Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 12 [2] January, 2023: 195-202

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

ORIGINAL ARTICLE **OPEN ACCESS**

A Study to Assess The Effect of Quadriceps Strengthening on Kinesiophobia and Function in Osteoarthritis of Knee Using Tampa Scale of Kinesiophobia (TSK) and Western Ontario and Mcmaster University Osteoarthritis Index (WOMAC) -An Interventional Study

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ABSTRACT

Background: Osteoarthritis (OA) is a chronic degenerative disorder primarily affecting the articular cartilage of synovial joints. It is characterized by presence of pain at joint line, stiffness, muscle weakness and decreased functional mobility along with negative psychological attributes like fear of movement or kinesiophobia which leads to activity avoidance thus reducing the patient's overall activity of daily living. Quadriceps weakness is considered clinically important in individuals with OA as it is associated with impaired physical function and increased loading over the joint. Hence, quadriceps strengthening exercises are an important component in exercise regime for patients with OA. The aim of this study was to find the effect of quadriceps strengthening exercise on fear of movement, along with its co-relation to simultaneous change in functional mobility in patients with primary osteoarthritis of knee. Method: The study was conducted on 35 patients with primary OA knee, age 50-60 years. They were selected as per inclusion and exclusion criteria. Patients underwent quadriceps strengthening regimen in the form of combined kinetic chain exercises for 4 weeks (6 days per week). The outcome measures Tampa Scale of Kinesiophobia (TSK) and Western Ontario and McMaster Universities Arthritis Index (WOMAC) were taken prior treatment and at the end of treatment sessions. Results: Data was analyzed by SPSS statistics 20.0 software. Pretreatment and post treatment comparison of TSK and WOMAC was done by Wilcoxon sign rank test. Co-relation of post-treatment score was done by Spearman's correlation coefficient. The result showed statistically significant difference between the pre-treatment and post-treatment scores of TSK (Z= -4.16, p=<0.05) and WOMAC (Z= -4.81, p=<0.05) and positive correlation between the post-treatment scores of TSK and WOMAC (r value=0.86, p=<0.05). Conclusion: The findings suggest that quadriceps strengthening improves functional mobility along with simultaneous reduction in negative psychological attributes like fear of movement or kinesiophobia.

Keywords: *Osteoarthritis, Kinesiophobia, Functional Mobility, Quadriceps Strengthening exercises*

Received 24.08.2022 Revised 14.11.2022 Accepted 18.12.2022

INTRODUCTION

The American College of Rheumatology defines osteoarthritis as "A heterogeneous group of conditions that lead to joint symptoms and signs which are associated with defective integrity of articular cartilage, in addition to related changes in the underlying bone at the joint margins."[1] Osteoarthritis is a leading cause of chronic disability between fourth and fifth decade of life, with prevalence of 22% to 39% in India.[2] The hip joint is commonly affected in a population with western living habits, while the knee is involved more commonly in a population with Asian living habits i.e., the habit of squatting and sitting cross legged.[3] Pathological features of osteoarthritis include the progressive destruction of articular cartilage and the formation of bone at the margin of the joint.[4] The pathophysiology states that osteoarthritic changes are due to imbalance between degradation and synthesis process of the articular cartilage.[5] The degeneration or progressive loss of normal structure and function of articular cartilage is the fundamental predicament of osteoarthritis[6]. The most widely used clinical classification schemes

for Osteoarthritis is based on the radiological appearance of the joint, well known as Kellgren-Lawrence classification of Osteoarthritis. Kellgren and Lawrence defined OA in five grades (0-normal to 4-severe).[1] Another well accepted classification is the criteria of the American College of Rheumatology (ACR). ACR's clinical and radiological criteria includes 1) Knee pain for most days of the prior month, and at least one of the following-a) Age >50-year, b) Stiffness <30 min, c) Crepitus plus osteophytes.[7]

Osteoarthritis is associated not only with poor physical outcomes but also with several negative psychological outcomes such as fear of movement or kinesiophobia.[8] Kinesiophobia is defined as an excessive, irrational, and debilitating fear of physical movement and activity resulting from a feeling of vulnerability due to painful injury or reinjury[9]. Studies have shown that fear of movement has an adverse impact on pain and disability in patients with OA and may cause a barrier in approaching for treatment.[10][11] Patients cope with their condition by avoiding physical activity and this avoidance leads to reduced physical and social activities which in turn increase disability. This cycle-chain of events is called fear avoidance model.[12][13] The study conducted by Heuts *et al*. (2004).[14]on pain related fear in osteoarthritis by using the Tampa scale of kinesiophobia stated that daily functioning influenced the level of pain, and that pain related fear has significant association with functional limitations. Another study conducted by Doury-Panchout et al. (2015)[11]reported that individuals without kinesiophobia walked further than individuals with kinesiophobia when completing the 6-minute walk test, which is suggestive of a significant decrease in knee function and daily functioning. Exercise has been recommended as a core treatment for knee osteoarthritis but despite positive research evidence, 65% of individuals diagnosed with knee OA are non-compliant with exercises[15] and this avoidance of exercise could be related to fear of movement. A reduction in muscle strength is a determinant of pain and quality of life in individuals with knee osteoarthritis with weaker muscle strength directly affecting functional performance.[16] Quadriceps weakness is clinically important in individuals with OA as it is associated with impaired dynamic knee stability and physical function.[17]

Quadriceps strengthening can be achieved through closed kinetic chain or open kinetic chain exercises. However, a study by Alkhazim Alghamdi MA [18] suggested a protocol by combining the two forms and applied the same on osteoarthritic patients. They concluded that combined form of kinetic chain exercises are better than individual open or closed kinetic chain exercises for pain reduction and functional improvement. An electrotherapy modality commonly used for osteoarthritic patients is short-wave diathermy (SWD). It is a high frequency current generated by an oscillator circuit that allows electrons to oscillate at a frequency of 27.12 MHz. The part to be treated is included in a separate circuit, either between two electrodes or close to an induction coil, which is tuned to have the same frequency as the oscillator circuit. Thus, high frequency electrical energy is then transferred to the tissues.[19]

Kinesiophobia in osteoarthritic patients can be assessed by using 17-item Tampa Scale for Kinesiophobia (TSK) questionnaire. Herein, each item is scored using a 4-point likert scale ranging from 1 to 4 (1=strongly disagree and 4=strongly agree). The total score is calculated by adding the scores of the individual items. The Tampa Scale of Kinesiophobia assess activity avoidance and Somatic focus of the individual.[20][21] The Tampa Scale of Kinesiophobia is a brief, reliable and a valid measure to link fear of movement with knee Osteoarthritis,[22] with good internal consistency- 0.68-0.80[23]and a test-re-test reliability of 0.89.[24] To assess pain, stiffness, and physical functional disability in osteoarthritic patients, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scale was used. The pain dimension or scale includes five items asking pain at activity or rest. The stiffness dimension includes two questions. The functional dimension explores the degree of difficulty in 17 activities. Reliability of WOMAC for pain, stiffness, and physical function subscales was 0.68, 0.48, and 0.68, respectively and validity for stiffness is 0.90, physical function is 0.95 and for pain is 0.89.[25]

The need of this study was to study effect of quadriceps strengthening exercises on fear of movement along with co-relation to functional mobility changes in osteoarthritic patients. We hypothesized that there would be significant difference in kinesiophobia and functional mobility before and after quadriceps strengthening exercises in patients with osteoarthritis of knee.

MATERIAL AND METHODS

PARTICIPANTS-

An interventional study was conducted with purposive sampling of osteoarthritic patients from physiotherapy centers in and around Rajkot city. 35 patients, both male and female were taken on the basis of their age being 50-60 and willing to participate, had positive of grade 2 and 3 over Kellgren and Lawrence classification system and those positive of American College of Rheumatology (ACR's) clinical and radiological criteria that includes 1)Knee pain for most days of the prior month, and at least one of the following-a) Age >50 year, b) Stiffness <30 min, c) Crepitus plus osteophyte.[7]

Patients were excluded if they were positive of any of the following- Diagnosed of gout in the knee, rheumatoid arthritis in over a lifetime, Severe dementia or other memory loss or neurological condition, Total joint replacement knee surgery, other hip, knee, ankle or spine surgery or deformity, meniscus tear, or ACL tear in over a lifetime, Fracture or trauma over lower limb or spine in past 6 months, Patients with secondary osteoarthritis.

MEASURES

Total 35 Subjects were taken including both males and females. All patients were explained briefly about the aims and objectives of the study, orientation about whole measurement procedure was also given to the patient.

Each subject's demographic data including name, age, gender, side affected, American college of rheumatology criteria and Kellgren-lawrence grade of knee osteoarthritis were recorded before starting the study.

The Tampa Scale for Kinesiophobia (TSK) and Western Ontario and McMaster University Osteoarthritis Index (WOMAC) scores were recoded before administering the intervention.

The intervention comprised of quadriceps strengthening program along with short wave diathermy for four weeks (six days per week)

EXERCISE PROTOCOL.[18][26]

STATIC QUADRICEPS: The patient was positioned in long sitting with knee extended. Patient was instructed to isometrically contract quadriceps as much as possible without producing pain and instructed to hold for 10 seconds, relaxed and repeated the exercise 10 times. This exercise was carried out by the participants throughout the duration of the study.(figure-1)

LAST 15^0 KNEE EXTENSION: The patient was in supine position. A sandbag was placed under the knee to support it in flexion. The patient was asked to extend the knee only against the resistance of gravity and it was held for 10 seconds. This exercise was carried out by the participants throughout the duration of the study.(figure-2)

UNILATERAL STRAIGHT LEG RAISING: The patient was positioned in supine position with knee extended. To stabilize the pelvis and low back the opposite hip and knee were flexed, and the foot was placed flat on exercise table. The patient was instructed to lift the leg about 45^0 degrees of hip flexion while keeping the knee extended. It was hold for 10 seconds then leg was lowered, the exercise was repeated 10 times. (figure-3) From third week SLR with weight was commenced by strapping an ankle weight equivalent to his/her 10 RM to the ankle region, the patient then lifted the lower extremity to about 45° of hip flexion while maintaining the knee in extension. The contralateral knee and hip were also each flexed. (figure-4)

Wall slides with weights- In a standing position, the participant positioned his back up against the wall with hips and knees flexed to about 60^0 if he was preparing to sit on a chair, the patient held dumbbells in both hands, their weight equivalent to his/her 10RM. This exercise was administered from the third week of the regime. (figure-5)

High sitting knee extension: The patient was in high sitting position on treatment table with knee comfortably flexed and patient was instructed to extend the knee fully and hold for 5 seconds. 3 bouts of 10 repetitions were given. This exercise was only administered only during the fourth week of the regime. (figure-6)

Short wave diathermy[19] was given to all the subjects for 15 minutes. (figure-7)

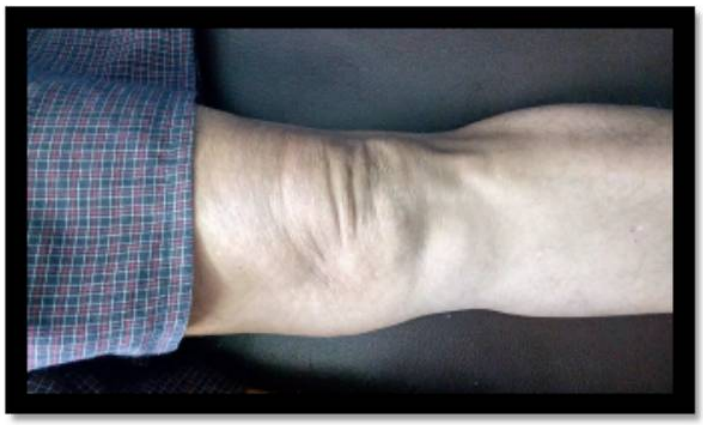

Figure-1 Static Quadriceps

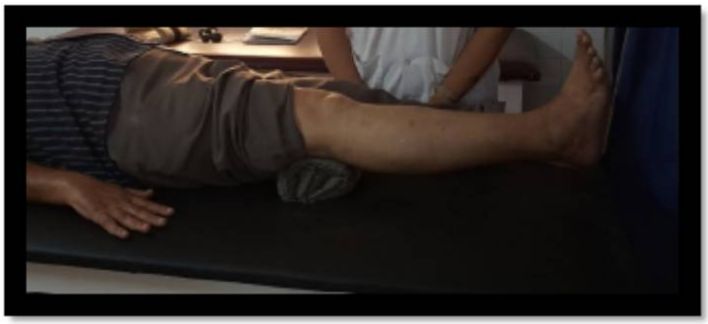

Figure-2 Last 15 knee extension

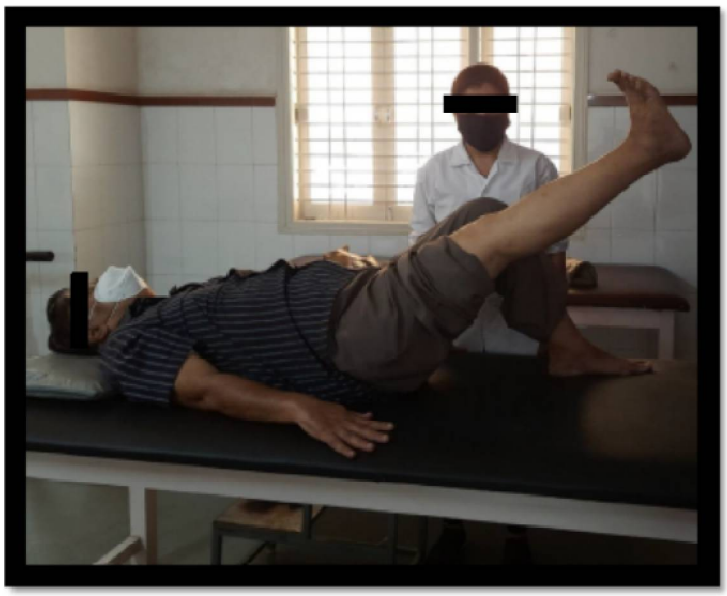

Figure-3 Unilateral Straight Leg Raise

Figure-4 Unilateral Straight Leg Raise with 10RM weight

Figure-5 Wall slides with 10RM weight

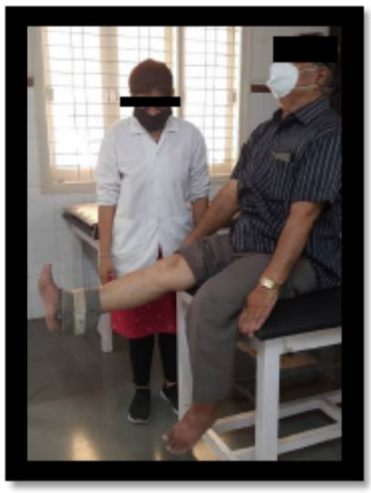

Figure-6 High sitting knee extension with 10RM weight

Figure-7 Shortwave diathermy application

RESULTS

STATISTICAL SOFTWARE AND TESTS

All statistical analysis was done by Statistical Package for the Social Science (SPSS) statistics version 20.0 for windows software.

Normality of data was checked by using Shapiro Wilk test which showed that the data does not follow normal distribution hence nonparametric tests were used to analyze TSK and WOMAC scores.

Means and Standard Deviation (SD) were calculated as a measure of central tendency and measure of dispersion respectively.

Pre-treatment and post treatment data of TSK and WOMAC were analyzed by Wilcoxon signed rank test and Correlation between post treatment data of TSK and WOMAC was assessed by Spearman's correlation coefficient test.

Level of significance (p value) was set to 0.05.

Table 1 Age distribution of osteoarthritis patients

Age distribution	Number of subjects	Percentage
50-55	24	69%
55-60	11	31%

Table 2 Mean, SD and pretreatment and post treatment scores of TSK

Outcome measure	TSK		Z score	p-value	Results
	Mean	SD			
Pre-treatment	41.06	12.07			
Post-treatment	36.29	12.43	-4.16	<0.05	Significant

Table 3 Mean, SD and pretreatment and post treatment scores of WOMAC

Outcome measure	WOMAC		Z score	p-value	Results
	Mean	SD			
Pre-treatment	43.17	16.14			
Post-treatment	35.57	13.36	-4.81	<0.05	Significant

Table 4 Spearman correlation coefficient showing correlation between TSK and WOMAC.

Measure	Spearman Correlation Coefficient (r value)	p-value	Number of patients
TSK and WOMAC	0.86	<0.05	35

RESULT

The above findings suggest a statistical significant difference between pre-treatment and post-treatment scores of TSK (Z=-4.16,p value=<0.05) and WOMAC(Z=-4.81,p value=<0.05). Positive correlation was found between post treatment scores of TSK and WOMAC (r value=0.86, p value=<0.05) Hence, experimental hypothesis is accepted

DISCUSSION

The knee joint is the most vulnerable and susceptible joint. Knee impairments are the common physical problems which impact the activities of daily living and mental health of these patients.[27] Patients' activities of daily living are restricted due to pain and joint deformation associated with OA knee and the formation of osteophytes on articular surfaces will further restrict activities. Therefore, the maintenance of activity through exercise therapy has been presented as a major treatment option for OA knee.[28]

The quadriceps are the largest group of muscles crossing the knee joint and have the greatest potential to generate and absorb forces at the knee. Quadriceps muscle weakness has been reported to contribute to functional impairment and pain in patients with OA knee. Muscle strength declines are result of the atrophy of type IIB fibers, which are responsible for the rapid production of power. Type IIB fibers have demonstrated the ability to hypertrophy after undergoing high tension and fatigue-inducing exercises hence, muscle weakness is correctable with strength training regime.[29] This can be the reason for improvement in WOMAC score.

Avoidance model suggests that pain during activity and fear of pain during activity leads to coping style of activity avoidance. As activity is avoided, muscle weakens further and disability load increases. In addition to activating Type IIB fibers as mentioned earlier, quadriceps strengthening also activates the pain suppressing, β- endorphin system leading to release of endorphins from higher centers. Mechanoreceptors are also stimulated that are associated with myelinated alpha beta and alpha delta at spinal level so sensory input to the central nervous system is favorably altered and the gate control mechanism is activated which regulates the pain perception.[18][29] Positive associations have been

found between increased muscle strength and reduced pain. This can be the reason for improvement in TSK scores. Isometric exercises increase the activation of the muscle around the knee joint by increasing motor unit activation.[29] An SLR in supine combines dynamic hip flexion with an isometric contraction of the quadriceps. The rectus femoris is the primary muscle in the quadriceps group that is active during SLR exercise.[26] Electromyographic analysis of terminal 15 degrees exercise suggested that the medial and lateral vastus are significantly more active during the last 15 degrees of extension than during other arcs of extension.[30]The strengthening regime of this study also includes wall supported squatting exercise. This type of exercise stimulates co activation of muscle groups also stimulate joint and muscle mechanoreceptors, promote dynamic stability[26], and provide greater proprioceptive and kinesthetic feedback.[18] Thus, based on above findings it can be stated that quadriceps strengthening exercises on improve score of functional mobility and reduce score of negative psychological attributes like kinesiophobia.

CLINICAL IMPLICATION

Osteoarthritis of knee is a degenerative musculoskeletal disorder characterized by pain, stiffness, muscle weakness, decreased functional mobility along with negative psychological attributes like fear of movement or kinesiophobia. Fear of movement stems from the belief that movement would increase pain thus leading to avoidance of activity, weakening the muscles further and increasing the overall disability load. Quadriceps has protective function at knee joint and its weakness results in increased loading at the knee joint.

Quadriceps strengthening exercises are an important component of exercise regimen for patients with osteoarthritis as literature suggests which is in line with the result of this study that quadriceps strengthening improve functional mobility and reduce scores of negative psychological attributes like kinesiophobia.

LIMITATIONS

Unequal ratio of male and female in study population. Limited age group, Follow up could not be conducted in the present study.

FURTHER RECOMMENDATIONS

Study can be conducted in patients' age over 60 years. Study can be done with advanced technology.

CONCLUSION

Based on the present study, it can be concluded that conservative treatment approach like physiotherapy in the treatment of osteoarthritis, is beneficial. Including quadriceps strengthening exercises in an exercise regime leads to improvement in functional mobility and reduction in negative psychological attribute like kinesiophobia in patients with primary osteoarthritis of knee.

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CITATION OF THIS ARTICLE

Payal Adwani, Sheetal Patel, Rahul Chhatlani, Yagnik Dave. A Study to Assess The Effect of Quadriceps Strengthening on Kinesiophobia and Function in Osteoarthritis of Knee Using Tampa Scale of Kinesiophobia (TSK) and Western Ontario and Mcmaster University Osteoarthritis Index (WOMAC) -An Interventional Study. Bull. Env. Pharmacol. Life Sci., Vol 12[2] Jan 2023: 195-202.