



Effectiveness of Closed Kinetic Chain to Improve Functional Ability in Knee Osteoarthritis

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Abstract: This article evaluates the effectiveness of closed kinetic chains to improve functional ability in knee osteoarthritis in a narrative form of literature. Knee osteoarthritis is chronic inflammation in the knee joint due to damage of the knee joint cartilage. This condition causes limitations in carrying out daily activities and decreases functional abilities. The intervention used is closed kinetic chain. Closed kinetic chain is an exercise with the distal extremity stationary or not moving. In this study, 13 articles were found which were then filtered and re-selected, and 9 articles were found that matched. Furthermore, further screening was carried out and the final results of the selection were 5 articles. This article aims to determine the effectiveness of closed kinetic chain exercises in increasing functional abilities in knee osteoarthritis patients and to find out the methods and doses for increasing functional abilities in knee osteoarthritis patients. The results found an increase in functional ability by using closed kinetic chain exercises, such as mini squats, lunges, quadricep settings and side step ups. The conclusion of this article is that closed kinetic chain exercises are effective in increasing functional ability in patients with knee osteoarthritis.

Keywords: Knee osteoarthritis, closed kinetic chain, Functional ability

1 Introduction

The knee joint is one of the joints of the body that functions to support the movement of the legs and support body weight. Excess weight and lack of activity can cause greater weight in the knees. In addition, age can also worsen the situation due to hormonal changes that can trigger speed in the process of degeneration of human joint structures. One of the complaints in the knee is osteoarthritis which is a degenerative disease whose causes are multifactorial. Degenerative diseases are diseases that arise as a result of the process of deterioration of body cell function from normal to worse conditions or the level of cell activity in the body that decreases and is chronic progressive. The female sex is also potentially greater than men to get this disease.

Osteoarthritis (OA) is a chronic joint disease characterized by abnormalities in cartilage and subchondral sclerosis based on biomechanical and metabolic factors (Maulana, 2021).

The cartilage itself is the part of the joint that lines the ends of the bones, to facilitate joint movement. Based on the cause, osteoarthritis is classified into two, namely primary and secondary. Primary osteoarthritis is produced by joint degeneration without an obvious cause or caused by age (wear and tear) while secondary osteoarthritis is produced by cartilage degeneration caused by certain causes such as obesity, joint hypermobility, malposition, history of injury, congenital, and other metabolic causes (Maulana, 2021) . This disease usually attacks the joints, including the joints of the hands, neck, back, waist, and most often is the knee joint. Osteoarthritis of the knee is one of the most common causes of knee pain and is so influential on physical function and quality of life that it can even cause psychological distress for sufferers. Osteoarthritis of the knee takes the greatest number of diseases that patients suffer from (Nabilla, 2010). The prevalence of osteoarthritis of the knee in Indonesia is quite high, It was recorded 15.5% in men and 12.7% in women from all sufferers. The results of Riskesdas in 2018 showed that joint disease occurred highest at the age of >75 years by 18.9%, ages 65-74 by 18.6%, and ages 55-64 by 15.5%. This shows that women (8.5%) are more susceptible than men (6.1%) to joint diseases (Nabilla, 2010).

The most common symptom of osteoarthritis of the knee is pain around the knee. The pain can be dull, sharp, constant and disappear. Pain can vary from mild to severe. Pain in osteoarthritis can cause limited joint scope of motion (LGS) in the knee joint. Crepitation sounds in joints, muscle weakness, swelling and joint stiffness are also examples of the most common symptoms (Maulana, 2021). That symptom causes limitations of functional ability in patients. Functional ability can be interpreted as a person's ability to perform specific tasks related to daily activities. In this case, knee joint pathology causes a person's limitation to carry out his or her functional tasks properly, such as getting up from sitting, squatting, standing, kneeling, walking, going up and down stairs, and other activities that are burdensome to the knee joint and require weight loss. Some patients also complain of difficulties during worship at home or in places of worship and defecation. The goal of physiotherapy in cases of osteoarthritis of the knee is to increase the functional activity of the muscles around the knee and help restore motion and functional to the patient. To overcome problematic therapies used, among others, modality therapy and exercise therapy. For exercise therapy in physiotherapy can provide benefits in terms of reducing knee pain and muscle spasms and increasing range of motion (ROM), muscle strength and functional ability in patients with osteoarthritis of the knee. The exercise therapy in question is a closed kinetic chain that functions as an increase in functional abilities.

Closed kinetic chain exercises can increase functional activity in patients with osteoarthritis of the knee, increase proprioceptive excitability in the knee joint, so that joint stability increases, pain in the knee joint is reduced, besides that by increasing stability can improve coordination of motion in the joints (Utary, 2020). Closed kinetic chain exercise is very useful for training the muscles of the lower limbs. Because in principle closed kinetic chain exercises are exercises that strengthen agonist and

antagonist muscles simultaneously which is a more physiological exercise for the lower limbs, and the role of each muscle itself is for the quadriceps muscle to act as the main muscle in maintaining active stabilization of the knee joint and as an agonist muscle in extension movements used in walking activities, Run, jump and so on. While the hamstring muscle as an antagonist muscle in extension motion. For knee flexion movements, the muscles that act as agonists are hamstring muscles and antagonists, namely quadriceps muscles.

In this study, the author will make a synthesis of articles of thought or research results starting with analyzing articles that are relevant to the topic to be reviewed by discussing / reviewing articles by making identification and classification based on the elements to be reviewed from several articles that discuss almost the same topic. Based on this background, the author raised and discussed the article entitled "The effectiveness of closed kinetic chain exercises in Osteoarthritis Knee patients to improve functional ability".

The purpose of this article is to determine the effectiveness of closed kinetic chain exercises in improving functional ability in knee osteoarthritis and to know the dosage and methods of increasing functional ability in knee osteoarthritis.

2 Method

This article is done by the authors with a literature review by collecting articles from the internet that are in accordance with the case raised. Evidence search is carried out on various databases that can be accessed online.

An online literature search was conducted using Medline, Proquest, Scopus, and Google Scholar databases. Searching for articles using the keywords "Osteoarthritis knee" OR "Osteoarthritis genu" AND "Closed kinetic chain" AND "Functional ability" OR "Quality of life" yielded 765 articles. The research articles were then screened for titles and abstracts, researchers found 13 articles. Feasibility assessment there are 9 articles, articles published and articles that do not meet the inclusion criteria are excluded. So that 5 journals were synthesized.

3 Results and discussion

Result. This literature review included five articles that met the inclusion requirements described in the research method. The following are the results of each study discussed. Can be seen in table 1.

Table 1. Result

Studies	Sampel	Age	Diagnosis	Intervention	Dose	Outcome Measure
Djawas F. A dan Isna W. F (Djawas & Isna, 2020)	T : 1 I : 1 C : 0	72 Year	OA Knee	Closed Kinetic Chain dan MWD	Frequency 1x/day, intensity 3x repetitions, 6 minutes. Exercise is done 2x/week.	WOMAC, VAS, MMT, ROM
Meenakshi, Apparao, Swamy, Chaturvedhi and Mounika (C, Meenakshi, 2021)	T : 68 I : 34 C : 34	40-75 Year	OA Knee grade 1 and 2	Closed Kinetic Chain and Pillates Exercise	6 weeks, 3x/week	WOMAC, VAS, (HHD)
Khairuruzal, Irianto dan Y. Ramba (Khairurizal, Irianto, 2019)	T : 26 I : 13 C : 13	40-75 Year	OA Knee	Hold relax exercise with Closed Kinetic Chain and hold relax and Open Kinetic Chain Exercise	3x/week for 3 weeks	WOMAC
Nahayatbin Mona,et.al. (Nahayatbin et al., 2018)	T : 48 I : 32 C : 16	45-65 Year	OA Knee grade 2 and 3	Tai Chi Exercise with Physiotherapy, Closed kinetic chain with Physiotherapy and only doing physiotherapy	Performed for 20 minutes Evaluation at Session 1, Session 6, Session 12 and one month after treatment	KOOS, six minute walking test
L, Sri Saadiyah	T : 32 I : 16	< 65 Year	OA Knee grade 2	MWD with Open-	Duration of	Stair Climbing Test

dan Sudaryanto (L. & Sudaryanto, 2018)	C : 16	and 3	Closed Kinetic Chain and MWD with concentric resistance training	contractio ns 8-10 seconds, repetition of the movement 10x, the treatments 10x.
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*T = Total Participants, I = Intervention Group, C = Control Group, WOMAC: Western Ontario and McMaster Universities Arthritis, VAS: Visual Analog Scale, MMT: Manual Muscle Testing, ROM: Range Of Motion, HDD: Hand Held Dynamometer, KOOS: Knee injury and Osteoarthritis outcome score.

Effectivness of closed kinetic chain in osteoarthritis of the knee. Based on five reviewed journals, it can be seen that the administration of closed kinetic chain can improve functional ability in patients with osteoarthritis of the knee. In Meenakshi's study, et.al (C, Meenakshi, 2021), as many as 68 participants were divided into 2 groups, namely group A with Pilates exercises (N = 34) and group B with Closed kinetic chain exercises (N = 34) with measurement parameters used to assess functional ability in the form of Ontario Wastern and McMaster Universities Osteoarthritis Index (WOMAC) along with other parameters such as Visual Analog Scale (VAS) and Hand Held Dynamometer (HHD). The intervention was carried out for 6 weeks, 3 times per week with a one-week evaluation. The results showed that in group A there was an increase in functional ability as measured by WOMAC experiencing a significant increase $p < 0.0002$. While in group B $p < 0.0001$. This shows that group A with pilates exercises experienced a significant improvement compared to group B with closed kinetic chain exercises. So in both groups statistically in pain reduction, increased muscle strength, and functional performance. However, more percentage increases were found in group A than in group B.

The second study was conducted by Khairuruizal, Irianto, Yonathan Ramba (Khairurizal, Irianto, 2019), with a sample of 26 people and divided into 2 groups. Group A with a combination of hold relax and open kinetic chain exercises (N=13), group B with a combination of hold relax and closed kinetic chain exercises (N=13) with the same parameters to assess functional ability, namely with WOMAC. The results showed that there was a significant difference in effect ($p < 0.05$) between group A exercise, a combination of hold relax and open kinetic chain exercises with group B exercise, a combination of hold relax and closed kinetic chain exercises on improving the functional ability of knee osteoarthritis patients.

Further research was conducted by Nahayatbin Mona, et.al. (Nahayatbin et al., 2018), with 48 participants divided into 3 groups, group A with CKCE and routine to physiotherapy (N = 16), group B with TCE and routine to physiotherapy (N = 16) and group C only with routine to physiotherapy (N = 16) carried out for one month. Results showed that the exercises performed by all three groups had equally effective results for improving QOL. But the effect of the TCE group (29.44) was greater than that of the CKCE group (22.07) and the CKCE group was larger than the group in the absence of exercise (8.44).

Then the research of Saadiyah Sri and Sudaryanto (L. & Sudaryanto, 2018) uses stair climbing as a tool to measure ability. A total of 32 participants were divided into group A (N=16) with MWD intervention and cocentric resistance exercise and group B with MWD and open-closed kinetic chain stabilization exercise (N=16). Results showed that MWD intervention and Open-closed kinetic chain stabilization exercise were not significantly more effective than MWD and cocentric exercise on changes in stair climbing test ability in patients with osteoarthritis of the knee.

According to research by Djawas.F.A and Isna.W.R (Djawas & Isna, 2020) with a sample A 72-year-old woman diagnosed with knee OA was given exercise therapy with the CKCE method, mini squatt movements, QSE, and step up and step down. The dose of exercise used in each movement is a frequency of 1x a day, intensity 3x reps, with a duration of 6 minutes. Exercise is done 2 times / week. This study used WOMAC parameters to measure the level of functional ability. In addition, there is also a Visual Analog Scale (VAS), a measurement of joint scope of motion and muscle strength. This study was evaluated 4 times in 2 weeks. For pain assessment, a significant reduction in pain was found. Then an increase in the scope of motion of the joint slowly rises. Muscle strength in the fourth eval rises. Then the WOMAC value itself from evaluation 1 to 4 underwent significant changes. WOMAC score on evaluation 1 score 37, evaluation 2 WOMAC score 34, evaluation 3 WOMAC score 31 and evaluation 4 WOMAC score to 26. In this case, it proves that the smaller the score obtained by the patient, the better the patient's condition. So, there is an increase in the functional activity of the patient. It can be concluded that the closed kinetic chain exercise (CKCE) exercise therapy method is considered effective in improving functional ability in knee osteoarthritis (OA) patients assessed using WOMAC parameters.

Based on the five articles included in the inclusion criteria, the use of Closed Kinetic Chain is effective in improving functional capabilities. CKC movement involves several muscle groups and joints where there will be a more even distribution of load so that it will activate the surrounding muscles simultaneously resulting in size pain, increased muscle strength and joint scope of motion, increasing stability, propioceptive and balance.

With good flexibility and muscle strength will support functional ability in patients with osteoarthritis of the knee (Khairurizal, Irianto, 2019).

Comparison with other intervention. Of the five articles above, there are four articles that use comparative interventions in the case of patients with osteoarthritis of the knee to determine the effectiveness of closed kinetic chain on improving functional ability. In Meenakshi's study, et.al (C, Meenakshi, 2021), which compared pillates and closed kinetic chain interventions. In this study it was stated that the results of the research analysis showed greater improvement in the group with pillates than in the closed kinetic chain intervention group in all measurements both from pain measurement, strength measurement and functional ability.

Meticulous research by Khairuruizal, Irianto, Yonathan Ramba (Khairurizal, Irianto, 2019) comparing hold relax and open kinetic chain interventions with hold relax and closed kinetic chains. Researchers say that both exercises are very influential but exercises with closed kinetic chains are more influential because closed kinetic chain motion techniques are motion exercises that are in accordance with the anatomical field of the knee joint, namely extension flexion movements and movements aimed at carrying out daily activities such as squatting, squatting to standing and toileting. The existence of flexibility and good muscle strength will support the ability to move in carrying out daily activities.

Nahayatbin Mona, et.al. (Nahayatbin et al., 2018), conducted a study by comparing tai chi exercises, closed kinetic chain and groups without exercise. The results obtained from this study are that the exercises performed have equally effective results to increase QOL. But the effect of the TCE group (29.44) was greater than that of the CKCE group (22.07) and the CKCE group was larger than the group in the absence of exercise (8.44).

Then the research of Saadiyah Sri and Sudaryanto (L. & Sudaryanto, 2018) uses stair climbing as a tool to measure ability. The result of this study is that both groups have changed. But the MWD group with open-closed kinetic chains was no more effective than the MWD group with cocentric resistance exercises.

4 Conclusion

From five articles that have been reviewed, the provision of closed kinetic chain exercises can improve functional ability in osteoarthritis of the knee. Because closed kinetic chain exercises have movements that are in accordance with the anatomical field of the knee joint, namely flexion and extension movements which are often used in daily activities such as squatting, standing, running, going up and down stairs and toileting. With good

flexibility and muscle strength will support functional ability (Khairurizal, Irianto, 2019). In addition to Closed kinetic chain exercises there are several more effective exercises such as Pillates, cocentric resistance exercises and Tai Chi Exercise

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