to stretch the muscles and

tendons so that the muscles and tendons will be stretched and cause increased muscle flexibility. Stretching exercise is performed on the wrist and hand, pectoralis major, elbow extensor, upper trapezius, rhomboid, anterior, and posterior neck stretching.

In each research variable, measurements were taken using a pressure algometer to assess pressure pain and the Indonesian version of the neck disability index to assess neck disability in mechanical neck pain. Data analysis used paired sample t-test to assess the difference in pressure pain and neck disability before and after intervention in groups 1 and 2, and independent sample t-test to assess the difference between the two groups.

3. RESULTS AND DISCUSSIONS

Results

Table 1. Distribution of Sample Data Based on Age and Duration of Work

Characteristics	Group 1 Mean±SD (n=8)	Group 2 Mean ±SD (n=8)	p-value
Age (years)	20.00±0.76	20.00±0.76	1.000
Duration of work (hours)	7.38±0.92	7.38±1.30	1.000

Based on table 1 above, the p-value on the characteristics of age and work duration was found to be p>0.05, indicating that there was no significant difference in the sample characteristics between the two groups so that the data could be compared.

Table 2. Distribution of Sample Data by Gender

Characteristics	Group 1 n (%)	Group 2 n (%)
Male	8 (50)	8 (50)
Female	0	0

Based on table 2 above, the gender characteristics of the research sample data in group 1 and group 2 are male.

Table 3. Test of Normality and Homogeneity of Pressure Pain Reduction Before and After Intervention

Data Groups		Normality Test[1]				Homogeneity Test[2]
		Group 1		Group 2		p-value
		Mean±SD	p-value	Mean±SD	p-value	
Right PPT	Pre-test	3.78±0.51	0.40	3.61±0.46	0.17	0.60
	Post-test	4.81±0.38	0.16	4.18±0.40	0.38	0.98
Left PPT	Pre-test	4.10±0.57	0.94	3.95±0.40	0.12	0.53
	Post-test	5.28±0.51	0.62	4.56±0.46	0.46	0.86

[1]Shapiro Wilk Test [2]Levene's Test ; PPT: pressure pain threshold (kg/cm^2)

Based on table 3 above, the normality test obtained the probability value for the data group before and after the intervention shows that the data before and after the intervention on the right and left pressure pain thresholds in group 1 and group 2 are normally distributed with a p>0.05 value. The homogeneity test for pressure pain data shows that the research data in both groups have the same variance or characteristics with a value of p>0.05.

Table 4. Normality and Homogeneity Test of Neck Disability Decrease Before and After Intervention

NDI	Normality Test[1]				Homogeneity Test[2]
	Group 1		Group 2		p-value
	Mean±SD	p-value	Mean±SD	p-value	
Pre-test	13.50±1.31	0.28	13.25±1.59	0.18	0.54
Post-test	8.13±1.36	0.51	9.88±1.46	0.52	0.93

[1]Shapiro Wilk Test [2]Levene's Test; NDI : Neck Disability Index

Based on table 4, the neck disability data shows that the normality test results obtained the probability value of the data before and after the intervention on neck disability in group 1 and group 2 are normally distributed

with a value of p>0.05. The homogeneity test on neck disability data in table 4 shows that the research data in both groups have the same variant or characteristics with a value of p>0.05.

Table 5. Differential Test of Pressure Pain Values Before and After Intervention in both groups

Data Groups		Group 1		Group 2	
		Mean±SD	p-value	Mean±SD	p-value
Right PPT	Pre-test	3.78±0.51	<0.001	3.61±0.46	<0.001
	Post-test	4.81±0.38		4.18±0.40	
Left PPT	Pre-test	4.10±0.57	<0.001	3.95±0.40	<0.001
	Post-test	5.28±0.51		4.56±0.46	

PPT : Pressure pain threshold (kg/cm^2)

Based on table 5, the results of the difference in the average value of pressure pain before and after intervention in each group were obtained. Group 1 with a p-value <0.001 on the right and left pressure pain thresholds which means that there is a decrease in the value of pressure pain before and after the intervention. Group 2 with a value of p <0.001 on the right and left pressure pain thresholds which means that there is a decrease in the value of pressure pain before and after the intervention.

Table 6. Differential Test of Neck Disability Before and After Intervention in Both Groups

Data Groups		Group 1 Mean±SD	p-value	Group 2 Mean±SD	p-value
NDI	Pre-test	13.50±1.31	<0.001	13.25±1.59	<0.001
	Post-test	8.13±1.36		9.88±1.46	

NDI : Neck Disability Index

Based on table 6, the results of the difference in the mean value of neck disability before and after the intervention was given to each group. Group 1 with a p-value <0.001 in neck disability which means that there is a decrease in neck disability before and after the intervention. Group 2 with a p-value <0.001 in neck disability which means that there is a decrease in the value of pressure pain before and after the intervention.

Table 7. Comparative Test of Difference in Pressure Pain Before and After Intervention in Both Groups

	Pressure Pain Threshold (kg/cm^2)	Groups	Mean±SD	Percentage Reduction	p-value
Difference	Right	Group 1	1.04±0.38	27.5%	<0.05
		Group 2	0.56±0.11	15.5%	
Difference	Left	Group 1	1.18±0.36	28.8%	<0.05
		Group 2	0.61±0.11	15.4%	

Based on table 7, the results of the calculation of the difference in the decrease in right pressure pain obtained a p-value <0.05, and the value of left pressure pain obtained a p-value <0.05. This shows that there is a significant difference in the provision of modified scapular exercise intervention and stretching exercise intervention in reducing pressure pain in mechanical neck pain.

The percentage decrease in right pressure pain in group 1 was 27.5% while in group 2 it was 15.5%. The percentage decrease in left pressure pain value in group 1 was 28.8% and while in group 2 it was 15.4%. Based on these results it can be said that the intervention of modified scapular exercise is better than stretching exercise on pressure pain in mechanical neck pain.

Table 8. Comparative Test of Difference in Neck Disability Before and After Intervention in Both Groups

NDI	Groups	Mean±SD	Percentage Reduction	p-value
Difference	Group 1	5.38±0.52	39.9%	<0.001
	Group 2	3.38±0.74	25.5%	

NDI : Neck Disability Index

Based on table 8, the results of the calculation of the difference in the reduction in neck disability obtained a value of p<0.001. This shows that there is a significant difference in the provision of modified scapular exercise intervention and stretching exercise intervention in reducing pressure pain in mechanical neck pain.

The percentage reduction in neck disability in group 1 was 39.9% while in group 2 it was 25.5%. It can be said that the provision of modified scapular exercise intervention is better than stretching exercise on neck disability in mechanical neck pain.

Discussion

Sample Characteristics

The study subjects totaled 16 men with an average age of 20.00 ± 0.76 in group 1 and group 2, the average work duration of group 1 was 7.38 ± 0.92 and group 2 was 7.38 ± 1.30. Age range, gender and work duration in using a laptop is one of the factors that can cause mechanical neck pain. The incidence of mechanical neck pain can occur as a person ages. This is due to the process of tissue degeneration that occurs in the neck as a person ages. This tissue degeneration process will cause a decrease in function that will cause disability in the neck. Gender is also one of the risks of neck pain due to physiological differences between women and men and women's higher stress levels compared to men which make women more susceptible to disease [2]. The duration factor of laptop use by students for a long period of time with a static posture tends to at risk of neck pain and causes disability in the neck [5]. This can be seen in the measurement of pressure pain and neck disability, where before the intervention, the right side pressure pain threshold in group 1 was 2.78 ± 0.51 and group 2.61 ± 0.46, the left side pressure pain threshold in group 1 was 3.10 ± 0.57 and group 2.95 ± 0.40, the average of neck disability in group 1 was 13.50±1.31 and 13.25±1.59 in group 2 and these figures indicate mild disability.

Mechanical neck pain is pain that occurs in the neck to shoulder area caused by neck work postures that are maintained statically and repeatedly over a long period of time. Mechanical neck pain can cause pressure pain and disability in the neck, in this case, students who use laptops with poor and non-ergonomic neck working postures are at risk of mechanical neck pain. Poor and static posture can cause muscles to contract longer so that blood flow to muscle tissue is limited so that pain occurs [17]. Using a laptop for more than 2 hours can also cause the energy used to be greater and the body position becomes static. Static postures that are carried out continuously will cause trigger points and taut bands in a muscle, causing tenderness in the muscles [2]. Research studies by Pertiwi (2017) also state that incorrect and static work postures can cause the balance between contraction and relaxation in the muscles cannot be maintained so there is tension and shortening in the muscles characterized by muscle spasm and pain when the muscles are palpated [18].

The results of the analysis of the characteristics of the research subjects in the two groups did not have significant differences because the subjects had been controlled based on age, gender, and duration of work. Therefore, it can be said that there were no differences in the characteristics of the research subjects including age, gender, and duration of work before the intervention in the two groups so as not to affect the results of the study. If after the intervention for six weeks, there is a difference in the results of the two groups, then it can be ascertained that this is due to the intervention given to each group.

Modified Scapular Exercise Intervention Can Reduce Pressure Pain and Neck Disability in Architecture Students with Mechanical Neck Pain

Based on the results of data analysis conducted in group 1, the right part obtained the average value of the pressure pain threshold before and after the intervention with a value of $p<0.001$, while the left part obtained the average value of the pressure pain threshold before and after the intervention with a value of $p<0.001$. The mean value of neck disability before and after the intervention was $p<0.001$. The p-value in both parts of pressure pain and neck disability in group 1 indicates a significant difference in pressure pain and neck disability before and after the modified scapular exercise intervention on mechanical neck pain. This increase in the value of the pressure pain threshold indicates a decrease in pressure pain in mechanical neck pain. The results of the analysis on the modified scapular exercise intervention showed that there was a decrease in pressure pain and neck disability in architecture students with mechanical neck pain in group 1.

Neck pain and disability arising from mechanical neck pain is caused by muscle tension and shortening characterized by muscle spasm and pain when the muscles are palpated, due to contraction and relaxation in the muscles cannot be maintained [18]. The modified scapular exercise intervention is one of the exercises modified from scapular stabilization exercises to treat neck pain [9]. The modified scapular exercise intervention provided to architecture students consists of stretching, functional exercise, and strengthening using body weight. A series of stabilization exercises on the scapula can increase flexibility, reduce discomfort and reduce the risk of re-injury to the neck and shoulders. This exercise on the scapula can improve posture and pain in the head, and it can also improve the patient's quality of life [14].

The modified scapular exercise intervention in reducing pressure pain and neck disability focuses on the trapezius, rhomboid, and posterior neck muscles. This exercise, which uses a combination of muscle function and mobility techniques, can improve muscle balance which helps maintain proper posture while working or performing daily activities. The modified scapular exercise intervention will cause the muscles to contract and relax against a certain amount of force, resulting in vasodilation of the blood vessels in the muscles it can cause the muscles to relax and reduce the initial pain [9]. Pain inhibition with stabilization exercises can also occur

through increasing muscle strength targeting weak neck muscles and decreasing muscle spasms simultaneously. The decrease in muscle spasms caused by scapula stabilization exercises can also improve circulation in muscle tissue so that the supply of food and oxygen in muscle tissue becomes better and causes pain in the muscles caused by spasms to decrease [19,20].

The modified scapular exercise intervention can also cause a reduction in tendon contraction. This is because in this intervention there are also stretching movements that can cause signal inhibition due to golgi tendon organs and pressure-sensing receptors responding to stretching movements. When signal inhibition occurs, muscles that were originally tense will relax so that there is a reduction in mechanical pain perception in the neck which is accompanied by a reduction in neck disability [9].

The results in this study are supported by previous research, where scapula stabilization exercises can significantly reduce neck pain and disability in chronic mechanical neck pain [15]. Research by Chuachan, et al. (2021) also states that modified scapular exercise can reduce neck pain and disability after 6 weeks of training [9]. Modified scapular exercise can improve balance in muscles that help maintain proper posture while working or doing daily activities. When muscle balance occurs, pain perception will decrease and flexibility of the muscles will increase so that it can lead to increased functional ability in the neck.

Stretching Exercise Intervention Can Reduce Pressure Pain and Neck Disability in Architecture Students with Mechanical Neck Pain

Based on the results of data analysis that has been done in group 2, the right part obtained the average value of the pressure pain threshold before intervention 2.61±0.46 and after intervention 3.18±0.40 with a value of $p<0.001$, while the left part obtained the average value of the pressure pain threshold before intervention is 2.95±0.40 and after intervention 3.56±0.46 with a value of $p<0.001$. The mean value of neck disability before intervention was 13.25±1.59 and after intervention was 9.88±1.46 with a value of $p<0.001$. The p-value in both parts of pressure pain and neck disability in group 2 showed a significant difference in pressure pain and neck disability before and after stretching exercise intervention in mechanical neck pain. This increase in the value of the pressure pain threshold indicates a decrease in pressure pain in mechanical neck pain. The stretching exercise intervention showed that there was a decrease in pressure pain and neck disability in architecture students with mechanical neck pain in group 2.

Stretching exercise intervention aims to stretch or increase the flexibility of the problematic muscles so that there is a decrease in pain [21]. Stretching movements on the wrist and hand, pectoralis major, elbow extensor, upper trapezius, rhomboid, neck flexor, and extensor can cause the sarcomere in these muscles to be stretched so that pain decreases [11]. Stretching exercise can also cause the onset of the inhibitory effect of the golgi tendon organ which causes a dampening effect on motor nerve release, thus causing relaxation of the musculotendinous unit by producing a resting length and modification of the pancinian corpus. This reflex will allow relaxation of the musculotendinous unit tension and a decrease in pain perception [10].

The results of this study are supported by research conducted by Deen, et al. (2020), which states that stretching exercise can cause a significant decrease in pain by 24% and neck disability by 7.9% [22]. Anand & Goyal's research (2020) also states that giving stretching exercise to the neck and shoulders causes a 22.1% decrease in pain in working from home (WFH) workers [23].

Pain in the neck that is felt can cause disruption of daily activities so that work productivity decreases. Giving stretching exercise can cause an increase in muscle tissue extensibility and tissues that experience spasm will be relaxed so that the pain felt in the neck decreases. When the pain felt in the neck decreases, it will be accompanied by a decrease in neck disability making it easier to carry out mobility and functional activities [11].

Differences in the Effectiveness of Modified Scapular Exercise Compared to Stretching Exercise on Pressure Pain and Neck Disability in Architecture Students with Mechanical Neck Pain

Based on the results of data analysis that has been done, the difference in the decrease in right-side pressure pain is obtained $p<0.05$ with the results of a percentage decrease of 27.5% in group 1 and 15.1% in group 2. While the difference in the decrease in left-side pressure pain is obtained $p<0.05$, with a percentage decrease of 28.8% in group 1 and 15.4% in group 2. The results of the analysis on neck disability had a value of $p<0.05$, with a percentage decrease of 39.9% in group 1 and 25.5% in group 2. This shows that there is a significant difference in the provision of modified scapular exercise compared to stretching exercise on pressure pain and neck disability in architecture students with mechanical neck pain.

Statistical comparison of the two interventions showed that modified scapular exercise was more effective than stretching exercise in reducing pressure pain and neck disability. The intervention in both groups used the same exercise dose, where each group was given exercise for 6 weeks at a dose of three times per week. This is based on the Kisner & Colby (2012) study, where the minimum time for muscles to be able to experience adaptation is for 4 weeks [20], besides that a combination of cervical stretching, strengthening, and endurance training lasting at least 6 weeks is stated as the most beneficial exercise regime [24].

Postural muscle shortening that occurs in mechanical neck pain due to statically maintained neck work postures often causes muscle balance disorders in maintaining postural balance [25]. Shortening of the postural

muscles results in muscle pain which often causes individuals to be afraid to move their neck it can cause a decrease in functional ability and disruption of mobility and daily activities [26]. Therefore, exercises are needed that can cause a decrease in the imbalance between the upper trapezius muscle and the serratus anterior muscle by improving the position of the scapula. Some studies state that improving the position of the scapula passively or actively has been shown to reduce chronic neck pain.

The modified scapular exercise intervention is more effective in reducing pressure pain and neck disability compared to stretching exercise because in this modified scapular exercise intervention there is a combination of several exercises such as functional exercise, stretching, and strengthening using body weight. The movements performed in this intervention can cause vasodilation of blood vessels caused by contraction and relaxation of muscles against a certain amount of force [9]. Vasodilation that occurs in the blood vessels in the muscles will cause increased tissue circulation so that the supply of food and oxygen to the muscles becomes better and causes a decrease in pain perception caused by muscle spasms. Reduction in pain perception also occurs due to an inhibitory effect on pain centers in the brain, where stimulation of mechanoreceptors causes the release of endogenous opioids and endorphins from the pituitary gland so that peripheral and central pain is blocked [27,28].

Pain inhibition in scapular stabilization exercises also occurs through increased muscle strength targeting weak neck muscles and decreased spasms simultaneously. Strengthening movements in the modified scapular exercise intervention use isometric and concentric contractions. Exercises performed in a quadruped position with arm press and push on elbow can activate the serratus anterior, rhomboid, and trapezius muscles. This causes an increase in muscle strength and stabilization in the scapula caused by neural adaptation that increases nerve impulses to the muscles resulting in greater motor unit recruitment and higher muscle contraction [20]. Along with increasing muscle strength, in scapula stabilization exercises there is also a decrease in spasm. The decrease in spasms can be caused by stretching movements. Stretching performed on the upper back with the target muscles trapezius, pectoralis major, latissimus dorsi, and levator scapula in this modified scapular exercise will cause a reduction in pain perception. When performing stretching movements, the sarcomere will be optimally stretched so that it can reduce irritation to type Aδ and type C nerves so that inhibition occurs which causes muscle relaxation and reduction in pain perception. Reduction of pain perception is also caused by the inhibitory effect of the golgi tendon organ which causes relaxation of the musculo-tendinous unit and causes vasodilation of blood vessels in the muscle so that the perception of pain caused by spasm is reduced [19,20].

Increased muscle strength and decreased spasms will lead to correction of the position of the scapula which can reduce tension in the axioscapular muscles and abnormal cervical load, causing pain to decrease [24]. Increased motor control also occurs in this exercise which causes a decrease in excessive tension and increased neck mobility so that patients are easier to perform movements and functional activities [19,20]. Controlled muscle activity due to this scapular exercise can reduce disability in the neck so that the patient's quality of life will improve [15].

Based on data analysis that has been carried out on pressure pain in group 1, the results obtained are 1.04 kg/cm2 on the right and 1.18 kg/cm2 on the left. Changes in pressure pain in group 2 amounted to 0.56 kg/cm2 on the right and 0.61 kg/cm2 on the left. Changes in pressure pain in the neck area are considered clinically meaningful when there is a statistically significant decrease with a minimum detectable change value of 1.57 kg/cm2 [29]. This shows that there is no clinical change in the right and left pressure pain of group 1 and group 2. Data analysis on neck disability in group 1 and group 2 showed changes of 5.38 and 3.38. Changes in neck disability in samples with mechanical neck disorders are considered clinically meaningful when there is a statistically significant decrease with a minimum detectable change of 10.2 [30]. Based on this, it can be stated that there was no clinical change in neck disability in group 1 and group 2.

Combination exercises for 6 weeks are said to be the most beneficial exercises in individuals with neck pain [24]. However, in this study, the intervention of modified scapular exercise and stretching exercise did not cause any clinically significant changes. Previous research states that scapular functions training can be added to clinically relevant treatment strategies for pain in the neck/shoulder area, where in this study the intervention was given for 10 weeks [31]. Research by Zebis, et al. (2014) states that to achieve optimal neck pain reduction, exercise should be given over a period of 15 weeks [32].

4. CONCLUSION

Based on the results of data analysis and discussion that has been carried out, it can be concluded that:

1. Modified scapular exercise can reduce pressure pain and neck disability in architecture students with mechanical neck pain in Denpasar.
2. Stretching exercise can reduce pressure pain and neck disability in architecture students with mechanical neck pain in Denpasar.
3. Modified scapular exercise is more effective in reducing pressure pain and neck disability in architecture students with mechanical neck pain in Denpasar compared to stretching exercise.

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