



The effect of additional postural neck muscle control on conventional physiotherapy rehabilitation in reducing shoulder pain and disability in recreational surfers



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ABSTRACT

Background: Shoulder pain and disability is a disorder commonly experienced by surfers, which is characterized by pain and limitations in the shoulder region when performing functional movements. Shoulder movement is closely related to the surfer's paddling movements when surfing, so high paddling intensity increases the risk of complaints in the shoulder region. This research aimed to prove that adding postural muscle neck control to conventional physiotherapy rehabilitation intervention was more effective in reducing shoulder pain and disability than conventional physiotherapy rehabilitation intervention.

Methods: This research was experimental with a randomized pre- and post-test two-group design. Research participants were randomly divided into two groups. This research measured shoulder disability using the shoulder pain and disability index (SPADI) questionnaire.

Results: The paired *T*-test analysis showed significant differences in the reduction in SPADI scores in group intervention, which was 23.2 ± 2.7 with p -value < 0.001 , and in group control, was 20.15 ± 3.3 with p -value < 0.001 in the patient's shoulder functional increase. The independent *T*-test obtained a p -value of 0.002, proving a significant difference between the intervention and control groups in reducing shoulder disability among recreational surfers.

Conclusion: There were significant differences in SPADI scores before and after both group interventions. In addition, data showed that the additional postural neck muscle exercise on conventional physiotherapy rehabilitation obtained better improvement in shoulder disability than conventional physiotherapy intervention only among recreational surfers.

Keywords: Conventional physiotherapy rehabilitation, postural muscle neck control, recreational surfers, shoulder pain and disability.

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INTRODUCTION

Surfing is one of the many ordinary lifestyles often practiced by sports activists, which is free and very easy to do. Petitenget Beach, Seminyak, is located in one of the tourism destination areas, Badung Regency, Bali, Indonesia. Surfing is very popular with guests and local people around the beach who spend 2-4 hours doing this sport because sufficient waves are available every day throughout the year. Surfing is included in the high-intensity water sports category, which requires a high energy expenditure, thus placing a burden on the body's mechanical system of this sports enthusiast, usually called a surfer.^{1,2}

As previously explained, surfing is a tiring sport to do. However, for ordinary people, the surfer's movements are limited to balancing to remain standing on the surfboard above the waves. According to statistical data, the most common movement when surfing is paddling, which reaches almost 70%, and the rest is sitting or surfing, which only lasts 2-3 minutes. Paddling is the movement of rowing a surfboard with the shoulder surfer as the primary mechanical motor unit. This movement is done when the surfer wants to create a forward movement towards the middle of the beach and is mainly used when chasing waves.³

Paddling is a complex movement that

occurs primarily at the glenohumeral joint. However, paddling solid movements are determined by the strength or power of the rotator cuff muscle but also the stability of the shoulder during the paddling movement to protect the shoulder biomechanics from mechanical pattern abnormalities. The main focus of paddling is basically on the shoulder or glenohumeral joint. Still, osteokinematics and arthrokinematics of the glenohumeral joint are also determined by the stability of the more proximal region, such as the upper back region or cranial-vertebral region, which is activated by the upper back muscles, especially the rhomboid muscle, levator scapula, upper, middle and

lower trapezius muscles. The instability in the neck region due to muscle imbalance greatly influences neck posture and movement in the scapula-shoulder, influencing the prevalence of surfer's shoulder pain.⁴

Imbalance in the neck region is caused by the biomechanics of the surfer's position when paddling, namely cervical hyperextension, which starts in the cervical-thoracic vertebrae region. The upper back muscles will receive eccentric contraction stress to maintain the hyperextension cervical surfer posture. Biomechanically, this posture expands the surfer's visualization in front and can increase mobility and strength from paddling. Muscle fatigue caused by cervical hyperextension while paddling is often overlooked as a slight movement. Still, it is often a factor rarely analyzed to get treatment for a comprehensive problem source related to biomechanical abnormalities in shoulder movement.⁵

Shoulder pain can be caused by overuse, which causes the supraspinatus tendon in the shoulder area to become inflamed or ruptured, or by degenerative processes that damage the joint surfaces of the acromioclavicular joint, sternoclavicular joint, and glenohumeral joint, among others.⁶ In general, conventional rehabilitation interventions by a physiotherapist that are currently carried out are still pain oriented using only standard equipment and interventions such as Transcutaneous Electrical Nerve Stimulation (TENS), Infra-Red, and stretching exercises on the shoulder with a focus on reducing long-term pain for complaints of shoulder pain.⁷

One of the problem sources of balancing on the neck that occurs will be intervened with postural neck muscle control exercises in the form of activation exercises for the postural neck muscles with the principle of carrying out isolated activation on neck muscles that are inactive due to fatigue and normalizing hypercontraction / tight muscle tone due to hyperextension posture compensation. Kinesio Taping improved proprioceptive neck control activation in surfers' cervical spines. This exercise is believed to improve the surfer's shoulder stability by increasing the synchronization of neck-scapula-

shoulder muscular co-contraction.⁸ Kinesiology tape serves to help joint function. The application of kinesiology tape can improve joint function by affecting muscle tone, imbalances can be corrected, and muscle balance is restored to muscle groups, resulting in improved joint function, leading to decreased pain and, therefore, shortening the healing process.⁹

Based on the background of the problem above, the author is interested in designing a study by combining additional postural muscle neck control exercises with conventional physiotherapy rehabilitation and comparing it with conventional physiotherapy rehabilitation intervention alone. Conventional physiotherapy rehabilitation interventions are generally carried out as conventional treatment, as well as to prove how significant the effect of adding postural muscle neck control is in reducing disability and pain in the shoulder compared to training without postural muscle neck control exercise.

METHODS

This was an experimental study with a pre-post control group design. The treatment group was the group that was given additional postural neck muscle control intervention and conventional physiotherapy rehabilitation. The control group was given conventional physiotherapy rehabilitation intervention only.

In both groups, pain was measured using shoulder disability measurements with the Shoulder Pain and Disability Index (SPADI) questionnaire before being given the intervention. Then, the intervention was given 12 times, and after that, the measurements were carried out again to determine the post-test results.

The study's population included all patients who were diagnosed with surfer's shoulder pain and disability at Petitenget Beach, Seminyak, Badung, based on a standard physiotherapy assessment.⁷ This study's accessible population was patients with shoulder pain and disability who came to the Petanu Medical Center Physiotherapy clinic. Hence, the total sample size was 32 surfers. The sample had to meet the inclusion criteria: a. Subjects with pain and reduced disability based

on physiotherapist examination results; b. Between the ages of 40 and 50; c. Have been surfing in Seminyak's Petitenget Beach for over six months.; d. Surfing intensity was 7-9 hours every week; e. The patient was not under doctor's medication; f. Capable of communicating effectively with the physiotherapist; g. Cooperative and ready to participate in this study. The exclusion criteria were: a. The presence of neurological disorders; b. Have cardiac problems; c. Malignant tumor; d. Patients with complaints of other diseases that can interfere with research results (such as cervical radiculopathy or hernia nucleus pulposus, scoliosis, fracture, dislocation, etc.).

Ethical permission from the ethics commission of FK Unud/RSUP Sanglah. The research was carried out from March to August at the Petanu Medical Center Physiotherapy Clinic. The sample will first be informed about the research procedures and fill in the form willing to become a sample by signing an informed consent. This study used block permutation techniques. The pre-test and post-test results were tested using statistical tests. The intervention was carried out thrice a week for four weeks. Data analysis used SPSS.

RESULTS

Table 1 shows the SPADI values before treatment in the intervention and control groups in the research sample characteristics table, which includes age before treatment in the intervention and control groups. According to the criteria table, the number of individuals in each group was 16, whereas the intervention group had 12 male subjects and four female subjects, with an age range of 38.44 ± 4.844 . The control group included nine male individuals and seven female subjects ranging in age from 36.63 ± 3.612 . Before treatment, the intervention group's mean SPADI score was 51.38 ± 3.931 , while the control group's mean SPADI score was 50.38 ± 4.272 , with the interpretation of the SPADI score for intervention and control groups being high shoulder disability before treatment.

The normality test results using the SPSS Shapiro-Wilk test and the homogeneity test using the SPSS Levene's

test in intervention and control groups are shown below. Table 2 shows the results and an explanation of the test values for the two groups. The normality test results were obtained using the SPSS *Shapiro-Wilk* test, and the results of the homogeneity test were obtained using the SPSS *Levene's* test in intervention and control groups with $p > 0.005$, indicating that the data in both groups were normally distributed and homogeneous. The data was examined using parametric statistical hypothesis testing based on the findings of the normality and homogeneity tests.

The paired sample *t*-test is used to determine the difference in the average functional decrease before and after intervention in the intervention group, which will receive the addition of postural neck muscle control intervention, while in the control group, which will receive conventional physiotherapy rehabilitation intervention, to test the mean decrease in SPADI scores before giving the combination of interventions. The results of the tests are listed in Table 3.

Table 3 shows the results of the SPSS test, specifically the paired T-test, in the intervention group that received the postural neck. Before the intervention,

the mean SPADI score was 51.38 ± 3.931 ; after the intervention, it was 28.19 ± 4.665 . With a value of $p = 0.001$ ($p < 0.05$) with the interpretation that there is a significant difference between the scores before the intervention of the postural neck muscle control intervention and after the intervention treatment. This value can be interpreted as proving that the intervention group's combination of therapies, particularly postural neck muscle control on traditional physiotherapy rehabilitation intervention, can minimize shoulder impairment in patients.

Table 3 shows the results of the SPSS paired sample *t*-test in the control group, which received only a conventional physiotherapy rehabilitation intervention. There was a difference in the mean SPADI score before and after the intervention, with an average before that equaling 50.38 ± 4.272 and after 30.62 ± 1.781 with $p = 0.001$ ($p < 0.05$). This *p*-value can show the significance of the difference between before conventional physiotherapy rehabilitation intervention and after conventional physiotherapy rehabilitation intervention and proves that this intervention can improve function in shoulder disability patients.

Table 3 describes the results and explanation of the SPSS independent *t*-test, which seeks to determine the average comparison of the decrease in SPADI scores in the two groups, with the interpretation that the greater the SPADI score obtained from the difference in the pre-test and post-test decrease in SPADI scores, the better the results to improve patient function. Table 3 shows that the difference between the reduction in SPADI scores in the intervention group was 23.19 ± 2.731 and the control group was 20.15 ± 3.341 toward the patient's functional improvement. A value of $p = 0.002$ ($p < 0.05$) was obtained, demonstrating that the intervention group, which received additional postural neck control exercise on top of the conventional physiotherapy rehabilitation intervention, outperformed the control group regarding reducing shoulder disability in patients.

DISCUSSION

The efficiency of postural neck muscular control exercises aimed to restore cervical muscle endurance and coordination. This exercise is proven effective by developing the control area of the proximal body to be more stable as support for the peripheral joint area, which carries out its mobility so that it is more controlled. When performing neck control, postural stabilization exercises are done with static (isometric) muscle contractions because they resemble the functional role of muscles in stabilizing body segments, especially during surfing sports that require very dynamic cervical-shoulder mobility. The concept of co-contraction

Table 1. Characteristics data of 16 surfers in each intervention and control groups

Characteristic	Intervention group			Control group		
	n	Mean	SD	n	Mean	SD
Age	16	38.44	4.844	16	36.63	3.612
Sex						
Male	12			9		
Female	4			7		
SPADI Pre-Test	16	51.38	3.931	16	50.38	4.272

N, frequency; SD, standard deviation; SPADI, shoulder pain and disability index.

Table 2. The results of normality and homogeneity tests of shoulder pain and disability index (SPADI) scores before and after both intervention and control groups interventions

Group Data	Test Normality with <i>Shapiro Wilk</i> Test				Test Homogeneity (<i>Levene's</i> Test) P-value
	Intervention group		Control group		
	Statistic	P-value	Statistic	P-value	
SPADI Pre-test	0.891	0.137	0.890	0.118	1.000
SPADI Post-test	0.883	0.131	0.859	0.137	0.877

Table 3. Results of paired and independent T-tests on shoulder pain and disability index (SPADI) between intervention and control groups

Group	Pre-test Intervention	Post-test Intervention	Mean Differences	Paired T-test P-value	Independent T-test P-value
Intervention	51.38±3.931	28.19±4.665	23.19± 2.731	0.000	0.002
Control	50.38±4.272	30.62±1.781	20.15±3.341	0.000	

of agonist muscles can also increase the effectiveness of the intervention.¹⁰

Postural neck muscle control exercise is a mechanism for simultaneously contracting prime and stabilizing muscles to perform valuable movements. This concept also emphasizes the importance of synergistic contractions in a movement, with good synergism providing effective muscle contractions during movement, such as the shoulder muscles that prioritize each rotator cuff muscle to be able to contract simultaneously, causing the quality of the pedaling movement to be controlled and follow the biomechanics of pedaling itself.¹¹

The efficacy of contractions and endurance in the muscles of the cervical-shoulder region is critical because it reduces excessive labor compensation from the body's inactive or weak muscles. Overhead is one of surfers' most common reason for limited shoulder movement pain. Repetitive shoulder movements are carried out for a long duration. This will result in fatigue that accumulates daily along with the surfing player's flying hours.¹² The effectiveness of conventional physiotherapy exercises in helping speed up recovery and rehabilitation in patients with shoulder pain disorders. The right training program and intensity will significantly benefit athletes/surfers with pain due to shoulder joint instability.¹³

Conventional physiotherapy consists of 3 primary modalities and fundamental treatments generally carried out by physiotherapy in treating patients with shoulder pain and disability. The infrared modality will provide superficial heating to the treated skin area, causing several physiological effects necessary for healing. These physiological effects act as activating superficial heat receptors in the skin, which will change the transmission or conduction of sensory nerves in transmitting pain so that pain will be felt to be reduced. This heating will also cause dilation of blood vessels (vasodilation) and increase blood flow in the area so that it will provide sufficient oxygen in the treated area, increase the activity of certain enzymes used for tissue metabolism, and remove unused metabolic waste so that in the end it will help speed up the tissue healing process, especially for the chronic

phase of injury such as in surfers.¹⁴

According to Maffiuletti and Minetto (2011), one of the problems of shoulder complaints is the presence of pain with high actuality in surfers.¹⁵ Transcutaneous Electrical Nerve Stimulation (TENS) is a therapeutic modality of physiotherapy that uses electrical waves that aim to stimulate sensory nerve fibers with high frequency, producing stimulation of the sensory nerves, which can reduce the pain the patient feels. The stimulus produced by the device is then sent through electrodes attached to the skin in the stimulated muscle area. The resulting stimulation mimics the action potential produced by the central nervous system, which causes the A-delta and C fibers to be stimulated, which then influences pain modulation. By reducing the pain the patient feels, it is hoped that the patient will be able to relax and stretch more efficiently.¹⁶

The final stage of conventional rehabilitation physiotherapy is usually stretching, a process carried out to move or lengthen the muscles to work optimally and support the body's activities when exercising or carrying out daily activities.¹⁷ Surfing activities are characterized by contraction movements or excessive repetition of movements, which can cause muscle and nerve injuries due to awkward / award positions or unsupportive positions. Hence, stiffness in the cervical region is standard. Stretching after rigorous exercise will help to reduce muscle tension, improve blood circulation, and reduce muscle weariness. According to fatigue physiology, there is an accumulation of lactic acid, which might cause a decrease in muscle work. Nervous and central elements may influence the exhaustion process. As a result, stretching can help relax the muscles and make them more flexible. Stretching increases oxygen supply, which increases flexibility, or the capacity to move muscles and joints through their complete range of motion.¹⁶

Postural neck muscle control exercise aims to improve the balance of the neck and upper back muscles to help maintain neck posture, increase neck muscle flexibility and endurance, and improve muscle imbalance. Stabilization exercises can promote spine or cervical area flexibility while reducing pain, repairing neck

disability, maintaining neck posture, and lowering the risk of reinjury. The power of stabilization exercises comes from their ability to improve sensory motor function and relax the muscles in the cervical region. Exercise therapy method on soft tissues and joints to restore ROM, reduce pain, and improve mobility, motor, and sensory function. Stability in the cervical region as a stabilizing area in the upper back and postural control of the scapula movement and shoulder movement make neck stabilization mandatory for surfing sports that use the shoulder area as a movement marker.¹³

Assessment is essential for a decrease in long-term impairment, as is awareness of the root of the pathological problem observed (source-oriented) rather than focusing merely on the patient's suffering. In chronic shoulder pain impairment, there has been a compensating alteration in malalignment or outward posture, frequently resulting in compensatory movements performed during normal daily activities.¹⁸

The shoulder's stability is governed by more than only the glenohumeral joint and the strength of the rotator cuff muscles. The muscles in the upper back, particularly those that control the scapula rhythm, such as the rhomboid muscle, subscapular muscle, infraspinatus, and mid trapezius, have a more significant influence on shoulder stability, and activation exercises on these muscles can indirectly influence the balancing movement of the shoulder during overhead movements when paddling in surfing.¹⁹

In surfers who experience shoulder problems, the tendency to protract the shoulder / rounded shoulder posture will cause the pectoralis muscle on the frontal side to gradually inhibit the stability of the upper back muscles on the dorsal side, namely the rhomboids and mid trapezius, to control posture on the shoulder. These two muscles contract eccentrically, the contraction that causes the most fatigue. Therefore, the effect of co-contraction exercises to improve balance and normalize the work of movement makers and stabilizers in the type of postural neck muscle exercise intervention is much more influential than only interventions that focus on the acute phase, such as

pain which is carried out in conventional physiotherapy interventions.^{20,21}

This study has some drawbacks. The sample size was small for the first time. Second, the study was conducted over approximately four weeks due to the short study period and the incapacity to examine the long-term effects of therapy. As a result, future research should be conducted over a more extended time and with a larger sample size.

CONCLUSION

This study showed that SPADI scores in intervention and control groups were improved after the interventions. In addition, the additional postural neck muscle exercise interventions on conventional physiotherapy rehabilitation intervention showed a better improvement in shoulder pain and disability than the conventional rehabilitation physiotherapy intervention only among the recreational surfer patients.

ETHICAL CONSIDERATION

Before reporting the condition, the authors obtained the patient's consent. They were granted permission from the Institutional Reviewer Board, Faculty of Medicine, and Prof. Ngoerah General Hospital (Registration number: 1931/UN14.2.2.VII.14/LT/2023) to write and publish the work.

CONFLICT OF INTEREST

There are no conflicts of interest in this study.

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AUTHOR CONTRIBUTIONS

IPYP develops study designs, data collection, processing, and manuscript

writing. MW, IDGAK, and AAGES collect data and revise the manuscript.

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