

# The Effectiveness of Ultrasound (US) Intervention and Static Bicycle Exercise to Improve Functional Ability in Genu Osteoarthritis

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**Abstract:-** Genu Osteoarthritis is a degenerative disease of the knee joint due to the abrasion of joint cartilage and the formation of new bone on the joint surface which can cause muscle and tendon weakness so that movement is limited and causes pain. Degenerative diseases of the genu can cause the erosion of the articular surface, this will cause pain and swelling in the genu. This research method is pure experimental with randomized pre-test and post-test group design. Samples of this study is 13 patients were given Ultrasound (US) and Static Bicycle Exercise 6 times for 2 weeks. Physiotherapy examinations and measurements were carried out using the WOMAC Index (Western Ontario and McMaster Universities Osteoarthritis Index). The results showed an increase in knee functional activity before and after treatments with the normality test using the Shapiro-Wilk test with value  $P$  value before = 0.034 ( $P > 0.05$ ) with a mean value of  $78.00 \pm 4.46$  and the  $P$  value after = 0.276 ( $P > 0.05$ ) with a mean of  $19.77 \pm 5.85$  then the normality value of the data is normally distributed so the research hypothesis test used Paired Samples Test with significant results  $P = 0.000$  ( $P < 0, 05$ ) with a mean value =  $58.23 \pm 5.49$ . The conclusion of this study is Ultrasound (US) and Static Bicycle Exercise can improve functional ability in patients with Genu Osteoarthritis.

**Keywords:-** Genu Osteoarthritis, Ultrasound, Static Bicycle Exercise.

## I. INTRODUCTION

Age is a major factor in the occurrence of osteoarthritis. According to the theory, more than 80% of individuals over the age of 65 develop knee osteoarthritis. This is due to a decrease in muscle strength that occurs due to a decrease in muscle morphology. There is a progressive loss of body mass or active body tissue that begins at the age of 40 years with a 2% decrease in basal metabolism accompanied by body systems, so that when age begins to increase, the incidence of knee osteoarthritis increases [1].

Degenerative joint disease or Osteoarthritis, generally affects one or more joints, localized destruction of joint cartilage and is characterized by progressive degeneration of cartilage, muscle atrophy, remodeling of the subchondral bone, and secondary inflammation of the synovial membrane. This disease is localized without any systemic effects, slowly progressive, and generally occurs in the elderly although age is not the only risk factor.

Osteoarthritis attacks mainly the hand joints or the joints that support weight or lower limbs, including the knee joints [2].

According to the World Health Organization (WHO) in 2019, Osteoarthritis is one of ten the most disabling diseases in developed countries. Worldwide, it is estimated that 9.6% of men and 18.0% of women over the age of 60 have symptomatic Osteoarthritis. 80% of those with Osteoarthritis will have limitations in movement, and 25% will be unable to perform their main daily functional activities. In Indonesia alone, the prevalence of Osteoarthritis is 11.9% of the total population of Indonesia with the highest occupational prevalence at the age of over 75 years, which is 33%. For knee osteoarthritis, the prevalence is about 15.5% in women and 12.7% in men [3].

Pain is the main complaint in patients with Osteoarthritis Genu. Usually the pain will increase when moving and slightly less when resting. These changes can be found even though osteoarthritis is still relatively early (radiologically). The pain will get worse until the joint can only be shaken and become contractures, the disruptions of the motion can be concentric (all directions of movement) or eccentric (one direction of movement only). Based on the results of Magnetic Resonance Imaging (MRI), it is suspected that the source of the pain that arises comes from joint inflammation (synovitis), joint effusion, and bone marrow oedema. Osteophytes are one of the causes of pain. As the osteophyte grows, the neurovascular innervation penetrates the base of the bone to the cartilage and into the developing osteophyte, this is what will cause pain [4]. Therefore, proper treatment by physiotherapy is needed to reduce the pain. The pain appears when the knee is moved, causing the patient to be reluctant/fearful to move the knee joint, resulting in decreased muscle strength, where the muscle is also the main stabilizer of the knee joint and also as a protector of the knee joint structure itself. Then the joint Range of Motion (ROM) will also decrease with this pain because the joints are infrequently moved. The presence of muscle weakness and decreased balance of posture, increases the risk of falling in patients with Osteoarthritis Genu. The high risk of falls and motion pain, this causes functional activities to be hampered, such as sitting and standing for a long time, going up and down stairs, praying, walking with heavy lifting, working, and even losing independence because they always need external help [5].

The task of Physiotherapy is to help reduce the pain and increase functional activity and reduce problems caused by Osteoarthritis genu. One of them is by providing a combination intervention of Ultrasound (US) and Static Bicycle Exercises. Ultrasound (US) can reduce pain with the right dose in combination with Static Bicycle Exercises which can make it easier to move with a wider range of joint motion, helping increase strength and functional activities that are lighter and more flexible [6]. Evaluating the results of the Ultrasound (US) method, and Static Bicycle Exercise on knee osteoarthritis, the researchers used measurements with several questionnaires in the form of the WOMAC Index (Western Ontario and McMaster Universities Osteoarthritis Index) to see the value of pain, stiffness, and increased functional activity.

**II. RESEARCH METHOD**

This research method is a "Quasi-Experimental" to determine the effectiveness of ultrasound intervention and Static Bicycle Exercise to improve the functional ability of the knee in the case of Osteoarthritis genu. This study used one-group pre-test-post-test design, that is, the research is taken from the comparison of values in the period before and after the intervention of Ultrasound and Static Bicycle Exercise. Physiotherapy examination and measuring instruments used to see and measure the increase in functional ability of the knee by used WOMAC Index (Western Ontario and McMaster Universities Osteoarthritis Index). Samples of the treatment is 13 people, 3 times a week for 2 weeks. Ethics in this study pays attention to informed consent, respondent confidentiality, and respondent security.

**III. RESULTS AND DISCUSSION**

The criteria for respondents can be seen based on the distribution of sample data given Ultrasound (US) and Static Bicycle Exercise tested based on Age, Weight, Height, Occupation and Gender, before and after test WOMAC scores. The results of the sample homogeneity test analysis are presented in Table 1 below:

Variable	Value			
	Minimum	Maximum	Mean	Std. Deviation
<b>N=13</b>				
<b>Age</b>	45	62	53.53	6.09
<b>Weight</b>	65	85	72.53	6.27
<b>Gender</b>	Male	Female	1.85	0.38
<b>Occupation</b>	Farmer	Housewife	1.95	1.32

Table 1

Based on table 1, the characteristics of respondents are based on age, weight, occupation and gender. In the research group with the number of samples (n = 13) it was found that the average age was 53.53 + 6.09 with a minimum age of 45 years and a maximum age of 63 years, an average body weight of 72.53 + 6.27 with a minimum weight of 65 kg and a maximum weight of 85 kg. The number of respondent female gender is 11 people (84.6%) and male gender is 2

people (15.4%), the maximum number of respondents based on work as a housewife as many as 7 people (53.8%) and the number of respondents based on work as a farmer as many as 1 person (7, 7%).

Samples (n = 13)	Shapiro Wilk Normality Test	
	Mean ± SD	P
Before	78.00±4.64	0, 034
After	19.77±5.85	0,276

Table 2

Table 2 describes the normality test of the WOMAC Index (Western Ontario and McMaster Universities Osteoarthritis Index) data before and after Ultrasound treatment and Static Bicycles Exercises to improve functional ability in Knee Osteoarthritis patients P value before = 0.034 (P> 0.05) with the mean value was 78.00±4.64 and P value after = 0.276 (P>0.05) with a mean of 19.77±5.85, the data were normally distributed to determine the difference before and after treatment using the paired sample test.

Samples (n=13)	Mean ± SD	P
Difference	58.23±5.49	0.000

Table 3

Based on the results of the paired t-test in table 3, the mean difference between before and after treatment was 58.23 + 5.49 with a significant value of p = 0.000 (p < 0.05), it showed significant results that there was a significant effect before and after the intervention Ultrasound and Static Bicycles Exercises to Improve Functional Ability in Knee Osteoarthritis.

The research on Knee Pain in Osteoarthritis Patients was obtained from all patients who went to the Mandau Duri Hospital on 17 May – 11 June 2021 as many as 13 patients consisting of 2 men and 11 women aged between 45-62 years. Samples were obtained from doctor's referrals and Physiotherapy examinations. The sample was only 1 group, according to the inclusion and exclusion criteria. From the number of samples taken, Ultrasound Intervention (US) and Static Bicycles Exercise to Increase Knee Functional Activities in Osteoarthritis Patients. Prior to physiotherapy intervention, at the beginning of the program, pain values were measured using the WOMAC Index (Western Ontario and McMaster Universities Osteoarthritis Index). Furthermore, the sample was given intervention 6 times and at the end of the program a re-measurement was carried out, this was done to determine the success rate of pain reduction from each treatment that had been given.

The distribution of data in the treatment group based on age, weight, height, occupation, gender can be seen in Table 5.1. It shows the sample characteristics related to age, weight, height, occupation and gender. In the research group with the number of samples (n = 13) it was found that the average age was 53 + 6.09 with a minimum age of 45 years and a maximum age of 63 years, an average height of 161 + 5.25 with a minimum height of 155 cm and a maximum height of 172 cm. While the number of respondents aged 45-

50 was 5 people (38.5%), while the number of respondents based on the age of 51-55 was 3 people (23%) as well as the number of respondents based on the age of 56-65 as many as 5 people (38.5%) and the number of respondents based on male gender as many as 2 people (15.4%), and the number of respondents based on female gender was 11 people (84.6%). This is in line with research according to the World Health Organization (WHO) in 2019, Osteoarthritis is one of the ten most disabling diseases in developed countries. Worldwide, it is estimated that 9.6% of men and 18.0% of women over the age of 60 have symptomatic Osteoarthritis. 80% of those with Osteoarthritis will have limitations in movement, and 25% will be unable to perform their main daily functional activities. In Indonesia, the prevalence of Osteoarthritis is 11.9% of the total population of Indonesia with the highest prevalence at the age above 75 years which is 33%. For knee osteoarthritis, the prevalence is quite high, about 15.5% in women and 12.7% in men [3]. According to theory, more than 80% of individuals over the age of 65 develop knee osteoarthritis. This is due to a decrease in muscle strength that occurs due to a decrease in muscle morphology. There is a progressive loss of body mass or active body tissue that begins at the age of 40 years with a 2% decrease in basal metabolism accompanied by body systems, so that as age begins to increase, the incidence of knee osteoarthritis increases.

The distribution of the data based on body weight on the Ultrasound and Static Bicycle Exercise intervention is in Table 1 the average body weight is  $72 + 6.27$  with a minimum weight of 65 kg and a maximum weight of 85 kg and in table 4.2 the number of respondents weighing 65 - 69 as many as 5 people (38, 5%), while the number of respondents based on body weight 70-75 as many as 4 people (30.8%) as well as the number of respondents based on body weight 76-81 as many as 3 people (23%) and the number of respondents based on body weight 82-87 as many as 1 people (7.7%). This shows that body weight is one of the factors that cause osteoarthritis, this study is in line with research Pratama [6] which explains that the primary cause of Genu Osteoarthritis is still not known for certain, but there are several risk factors: age, gender, genetics, weight, occupation, trauma, skeletal malformations, and metabolic disease and other factors. Weight gain is usually associated with triggers for Knee Osteoarthritis. Obesity increases the joint load so that the resultant force will shift to the medial or varus. Then, Wijaya's research [7] explains that someone with obesity has a 2.96 times higher risk of developing osteoarthritis than people who have a normal body index. While overweight 2 times higher risk of developing osteoarthritis. Obesity increases the risk of osteoarthritis by several mechanisms, such as increasing joint load, especially on weight-bearing joints, changing behavioral factors such as decreased physical activity which ultimately reduces the ability and protective strength of the muscles around the joints. In knee osteoarthritis, obesity causes weakness of the muscles around the knee joint and increases the incidence of arthroplasty. In obese patients, fatty tissue can also be found behind the patella in the knee joint area, commonly called the infra patellar fat pad, the fat tissue can produce adipokines, which are cytokines produced by fat cells, such as leptin, adiponectin, resistin, and visfatin. These

adipokines can be dysregulated which can secrete proinflammatory factors.

Description of work activities shows that the research sample is the treatment group with the level of often doing work. Table 1 above, the number of respondents based on work as a teacher in the Ultrasound and Static Exercises intervention was 3 people (23.1%), the maximum number of respondents based on work as a housewife as many as 7 people (53.8%) and the number of respondents based on work as a farmer as many as 1 person (7, 7%). This is in line with secondary research by Ismaningsih and Selviani [8] which explains that Osteoarthritis most often occurs in trauma or occurs as a result of a job. and Wijaya's research [7] which explains that activity and work are risk factors for osteoarthritis where repetitive joint movements can predispose to osteoarthritis or are related to a history of injury. An injury that increases the risk of knee osteoarthritis is a torn meniscus or anterior cruciate ligament injury. Pratama [6] also explains that activities and work will cause oxidative damage, thinning of cartilage, weakening of muscles resulting in mechanical stress in the secondary joints so that there is a change in proprioception and a changing gait that causes quadriceps muscle weakness and the process of decreasing the joint that absorbs muscle material.

Normality Test Data on increasing functional activity before and after treatment on hypothesis testing in the group with the provision of Ultrasound Intervention (US) and Static Bicycle Exercise to increase functional activity in Osteoarthritis Genu patients using parametric test with paired sample test. Because the Shapiro Wilk Test Normality Test data is normally distributed, it can be seen with the value before,  $P = 0.034$  the average result before treatment  $78.00 + 0.034$  then  $P > 0.05$  and the value after  $P = 0.276$  then  $P > 0.05$  the average after treatment  $19.77 + 0.276$ .

Based on the parametric test with the paired sample test in the hypothesis test, it was reported that the mean difference before and after the data obtained was  $58.23 + 5.49$  in the Treatment Group with a  $P$  value = 0.000 then  $P < 0.05$ , meaning  $H_0$  was rejected and  $H_a$  was accepted. The conclusion of this study is that there is an effect of Ultrasound (US) Intervention and Static Exercises Bicycles to Improve Functional Ability in Genu Osteoarthritis Patients. There was a decrease in knee pain and an increase in functional activity as a result of an exercise program carried out progressively from week 1 to week 2, with a frequency of 3 times per week with measurements using WOMAC. This research is supported by Pratama [6], this study explains that to reduce knee pain in Osteoarthritis patients, physiotherapy intervention is given for 2 weeks at a dose of 3 times per week. Ultrasound (US) can reduce pain and the right quadriceps spasm disappears.

Pramita and Wahyudi's research [9] explained that Osteoarthritis causes pain and movement disorders in a person. Not only that, Osteoarthritis also causes joint stiffness and lack of proprioception as well as a decrease in quadriceps muscle strength. This will lead to impaired

immobilization and decreased functional activity. Osteoarthritis genu is often accompanied by several types of pain such as pain at rest, when moving and when walking. The intensity of pain will increase when a person performs daily functional activities, thereby reducing the ability of functional activities. Symptoms that occur in knee osteoarthritis are knee pain. The presence of knee pain causes sufferers to be afraid to do activities or movements so that it reduces their quality of life. Suggested non-pharmacological therapy such as exercise / knee exercises. Other types of exercise that can be done are home exercise, Range of Motion (ROM), strengthening exercise including quadriceps and hamstring exercises as well as aerobics such as walking, cycling, swimming. The purpose of this exercise is to improve joint function, increase joint strength, protect joints from damage by reducing stress on joints, prevent disability and improve physical health. This exercise will of course be adjusted to the patient's condition and ability [10]

Khatri's research [11] explains that ultrasound intervention 3 MHz continuous ultrasound intensity heats three times faster than 1 MHz. However, the intensity of 1 MHz penetrates deeper than 3 MHz. Generally, the frequencies used in therapy are 1 and 3 MHz. For cases in subacute conditions, the time is 3 minutes, repetition 1x1 day, 10x a day. For cases in chronic conditions, the time is 5-10 minutes, refining 1x1 day or 1x2 days. The therapeutic effects of ultrasound, among others, relieve acute, subacute, and chronic musculoskeletal pain. The pain relief is not yet known. However, some may be due to restoration of inflammation, elimination of waste products or changes in the permeability of cell membranes to sodium, which can alter electrical activity or pain thresholds. therapeutic effect overcomes inflammation by increasing blood supply, white blood cells, and removing waste products or substances that are not useful in body tissues and preventing soft tissue adhesions then the next therapeutic effect is to speed up recovery or repair by regenerating or replacing damaged cells with the same cells, which have the same structure and function. The thermal effect of ultrasound therapy was found to be very beneficial in the treatment of musculoskeletal disorders, destroying scar tissue and helping to stretch tendons. The use of ultrasound in heat therapy can be combined with electrical stimulation of muscles. This combination can increase the ability to clear metabolic wastes, reduce muscle spasm and tissue adhesions. Therapeutic ultrasound can reduce joint pain and stiffness. This therapy can be used to improve nerve root impingement. and several types of neuritis (inflammation of nerves) and is also useful for post-injury healing. In addition to thermal effects, ultrasound therapy also produces non-thermal effects in the form of cavitation and microstreaming. Cavitation is a process in which there are air bubbles that can enlarge in the tissue so that it can increase the flow of plasma in the tissue. Microstreaming is the insistence of sound waves on cell membranes that can increase the work of the cell's sodium pump which can speed up the healing process.

The results of this study are supported by research by Salacinski [12] who explains that physical fitness and aerobic exercise capacity using a static bicycle are effective

in patients with knee Osteoarthritis, because there is no weight bearing so that there is no excessive loading on the knee joint when exercising. The provision of static bicycle training aims to strengthen the quadriceps muscle. Osteoarthritis patients usually have a lower quality of life due to knee pain, causing their extremity muscles to become weaker, thus static bicycle exercise can reduce pain and can improve daily functional activities thereby improving the quality of life in patients with knee Osteoarthritis. Static cycling for 5 – 30 minutes as often as possible 3 times per week in Genu OA Patients by maintaining exercise intensity, can increase muscle strength, increase muscle flexibility, maintain joint proprioceptive, increase ligament strength so as to reduce pain can be overcome by triggering the release of endorphins. as well as hormones that enter the circulation of the bloodstream so that it provides a two-fold sedative effect on the joints.

Static Bicycle Exercises are active motion exercises that involve external assistance, both human and machine. This movement will force the muscles to contract and the joints also move to the maximum extent. an active movement exercise that trains several muscle groups and joints at once. Exercise also exerts a large proprioceptive and kinesthetic stimulus effect through the resulting joint approximation. Contraction of more than one muscle, without weight bearing during the exercise process stimulates mechano receptors in muscles and receptors around the joints to increase sensory input in the control of movement. This exercise can produce co-contraction (contraction of agonist-antagonist muscles at the same time), approximation and activation of multiple muscles which are all related and have a very large role in creating functional movements. So that the muscles are able to stabilize the joints better so that it affects the quality of the resulting movement. Multiple muscle contractions will greatly help produce synergistic movements in accordance with the stages of normal movement, so as to reduce pain and increase functional ability in the knee joint and provide exercise with a wider range of joint [13].

#### IV. CONCLUSION

Based on the research carried out on the handling and discussion above, it can be concluded that there is an effect of Ultrasound Intervention and Static Bicycle Exercises to reduce knee pain in patients with knee osteoarthritis, which can be seen from the hypothesis analysis of the data in the treatment group with a mean value of  $58.23 + 5.49$  with a significant value of  $p = 0.000$  ( $p < 0.05$ ).

Physiotherapists need to establish the correct diagnoses, it is expected that the physiotherapist will carry out specific physiotherapy examinations. For patients with genu osteoarthritis who experience increasing activity and functional abilities, it is hoped that they can continue static exercises at home.

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