

Effect of Open Kinetic Chain on Functional Activities of Patients with Knee Osteoarthritis

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ABSTRACT

In doing daily activities, limbs of the lower extremities are the most important parts of the body. The knee is the main joint to support the body that the joint cartilage becomes inflamed which can cause pain so it can interfere to its functional activities. Nowadays, our society cannot be separated from all physical activities that involve personal or group activities. Walking, squatting, going up and down stairs, and even running are the most physical activities done by the society. Osteoarthritis is a process of degeneration and repairment of connective tissue, cartilage, synovium, and subchondral bone. Interventions can be given in the form of exercises improving the ability of functional activities, namely open kinetic chain which this exercise can accelerate blood circulation, prevent contractures, increase muscle strength or muscle strength, relax muscles and knee joints. The aim of this study was to determine the effect of open kinetic chain exercise and increased functional activity on knee osteoarthritis. This study used a quasi-experimental and one group pre and post-test design. The sample of this study was 12 people who had been characterized by the inclusion and exclusion criteria. Measurement of the functional activity value was carried out by women and the results of the study were analyzed using the repeated ANOVA measurable test. The data analysis test showed that the open kinetic chain can increase functional activity on knee osteoarthritis from time to time with an increasing average value of 12% in patients' functional activity within 3 treatments and 24% within 6 treatments.

Keywords: Open Kinetic Chain; Functional Activity; Osteoarthritis Knee

INTRODUCTION

Performing daily activities, the most important part of the body is the limbs of the lower extremities. The knee is the main joint that supports the body so that the knee is prone to inflammation or inflammation which can cause pain so that its functional activities can be disrupted. Until now, society cannot be separated from all physical activities that involve personal and group activities. Physical activity that is often done by the community is walking, squatting, going up and down stairs and even running. Meanwhile, WHO as quoted by Suhendriyo (2014) stated that around the world, osteoarthritis affects approximately 151 million people, and in Southeast Asia there are 24 million people with osteoarthritis. The prevalence of knee and hip osteoarthritis is higher than other joints because these two joints support the body's weight more.

It is said that the prevalence of hip osteoarthritis is 7.4% in women, (8%) higher than men (6.7%). While the knee prevalence is 12.2% for women (14.9%) higher than for men (8.7%) followed by an increase in age (Ismaningsih, 2018). Meanwhile, the National Centers for Health Statistics estimates that there are 15.8 million (12%) adults between the ages of 25-74 years who have complaints of

osteoarthritis (Kaur et al, 2018). The prevalence of osteoarthritis in Malang Regency and Malang City was found to be 10% and 13.5%. In Central Java, the incidence of osteoarthritis is 5.1% of all residents (Sianturi 2013, in Ridho, (2018).

The prevalence in Indonesia reaches 5% at the age of 40 years, 30% at the age of 40-60 years, and 65% at the age of 61 years (Ismaningsih, 2018). The decrease in the level of joint flexibility at the age of 30-70 years reaches 40-50%, so it is necessary to carry out movement activities in the joints. The goal is to prevent the process of cell degeneration through joint movement and these activities do not cause excessive stress on the muscles for recovery.

Research that has been conducted at the Haji Adam Malik General Hospital found the results, the number of people with osteoarthritis suffered the most at the age of 40-65 years, namely 70.3%, then followed by the age of 16-40 years, which was 16.1% and the lowest was at the age of 16. > 65 years ie 13.6%. More female sufferers, namely 61.9%, in males 38.1%. Then followed by pain for less than one year as many as 56.3% with the main complaint of joint pain as much as 74.3% and those experiencing more than one joint affected by osteoarthritis 27.9%. Semestara Based on data from the Medical Records of TK II Putri Hijau Hospital in Medan, patients with osteoarthritis were hospitalized in 2014 as many as 38 patients, in 2015 as many as 38 patients and in 2016 increased to 40 patients (Rabiatul A. H., 2017).

Osteoarthritis of the knee is the destruction of the joint cartilage that covers the surface of the femur and tibia, this destruction causes cartilage erosion, which then causes problems. Problems that occur due to osteoarthritis of the knee can cause interference with physical capacity. Impaired physical capacities include knee pain, quadriceps and hamstring muscle spasms, limited range of motion (LGS), decreased flexor and extensor muscle strength in the knee joint, difficulty in performing basic functional activities such

as rising from sitting, squatting, standing, kneeling, walking, going up and down stairs, and other activities that put a strain on the knee joint (Indri, et al, 2015).

Functional ability is defined as a person's ability to perform specific tasks related to daily activities. In osteoarthritis, the pathology of the knee joint helps a person to perform his or her functional tasks well. Decreased muscle strength in osteoarthritis has an impact on decreasing the reaction time of these muscles to changes in force. The delay in reaction time will increase the risk of falls in people with osteoarthritis.

The decrease in strength is accompanied by a loss of contraction power that is not synergistic (non-physiological). These non-physiological movements increase excessive stress loading on one of the joint contact surfaces, thereby increasing the progression of the joint degenerative process. People with osteoarthritis will tend to limit leg movements to avoid the pain and discomfort they feel. However, this tends to worsen the situation such as the occurrence of symptoms in the form of muscle wasting or atrophy of the muscles around the knee (Gede, et al, 2017).

Knee functional ability was measured using the Western Ontario And Master Universities Osteoarthritis Index (WOMAC) which was used to assess the condition of patients with osteoarthritis of the knee (Choundary & Kishor, 2013). The knee joint has a very important function, so the management of osteoarthritis in the knee must be optimally managed, by first understanding the complaints caused by the osteoarthritis disease.

Based on a preliminary survey at the Medan Adventist Hospital, it was recorded that the number of physiotherapy patients in 2020 was 2987 patients, while specifically for knee osteoarthritis patients from January to December 2020 as many as 720 patients so that the average patient visits per month were 60 people. Osteoarthritis of the knee is a disease with the second prevalence in Medan Adventist Hospital after low back

pain (LBP). To overcome the problems that arise due to osteoarthritis of the knee joint, open kinetic chain can be given with the aim of increasing functional activity and increasing the range of motion of the knee joint (Ismaningsih, 2018). Open kinetic chain is a form of exercise with a single joint movement, only movement occurs in the distal segment without any movement of the proximal segment.

Research conducted by Bayrak et al, 2009 states that the effect of giving open kinetic chain exercise to patients with knee osteoarthritis can increase muscle strength and functional ability of the knee joint. This is also in line with the research of Verma Sadhana, (2012) regarding the provision of open kinetic chain exercise in patients with osteoarthritis of the knee, showing that open kinetic chain exercise can increase muscle strength and functional knee activity. Open kinetic chain exercise, the movement of the distal limb only occurs in one joint without movement in the proximal segment. For example, open kinetic chain movements, namely swinging the legs when walking, kicking or throwing a ball, swinging hands when walking.

A survey conducted by researchers at the Medan Adventist Hospital by looking at the visit data of OA patients at the physiotherapy polyclinic found problems with functional activity disorders. To treat these patients, the intervention was given by IR, TENS, and TL. However, the intervention has not shown any significant increase or change in the problem of functional activity disorders. Based on the description above, the researchers will conduct research on open kinetic chain exercise techniques to reduce pain intensity and stiffness, as well as increase functional activity in osteoarthritis sufferers at the Medan Adventist Hospital. There are reasons why the researcher took the title, including 1) Physiotherapy interventions in knee OA generally still use physiotherapy modalities of IR, TENS, US, MWD, SWD, and TL, 2) There are no interventions that specifically address functional activity

disorders, 3) Because Therefore, the authors need to examine the action of the open kinetic chain on the patient's functional activity. The purpose of this study was to determine the effect of open kinetic chain in increasing functional activity in patients with knee osteoarthritis at Medan Adventist Hospital in 2021.

MATERIALS & METHODS

This type of research is a type of quantitative research that is quasi-experimental with a one-group pre-test and post-test design approach. Before the intervention was given, the respondent was given a pretest or measurement of functional activity in the knee joint of patients with knee osteoarthritis with WOMAC, then the respondent was given an intervention / treatment. The post test was carried out twice after the third and sixth day of intervention. The design of this study was to measure functional activity with WOMAC before giving an open kinetic chain, then give an open kinetic chain intervention, then measure functional activity with WOMAC after giving an open kinetic chain three times and six times. The sample in this study was knee osteoarthritis patients undergoing therapy in the Physiotherapy room at Medan Adventist Hospital in 2021. The number of samples in this study was determined based on inclusion and exclusion criteria. Based on these criteria, the number of samples in this study was 12 people. The variables in this study are divided into 2, namely: the independent variable (independent variable) namely the open kinetic chain and the dependent variable (the dependent variable) namely functional activity.

The measuring instrument used to measure the ability of functional activities using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The WOMAC index is an index concerning the functional ability of patients that is used to measure patients with knee osteoarthritis. WOMAC is the most sensitive instrument for assessing knee OA

and is widely used in clinical trials. There are 24 parameters with the maximum value of each parameter is 4 (Four). The total value of 96 indicates good functional ability. The higher the value obtained indicates the magnitude of the patient's functional limitations, while the lower value indicates the improvement in functional ability. This research was conducted in January-June 2021.

Statistical Analysis

The data analysis technique used in this research is to use repeated measures ANOVA test which aims to test whether there are factual (significant) differences between various measurement results that are carried out repeatedly on a research variable. This repeated measures anova test is used to test the differences of three or more samples that are paired with each other. The requirement that must be met in the repeated measures ANOVA test is that the standardized residual value for functional measurement data for three measurements is normal. If one of the variables is not normal, then the alternative used is carrying out the Friedman test as a substitute for the repeated measures ANOVA test. The basis for decision making in the normality test with the following conditions:

1. If the value of Sig. <0.05, then the variable is not normally distributed.
2. If the value of Sig. > 0.05, then the variable is normally distributed.

If the data is normally distributed, then it is continued with repeated measures ANOVA test. The basis for decision making in the repeated measures ANOVA test is:

1. If the Greenhouse-Geisser Sig. > 0.05, then H₀ is accepted and H_a is rejected or in other words there is no difference in the average of giving open kinetic chain exercise to the factual (significant) functional improvement from time to time.
2. If the Greenhouse-Geisser Sig. < 0.05, then H₀ is rejected and H_a is accepted or in other words there is a difference in

the average of giving open kinetic chain exercise to a factual (significant) functional increase from time to time.

RESULT

The sample in this study found 12 people suffering from knee osteoarthritis who were eligible to become respondents with the provisions that had been made. The following are the characteristics of the study based on gender, age and body mass index. The characteristics of this research sample can be seen in Table 1.

Table 1. Characteristics of the sample by age, gender and BMI

Characteristics	n	%
Age		
40-46	4	33,0
47-53	5	42,0
54-60	3	25,0
Total	12	100
Gender		
Man	5	42
Women	7	58
Total	12	100
Category IMT		
Weight below normal	0	0
Normal Weight	12	100
Over weight	0	0
Obesity	0	0
Total	12	100%

Based on table 1, the majority of the age group are 47-53 years old, totaling 5 people (42%). while the number of respondents who have a BMI in the normal weight category is 12 people (100%), while there are none (0%).

Table 2. Average Functional Activity Value of Samples before Open Kinetic Chain in Knee Osteoarthritis Patients

WOMAC Scale	Mean	Std Deviation	95 % CI
Pretest	59.417	3.334	52.1 - 66.7
Post Third therapy	47.417	38.955	38.9 - 55.9
Post Sixth therapy	34.833	27.927	27.9 - 41.7

Based on table 2, above explains that the average value of the WOMAC scale felt by the respondents on the first day before the open kinetic chain intervention was 59,417 with SD = 3,334 with the heavy WOMAC scale category. Meanwhile, the mean value of the WOMAC scale felt by respondents in the 3rd intervention with an open kinetic chain was 47,417 with SD = 38,955. And the mean value of the WOMAC scale felt by the respondents in the 6th intervention with an open kinetic

chain was 34,833 with SD = 27,927 with a medium WOMAC scale category.

Table 3. Effect of Open Kinetic Chain Intervention on Respondent's Functional Activities, initial therapy, during 3 times of therapy and 6 times of therapy

Variable	Intervention Open Kinetic Chain					
	1st 3rd therapy		1st 6th therapy		3rd to 6th therapy	
	Mean ± SD	p	Mean ± SD	p	Mean ± SD	p
Functional activity ability	12.000±1.343	0.000	24.583 ± 2.050	0.000	12.583± 1.649	0.000

The 1st intervention to the 3rd intervention, there was an average increase in functional activity of 12,000 with a standard deviation of 1.343 and the increase was significant where the sig. $0.00 < 0.05$. The 1st intervention to the 6th intervention, there was an average increase in functional activity of 24,583 with a standard deviation of 2,050 and the increase was significant where the sig. $0.00 < 0.05$. While the 3rd intervention to the 6th intervention there was an increase in functional activity of 12,583 with a standard deviation of 1,649 and the increase was significant where the value of sig. $0.00 < 0.05$. This means that routinely providing an open kinetic chain intervention can increase the respondent's activity ability by 12,000 within 3 treatments and 24,583 within 6 treatments.

DISCUSSION

Based on the characteristics of the respondents in this study, the majority of respondents aged between 47-53 years were 5 people. Age is a major factor in the decline in the musculoskeletal system, degeneration of the knee joint where there is a decrease in muscle size, muscle mass, and strength.

The decrease in strength occurs with morphological changes in the muscles. In accordance with the progressive loss of body mass or active body tissue that begins at the age of 40 years with a decrease in basal metabolism of 2% per body accompanied by body systems. In addition, aging is a biochemical aspect that is characterized by a reduction in the ability of estrogen receptors in the joints, so that the absorption of important joint minerals is delayed, resulting in a decrease in Glucosaminoglycanus and cell matrix fluid that occurs because it is a large amount of plastic substances as precursors for the

formation of proteoglycans, which are the contents of GAG's. This is what happens causing joint strength where there will be a decrease in flexibility (Frontera et al., 2006).

Based on gender, it is known that the majority of those suffering from osteoarthritis of the knee are women, namely 7 people (58%) and men, as many as 5 people (42%). Women who are more than 50 years old or entering menopause will experience a decrease in hormones, especially estrogen and other physiological functions of the body, while one of the functions of the hormone estrogen is to help the synthesis of bone matrix chondrocytes, and if estrogen decreases, the synthesis of chondrocytes decreases so that the synthesis of proteoglycans and Collagen also decreases while lysosomal activity increases, this is what causes knee osteoarthritis to occur in women (Kasper et al., 2008).

Based on the Body Mass Index (BMI) category, the BMI category of all respondents was in the normal weight category, as many as 12 respondents (100%) with normal body mass index values between 18-24.9. BMI in the normal category is related to adequate nutritional intake with good nutritional status.

Body Mass Index is an excellent indicator to measure past and present nutritional status because weight has a linear relationship with height (Supariasa, 2014). Malnutrition will result in a further decrease in the quality of human resources so that it can result in failure of physical growth, mental and intellectual development, decreased productivity, increased morbidity and mortality (Notoatmodjo, 2012).

The results of this study indicate that there is a significant effect of open kinetic chain exercise in increasing the functional

activity of the knee joint in knee osteoarthritis patients before and after being given open kinetic chain intervention for three treatments and six times therapy in knee osteoarthritis patients at the Medan Adventist Hospital. This is evidenced by the good results of the open kinetic chain intervention.

The Open Kinetic Chain (OKC) exercise technique is an active movement exercise that involves only one muscle and joint (single joint) and without movement in its proximal segment. Open Kinetic Chain (OKC) exercise on the network, namely changing the local environment in irregular matrix fibers through slow inter-joint motion which will stimulate mechano growth factors due to an increase in lubrication as a condition for increasing the amount of plastin substances, plastin substances as precursors to stimulating glucosaminoglycans (GAG's).).

This plastin substance functions as a substitute for new tissue consisting of protein amino acids which will be synthesized by facilitating slow motion which will break down deposits and form new distances to regulate collagen synthesis, which aims to reduce abnormal adhesive formation (stiffness).

Through an increase in contractile protein and the oxidation system in the quadriceps and hamstring muscles, marked by an increase in the oxygen supply to the muscles as the beginning of an increase in metabolism and tissue repair with the production of new tissue and repair of cartilage, it will increase the Range of Motion (ROM) of the knee joint. Susilawati et al., 2015).

Open kinetic chain exercise is very useful for training the muscles of the lower limbs, especially to increase functional activity. The effect of open kinetic chain exercise on connective tissue, namely changing the local environment in irregular matrix fibers through slow inter-joint motion which will stimulate mechano growth factors due to an increase in lubrication as a condition for increasing the

amount of plastin substance, plastin as a stimulant for GAG's has an important role in forming The new GAG's, which occur through increased contractile and oxidative muscle tone, are responsible for the reduction in abnormal adhesive formation (stiffness) in the knee joint.

This is what ultimately causes an increase in functional activity in patients with knee osteoarthritis by increasing muscle strength and flexibility, so that the achievement of the value of the joint range of motion and increased muscle strength helps in the movement of body functions in activities (Mayer et al., 2003). The limitations of this study include 1) the time of the study was carried out only within 2 weeks with a frequency of 3 times a week, so it could not maximally assess the effect of the open kinetic chain in increasing the patient's functional activity, 2) The number of research samples was only 12 people, 3) Samples this study only used one intervention group and did not use a control group, so it could not compare the effect of this intervention on the sample given the intervention and the sample not given the intervention.

Based on the results obtained in this study, the clinical implications of open kinetic chain intervention can be a solution in overcoming impaired functional activity of the knee joint in patients with knee osteoarthritis. The open kinetic chain exercise method can increase the functional activity of the knee. The accuracy and speed of intervention will accelerate the process of increasing the patient's functional activity. Open kinetic chain can be used as a method that can be used to overcome functional activity disorders of the patient's knee joint.

CONCLUSION

The conclusion of this study is that there is an effect of open kinetic chain exercise on increasing the functional activity of the knee joint in osteoarthritis patients at the Medan Adventist Hospital. This is indicated by the data at the time after the intervention, the average increase in the

patient's functional activity was 12% within 3 treatments and 24% within 6 treatments.

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