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The effectiveness of single leg mini squat and straight leg raise on pain intensity, muscle strength and physical function in patients with osteoarthritis KNEE in geriatric population: A comparative study

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Abstract---Background: Osteoarthritis is a degenerative joint disease, occurring primarily in older person, characterized erosion of articular cartilage, hypertrophy of the bone at the margins. Osteoarthritis is the most common joint disorder among adults 45 to 80 years of age or older, symptomatic disease occurs in approximately 12.1% population. Method: A total number of 40 participants of age between 60 to 80 years were divided into 2 groups as group A and group B, in which each group consist of 20 participants. The group A received single leg mini-squat exercise with hot pack and IFT and group B received straight leg raise exercise with hot pack and IFT for 15 days (20 times twice daily).the number of exercises was increased by five every two days so that by end of the program (15 day), the

participants was performed 55 single leg MSE twice a day of group A and 55 SLRE twice a day of group B. Result: The participants in the two groups showed improvement after the treatment but there was significantly more decrease in pain, increase muscle strength and physical function among participants in single leg mini squat exercise group when compared to SLRE. The p value for Single leg MSE group for VAS was <0.001, for MMT was <0.005 and for KOOS-PS was <0.001 obtained were statistically significant. Conclusion: This study concludes that, Single leg MSE and SLRE were effective in reducing pain, improving muscle strength and physical function score. After comparison it showed that Single leg MSE was statistically more effective for reducing pain, improving muscle strength and physical function than SLRE group.

Keywords---osteoarthritis, single leg MSE, SLRE, pain, muscle strength, physical function.

Introduction

Osteoarthritis is a most common musculoskeletal condition affecting the quality of life of older adults. It is a chronic and degenerative joint disease primarily affecting articular cartilage as well as soft tissue and is consider one of the most common musculoskeletal disorders[1]. Radiographically and pathological changes of OA are present in most persons over the age of 60 years. Because of knee joint is weight bearing and contributes to ambulation, patient usually experience functional limitations in activities of daily living[2]. It is second most common public health problem causes functional impairment and reduces quality of life. According to world health organization prevalence of OA is 22%-39% in India in 2019. Where 9.6% of male and 18% of female over 60 years. Males are affected more than females below 45 years, while females are more affected after 45 years[3]. Most cases of osteoarthritis have no known cause are referred to as primary osteoarthritis. Primary osteoarthritis is mostly related to ageing. It can present as localized, generalized or as an erosive osteoarthritis[4].

The secondary osteoarthritis causes by another disease or degenerative condition. Osteoarthritis is second most common rheumatologic problem and most frequent joint disease. OA leads to joint symptoms and signs which are associated with defective integrity of articular cartilage in addition to relative changes in underlying bone and its joint margin[4]. The main clinical symptoms related by patient with OA include pain, articular stiffness, crepitus, articular edema, joint deformity, muscle weakness and decreased range of motion[5]. Strength of quadriceps musculature is one of the most intrinsic factor that has been shown to affect the knee joint function[6]. There is increased risk of development or progression of disease due to greater and uncontrolled loading on the joint; therefore, quadriceps strength needs to be considered in the study of knee OA[7].

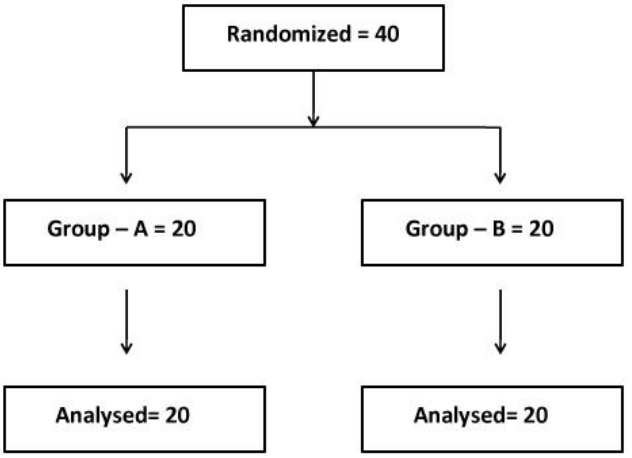
The physiotherapy modalities commonly used include interferential current, transcutaneous electrical nerve stimulation, exercises, cold therapy, acupuncture, low energy laser and orthotic devices[7]. Primary goals for OA therapy are pain

relief, maintenance of joint integrity, improvement in functional status, and a decrease in deformity and instability[8]. The active exercises such as muscle strengthening exercises have been found to be effective in reducing pain and disability as well as in improving the quality of life and performance of functional tasks in patients with knee OA. Exercises to improve muscle strength and joint mobility often require a considerable commitment by patients over long periods of time[9]. However, their efficacy has been proven as a previous study has found that exercise had a small to-moderate effect on pain, quadriceps strength, and physical function.

Straight leg raises and single leg mini-squats are very commonly prescribed to increase the strength and control of the knee muscles. Straight leg raises as an open kinetic chain exercise (OKCE) and are a movement with a free distal extremity that improves the strength of the knee muscles and protects the knee joint. Single leg Mini-squats as a closed kinetic chain exercises (CKCE) that target only the knee joint and are performed under weight-bearing or simulated weight bearing conditions with a fixed distal extremity[10]. Straight leg raises increase knee muscle strength and protect the knee without including the knee joint while single leg mini-squats strengthen knee muscles by including the knee joint. Therefore the purpose of the study was to investigate the effect of straight leg raises and mini squats on patients with osteoarthritis knee in geriatric population.

Material and Methods

A comparative design was chosen for the study. Approval from the institutional ethical committee of Maharashtra Institute of Physiotherapy, Latur was obtained before recruiting the participants. An informed consent was taken from all the participants. Total Sample size was 40, Duration of intervention was 3 weeks.



All the participants were selected from the Physiotherapy OPD of Maharashtra institute of physiotherapy. The participants were selected according to inclusion criteria and demographic data was collected. The purpose and treatment protocol was explained to the participants and written informed consent was obtained

from them. 40 participants, both genders, with the confirmed diagnosis of unilateral osteoarthritis of knee (grade 2 and 3 on Kellgren-Lawrence scale) with the age ranging from 60 to 80 years (14 males and 26 females), knee joint pain greater than 7 on VAS, were included. The participants having recent history of knee surgery, malignancy, tumors, lower limb deformity and currently on analgesics were excluded from the study. The study participants were randomly assigned by simple random sampling into group A and group B, 20 participants each group, by an independent collaborator by using coin method. The outcome measures assessed were pain by VAS[11], quadriceps strength by MMT[12] and KOOS-PS scale[13], which was reported to be valid and reliable for the assessment and physical function disability with OA knee. The measurements were recorded before the first treatment session and at the end of exercise program.

- Group A: received treatment with Single Leg MSE along with hot pack and IFT.
- Group B: received treatment with SLRE along with hot pack and IFT.

IFT was conducted with following characteristics: 4 pole vector field method with carrier frequency 4000Hz; beat frequency 80 Hz; frequencies 50-100Hz have been reported as generally more comfortable than 5HZ. The current intensity was adjusted until the participant reported feeling a strong tingling sensation[14]. Group A Includes 12 females and 8 males and Group B includes 14 females and 6 males Participant rated the 17 questions about physical function. Participant attended 5 treatment sessions each week for 3 weeks.

Group-A
Single Leg MSE (Mini Squat Exercise)

The participants in the Single leg MSE group followed an exercise program for three weeks (20 times twice daily). The number of exercises was increased by five every two days so that by the end of program (days 15), the participants performed 55 Single leg MSE twice a day. To perform the single leg mini-squat, the participant was asked to stand on the lower extremity to be exercised and hold onto a stable surface using their hands, meanwhile the other lower extremity was in 90 ^{0} hip and knee flexion. The participant was then ordered to flex the extended knee 15-20^{0} and hold this position for 3-4 seconds. Then they brought it to full extension and remained in that position for 3-4 seconds rest[1]. The measurements which included knee pain, quadriceps muscles strength and physical function were performed before the first treatment session and at the end of the exercise program.

Group-B
SLRE (Straight leg raise exercise)

The participants in the SLRE group were following an exercise program for three weeks (20 times twice daily). The number of exercises was increased by five every two days so that by the end of program (days 15), the participants performed 55 SLRE twice a day. To perform these exercises, the participant was in supine position with their hip and knee flexed in both extremities while the soles of their feet were on the treatment table. They were asked to extend one leg and hold it

with an extended knee until 45° hip flexion for five seconds. Then they let it down for a five second rest. The measurements which included knee pain, quadriceps muscle strength and physical function were performed before the first treatment session and at the end of exercise program[1].

Statistical Analysis

Descriptive statistical data was presented in the form of mean +/- standard deviation and mean difference percentages were calculated and presented. Paired T test was performed to assess the statistical difference within the group for the VAS, MMT and KOOS-PS (pain, strength and physical function) from the pre and post values. Unpaired T test were performed to assess the statistical significant difference between the groups for the pain, strength and functioning variables. For all the statistical analysis, $p<0.05$ was considered as statistically significant.

Table 1.0
The table below shows the no. of male and female patients

GENDER	NO OF PATIENTS
MALE	14
FEMALE	26

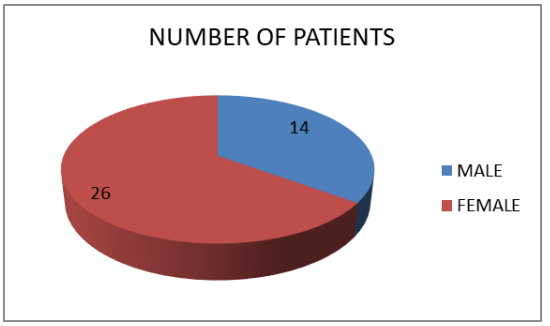


Figure 1.0. The graph below shows the distribution of male and female patients.

Results

Group-A: Comparison of pre and post test of VAS

Table 1.1
Group A (pre and post values of VAS)

	MEAN	SD	t VALUE	P-VALUE	INFERENCE
PRE TEST	4.15	1.089	4.84	0.0001	Significant
POST TEST	1.3	0.571			

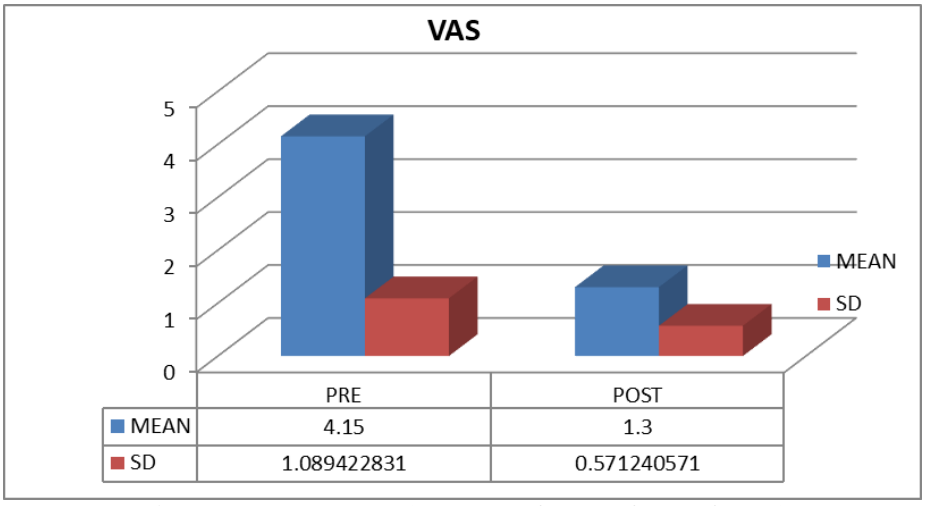


Figure 1.1. Group A (mean and SD values of VAS)

The mean value of pre and post-test are 4.15 and 1.3 and standard deviation of pre and post test is 1.089 and 0.571 and T value is 4.84 and P value is 0.0001, P value suggest there is significant improvement between pre and post-test value in Single Leg Mini Squat Exercises.

Group-B: Comparison of pre test and post test of VAS

Table 1.2
Group B (pre and post values of VAS)

	MEAN	SD	t VALUE	P-VALUE	INFERENCE
PRE TEST	4.675	0.9497	1.95	0.06	Not Significant
POST TEST	1.45	0.6048			

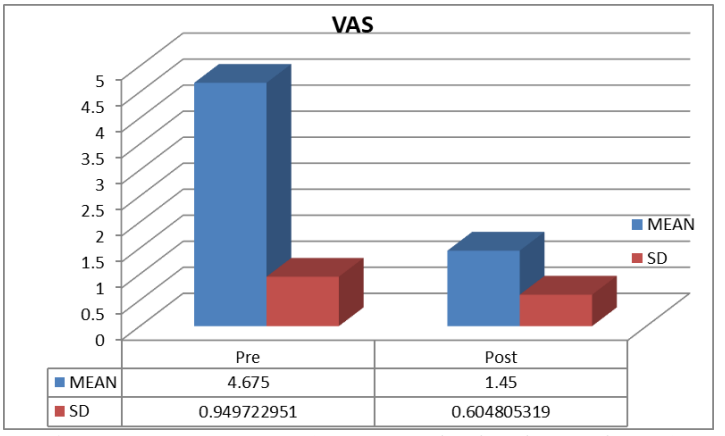


Figure 1.2. Group B (mean and sd values of VAS)

The mean value of pre and post-test are 4.675and 1.45 and standard deviation of pre and post-test is 0.9497 and 0.6048 the T test value is 1.95 and P value is 0.06. The P value suggests there is no significant improvement between pre and post-test value of VAS in Straight Leg Raise Exercises.

Comparison of group A and group B (VAS)

Table 1.3
Comparison of Group A and Group B of VAS

	MEAN	SD	t VALUE	P-VALUE	INFERENCE
Group A	1.3	0.5712	3.8	0.001	Significant
Group B	1.45	0.6048			

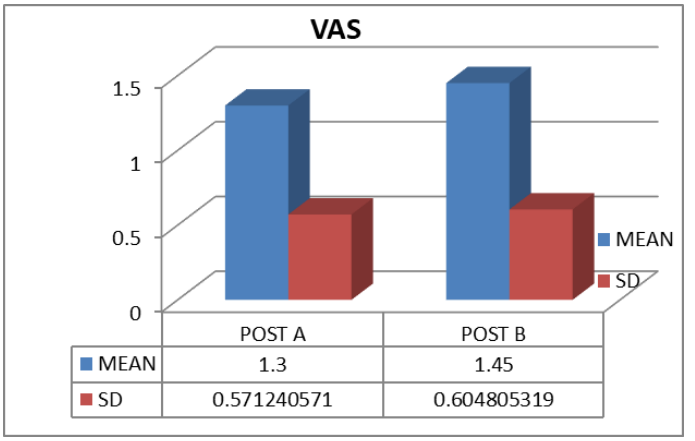


Figure 1.3. Mean and SD values of group A and B of VAS

The mean value of group A and B is 1.3and 1.45 and standard deviation of group A and B is 0.571 and 0.604. The T value is 3.8 and p value is 0.001, T and P values of VAS suggest that there is significant improvement between group A and not significant in group B, therefore group A is highly significant than group B.

Group A: Comparison of pre and post test of MMT

Table 2.1
Group A (pre and post values of MMT)

	MEAN	SD	t VALUE	P-VALUE	INFERENCE
PRE TEST	3.75	4.9	2.11	0.04	Significant
POST TEST	0.4442	0.3077			

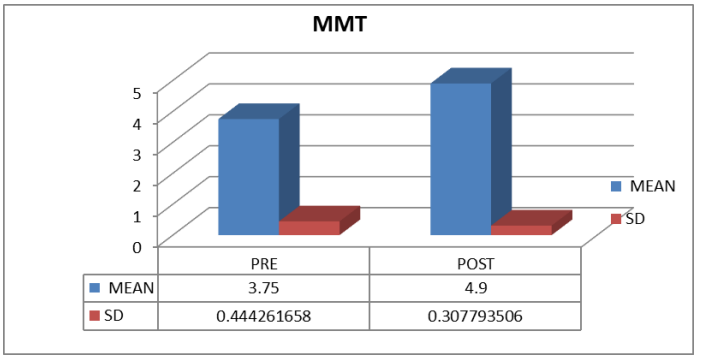


Figure 2.1. Group A (mean and SD values of MMT)

The mean value of pre and post-test are 3.75 and 4.9 and standard deviation of pre and post-test are 0.4442 and 0.3077 the T value is 2.11 and p-VALUE is 0.04. The P value suggests that there is significant improvement between pre and post-test value of MMT in group A.

Group B: Comparison of pre test and post test of MMT

Table 2.2
Group B (pre and post values of MMT)

	MEAN	SD	t VALUE	P-VALUE	INFERENCE
PRE TEST	3.65	0.489	4.24	0.0005	Significant
POST TEST	4.7	0.4701			

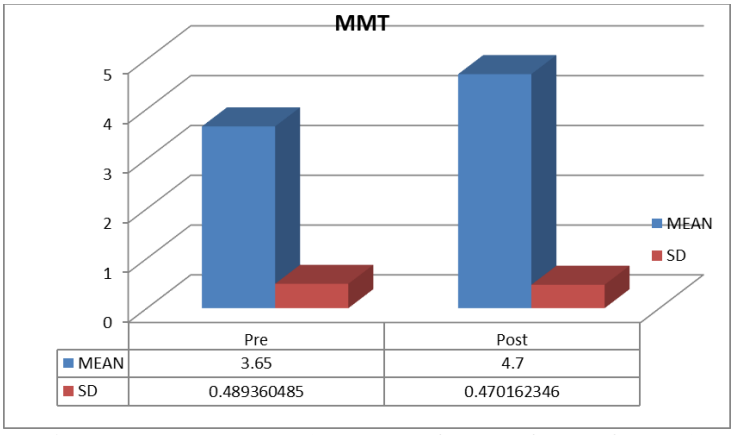


Figure 2.2. Group B (mean and SD values of MMT)

The mean value of pre and post-test are 3.65 and 4.7, the standard deviation of pre and post-test is 0.489 and 0.470. T test value is 4.24 and p- value is 0.0005. The P value suggests that there is significant improvement between pre and post-test value of MMT in group B.

Comparison between group A AND group B (MMT)

Table 2.3
Comparison between Group A and Group B of MMT

	MEAN	SD	t VALUE	P-VALUE	INFERENCE
Group A	4.9	0.3077	9.8	0.005	Significant
Group B	4.7	0.4701			

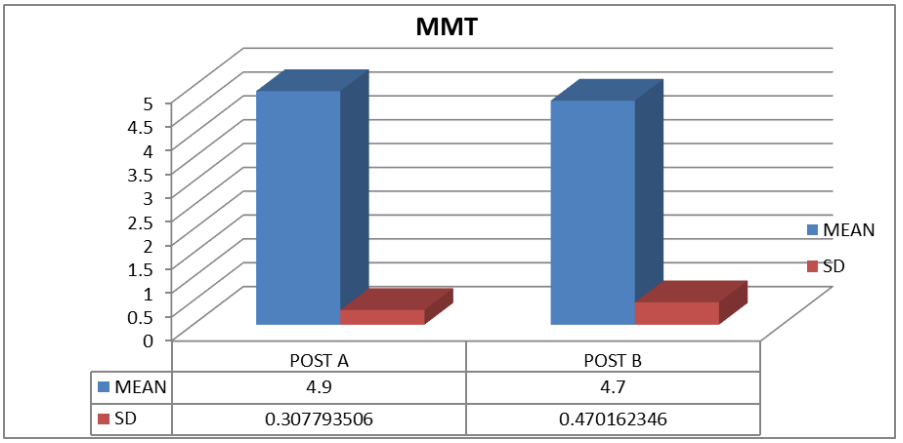


Figure 2.3. Group A and B (mean and sd values of MMT)

The mean value of group A and group B is 4.9 and 4.7 and Standard deviation of group A and group B is 0.3077 and 0.4701, the T test value is 9.8 and p- value is 0.005. The P value suggest that there is significant improvement between group A and group B, but group A is significant than group B.

Group-A: Comparison of pre and post test of KOOS-PS

Table 3.1
Group A (Comparison between Pre and Post)

	MEAN	SD	t VALUE	P-VALUE	INFERENCE
PRE TEST	30.25	3.668	4.56	0.0002	Significant
POST TEST	10.55	2.480			

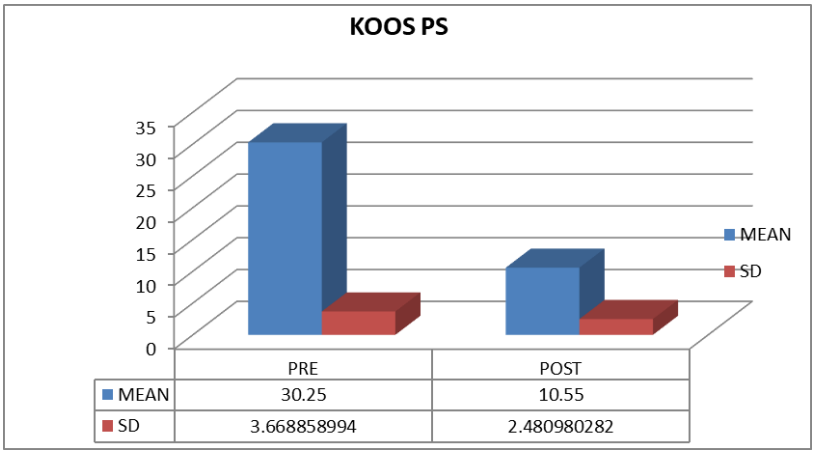


Figure 3.1. Group A (Comparison between Pre and Post)

The mean value of pre and post-test are 30.25 and 10.55 and standard deviation of pre and post-test are 3.668 and 2.480. The T value is 4.56 and p-VALUE is 0.0002. The P value suggests that there is significant improvement between pre and post-test value in group A.

Group-B: Comparison of pre and post test of KOOS-PS

Table 3.2
Group B (Comparison between Pre and Post)

	MEAN	SD	t VALUE	P-VALUE	INFERENCE
PRE TEST	31.3	4.953	3.86	0.001	Significant
POST TEST	12.2	2.504			

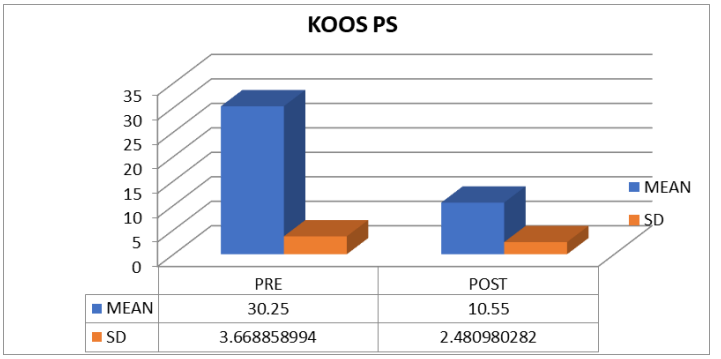


Figure 3.2. Group B (Comparison between Pre and Post)

The mean value of pre and post-test are 31.3 and 12.2 and standard deviation of pre and post-test are 4.953 and 2.504. The T value is 3.86 and p-VALUE is 0.001. The P value suggests that there is significant improvement between pre and post-test value in group B.

Comparison between Group A AND Group B (KOOS-PS)

Table 3.3
Comparison between Group A and Group B

	MEAN	SD	t VALUE	P-VALUE	INFERENCE
Group A	10.55	2.480	3.7	0.001	Significant
Group B	12.2	2.504			

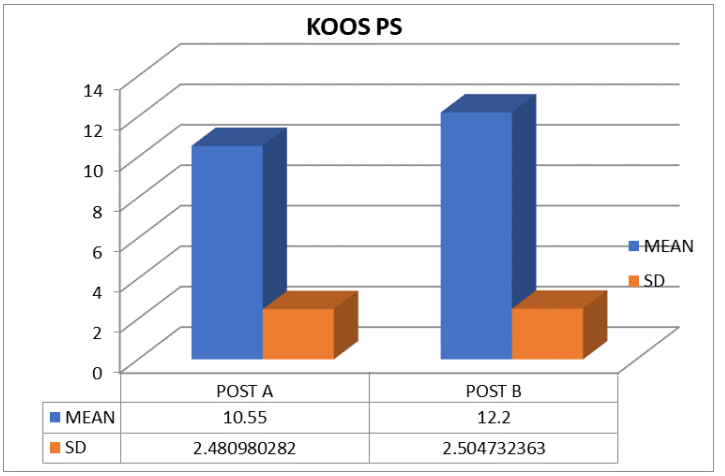


Figure 3.3. Group A and Group B (mean and SD values of KOOS-PS)

The mean value of group A and group B is 10.55 and 12.2 and Standard deviation of group A and group B is 2.480 and 2.504, the T test value is 3.7 and p- value is 0.001. The P value suggest that there is significant improvement between group A and group B, but group A is significant than group B.

Discussion

Osteoarthritis is most common cause of chronic pain in the general population. It is progressive joint disorder characterized by gradual loss of cartilage. Osteoarthritis is a chronic condition of joint; the most commonly affected is knee. This is characterized by joint pain and in more advanced stage, joint deformities, contracture and muscle atrophy leading to severe disability. It's demonstrated that quadriceps weakness is correlated with knee pain and other study indicated that quadriceps plays a crucial role in maintaining knee stability and functionality in patients with knee OA. Various types of exercises have been commonly used and are effective non pharmacological treatment modalities for patients with lower limb OA[15]. A more recent study accentuated the fact that exercise is the core component for the management of knee OA[16]. The strengthening exercises are effective for reducing pain and disability, improving the quality of life[23], and slowing disease progression for all patients with OA, but they are especially useful for patients with knee OA[17].

The purpose of my study was to demonstrate the effectiveness of single leg mini-squat and straight leg raise on pain intensity, muscle strength and physical

function in patients with osteoarthritis knee in geriatric population. Both types of exercise exhibit that they can be used to reduce pain and disease-related functional losses in OA. The result of my study shows that p value for VAS of both groups is 0.001, for MMT of both groups is 0.005 and for KOOS-PS of both groups is 0.001 which is statistically significant. Straight leg raises increase knee muscle strength and protect the knee without including the knee joint while single leg mini-squats strengthen knee muscles by including the knee joint. According to the literature, CKCE are more functional than OKCE because they occur in a range of motion more closely corresponding to typical daily activities[18].

Bakhtiary and Fatemi found similar pain reduction and increased strength of the quadriceps muscle in patients doing mini-squats compared with those performing straight leg raises in the treatment of patellar Chondromalacia. They used straight leg raises as an open kinetic chain exercise (OKCE) and mini-squats as a closed kinetic chain exercise (CKCE) in their program targeting knee muscles[7]. The CKCE exercises are more related to function than OKCE. A study on knee OA included traditional physical therapy program in which participants either performed straight leg raises or mini squats. They were aware of the exercise barriers faced by OA patients; therefore they preferred to implement an exercise protocol that consisted of only the two types of exercise, that is, OKCE and CKCE. According to them mini-squats, a CKC exercise, could be viewed as being helpful for strengthening quadriceps muscles and have advantage of providing functional progression in patients with knee OA. On the other hand straight leg raises group saw increase in strength of knee flexor muscle[1].

A study showed that IFT stimulation provides better pain management by pain gate mechanism[19]. Nociceptor afferent fibers enters in the spinal cord via dorsal root and makes synapse, 2nd order neuron crosses the midline of spinal cord and transmit information to higher center via lateral spinothalamic tract. Other studies also showed significant improvement in VAS by application of IFT[20]. We found an increase in knee extensor strength in single leg mini-squats and an increase in knee flexor strength in straight leg raise group. Gravity may be a reason for this. In straight leg raises, as leg is raised, knee flexors contract eccentrically against gravity but in mini squats as the knee is bent, the knee extensors contract eccentrically against gravity[21].

A study suggested that straight leg raises would be as effective as active knee extension in developing quadriceps femoris muscle strength[24]. Although these exercises are often given to strengthen the quadriceps muscle, especially the vastus medialis, they also target hip flexors[22]. In a few studies in the literature, straight leg raises were preferred as an exercise for hip joint, in one of those studies the rectus femoris, iliacus, adductor longus and psoas muscles demonstrated similar activity according to the electromyogram (EMG) analysis. Moreover three muscles began to contract even before the psoas muscle, because of bi-articular structure of rectus femoris part of quadriceps muscle, we preferred straight leg raises. According to my result, single leg mini-squats are helpful for strengthening quadriceps muscle and also providing functional progression than straight leg raise therefore study shows that single leg mini-squats exercises are more effective than straight leg raise exercises on reducing pain, and improving

muscle strength and physical function in patients with OA knee in geriatric population.

Conclusion

The present study concludes that, Single leg mini squats and straight leg raise exercises both were effective in reducing VAS, improving MMT and KOOS-PS score. After comparison between the two groups, it showed that group A i.e. Single leg mini squats was statistically more effective for reducing pain, improving strength and functional activities than Straight leg raise exercises in patients with OA knee in geriatric population.

Ethical approval

Ethical Approval done by Institutional Ethics Committee of Maharashtra Institute of Physiotherapy, Latur (India) No.: IEC/2020/UG-15/2020

Conflict of interest

The authors confirm that they have no conflicts of interest and no funding to declare.

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References

1. Albornoz-Cabello M, Maya-Martín J, Domínguez-Maldonado G, Espejo-Antúnez L, Heredia-Rizo AM. Effect of interferential current therapy on pain perception and disability level in subjects with chronic low back pain: a randomized controlled trial. Clin Rehabil. 2017;31(2):242-249.
2. Arzu Daskapan, Bahar Anaforoglu Kulunkoglu: They had done a study on comparison of mini squats and straight leg raises in patients with knee osteoarthritis: A randomized controlled clinical trial. Turk J Rheumatol 2013;28(1):16-26.
3. Baker KR, Xu L, Zhang Y, et al. Quadriceps weakness and its relationship to tibiofemoral and patellofemoral knee osteoarthritis in Chinese: the Beijing osteoarthritis study. Arthritis Rheum. 2004;50(6):1815-1821.
4. Bakhtiary AH, Fatemi E. Open versus closed kinetic chain exercises for patellar chondromalacia. Br J Sports Med. 2008;42(2):99-102.
5. Bennell KL, Hinman RS. A review of the clinical evidence for exercise in osteoarthritis of the hip and knee. J Sci Med Sport. 2011;14(1):4-9.
6. Bezalel T, Carmeli E, Katz-Leurer M. The effect of a group education programme on pain and function through knowledge acquisition and home-based exercise among patients with knee osteoarthritis: a parallel randomised single-blind clinical trial. Physiotherapy. 2010;96(2):137-143.
7. Bhatnagar G, Ghule S, Dangat P, Mohammed R, Pawadshetty V. Efficacy of Quadriceps sets with Biofeedback and Modified Quadriceps sets with Biofeedback along with Ultrasound in Reduction of Pain and Active Extension Lag in Bilateral Knee Osteoarthritis- A Comparative Study. Int J Cur Res Rev.2022;14(12):26-32. http://doi.org/10.31782/IJCRR.2022.141201

8. Boonstra AM, Schiphorst Preuper HR, Reneman MF, Posthumus JB, Stewart RE. Reliability and validity of the visual analogue scale for disability in patients with chronic musculoskeletal pain. Int J Rehabil Res. 2008;31(2):165-169.
9. Buenavente MLD, Gonzalez-Suarez C, Lee-Ledesma MAB, Liao LAS. Evidence on the effectiveness of interferential current therapy in the treatment of knee osteoarthritis: A meta-analysis. OA Arthritis. 2014;10;2(1):7.
10. Cetin N, Aytar A, Atalay A, Akman MN. Comparing hot pack, short-wave diathermy, ultrasound, and TENS on isokinetic strength, pain, and functional status of women with osteoarthritic knees: a single-blind, randomized, controlled trial. Am J Phys Med Rehabil. 2008;87(6):443-451.
11. Cuthbert SC, Goodheart GJ Jr. On the reliability and validity of manual muscle testing: a literature review. Chiropr Osteopat. 2007;15:4.
12. Dannelly BD, Otey SC, Croy T, et al. The effectiveness of traditional and sling exercise strength training in women. J Strength Cond Res. 2011;25(2):464-471.
13. Eftekharsadat B, Babaei-Ghazani A, Habibzadeh A, Kolahi B. Efficacy of action potential simulation and interferential therapy in the rehabilitation of patients with knee osteoarthritis. Ther Adv Musculoskelet Dis. 2015;7(3):67-75.
14. Hunter DJ, McDougall JJ, Keefe FJ. The symptoms of osteoarthritis and the genesis of pain. Rheum Dis Clin North Am. 2008;34(3):623-643.
15. Jonsson P, Alfredson H. Superior results with eccentric compared to concentric quadriceps training in patients with jumper's knee: a prospective randomised study. Br J Sports Med. 2005;39(11):847-850.
16. Knight KL, Martin JA, Londeree BR. EMG comparison of quadriceps femoris activity during knee extension and straight leg raises. American Journal of Physical Medicine. 1979 Apr;58(2):57-67.
17. Kwon YJ, Park SJ, Jefferson J, Kim K. The effect of open and closed kinetic chain exercises on dynamic balance ability of normal healthy adults. J Phys Ther Sci. 2013;25(6):671-674.
18. O'Reilly SC, Jones A, Muir KR, Doherty M. Quadriceps weakness in knee osteoarthritis: the effect on pain and disability. Ann Rheum Dis [1998]57:588-94.
19. Perruccio AV, Stefan Lohmander L, Canizares M, et al. The development of a short measure of physical function for knee OA KOOS-Physical Function Shortform (KOOS-PS) - an OARSI/OMERACT initiative. Osteoarthritis Cartilage. 2008;16(5):542-550.
20. Petrella RJ, Bartha C. Home based exercise therapy for older patients with knee osteoarthritis: a randomized clinical trial. J Rheumatol. 2000;27(9):2215-2221.
21. Roddy E, Zhang W, Doherty M, et al. Evidence-based recommendations for the role of exercise in the management of osteoarthritis of the hip or knee--the MOVE consensus. Rheumatology (Oxford). 2005;44(1):67-73.
22. Rogind H, Bibow-Nielsen B, Jensen B, Moller HC, Frimodt-Moller H, Bliddal H. The effects of a physical training program on patients with osteoarthritis of the knees. Arch Phys Med Rehab [1998] 79:1421-7.
23. Roos EM, Toksvig-Larsen S. Knee injury and Osteoarthritis Outcome Score (KOOS) - validation and comparison to the WOMAC in total knee replacement. Health Qual Life Outcomes. 2003;1:17.

24. Sahu R, Kumar S, Yadav P. A study on the quality of life among stroke survivors: A cross sectional study. J Med Res Innov. 2021;5(1):e000244. https://doi.org/10.32892/jmri.244
25. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). Health and treatment of diabetes mellitus. *International Journal of Health Sciences*, *5*(1), i-v. https://doi.org/10.53730/ijhs.v5n1.2864
26. Wardana, I. M., Ardani, I. G. A. I., Aryani, L. N. A., Windiani, I. G. A. T., Adnyana, I. G. N. S., & Setiawati, Y. (2022). Other mental disorders ydt due to brain damage and dysfunction and physical disease in patients with anti-NMDA encephalitis: Case report. International Journal of Health & Medical Sciences, 5(4). https://doi.org/10.21744/ijhms.v5n4.1948