JMCH Journal of Maternal and Child Health (2024), 09(01): 120-127
Masters Program in Public Health, Universitas Sebelas Maret

Research
Open Access

Effect of Closed Kinetic Chain Exercise to Reduce Pain and Increase Functional Ability in Patient with Osteoarthritis Genu

Siti Fadhilah, Agus Widodo

Department of Fisioterapi, Faculty of Health Science, Universitas Muhammadiyah Surakarta

Received: 30 August 2023; Accepted: 14 December 2023; Available online: 16 January2024

ABSTRACT

Background: Osteoarthritis genu is a degenerative disease with symptoms of chronic inflammation of the joint cartilage which causes pain, limited movement and function. Closed kinetic chain exercise is an active movement that involves many joints and muscle groups simultaneously. This study aims to analyze the effect of closed kinetic chain exercise on reducing pain and increasing functional ability in osteoarthritis genu.
Subjects and Method: A quasi experimental study was conducted at dr. Soedjono Army Hospital, in Magelang, Central Java, from May to June 2023. A total of 20 osteoarthritis genu patients were divided into two groups: (1) The intervention group was given closed kinetic chain exercise and (2) The control group was given conventional physiotherapy. Pain level was measured using the Visual Analog Scale (VAS). Functional ability was measured by the Western Ontario and McMaster Osteoarthritis Index (WOMAC). Mean differences between the closed kinetic chain exercise group and the conventional physiotherapy group were analyzed using the independent t-test.
Results: Closed kinetic chain exercise is effective in reducing immobilization pain (Effect Size= 1.20; p= 0.014), pressure pain (Effect Size= 0.99; p= 0.004), movement pain (Effect Size= 1.37; p= 0.023), and increasing functional ability in osteoarthritis genu patients (Effect Size= 0.10; p= 0.023).
Conclusion: Providing closed kinetic chain exercise can reduce pain and increase functional ability in osteoarthritis genu.

Keywords: closed kinetic chain exercise, pain, functional ability, osteoarthritis genu

Correspondence:
Siti Fadhilah. Department of Physiotherapy, Faculty of Health Sciences, Universitas Muhammadiyah Surakarta. Jl. A. Yani, Pabelan, Kartasura, SukoharjoCentral Java 57169 Indonesia. Email: j120221270@student.ums.ac.id. Mobile: 081267705503.

Cite this as:
Fadhilah S, Widodo A (2024). Effect of Closed Kinetic Chain Exercise to Reduce Pain and Increase Functional Ability in Patient with Osteoarthritis Genu. *J Matern Child Health*. 09(01): 120-127. https://doi.org/10.26911/thejmch.2024.09.01.12.

BACKGROUND

Osteoarthritis is degenerative arthritis due to damage to cartilage, thickening of subchondral bone, formation of osteophytes and a mild inflammatory process in the nonspecific synovium (Putri et al., 2022). Osteoarthritis is caused by acute, chronic injury or repeated use, causing joint "wear and tear" (Pratama, 2019). Osteoarthritis is divided into primary and secondary osteoarthritis. Primary osteoarthritis is caused by increasing age, genetics, repetitive use of

joints and obesity. Meanwhile, secondary osteoarthritis is caused by deformity or trauma (Zaki, 2013).

According to WHO, the prevalence of osteoarthritis in the world is 9.6% in men and 18% in women over 60 years. In Indonesia, 5% of osteoarthritis sufferers are aged 61 years, with a prevalence of 15.5% for men and 12.7% for women out of a total of 255 million people (Jamaludin & Widodo, 2021).

A common symptom experienced by osteoarthritis patients is joint pain (Pratiwi et al., 2021). Pain can reduce quadriceps muscle strength by around 15-20% (Purnama et al., 2018). This also causes impaired functional abilities in knee osteoarthritis patients (Herman et al., 2021). If not treated immediately, the ability to carry out daily activities such as walking, squatting and bathing will be greatly impaired due to pain in the knee joint (Rohmadhani et al., 2022).

One of the roles of physiotherapy is to provide exercises to increase the quadriceps muscles in the form of closed kinematic chain exercises (Purnama et al., 2018). Closed kinetic chain exercise is an active movement in a fixed position of the lower body, such as the soles of the feet on the ground, which involves the coordination of several muscle groups, especially the quadriceps and joints, to improve joint stability and activate proprioception of the soles of the feet. The movements are like functional movements in daily activities (Djawas and Isna, 2020). This movement functions to train the muscles of the lower body, especially improving functional ability in osteoarthritis genu. This is because this movement can simultaneously strengthen agonist and antagonist muscles (Khairuruizal et al., 2019).

From this background, the aim of this study is to see whether closed kinetic chain exercise can reduce pain and improve functional ability in osteoarthritis genu.

SUBJECTS AND METHOD

1. Study Design

This was a quasi-experimental study conducted at dr. Soedjono Army Hospital, Magelang, from May to June 2023.

2. Population and Sample

The population and samples taken in this study were all genu osteoarthritis sufferers at RST dr. Soedjono Magelang since the last 3 months. A sample of 26 genu OA was selected for this study purposively. They were divided into two groups. After being given therapy 3 times a week, 6 people dropped out. 20 participants were included for analysis.

3. Study Variables

The dependent variables were pain and functional ability. The independent variable was closed kinetic chain exercise

4. Operational Definition of Variables

Closed kinetic chain exercise is a weight bearing exercise that uses more than one joint to move based on body weight. Closed kinetic chain exercises provided, namely wall slides, step ups and step downs. Wall slides are in a standing position, with your back against the wall with your hips and knees flexed 60^0 as if you are preparing to sit. Step up and step down is by using a wooden box or board 5 cm high. Closed kinetic chain exercise is given 3 times per week for 2 weeks with an intensity of 2 sets of 10 repetitions and a rest time of 8 seconds. This type of exercise is isotonic exercise.

Pain is pain that is associated with tissue damage or that can cause tissue damage. Pain assessment uses the VAS measurement tool. The tool used is the Visual Analogue Scale (VAS), the measurement scale is the Ordinal scale and the interpretation is 0 for no pain/normal, 1-3 for mild pain, 4-6 for moderate pain, 7-9 for severe pain and A score of 10 is unbearable pain.

Functional abilities are the physical abilities possessed by all people in carrying out

activities in their daily lives. Functional ability assessment uses the WOMAC measuring instrument. The tool used is the Western Ontario and McMaster Osteoarthritis Index (WOMAC), the measurement scale is an ordinal scale, the total score interpretation is 0-24, namely mild, 25-48, namely moderate, 49-72, namely severe and 73-96, namely very severe.

5. Study Instruments

instrument used to measure pain uses the Visual Analogue Scale (VAS) measuring The tool, which is then recorded on the observation sheet. In addition, functional ability was measured through the WOMAC questionnaire.

6. Data analysis

Data were analyzed using the Shapiro-Wilk normality test, the influence test with the paired sample t-test, and the difference test with the independent sample t test.

7. Research Ethics

Ethics in this study, namely an ethical permission letter, as well as informed consent which is signed and is confidential during the research. Eric's permission letter for this study was obtained from the Research Ethics Committee of Tk Hospital. II 04.05.-01 dr. Soedjono, Magelang, Indonesia, No. 90/EC/VI/2023.

RESULTS

1. Sample Characteristics

Table 1 shows that the majority of ages were 51-60 years (50%) in the treatment group and 71-80 years (50%) in the control group. The majority of subjects were women, 7 (70%) in the treatment and control groups. The highest BMI in the treatment group was 7 people (normal) and the control group was 8 people (overweight).

Table 1. Distribution of respondent characteristics

Characteristics	Control Group		Treatment group	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Age (year)				
41-50	1	10	2	20
51-60	3	30	5	50
61-70	1	10	3	30
71-80	5	50	0	0
Gender				
Male	3	30	3	30
Female	7	70	7	70
BMI				
Normal	2	20	7	70
Overweight	8	80	3	30

2. Bivariate Analysis

Table 2 shows that the closed kinetic chain exercise intervention is effective in reducing silent pain with a large effect size (Effect Size= 1.20 > 0.80), tender pain with a large effect size (Effect Size= 0.99 > 0.80), and movement pain with a large effect size. large (Effect Size= 1.37 >0.80) in patients with osteoarthritis genu.

Based on Table 2, it shows that there is a difference in the mean level of pain before and after the intervention in the closed kinetic chain exercise group and the conventional physiotherapy intervention group. Before the intervention, the average value of silent pain in the closed kinetic chain exercise group was higher (Mean= 3.19; SD= 0.47) than in the conventional physiotherapy intervention group (Mean= 2.97;

SD= 0.72). After the intervention, the average value of silent pain in the closed kinetic chain exercise group was lower (Mean= 0.80; SD= 0.60) than in the conventional physiotherapy intervention group (Mean= 1.44; SD= 0.46) and the results were statistically significant (p = 0.014) .

Before the intervention, the average pressure pain score in the closed kinetic chain exercise group was higher (Mean= 3.78; SD= 0.71) than the conventional physiotherapy intervention group (Mean= 3.62; SD= 0.50). After the intervention, the average pressure pain score in the closed kinetic chain exercise group was lower (Mean= 1.19; SD= 0.75) than the conventional physiotherapy intervention group (Mean= 1.93; SD= 0.74) and the results were statistically significant (p = 0.040) .

Before the intervention, the average movement pain score in the closed kinetic chain exercise group was higher (Mean= 5.48; SD= 0.76) than in the conventional physiotherapy intervention group (Mean= 5.37; SD= 0.85). After the intervention, the average movement pain score in the closed kinetic chain exercise group was lower (Mean= 2.75; SD= 0.75) than the conventional physiotherapy intervention group (Mean= 3.73; SD= 0.68) and the results were statistically significant (p = 0.007) .

Table 2. Effect of closed kinetic chain exercise to reduce pain in osteoarthritis genu sufferers

Pain	N	Mean	SD	Effect Size	p
Immobilization pain					
Pre Intervention					
Intervention	10	3.19	0.47		0.428
Control	10	2.97	0.72		
Post Intervensi					
Intervention	10	0.80	0.60	1.20	0.014
Control	10	1.44	0.46		
Pressure Pain					
Pre Intervensi					
Intervention	10	3.78	0.71		0.567
Control	10	3.62	0.50		
Post Intervensi					
Intervention	10	1.19	0.75	0.99	0.040
Control	10	1.93	0.74		
Movement Pain					
Pre Intervensi					
Intervention	10	5.48	0.76		0.764
Control	10	5.37	0.85		
Post Intervensi					
Intervention	10	2.75	0.75	1.37	0.007
Control	10	3.73	0.68		

Based on Table 3, it shows that the closed kinetic chain exercise intervention is effective in improving functional abilities with a large effect size (Effect Size= 1.10 > 0.80) in people with osteoarthritis genu.

Based on Table 3, it shows that there is a difference in the mean level of functional ability before and after the intervention in the closed kinetic chain exercise group and the conventional physiotherapy intervention group. Before the intervention, the average

functional ability score in the closed kinetic chain exercise group was higher (Mean= 46.70; SD= 9.52) than the conventional physiotherapy intervention group (Mean= 43.20; SD= 10.02). After the intervention, the average functional ability score in the closed kinetic chain exercise group was lower (Mean= 20.20; SD= 6.37) than the conventional physiotherapy intervention group (Mean=27.20; SD= 6.25) and the results were statistically significant (p = 0.023).

Table 3. Effect of Closed Kinetic Chain Exercise to Improve Functional Ability in Osteoarthritis Genus Sufferers

Functional Capabilities	N	Mean	SD	Effect Size	p
Pre Intervensi					
Intervention	10	46.70	9.52		0.434
Control	10	43.20	10.02		
Post Intervensi					
Intervention	10	20.20	6.37	1.10	0.023
Control	10	27.20	6.25		

DISCUSSION

Osteoarthritis genu is a chronic joint disease characterized by friction between bones. This causes stiffness, pain and deformity. In addition, genu osteoarthritis can cause interference with daily activities (Susanti and Wahyuningrum, 2021).

Age, gender and BMI are several risk factors that can cause osteoarthritis genu. Based on the results of this study, most of the sufferers were over 51 years old. This study is in line with research by Putri RAASH and colleagues, namely that the majority of genu osteoarthritis cases were aged between 50-80 years (Putri et al., 2022). The biggest risk factor that can cause osteoarthritis genu is age. Based on the results of this study, it is known that the majority of women experience genu osteoarthritis because women are in the menopausal phase (Nikmah et al., 2023). This study is in line with research by Rumajar HE and colleagues who stated that in women there is estrogen deficiency after menopause and a decrease in muscle strength (Rumajar et al., 2020). Based on the results of this study, the majority of genu osteoarthritis sufferers are overweight with a percentage of 80%. This study is in line with research by Mutiwara E and colleagues, that 88.9% of obese patients based on BMI measurements have OA (Mutiwara et al., 2016).

According to research conducted by Widodo and colleagues, pain in genu osteoarthritis originates from increased excitation of nociceptive neurons from inflammatory mediators produced by the synovium and subchondral bone (Widodo et al., 2022). This pain causes the muscles around the knee to spasm and become weak so that sufferers tend to be reluctant to move their joints (hypomobile) (Suriani and Lesmana, 2013). People who experience osteoarthritis will complain of pain which can affect their function (Astuti et al., 2021).

Closed kinetic chain exercise is an active movement exercise that can strengthen the muscles around the knee because basically this exercise teaches the muscles to control concentrically and eccentrically. This study is in line with research by Susilawati and colleagues, that closed kinetic chain exercise is an active movement exercise that is safe for people with osteoarthritis genu (Susilawati et al., 2015). This exercise involves many joints, and activates and trains the muscles of the lower extremities to produce functional movements (Kisner and Colby,

2012). This movement helps the muscles stabilize the joints better, thereby improving the quality of movement and being synergistic with normal movement stages (Wuryaningsih et al., 2022). The principle of loading in weight bearing conditions involves knee flexion-extension and slight rotation, resulting in a change in length and muscle strengthening simultaneously which has an active stabilizing impact, so that pain can decrease and is followed by an increase in the functional ability of the knee.

Based on the research results, there is an effect of closed kinetic chain exercise on reducing pain and increasing functional ability in osteoarthritis genu.

AUTHOR CONTRIBUTION

This study is self-funded.

ACKNOWLEDGMENT

Researchers would like to thank Dr Soedjono Magelang Hospital.

FUNDING AND SPONSORSHIP

This study is self-funded.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

REFERENCE

Astuti ABS, Halimah N, Wardoyo P, Pradita A (2021). Pengaruh open kinetic chain exercise terhadap peningkatan kemampuan fungsional pada kondisi osteoarthritis knee di RSUD Gambiran Kota Kediri (The effect of open kinetic chain exercise on increasing functional ability in osteoarthritis knee conditions at Gambiran Regional Hospital, Kediri City). Jurnal Penelitian Kesehatan Suara Forikes. 12: 164–167.

Djawas FA, Isna WR (2020). Closed kinetic chain exercise efektif dalam meningkatkan kemampuan fungsional pada osteoartritis lutut. Jurnal Ilmiah Fisioterapi. 3(2): 1–7. doi: https://doi.org-/10.36341/jif.v3i2.1379

Herman A, Thalib S, Sunarti S (2021). Efektifitas closed kinetic chain exercise terhadap peningkatan kekuatan fungsional pada penderita osteoarthritis knee. Jurnal Ilmiah Kesehatan Sandi Husada. 10(2): 671–675. doi: https://-doi.org/10.35816/jiskh.v10i2.671

Jamaludin U, Widodo A (2021). Pengaruh pemberian terapi mobilisasi belt terhadap penurunan nyeri pada Osteoarthritis (OA) knee kronis di RSU 'Aisyiyah Ponorogo (The effect of providing belt mobilization therapy on reducing pain in chronic knee osteoarthritis (OA) at RSU 'Aisyiyah Ponorogo). FISIO MU. 2(1): 23–29. doi: https://doi.org/10.23917/fisiomu.v2i1.12927

Khairuruizal, Irianto, Ramba Y (2019). Perbandingan pengaruh kombinasi latihan hold relax dan open kinetic chain dengan latihan hold relax dan close kinetic chain terhadap penigkatan kemampuan fungsional pasien osteoartritis knee (Comparison of the effect of a combination of hold relax and open kinetic chain exercises with hold relax and close kinetic chain exercises on increasing the functional ability of osteoarthritis knee patients). Nusantara Medical Science Journal. 4(2): 55–63. doi: https://doi.org/10.20956-/nmsj.v4i2.6564 Abstract

Kisner C, Colby LA (2012). Therapeutic exercise: foundations and techniques (Sixth Edit). F. A. Davis Company.

Mutiwara E, Najirman, Afriwardi (2016). Hubungan indeks massa tubuh dengan derajat kerusakan sendi pada pasien osteoartritis lutut di RSUP Dr. M. Djamil Padang (The relationship between body mass index and the

degree of joint damage in knee osteoarthritis patients at RSUP Dr. M. Djamil Padang). Jurnal Kesehatan Andalas. 5(2): 376–380. doi: https://-doi.org/https://doi.org/10.25077/-jka.v5i2.525

Nikmah BK, Fariz A, Kusuma WT, Sartoyo (2023). Pengaruh latihan isometric quadriceps terhadap penurunan nyeri lutut pada pasien osteoarthritis knee bilateral di RS Wava Husada Kepanjen (The effect of isometric quadriceps training on reducing knee pain in bilateral knee osteoarthritis patients at Wava Husada Kepanjen Hospital). Jurnal Keperawatan Muhammadiyah. 8(1): 73–78. doi: https://doi.org/10.-30651/jkm.v8i1.16075

Pratama AD (2019). Intervensi fisioterapi pada kasus osteoarthritis genu Di RSPAD Gatot Soebroto (Physiotherapy intervention in cases of osteoarthritis genu at RSPAD Gatot Soebroto). Jurnal Sosial Humaniora Terapan. 1(2): 21–34. doi: https://-scholarhub.ui.ac.id/jsht/vol1/iss2/5/

Pratiwi A, Muhlisin A, Rahayu UB (2021). Terapi psikososial pada osteoartritis di komunitas (Psychosocial therapy for osteoarthritis in the community). Aksiologiya: Jurnal Pengabdian Kepada Masyarakat. 5(3): 367–380. doi: https://doi.org/10.30651/aks.v5i3.-3637

Purnama NMD, Andayani N, Wahyuni N, Sugiritama IW (2018). Intervensi ultrasound dan closed kinematic chain exercise lebih efektif daripada intervensi ultrasound dan open kinematic chain exercise dalam menurunkan nyeri pada pasien osteoarthritis lutut dengan skor nyeri 8-20 di daerah Bandung (Ultrasound intervention and closed kinematic chain exercise are more effective than ultrasound intervention and open kinematic chain exercise in reducing pain in knee osteoarthritis patients with a pain score of 8-20 in the Bandung area). Majalah Ilmiah Fisioterapi Indonesia. 5(1): 5–8. doi:https://doi.org/10.24-843/MIFI.2017.v05.i01.p02

Putri RAASH, Ilmiawan MI, Darmawan (2022). Faktor-faktor yang berhubungan dengan kejadian osteoarthritis lutut pada petani di Desa Bhakti Mulya Kecamatan Bengkayang (Factors associated with the incidence of knee osteoarthritis in farmers in Bhakti Mulya Village, Bengkayang District). Jurnal Kedokteran Dan Kesehatan. 18(1): 1–15. https://doi.org/10.24853-/jkk.18.1.1-15

Rohmadhani W, Santoso TB, Sugijanto (2022). Efektifitas pemberian manual terapi dan terapi latihan untuk meningkatkan kemampuan fungsional pada penderita osteoarthritis knee (The effectiveness of providing manual therapy and exercise therapy to improve functional abilities in sufferers of knee osteoarthritis). Jurnal Kesehatan Dan Fisioterapi. 2(3): 85–91.

Rumajar HE, Gessal J, Damopolii CA (2020). Pengaruh terapi high intensity laser terhadap nyeri dan kemampuan fungsional pada osteoarthritis lutut (The effect of high intensity laser therapy on pain and functional ability in knee osteoarthritis). Jurnal Medik Dan Rehabilitasi. 2(1): 1–6.

Suriani S, Lesmana SI (2013). Latihan theraband lebih baik menurunkan nyeri daripada latihan quadricep bench pada osteoarthritis genu (Theraband exercises are better at reducing pain than quadricep bench exercises in genu osteoarthritis). Jurnal Fisioterapi. 13(1): 46–54.

Susanti N, Wahyuningrum P (2021). Penyuluhan dan penanganan fisioterapi pada osteoarthritis bilateral menggunakan intervensi isometric exercise di komunitas keluarga Desa Pasekaran Batang (Counseling and physiotherapy treatment for bilateral osteoarthritis using isometric exercise intervention in the family community of Pasekaran Batang Village). Jurnal ABDIMAS. 2(2). 12–21. doi: https://doi.org/10.31941/abdms.-v2i2.1503

Susilawati I, Tirtayasa K, Lesmana SI (2015). Latihan closed kinetic chain lebih baik daripada open kinetic chain untuk meningkatkan kemampuan fungsional pada osteoarthritis lutut setelah pemberian micro wave diathermy (MWD) dan transcutaneus electrical nerve stimulation (TENS) (Closed kinetic chain training is better than open kinetic chain for improving functional ability in knee osteoarthritis after administration of micro wave diathermy (MWD) and transcutaneous electrical nerve stimulation (TENS). Sport and Fitness Journal. 3(1): 26–34.

Widodo A, Jamilah N, Salam ME, Oktavia N, Falah N, Afrelia K, Gunawan A (2022). Peran fisioterapi komunitas dalam penanganan osteoarthritis genu di Paguyuban ibu-ibu perumahan Graha Aisyiyah Bojonegoro (The role of community physiotherapy in treating genu osteoarthritis in the Graha Aisyiyah Bojonegoro residential mothers' association). Jurnal Pengabdian Kepada Masyarakat Wahana Usada. 4(2): 73–81. doi: https://doi.org/10.47859/-wuj.v4i2.278

Wuryaningsih R, Fariz A, Prisusanti RD, Endaryanto AH (2022). Intervensi latihan close kinetic chain efektif menurunkan nyeri lutut pada osteorthritis genu di RS Gambiran Kediri (Close kinetic chain training intervention is effective in reducing knee pain in osteoarthritis genu at Gambiran Kediri Hospital). Jurnal Penelitian Kesehatan Suara Forikes. 13(1): 132–135. doi: https://doi.org/http://dx.doi.org/10.33846/sf13124

Zaki A (2013). Buku saku ostearthritis lutut (Knee osteoarthritis pocket book) (Edisi Pert). Celtics Press.