

EFFECTS OF INTEGRATED THERAPEUTIC EXERCISES ON PAIN AND DISABILITY IN MEDIAL KNEE OSTEOARTHRITIS

Sumit Raghav^{B, C, D}

Department of Physiotherapy, IIMT University, Meerut, Uttar Pradesh, India
ORCID: 0000-0003-4485-9725 | e-mail: drsumit.svsu@gmail.com

Anshika Singh^{A, B, D}

Department of Physiotherapy, IIMT University, Meerut, Uttar Pradesh, India
ORCID: 0000-0002-2254-6632

Suresh Mani^{A, C}

Department of Physiotherapy, Lovely Professional University, Phagwara, Punjab, India
ORCID: 0000-0003-1703-092X

Anirudh Srivastava^{C, D}

Central Research and Incubation Center, Swami Vivekanand Subharti University, Meerut, Uttar Pradesh, India
ORCID: 0000-0002-0297-5106

Mukul Kumar^{B, D}

Central Research and Incubation Center, Swami Vivekanand Subharti University Meerut, Uttar Pradesh, India
ORCID: 0000-0002-4864-5823

^A Study Design; ^B Data Collection; ^C Statistical Analysis; ^D Manuscript Preparation

Abstract The purpose of this study was to compare the effect of quadriceps isometric exercises along with hip abductors isometric exercises as integrated exercise with quadriceps exercises in reducing pain, disability in medial knee osteoarthritis. The Total of 54 patients (both male and female) were recruited in this study but on the basis of inclusion and exclusion criteria, only 32 were included in this study. Womac index was opted as outcome measures to collect the data of pain, disability and functional limitation. Participants were randomly assigned to integrated exercise group; (n = 16) (mean age 52) who performed exercises [Quadriceps isometric along with hip abductor isometric exercises] and quadriceps isometric exercises group (n = 16) (mean age 49) performed for 3 weeks. 32 patients were analyzed and the effect of integrated exercises [Quadriceps isometric along with hip abductor isometric exercises] showed a statistically significant difference in pain, disability and functional limitation ($p < 0.000$). Total duration to collect the pre and post data of pain, disability and functional limitation was 3 weeks. 3 weeks of exercise protocol was effective in both groups in terms of reducing pain and disability but integrated exercises were found to be more effective than quadriceps exercise in improving the pain, disability and functional limitation over the time at the level of significance.

Key words: knee osteoarthritis, integrated exercises, pain, disability

Introduction

Osteoarthritis is a bone and joint degenerative disorder that affects the large peripheral joints such as hip and knee joints in the human body. It is a chronic degenerative joint disease with progressive destruction of articular cartilage and decreases in the synovial fluid that lubricates those joints (Dieppe & Lohmander, 2005). Knee osteoarthritis is a degenerative arthritis occurs in the intra-articular and extra-articular surface of the knee joint. It progresses slowly with usual sign and symptoms being pain and limitation of the range of motion of the knee joint. Age is a one of the strongest risk factors for OA of all joints (Xiao et al., 2019).

The increase in the prevalence and incidence of osteoarthritis with age is probably a consequence of cumulative exposure to various risk factors and biologic changes that occur with aging that may make a joint less able to cope with adversity, such as cartilage thinning, weak muscle strength, poor proprioception, and oxidative damage (Mayoral Rojals, 2021). As a person ages, the water content of their cartilage decrease, thus weakening it and making it less resilient and more susceptible to degradation (Wittenauer et al., 2013). There are strong indications that genetic inheritance is a factor, as up to 60% of all osteoarthritis cases are through to results from genetic factor (Spector & MacGregor, 2004). The latest evidence to date indicates that half of the risk of developing osteoarthritis of the hand and hip (approximately 25% for the knee) can be attributed to genetic factors (Allen et al., 2022).

During examination, slight thickening is often found on palpation; it is mainly a bony thickening caused by the marginal osteophytes (Serban et al., 2016). Movements are impaired slightly or markedly according to the degree of arthritis; in the larger joints movement is accompanied by palpable or audible repetition of a rather coarse type (Rossi et al., 2020). Fixed deformity is often found in the hip, and sometimes in the knee and in other joints (Bhan et al., 2008). The radiological feature of osteoarthritis knee are the joint space narrowing, and sclerotic margins and osteophytes formation at the margin of the joint, with the slight flattening of the condyles (Ahmad et al., 2009). Magnetic resonance imaging can demonstrate early cartilage changes (Jazrawi et al., 2011). Arthroscopy can reveal early fissuring and surface erosion of the cartilage (Hattori et al., 2005).

Physiotherapy consists of major two approaches: electrotherapy and exercise therapy. In electrotherapy, there are various physical agents or modalities which help in reducing pain, swelling or associated symptoms related to the injury (Hanks et al., 2015). On the other hand, there are various forms of exercise such as strengthening exercise progressive resisted exercise isometric and isotonic exercise which help in building the muscle strength and mobility of the joint. They also help in building the independence level of the patients (Hanratty et al., 2012) strength, function, and quality of life. Data were summarized qualitatively using a best evidence synthesis. Treatment effect size and variance of individual studies were used to give an overall summary effect and data were converted to standardized mean difference with 95% confidence intervals (standardized mean difference (SMD). This study was conducted to evaluate the comparative effect of integrated exercises [Quadriceps isometric along with hip abductor isometric exercises] and quadriceps isometric exercises program on pain and disability in patients with medial knee osteoarthritis.

Materials and Methods

This study was conducted after approval from research committee of Swami Vivekanand Subharti University, Meerut, Uttar Pradesh, India. This is a simple pre and post experimental design study. The purpose and procedure

of the study were explained in detail and consent form was taken from each participant and participants were free to withdraw any time without giving any reason. The participants were selected according to the inclusion and exclusion criteria and divided into 2 groups – Integrated exercises group (Group-A) and Isometric exercises group (Group B).

Selection criteria

Out of 54, 32 participants took part in this study, including 7 male and 25 females. The participants were randomly allocated into 2 groups i.e. group A (n = 16) and the group B (n = 16) respectively as explained in the flowchart of Figure 1. Patients having a complaint of knee pain at medial aspect with age group between 45–65 years who referred from Orthopedic OPD of Subharti hospital were included in this study. The stage of knee osteoarthritis was determined by X-ray. Patients having a history of recent injury of the knee joint, bone and joint tumor, bone tuberculosis, severe knee pain due to trauma, infection, fracture and no history of any kind of medication for pain were excluded from selection criteria.

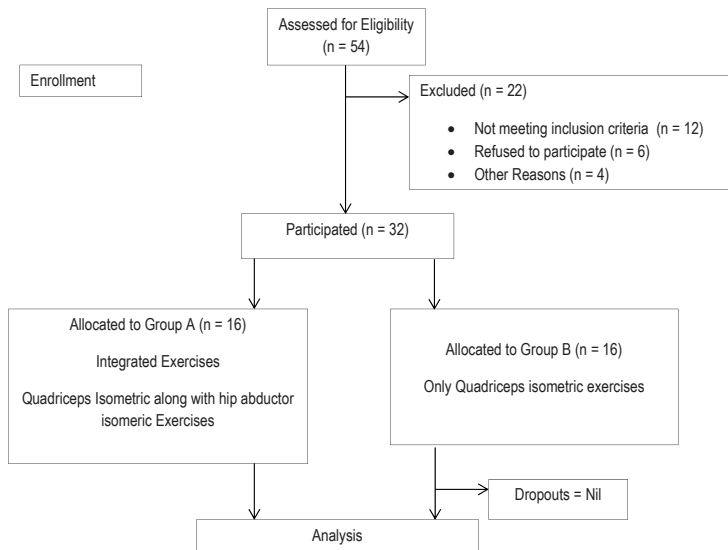


Figure 1. Methodology adopted in this study

Outcome Measure

WOMAC Scale

Pain, disability and function were assessed by the WOMAC (Western Ontario and McMaster Universities Arthritis Index) scale including all three subscales (measured by a Likert version and the possible range of scores is 0 = none to 4 = extreme) were used to determine the degree of functionality of the knee (Riddle & Perera, 2020).

Intervention

Based on the patient assessment, the treatment for both groups involved applying a moist heat pack to the knee joint for 15–20 minutes in order to reduce muscle spasms and pain, while improving tissue extensibility. Group A received sessions of integrated exercises program; quadriceps isometrics exercise along with hip abductor isometric exercises for six days in a week for three weeks. Group B received sessions of only quadriceps isometrics exercise with for six days in a week for three weeks. Initially according to the patient's condition the number of repetitions of exercises may be less or decreased but upgraded or increased later on. After 3 weeks post intervention of quadriceps and hip abductor strength and knee pain and functions were re-evaluated. Pre- and post- intervention data was analyzed for any statistical significance.

Data Analysis

First of all, baseline characteristics i.e. age, height, BMI and body mass of all patients were analyzed. Outcome measures: pain, disability, functions and muscle strength were analyzed for statistical significance. SPSS version 22.0 was utilized to analyze the data. The mean change of WOMAC score at baseline and after 3rd week of intervention within the groups was compared. Assessment for the significant difference at predetermined significant level between pre-and post WOMAC score of both groups was done by Paired t-tests. P value was set at ≤ 0.05 level.

Results

Overall compliance of subjects to the integrated exercise program was 100% as optional session was arranged if a subject could make any of the sessions and also there were no dropouts during the study. There were no significant differences between groups for age, body mass, height, and BMI at baseline ($P < 0.05$) in Table-1. Assessments were done at baseline and after 3 weeks of interventions, and the results presented in Table 2 and 3. There were only a few reports regarding muscle soreness in the first week of exercises.

Table 1. Characteristics of patients with knee osteoarthritis in both groups

Groups	Age (year)	Height (cm)	Body Mass (kg)	Body Mass Index (kg/m ²)
Group A	52	162	71	27.05
Group B	49	158	68	27.23

Table 2. Pre and post WOMAC score of group A

Variable	Pre-score (1 st Day)		Post-score (20 th Day)		t-value	p-value
	Mean	S.D	Mean	S.D		
WOMAC Domain						
Joint Pain	12.3	4.3	5.1	3.4	4.698	0.000
Joint Stiffness	5.4	1.9	3.1	1.6	3.703	0.000
Functional Limitation	41.7	5.4	26.3	11.7	4.780	0.000

Table 3. Pre and Post WOMAC score of group B

Variable	Pre-score (1 st Day)		Post-score (20 th Day)		t-value	p-value
	Mean	S.D	Mean	S.D		
WOMAC Domain						
Joint Pain	11.3	3.1	8.3	3.9	2.408	0.022
Joint Stiffness	5.4	1.8	3.9	1.6	2.491	0.018
Functional Limitation	39.7	6.9	30.6	13.1	2.458	0.019

Pain and Disability

Group-A

The mean comparison within the group at different time points is shown in Table 2. The effect of integrated exercise level illustrated that there was a statistically significant difference between baseline data and after 3 weeks of data of WOMAC. On the basis of mean difference, WOMAC score at baseline with calculated value i.e. joint pain (12.3), joint stiffness (5.4) and functional limitation (41.7) significantly improved after performing the integrated exercise for 3 weeks and reported as WOMAC score with joint pain (5.1), joint stiffness (3.1) and function limitation (26.3). Paired t-test of treatment at baseline and after 3rd week was performed and the result of within group comparisons indicated that quadriceps isometrics exercise along with hip abductor isometric exercises compared at baseline to 3rd week ($P < 0.05$) of intervention was statistically significant.

Group-B

The mean comparison within the group at different time points is shown in Table 3. The effect of quadriceps isometric exercise level illustrated that there was a difference between times between baseline data and after 3 weeks of data of WOMAC. On the basis of mean difference, WOMAC score at baseline with calculated value i.e. joint pain (11.3), joint stiffness (5.4) and functional limitation (39.7) significantly improved after performing the integrated exercise for 3 weeks and reported as WOMAC score with joint pain (8.3), joint stiffness (3.9) and function limitation (30.6). Paired t-test of treatment at baseline and after 3rd week was performed and the result of within group comparisons indicated that quadriceps isometrics exercise along with hip abductor isometric exercises compared at baseline to 3rd week ($P > 0.05$) of intervention was not statistically significant as compared to group-A who received integrated exercises for 3 weeks.

Discussion

The purpose of this study was to find out the combined effects of quadriceps isometric exercise with hip abductor isometric exercise as integrated exercises approach in subjects with medial osteoarthritis of the knee. Effects of quadriceps isometric exercises were studied and revealed the effectiveness in reduction of pain and improvement in functions (Suzuki et al., 2019). Hip strengthening exercise can be added with quadriceps strengthening exercises for improving pain and quality of life in knee osteoarthritis as supplementary content over the quadriceps exercises alone if it is found to be more effective (Xie et al., 2018). Hip abductor muscles exercises along with quadriceps isometric exercise were of interest as integrated exercises for medial knee osteoarthritis.

Significant improvement in pain, disability and functional limitation was displayed following integrated exercises at baseline and after 3 weeks compared to quadriceps isometric exercises. Our findings agree with previous literature; however, it is the first exploratory study to analyze the effect of integrated exercise protocol in medial knee osteoarthritis. A significant decrease in pain, disability and functional limitation following integrated exercises were delivered for medial knee osteoarthritis both, over the period of 3 weeks compared to baseline. The results of our study are consistent with previous work over the 6 weeks of intervention (Shah Sohil Yunusbhai, 2023; Aalaa et al., 2020). Findings have implications on the clinical decision process of physiotherapists in the context of standard exercise protocol applications pitch side and the resultant or lasting effects on pain, disability and functional limitation in knee osteoarthritis. Physiotherapists should however consider the outcome measures that can impact multiple factors of response to exercises and the context of their application. The current study reflects the necessity of research required in the topic of optimizing integrated exercises application and the impacts on pain and disability that support the functional improvement.

Data of WOMAC index for measuring pain, disability and functional limitation of the subjects of both groups for pre and post interventional study expressed in terms of mean and S.D shown in table 2 and 3. Within the group pre and post values were assessed by paired t-test in both the groups which has mentioned in table 2 and 3. In both groups, p-value was significant i.e., $p < 0.05$ with WOMAC, score; joint pain (0.0000), joint stiffness (0.0000) and functional limitation (0.0000). The 3 weeks protocol quadriceps isometric exercise with hip abductor isometric exercise and quadriceps isometric exercise alone showed significance in both group in terms of decreasing pain and disability but group A, quadriceps isometric exercise with hip abductor isometric exercise showed statistically more significant difference in decreasing pain and disability.

A study was conducted on the role of quadriceps exercise in osteoarthritis of knee joint. In their study total number of 100 subject aged of 40–65 years suffering with mild to moderate O.A of knee joint were enrolled. Subjects were equally divided into two groups. Group 1 & 2; group 1 received drug therapy and group 2 received physiotherapy alone with drug therapy in the form of quadriceps exercise. The patients were assessed often two weeks of protocol. This study shows that group 2 who received drug therapy along with quadriceps strengthening exercise had significant improvement in order to decrease pain and increase ROM and function (Ansari & Asimuddin, 2014).

Another study was conducted on the effect of the exercise of lower limb strengthening as treatment for knee osteoarthritis. Total 88 participants with painful radio-graphically affirmed medial compartment knee osteoarthritis and section enrolled form the network and were randomly assessed to a hip strengthening or control group utilizing concealed allocation stratified by disease severity. The hip strengthening group performed to strengthen the hip abductor and adductor muscles at home 5 times per week for 12 weeks and the control group was requested to continue with their usual care.

Blinded follow up assessment was conducted at 12 weeks after randomization. This study showed that the hip strengthening exercise was significantly effective on knee loads and symptoms in people with medial compartment knee osteoarthritis and has the potential to slow the disease progression (Uthman et al., 2013)two hip, 14 mixed. As the authors expected in this study, the result supported the previous studies that examined the different exercise program concerning reduction of pain and disability in knee osteoarthritis.

It is worth noting that different studies have linked in reduction in pain and disability to an increase function to mobility in the patients with knee osteoarthritis. This was likely due to the intrinsic factors associated with ageing,

such as degenerative processes in musculoskeletal systems that lead to muscle weakness and limit the mobility of knee joint. Hence also in this study an improvement in muscle strength as well as functions was observed which can support the previously published studies.

Conclusion

Integrated exercises for quadriceps and hip abductor muscles have a significant effect on pain and disability of the elderly population with medial knee osteoarthritis. After 3 weeks of integrated exercise protocol, there has been a significant improvement on pain and disability as well as functional limitation. This result showed that even short-term integrated exercise protocol can be effective in the elderly population to improve their function via reducing the pain and disability. Integrated exercises were found to be more effective than quadriceps exercise in improving the data of joint pain, joint stiffness and functional limitation over the time at the 5% level of significance.

References

- Sweelam, A. M., Shawki, M. A., Hegazy, M. M., & Azzam, A. H. (2020). Effect of hip abductors versus knee extensor strengthening on pain, function and quadriceps isometric strength in knee osteoarthritis : Protocol for a randomized clinical trial. *International Journal of Advanced Research*, 8(9), 588–595. <https://doi.org/10.21474/ijar01/11696>
- Ahmad, M., Hollender, L., Anderson, Q., Kartha, K., Ohrbach, R., Truelove, E. L., John, M. T., & Schiffman, E. L. (2009). Research diagnostic criteria for temporomandibular disorders (RDC/TMD): Development of image analysis criteria and examiner reliability for image analysis. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, 107(6), 844–860. <https://doi.org/10.1016/j.tripleo.2009.02.023>
- Ilen, K., Thoma, L., & Golightly, Y. (2022). Epidemiology of osteoarthritis. *Osteoarthritis and Cartilage*, 30(2), 184–195. <https://doi.org/10.1016/j.joca.2021.04.020>
- Ansari, M., & Asimuddin, M. (2014). Osteoarthritis of knee joint – role of quadriceps exercises. *International Journal of Research in Medical Sciences*, 2(4), 1652–4. <https://doi.org/10.5455/2320-6012.ijrms20141176>
- Bhan, S., Eachempati, K. K., & Malhotra, R. (2008). Primary Cementless total hip arthroplasty for BONY ankylosis in patients with ankylosing spondylitis. *The Journal of Arthroplasty*, 23(6), 859–866. <https://doi.org/10.1016/j.arth.2007.07.014>
- Dieppe, P. A., & Lohmander, L. S. (2005). Pathogenesis and management of pain in osteoarthritis. *The Lancet*, 365(9463), 965–973. [https://doi.org/10.1016/s0140-6736\(05\)71086-2](https://doi.org/10.1016/s0140-6736(05)71086-2)
- Hanks, J., Levine, D., & Bockstahler, B. (2015). Physical agent modalities in physical therapy and rehabilitation of small animals. *Veterinary Clinics of North America: Small Animal Practice*, 45(1), 29–44. <https://doi.org/10.1016/j.cvsm.2014.09.002>
- Hanratty, C. E., McVeigh, J. G., Kerr, D. P., Basford, J. R., Finch, M. B., Pendleton, A., & Sim, J. (2012). The Effectiveness of Physiotherapy Exercises in Subacromial Impingement Syndrome: A Systematic Review and Meta-Analysis. *Seminars in Arthritis and Rheumatism*. Volume 42(3), 297–316. <https://doi.org/10.1016/j.semarthrit.2012.03.015>
- Hattori, K., Takakura, Y., Ohgushi, H., Habata, T., Uematsu, K., Yamauchi, J., Yamashita, K., Fukuchi, T., Sato, M., & Ikeuchi, K. (2005). Quantitative ultrasound can assess the regeneration process of tissue-engineered cartilage using a complex between adherent bone marrow cells and a three-dimensional scaffold. *Arthritis Res Ther* 7, R552-59. <https://doi.org/10.1186/ar1710>
- Jazrawi, L. M., Alaia, M. J., Chang, G., FitzGerald, E. F., & Recht, M. P. (2011). Advances in magnetic resonance imaging of articular cartilage. *Journal of the American Academy of Orthopaedic Surgeons*, 19(7), 420–429. <https://doi.org/10.5435/00124635-201107000-00005>
- Mayoral Rojals, V. (2021). Epidemiology, clinical impact and therapeutic objectives in osteoarthritis. *Rev. Soc. Esp. Dolor* [online]. vol. 28, suppl. 1, pp. 4–10. Epub 08-Mar-2021. ISSN 1134-8046. <https://dx.doi.org/10.20986/resed.2021.3874/2020>
- Riddle, D., & Perera, R. (2020). The western Ontario and McMaster universities arthritis index pain scale demonstrates cross talk from co-occurring pain sites in persons with knee pain: A cross-sectional multicenter study. *Osteoarthritis and Cartilage*, 28, 360–361. <https://doi.org/10.1016/j.joca.2020.02.563>
- Rossi, J., Vitulli, S., Poncet, D., Edouard, P., Largeron, H., & Sangnier, S. (2020). Biomechanical analysis of different knee angle starting positions in nordic hamstring exercise: Preliminary study. *Computer Methods in Biomechanics and Biomedical Engineering*, 23(sup1), S265–S267. <https://doi.org/10.1080/10255842.2020.1815315>

- Serban, O., Porojan, M., Deac, M., Cozma, F., Solomon, C., Lehighel, M., Micu, M., & Fodor, D. (2016). Pain in bilateral knee osteoarthritis – correlations between clinical examination, radiological, and ultrasonographical findings. *Medical Ultrasonography*, 18(3), 318–325. <https://doi.org/10.11152/mu.2013.2066.183.pin>
- Shah Sohil Yunusbhai (2023). "Effects of Quadriceps Combined with Abductor Strengthening Verses Quadriceps Combined with Hamstring Strengthening in Treating Knee Osteoarthritis". 106–113. *Acta Scientific Orthopaedics*
- Spector, T. D., & MacGregor, A. J. (2004). Risk factors for osteoarthritis: Genetics11Supported by Procter & Gamble pharmaceuticals, Mason, OH. *Osteoarthritis and Cartilage*, 12, 39–44. <https://doi.org/10.1016/j.joca.2003.09.005>
- Suzuki, Y., Iijima, H., Tashiro, Y., Kajiwara, Y., Zeidan, H., Shimoura, K., Nishida, Y., Bito, T., Nakai, K., Tatsumi, M., Yoshimi, S., Tsuboyama, T., & Aoyama, T. (2018). Home exercise therapy to improve muscle strength and joint flexibility effectively treats pre-radiographic knee OA in community-dwelling elderly: A randomized controlled trial. *Clinical Rheumatology*, 38(1), 133–141. <https://doi.org/10.1007/s10067-018-4263-3>
- Uthman, O. A., Van der Windt, D. A., Jordan, J. L., Dziedzic, K. S., Healey, E. L., Peat, G. M., & Foster, N. E. (2013). Exercise for lower limb osteoarthritis: Systematic review incorporating trial sequential analysis and network meta-analysis. *BMJ*, 347(sep20 1), f5555–f5555. <https://doi.org/10.1136/bmj.f5555>
- Wittenauer, R., Smith, L. & Aden, K. (2013). Background Paper 6.12 Osteoarthritis. In *Priority Medicines for Europe and the World*. 1–3
- Xiao, K., Ma, J., Zhu, T., Zhang, R., & Xiao, K. (2019). Clinical study on the treatment of knee osteoarthritis with traditional acupuncture combined with intra-articular injection of sodium hyaluronate. *Osteoarthritis and Cartilage*, 27, S223. <https://doi.org/10.1016/j.joca.2019.02.348>
- Xie, Y., Zhang, C., Jiang, W., Huang, J., Xu, L., Pang, G., ... Wang, J. (2018). Quadriceps combined with hip abductor strengthening versus quadriceps strengthening in treating knee osteoarthritis: a study protocol for a randomized controlled trial. *BMC musculoskeletal disorders*, 19, 1–7. <https://doi.org/10.1186/s12891-018-2041-7>

Cite this article as: Raghav, S., Singh, A., Kumar, M., Srivastava, A., & Mani, S. (2023). Effects of Integrated Therapeutic Exercises on Pain and Disability in Medial Knee Osteoarthritis. *Central European Journal of Sport Sciences and Medicine*, 4(44), 55–62, <https://doi.org/10.18276/cej.2023.4-05>