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# Effect of Static and Dynamic Quadriceps Exercise Program on Pain Reduction in Knee Osteoartrose Patients in Dempo Surgery

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**ABSTRACT**

Osteoarthritis is a degenerative disease of the joints that involves cartilage, joint lining, ligaments, and bones, causing pain and stiffness in the joints. This study aims to explain the effect of the Static and Dynamic Quadriceps Exercise Program on reducing pain in Knee Osteoartrose Patients at Dempo Surgery. This study is a quantitative using a quasi-experimental design with a two groups pretest-posttest approach with control group design, namely by adding a comparison group where the first group, namely the treatment group, was given static quadriceps exercise and the second group, namely the control group with dynamic quadriceps exercise and taking medication that is provided by the health center. The structure of the research design contains 3 components, namely the initial state, the treatment and the condition due to the treatment. This study involved 28 samples were determined by total sampling technique because the number of respondents was not so large that the results were expected to be more valid. Collecting data on signs and symptoms of knee osteoarthritis which includes knee joint pain was measured by VAS. The data that has been collected is then processed and analyzed using the SPSS program. Before analyzing the data, the researcher conducted a Classical Assumption test by testing homogeneity and normality. The test results show that the data collected is normally distributed and homogeneous. The results of hypothesis testing indicate that there is an effect of the Static and Dynamic Quadriceps Exercise Program on reducing pain in Knee Osteoartrose Patients at Dempo Surgery.

**Keywords:** knee osteoartrose, pain, static quadriceps exercise



## INTRODUCTION

Osteoarthritis (OA) is a degenerative disease of the joints that involves cartilage, joint lining, ligaments, and bones causing pain and stiffness in the joints (Center for Disease Control and Prevention (CDC), 2014). The cause of OA is not known for certain, but age, gender, race, family history of osteoarthritis, obesity, history of injury and excessive physical activity are risk factors for osteoarthritis (Sambrook et. al, 2005).

The incidence of OA in the world is quite high. WHO estimates that 25% of people aged 65 years in the world suffer from OA (Andriyasa and Putra, 2012). Meanwhile in Southeast Asia, the number of OA sufferers reaches 24 million people (Saga, 2013). There is no clear report on the prevalence of OA in Indonesia. However, in 2000 the number of elderly people in Indonesia is projected to be 7.28% and in 2020 it will be 11.43% (Maryam, 2008). According to Nugroho (2008) almost 8% of people aged 50 years and over have complaints in their joints, especially rheumatic pain, aches and sometimes it feels very painful. One part of the joint that is often affected is the knee joint because the

joint often holds the body's weight. Meanwhile, Pratintya et al, (2014) said the prevalence of osteoarthritis in Malang was more than 855 osteoarthritis patients. Another study from Pratiwi, (2015) said that the prevalence of osteoarthritis aged 49-60 years in Malang was around 21.7% consisting of 6.2% in men and 15.5% in women.

Problems with osteoarthritis not only affect the patient, but also have an impact on the family and the environment (Masyhurrosyidi et al, 2016). Osteoarthritis is more commonly affected in the knee joint, changes occur in the articular cartilage and are followed by changes in the subchondral bone (Heijink et al, 2012). Pain is a clinical symptom of knee osteoarthritis. Pain is a feeling that is often complained of by osteoarthritis patients to doctors at the beginning of coming to health services or hospitals. Pain is an important key that indicates the direction the patient is experiencing disability. The International Association for the Study of Pain (IASP) defines pain as an unpleasant sensory and emotional experience resulting from actual and potential tissue damage (Steeds, 2009).

In carrying out all movements or activities such as sports, walking, squatting, running, jumping, and going up and down stairs, optimal muscle strength is needed. Muscular strength is the ability of a muscle or muscle group to produce tension and power during maximum effort either dynamically or statically. This muscle strength will increase when a person does weight training with a certain dose or a certain exercise program (Kisner, 2007). To increase the strength of the quadriceps femoris muscle, it can be done with various techniques and exercises both statically and dynamically. It can be done statically by isometric contraction exercise of quadriceps femoris known as quadriceps sitting exercise. While the dynamic ones are squats, dumbbell step up exercises, wall squats, and static bicycles. The quadriceps femoris muscle is a muscle in the knee joint that functions as an active stabilizer of the knee joint, plays a role in the movement of the extensor for the tibiofemoral extension of the patella, the tibiofemoral stabilizer which plays a role in the anterior glide of the tibia there is the femur together holding the posterior glide with the posterior cruciate ligament, the knee joint is extension movements used in the activity of going up and down stairs, if the stability of the knee joint and the strength of the quadriceps femoris muscle is impaired, the ability to go up and down stairs will decrease. To maintain and improve these abilities, physiotherapy measures are needed in the form of exercises with various methods or techniques.

According to Permenkes No. 80 of 2013 article 1 paragraph 2, "Physiotherapy is a form of health service aimed at individuals and or groups to develop, maintain, and restore body movement and function throughout the life span by using manual handling, movement improvement, equipment (physical, electrotherapeutic and mechanical), functional and communication training." Therefore, physiotherapists as one of the health workers who provide health services in the field of sports must have the skills and abilities to improve (promotion), prevent (preventive), treat (curative), and restore or restore (rehabilitation) motion and body functions.

Pharmacological therapy such as NSAIDs (Non-Steroid Anti-Inflammatory Drugs) consumed by OA sufferers is feared to interfere with other organ systems such as digestion and kidneys, so that other supporting therapies such as non-pharmacological therapy are needed, one of which is physical therapy in the form of static and dynamic stretching. Static and dynamic stretches are a combination of two types of stretching that have different movements where these two movements are carried out in a controlled manner until they reach the widest range of motion of the joints being exercised (Paramitha, et al., 2014). If these movements are combined, they can be used as an alternative to physical therapy that can be done by clients with OA. According to the American College of Sports Medicine (ACSM) to get optimal results in stretching, especially for OA patients, it takes 10-15 minutes for each implementation with a frequency of three times a week (Jennifer K. Cooney. 2011).

Some of the benefits of static and dynamic stretching include increasing the speed of transmission of nerve signals that command and regulate body movements, facilitating the process of muscle contraction-relaxation more quickly and efficiently, and increasing joint flexibility so as to minimize friction that occurs due to joint stiffness in people with osteoarthritis. (American Geriatric Society Panel on Exercise and OA, 2001). This study aims to explain the effect of the Static and Dynamic Quadriceps Exercise Program on reducing pain in Knee Osteoartrose (OA) Patients at Dempo Surgery.

## METHODS

This study is a quantitative study using a quasi-experimental design with a two groups pretest-posttest approach with control group design, namely by adding a comparison group where the first group, namely the treatment group, was given static quadriceps exercise and the second group, namely the control group with dynamic quadriceps exercise and taking drugs that given by the puskesmas (Sugiono, 2016). The structure of the research design contains 3 components, namely the initial state, the treatment and the condition due to the treatment (effect). The research design scheme can be seen in the table below:

**Table 1.** Research Design

| Subject | Pre-test | Treatment | Post-test |
|---|---|---|---|
| KA | O | S | O1-A |
| KB | O | D | O1-B |

Source: Nursalam (2016)

Information:

| | | |
|---|---|---|
| KA | : | subjects (OA patients) treatment |
| KB | : | subject (OA patient) control |
| O | : | pain measurement before intervention |
| S | : | Intervention with static exercises |
| D | : | Intervention with dynamic exercises |
| O1 (A+B) | : | Measurement of pain with a scale (VAS) after the intervention, either the intervention group or the control group. |

This study uses a total sample for data collection because the number of respondents is not so large so it is expected that the results are more valid. During the study, there were 28 patients with knee osteoarthritis who were identified during treatment and met the criteria set by the ACR. The study was conducted in the Dempo Surgical Clinic Area. Samples were taken from Dempo Surgery Clinic. This research was conducted for approximately one month, namely in July 2020. The data collected in this study included basic data including age, gender, BMI (Body Mass Index), signs of inflammation symptoms consisting of pain. For basic data consisting of age, gender, obtained by using a questionnaire made by the researcher, BMI was measured with a scale and height meter certified by the Indonesian National Standard.

Collecting data on signs and symptoms of knee osteoarthritis which includes knee joint pain is measured with a special tool to measure knee pain scale. Visual Analog Scale (VAS) is a tool to measure pain scale.

The data that has been collected is then processed and analyzed using a computer. Data analysis includes univariate and bivariate analysis. In bivariate analysis, all statistical tests were performed at the level of significance ( $\rho < 0.05$). Before analyzing the data, the researcher conducted a Classical Assumption test by testing the homogeneity and normality of the data first to determine the type of analysis to be used.

Homogeneity Test

Homogeneity test was conducted to analyze whether the research data had the same variation between the treatment group and the control group. The homogeneity test used the Levene Test at a significance level of 5%.

Normality test

The data normality test was carried out on the normality of the data for each group using Saphiro Wilk (Sample <50) with a 95% confidence level. The data is said to be normal if the p value 0.05.

## RESULTS

### Pain Level Before Treatment of Static Quadriceps and Dynamic Quadriceps

This study took 28 respondents of different gender, age and BMI. For more details, see the table below:

**Table. 2** Pain Levels Before Static Quadriceps Treatment

| No | Category | Range | Amount | Percentage |
|---|---|---|---|---|
| 1 | No pain | 0 | 0 | 0% |
| 2 | Mild (Mild Pain) | 1-2 | 0 | 0% |
| 3 | Moderate (Medium Pain) | 3-6 | 12 | 43% |
| 4 | Severe (Severe Pain) | 7-10 | 16 | 57% |
| Total | | | 28 | 100% |
| Average | | | 6.62 | |
| Highest | | | 9.00 | |
| Lowest | | | 4.00 | |

It can be concluded that people who experience Osteoartrose (OA) of the Knee before participating in the Static Quadriceps exercise at Dempo Surgery are at the most severe level. Meanwhile, the level of pain before the Dynamic Quadriceps treatment can be seen based on the table below:

**Table. 3.** Pain Level Before Dynamic Quadriceps Treatment

| No | Category | Range | Amount | Percentage |
|---|---|---|---|---|
| 1 | No pain | 0 | 0 | 0% |
| 2 | Mild (Mild Pain) | 1-2 | 0 | 0% |
| 3 | Moderate (Medium Pain) | 3-6 | 10 | 36% |
| 4 | Severe (Severe Pain) | 7-10 | 18 | 64% |
| Total | | | 28 | 100% |
| Average | | | 4.00 | |
| Highest | | | 6.72 | |
| Lowest | | | 9.00 | |

It can be concluded that people who experience knee osteoarthritis (OA) before participating in Dynamic Quadriceps Exercise in Dempo Surgery are at the most severe level.

### Pain Level After Treatment of Static Quadriceps and Dynamic Quadriceps

There is a change in the pain level of the respondents after the Static and Dynamic Quadriceps treatment. For more details, see the table below:

**Table. 4** Pain Levels After Static Quadriceps Treatment

| No | Category | Range | Amount | Percentage |
|---|---|---|---|---|
| 1 | No pain | 0 | 0 | 0% |
| 2 | Mild (Mild Pain) | 1-2 | 5 | 18% |
| 3 | Moderate (Medium Pain) | 3-6 | 21 | 75% |
| 4 | Severe (Severe Pain) | 7-10 | 2 | 7% |
| Total | | | 28 | 100% |
| Average | | | 4.08 | |
| Highest | | | 7.00 | |
| Lowest | | | 1.00 | |

Pain level after Dynamic Quadriceps treatment. For more details, see the table below:

**Table. 5** Pain Levels After Dynamic Quadriceps Treatment

| No | Category | Range | Amount | Percentage |
|---|---|---|---|---|
| 1 | No pain | 0 | 1 | 4% |
| 2 | Mild (Mild Pain) | 1-2 | 18 | 64% |
| 3 | Moderate (Medium Pain) | 3-6 | 9 | 32% |
| 4 | Severe (Severe Pain) | 7-10 | 0 | 0% |
| Total | | | 28 | 100% |
| Average | | | 1.00 | |
| Highest | | | 2.76 | |
| Lowest | | | 5.00 | |

It can be concluded that people who experience Knee Osteoartrose (OA) after following the Dynamic Quadriceps Exercise in Dempo Surgery are the most Mild (Mild Pain) levels.

**Classic assumption test**

Normality test

The normality test method that can be used to test residual normality is the Kolmogorov-Sminov (KS).

**Table 6.** Normality Test Results

Based on Table 4.8 shows that the value generated in *Asym.sig* is 0.290 which can be said that

One-Sample Kolmogorov-Smirnov Test

| | | Static_Before | Dynamic_Before | Static_After | Dynamic_After |
|---|---|---|---|---|---|
| N | | 28 | 28 | 28 | 28 |
| Normal Parameters [a,b] | mean | 6.6786 | 6.7500 | 4.1071 | 2.8214 |
| | Std. Deviation | 1.38921 | 1.45615 | 1.59488 | 1.21879 |
| Most Extreme Differences | Absolute | .163 | .211 | .188 | .178 |
| | Positive | .116 | -124 | .170 | .178 |
| | negative | -.163 | -.211 | -188 | -155 |
| Test Statistics | | .163 | .211 | .188 | .178 |
| asymp. Sig. (2-tailed) | | .055 [c] | .252 [c] | .290 [c] | .228 [c] |

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

The value of *asymp.sig* 0.290 is greater than 0.05, it can be said that the data is normally distributed.

Homogeneity Test

Homogeneity test is used to determine whether some of the population variances are the same or not. The basis for decision making in the homogeneity test are:

a) If the significance value is < 0.05, it is said that the variance of two or more data population groups is not the same.
b) If the significance value is > 0.05, then it is said that the variance of two or more data population groups is the same.

**Table 7.** Homogeneity Test Results

Test of Homogeneity of Variances

| | | Levene Statistics | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| **Pain_Level** | Based on Mean | 1,719 | 1 | 54 | .195 |
| | Based on Median | .808 | 1 | 54 | .373 |
| | Based on Median and with adjusted df | .808 | 1 | 52,975 | .373 |
| | Based on trimmed mean | 1,814 | 1 | 54 | .184 |

The test results above indicate that the test has a significance (p>0.05), it can be said that the variance of two or more groups of population data in this study is the same (homogeneous).

The next step is test analysis. The test used in this analysis is a two-sample t -*test* ( *Independent Sample Test* ). Based on the results of statistical analysis using *SPSS 25* . It can be seen that there are differences in the results of the speaking skills of the experimental class and the control class as shown in the table below.

**Table 8.** Test Results of Independent Sample Test

Independent Samples Test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | | Lower | Upper |
| **Pain_Level** | Equal variances assumed | 1,719 | .195 | 5.816 | 54 | .000 | 1.46286 | .25152 | .95859 | 1,96712 |
| | Equal variances not assumed | | | 5.816 | 53.916 | .000 | 1.46286 | .25152 | .95857 | 1,96714 |

Hypothesis Submission:

$H_0$ : There is no effect of Static and Dynamic Quadriceps Exercise Program on Pain Reduction in Knee Osteoartrose (OA) Patients in Dempo Surgery.

$H_1$ : There is an Influence of Static and Dynamic Quadriceps Exercise Program on

It can be concluded that $H_1$ is accepted, so there is a difference between patients who follow the Static and Dynamic Quadriceps Exercise Program on Reduction of Pain in Osteoarthrosis (OA) Knee Patients at Dempo Surgery.

## DISCUSSION

### There is an Effect of Static and Dynamic Quadriceps Exercise on Pain Reduction in Knee Osteoartrose ( OA ) Patients in Dempo Surgery

Osteoarthritis (OA) is a degenerative disease of the joints that involves cartilage, joint lining, ligaments, and bones causing pain and stiffness in the joints (Center for Disease Control and Prevention (CDC), 2014). Osteoarthritis (OA) is a chronic non-inflammatory degenerative joint disease associated with joint cartilage damage. This disease is slowly progressive, characterized by degeneration of articular cartilage, bony hypertrophy at the edges, subchondral bone sclerosis, changes in the synovial membrane, accompanied by pain, usually after prolonged activity, and stiffness, especially in the morning or after inactivity (Price and Wilson, 2013).

This disease is related to pain that occurs in the human spine. Although the exact cause is not known, this disease generally affects the elderly. The aging process will cause various changes that occur in the body such as physical changes and body physiology so that it will result in a decrease in the immune system and musculoceletal system from these changes, the elderly will experience various

diseases, one of which is osteoarthritis (Anggraini, et al., 2012). In accordance with this theory, in this study, it was found that the most people who experienced Osteoartrose (OA) of the Knee and followed the Static Quadriceps exercise in Dempo Surgery were > 60 years old.

Secondary osteoarthritis is OA caused by other diseases or conditions, such as post-traumatic, congenital and growth disorders (both local and generalized), bone and joint disorders, diseases due to calcium deposits, endocrine, metabolic, inflammatory disorders, prolonged immobility. , as well as other risk factors such as obesity, repeated operations on joint structures, and so on (Kivitz et al, 2001). In accordance with one of these factors, it is known in this study that the most people who experienced Osteoartrose (OA) of the knee and participated in the Static Quadriceps exercise in Dempo Surgery were BMI > 27 (obesity).

Muscle response to static stretching depends on the structure of the muscle spindle and golgi tendon organs, when the muscle is stretched very quickly, the primary afferent fibers stimulate alpha motor neurons in the spinal cord and facilitate contraction of extrafusal fibers, which increases muscle tension. But if this stretch is done slowly on the muscle, then the Golgi tendon organ is stimulated and inhibits muscle tension so that there is an elongation of the elastic component of the muscle (Wismanto, 2011).

The exercise begins with isometric contractions aimed at reducing pain and increasing the patient's confidence to contract his muscles. Isometric exercises are performed in a supine sleeping position, legs straight on a flat surface. For the quadriceps muscle, the patient is asked to press his knee towards the bed. for the static quadriceps exercise each exercise for 10 repetitions with 6-seconds, and 10 seconds of rest in each repetition (Deyle, 2000), with a frequency of exercise 3 times a week for 4 weeks.

In a study conducted by Fredrick in Srinivas Mondam, et al., (2015), found that dynamic stretching can stimulate the nervous system and reduce the potential for injury, increase muscle temperature and stretch muscles. In another study by Faigenbaum et al, (2005) and Srinivas Mondam, et al., (2015), stated that the comparison between dynamic stretching and static stretching at different ages and in various athletes showed that dynamic stretching increased flexibility and improve ability in vertical jump.

After doing Dynamic and Static Quadriceps exercises in Dempo Surgery in Osteoarthritis patients. The study showed the effect of patients who took static and dynamic quadriceps exercise program on reducing pain in knee osteoarthritis (OA) patients in Dempo Surgery.

## CONCLUSION

1. The level of pain before and after static quadriceps exercise in Osteoartrose (OA) knee patients at Dempo Surgery in this study there was a decrease in the level of pain from Severe (severe pain) before being given Static Quadriceps treatment at Dempo Surgery and decreased to a Moderate level ( Moderate Pain) after being given Static Quadriceps treatment in Dempo Surgery.
2. The level of pain before and after dynamic quadriceps exercise in Osteoartrose (OA) knee patients at Dempo Surgery in this study there was a decrease in the level of pain from Severe (severe pain) before being given Dynamic Quadriceps treatment at Dempo Surgery and decreased to Mild level ( Mild Pain) after being given Dynamic Quadriceps Treatment in Dempo Surgery.
3. The results of hypothesis testing show that there is an effect of static and dynamic quadriceps exercise on reducing pain in knee osteoarthritis (OA) patients at Dempo Surgery. in this study showed the effect between patients who followed the Static and Dynamic Quadriceps Exercise Program on Reduction of Pain in Osteoarthrosis (OA) Knee Patients at Dempo Surgery.

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