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Original Research Article

Knee Joint Muscle Flexibility in Knee Osteoarthritis Patients and Healthy Individuals

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ABSTRACT

According to World Health Organization, Osteoarthritis (OA) is the major public health problem. It is the major cause for impairment in function that decreases quality of life (QOL) worldwide. Knee joint is the most common weight-bearing joint affected by OA .Muscle dysfunction is also involved in pathogenesis of knee OA. Muscle dysfunction may arise from either due to quadriceps weakness or of the hamstrings weakness. Flexibility of muscles is an important characteristic, which deceases with individual's increasing age. The lack of muscle flexibility leads to alteration in joint function. Regular stretching of muscles &exercises protocol increase flexibility of muscle, ROM and also provide functional benefits for patients with knee OA and also delay the need for surgical interventions. This article intends to discuss the assessment and comparison of knee joint muscle flexibility in knee OA and Healthy individuals.

KEY WORDS: Knee OA, healthy, flexibility.

INTRODUCTION

According to World Health Organization, Osteoarthritis (OA) is regarded a major public health problem. It is the major causes for impaired function that decreases quality of life (QOL) worldwide. [1]

OA is degenerative disorder which is a progressive in nature affecting the joint cartilage, subchondral bone, and the capsule of synovial joint. Knee osteoarthritis is one of the leading causes for the pain in knee and functional impairments in elderly people which causes decreased joint range of motion (JROM) and muscle flexibility. KOA affects approx 60% of individuals above50 years of age.[2] Knee joint is commonly involved because of its weight bearing nature. Knee joint is easily prone to wear and tear under pressure, especially if already in a pathological and deformed state. Patients with knee OA have reduced capacity of function that can lead to joint pain, stiffness, and loss of muscle strength of the lower extremity muscles. The clinical features are pain in joint, stiffness, decreased range of joint movement, weakness of the quadriceps muscle and proprioception alterations.[3] These features significantly decreases an individual's ability to get up from a chair, walk or climb stairs.[4] Limping, poor alignment of the limb and instabilities can also be found in KOA. Knee joint is the most commonly affected by OA, with the disease mostly affecting the medial compartment of the tibiofemoral joint.[4]

The (ACR)American College of Rheumatology OA criteria were used to standardize the definition of hip, knee, and

hand OA and which consist of joint symptoms, exclusion of inflammatory conditions, and positive joint radiography.[5] Patients with knee OA have different kinematics of gait and kinetics as compared to healthy asymptomatic persons. Alterations in gait includes reduced excursion of knee and also different muscle activity patterns in lower extremity. Pone et al. noted that in patients with PFPS, there is decreased flexibility in the quadriceps was greater than in healthy people.

The Hamstring muscle complex is flexors for the knee joint and OA causes weakness in muscle, atrophy and shortening in this group. Reduced strength in the muscle group causes a progressive loss of function.

The quadriceps and the hamstrings are the two main muscle groups which control knee movement and provide stability. Due to their abduction and/or adduction moment arms the quadriceps and hamstring muscles have the power to provide dynamic frontal plane knee stability.[5] Muscle dysfunction is involved in pathogenesis of knee OA because the lower limb musculature is the natural brace for the knee joint, muscle dysfunction may arise from either quadriceps weakness or weakness of the hamstrings relative to the quadriceps, which can be assessed by the quadriceps: hamstring (Q:H) ratio. Thus, for the evaluation of muscle dysfunction in relation to the knee joint should examine the both quadriceps and hamstring muscles strength as well as the balance of muscle strength.

Zachezeweski has defined muscle flexibility "it is the ability of a muscle to lengthen and allowing one joint to move through particular range of motion".[7] During the pathogenesis of OA chondrocytes, get malfunctioned and which affect the flexibility of the muscles.

Muscle weakness and poor flexibility are the two major components for joint pain and dysfunction.[8] Enhanced flexibility decreases the chances of injury, relieves pain, and improves the overall performance. Weakness of quadriceps is one of the most common impairments in individuals with knee osteoarthritis.

Regular stretching exercises protocol increase flexibility of muscle, ROM and also provide functional benefits for patients of knee OA and may also delay the surgical interventions need.

Objective

To assess and compare the flexibility of knee joint muscles in knee osteoarthritis and healthy individuals.

REVIEW OF LITERATURE

A search of the literature for the present study was performed using Pub med, Google scholar. All the articles were read and the outcome measures were reviewed. The references of identified articles were examined to identify additional articles relevant to the study.

Ali H. Alnahdi, Joseph A. Zeniand Lynn Snyder-Mackler in 2012concluded that muscle impairments associated with knee osteoarthritis (OA) are the primary underlying cause of functional limitations. Muscle impairments in patients with OA are not limited to quadriceps but also involve hamstrings and the muscles of the hip. Quadriceps, hamstrings, and hip muscles are significantly impaired in subjects with knee OA compared with age matched control. Muscle strength, especially quadriceps, is a major determinant of both performance-based and self-reported physical function. This study concluded that patients with knee OA have significant muscle impairments. These impairments in muscles of both hip & knee affect physical function of patients and should be targeted in therapy.[19]

Sara Abolahrari Shirazi, Farahnaz Ghafari Nezhad, Maryam Ebrahimian, Elham Nouraddini, Azadeh Mansoorian , Farahnaz Emami in 2015 compare the flexibility of knee joint muscles in women with knee osteoarthritis and healthy controls. Significant lower flexibility of the bilateral quadriceps muscles was found in patients compared to healthy women ($P<0.05$).

Quadriceps flexibility correlated significantly with pain intensity in patients (P<0.001). Quadriceps stretching is thus a potentially important component of treatment, which may influence pain reduction in these patients. This study hypothesized that quadriceps muscle flexibility in women with knee OA was lower than in healthy women.[20]

Kim L. Bennell, Tim V. Wrigley, Michael A. Hunt, Boon-Whatt Lim, Rana S. Hinman in 2013 concluded that the muscles of the lower limb, particularly the quadriceps, play an important role in the genesis and management of knee osteoarthritis (OA). Muscle weakness has been identified as a potential risk factor for disease development due to increased joint loading. In addition, the presence of OA has a negative impact on the integrity of the structure and function of muscles, potentially further affecting the disease process.[21]

Ayodele Teslim Onigbinde, Oyebukola Akindoyi, Funmilola Adenike Faremi, Adaobi Okonji, Oniyangi Shuaib, Olaitan Olukunmi Lanre in 2013 assess and compare hamstring flexibility of subjects with knee osteoarthritis with their age matched healthy Control. The study concluded that the mean flexibility of apparently healthy individual was significantly higher than that of subjects with knee osteoarthritis [t = 2.84, p<0.001]. This study hypothesized that the mean flexibility of hamstring of patients with knee osteoarthritis was significantly lower than that of apparently healthy individuals.[22]

Jayanta Nath and Kabul Chandra Saikia et al in March 2015 investigated the role of quadriceps muscles and pathophysiology behind the development of knee osteoarthritis. Knowing pathophysiology is very important for effective management of condition. Quadriceps muscles play an important role in pathogenesis of knee OA. Greater quadriceps strength and flexibility is associated with lower risk for development of tibiofemoral OA.[23]

Kristin R. Baker, Ling Xu, Yuqing Zhang, Michael Nevitt, Jingbo Niu,Piran Aliabadi, Wei Yu, and David Felson in 2007 concluded that lower extremity muscle weakness may play an important role in knee osteoarthritis (OA). It has been well established in cross-sectional studies that individuals with symptomatic knee OA weaker quadriceps than do age-matched subjects without knee OA.This study hypothesized that in women, quadriceps weakness was associated with tibiofemoral OA (odds ratio [OR] 0.7, 95% confidence interval [95% CI] 0.4–1.0), patellofemoral OA (OR 0.6, 95% CI 0.4–0.9), and mixed OA (OR 0.4, 95% CI 0.3–0.6). In men, weakness was associated with mixed OA (OR 0.5, 95% CI 0.3–0.8 .So this concluded that there is a relationship between weakness & flexibility of quadriceps muscle and knee OA in all compartments, with the strongest association in mixed disease. Pain may contribute to some of this weakness.[24]

Sheila C O'Reilly, Adrian Jones, Ken R Muir, Michael Doherty et al in 2007 investigated that quadriceps weakness role in knee osteoarthritis. This study hypothesized that subjects with knee pain had lower voluntary quadriceps strength than those without pain (p<0.005). Quadriceps activation was also lower (p<0.005).[25]

W.W.A.S.M. Fernando1, A.H. Wettasinghe and W.D.N. Dissanayake et al in july 2014 Assess the relationship between OA of the knee joint and the Hamstring Muscle Length (HML).HML of those with OA of the knee were significantly lower than the HML of the control group (p<0.05). A significant difference was found in HML between the two legs of the patients (OA leg=141.650± 3.03, non OA leg=146.460±3.02, n=50, p<0.05). There was a significant positive correlation between HML of those with OA.[26]

Ahmed H A-Johani, PT, Shaji John Kachanat hu, Ashraf Ramadan Hafez, Abdulaziz Al-Ahaideb, Abdulrahman D Algarni, Abdulmohsen Meshari Alroumi, Aqeel M. Alenazi, PT in 2014 compare exercise treatments for hamstring and quadriceps strength in the management of

knee osteoarthritis. This study hypothesized that strengthening of the hamstrings in addition to strengthening of the quadriceps was shown to be beneficial for improving subjective knee pain, range of motion and decreasing the limitation of functional performance of patients with knee osteoarthritis.[27]

Ashraf Ramadan Hafez, Ahmed H. Al-Johani, Abdul Rahim Zakaria,Abdulaziz Al-Ahaideb, Syamala Buragadda4, Ganeswara Rao Melam, Shaji J. Kachanathu in 2013 investigated the effect of hamstring and quadriceps strengthening exercises on pain intensity, gait velocity, maximum isometric strength, and activities of daily living of patients with knee osteoarthritis (OA).A total of 20 patients with knee OA, 50 to 65 years of age (57.65 ± 4.78 years), received hot packs, strengthening exercises for the quadriceps and the hamstring muscles and stretching exercises for hamstring muscles. Outcome measures included in this study were the Western Ontario and McMaster Universities OA index questionnaire (WOMAC) scores for assessing health status, outcomes of knee OA; self-reported pain intensity scores, measured by using a visual analogue scale(VAS); the 50 ft. walk test (The measure for velocity of gait and function). There were a significant difference between pre- and post-intervention measures of pain intensity; 50 ft. walk test, hamstring muscle strength, and quadriceps muscle strength. Significant differences in WOMAC scale were also observed. This study concluded that strengthening of the hamstring muscles in addition to strengthening of the quadriceps muscles proved to be beneficial for the perceived knee pain, range of motion, and also decreasing the limitation of functional performance of patients with knee OA.[28]

METHODOLOGY

Sample collected from Guru Jambeshwar University, Physiotherapy Department, Hisar. Total sample size is of 60 patients. There were 2 groups of 30 patients each with included both males and females.

Inclusion criteria:-

1. Age - 40 years to 60 years of patients of Knee OA
2. Knee osteoarthritis as per diagnosed by orthopaedician.
3. Duration of knee pain in patients - days to 5-6 weeks during 6 months prior to study.

Exclusion criteria:-

1. History of low back pain
2. Unilateral knee OA,
3. Trauma to the knee joint,
4. Loss of joint play in tibiofemoral and patellofemoral articulations,
5. Lower extremity fracture and surgery,
6. Neurological deficit or movement disorder,
7. And those who were athletes or who had been treated with physiotherapy during the previous 6 months.

PROCEDURE

Materials used for study-

Goniometer
Stadiometer
Weighing Machine

Measurement of muscle flexibility

Hamstring-For measurement of hamstring flexibility, in supine position passive knee extension tests were done, as follows. The pelvis was immobilized, and the leg which is to be measured was positioned in 90-90 degree of both hip and knee flexion. Then one examiner extended the patient's knee joint passively a point where he/she felt resistance to the movement. And the second examiner placed the centre (fulcrum) of a universal goniometer on the lateral femoral condyle with the stationary arm of the universal goniometer aligned on the patient's lateral malleolus and the moving arm aligned or along with the greater trochanter. All these measurements performed by the same examiner.[9-14]

Quadriceps- For measurement of quadriceps flexibility the examiner flexed the patient's knee joint passively in the prone position. The centre of the universal goniometer was

positioned or placed on the femoral lateral condyle with the stationary arm aligned on the patient's thigh and the moving arm of the universal goniometer aligned on the tibia, and the angle was recorded after at least 90%.[15]

Adductors- For measurement of adductor flexibility- patient is in the supine position, the non-test leg of patient was immobilized at the midline and the other leg was abducted passively until he/she felt firm resistance. The centre of the universal goniometer was placed on the anterior superior iliac spine (ASIS) of patient, and the moving arm of the universal goniometer was positioned along the thigh midline while the stationary arm of goniometer was placed along the imaginary line that connecting the two or both ASIS of patient. [16]

Gastrocnemius- For evaluation of gastrocnemius flexibility the participant was in prone position with his/ her knee extended and the foot hanging from the end of the plinth (couch). Passive ankle dorsiflexion was done by examiner until resistance was felt. The centre of the universal goniometer was placed on the lateral malleolus, and the stationary arm of the universal goniometer was aligned with the patient's leg while the moving arm of universal goniometer was positioned on the lateral side of foot.[16]

Iliotibial band - For measurement of Iliotibial band flexibility the participant is in side lying position. The lowermost limb of patient was flexed and the uppermost (test) limb of the patient was extended and abducted with the knee flexed at 90 degrees. The examiner helped the patient to keep the test limb (uppermost) in the above position and prevent unwanted hip rotation. Then adduction of limb was allowed with the force of gravity. The centre of the universal goniometer was placed on ASIS of patient with the stationary arm aligned with line connecting the both ASIS of patient and the other arm positioned on the longitudinal axis of the adducted extremity.[17,18]

Data Analysis

Data analysis was done using SPSS 16. Data consisted of a total of 60 subjects .The Mean and SD of all variables [Age (years), Weight (kg), Height (cm) and Muscle flexibility (degrees)] were calculated. Comparison of muscle flexibility in patients with knee osteoarthritis and healthy individuals was done using unrelated t-test.

Table 1: Baseline characteristics of the subjects

Group	OA Patient (n=30)	Healthy (n=30)	t Value	p Value
Variable	Mean± SD	Mean± SD		
Age (years)	51.57±6.45 years	48.47±5.75 years	1.9652 years	0.0542
Weight(kg)	73.163±10.266 kg	61.620±4.855 kg	5.5676 kg	0.0001 *
Height(cm)	157.93±8.24 cm	155.37±3.65 cm	1.5594 cm	0.1243

***p value<0.01**

The differences in age and weight in both the groups are considered not to be statistically significant.

Table 2: Comparison of muscle flexibility in patients with knee osteoarthritis and healthy

Group	OA Patient (n=30)	Healthy (n=30)	t Value	p Value
Muscle Flexibility	Mean± SD (in degrees)	Mean± SD (in degrees)		
RT Quadriceps	100.50*±9.13*	128.50*±4.58*	15.0160*	0.0001*
LT Quadriceps	100.83*±8.42*	128.50*±4.38*	15.9683*	0.0001 *
RT Hamstring	25.50*±6.34*	38.67*±5.71*	8.4463*	0.0001 *
LT Hamstring	25.00*±6.57*	37.50*±5.53*	7.9747*	0.0001 *
RT Gastrocnemius	20.17*±3.82*	29.50*±4.42*	8.7421*	0.0001 *
LT Gastrocnemius	20.17*±4.82*	29.33*±4.50*	7.6145*	0.0001 *
RT Adductor	21.33*±4.54*	35.00*±5.09*	10.9848*	0.0001 *
LT Adductor	21.17*±3.64*	33.67*±5.24*	10.7294*	0.0001 *
RT Iliotibial band	21.17*±5.20*	31.83*±3.59*	9.2442*	0.0001 *
LT Iliotibial band	20.17*±5.17*	31.33*±3.46*	9.8381*	0.0001 *

***p value<0.01**

The differences in muscle flexibility in OA patients and healthy people are considered highly statistically significant

RESULT

The descriptive characteristics of participants are shown in Table 1. There were no significant differences between the groups in baseline characteristics.

There were significant differences between groups in flexibility(degrees) of the quadriceps, hamstring, gastrocnemius, iliotibial band and adductor muscles ($P<0.01$) as shown in Table 2.

The quadriceps muscle was found to be most affected having least flexibility followed by hamstring muscle, iliotibial band and gastrocnemius. The adductor muscles were found to be least affected among knee osteoarthritis patients.

DISCUSSION

Osteoarthritis (OA) of the knee is one of the leading causes for knee pain and functional limitations in elderly people. This leads to limited range of motion (ROM) of the joint and muscle flexibility.

Only a few researches have investigated the role of muscle flexibility around knee joint in knee osteoarthritis.

The aim of the present study was to assess the knee joint muscle flexibility in patients with knee osteoarthritis and healthy individuals. The study included both males and females between the age group of 40-60 years. The results of study show that there is decreased knee joint muscles flexibility in knee osteoarthritis patients when compared with healthy individuals.The result of current study suggests that there were significant difference between groups in flexibility of the quadriceps, hamstring, gastrocnemius, iliotibial band and adductor muscles. Our result was consistent with the result of previous study in case of quadriceps muscle. However, the remaining muscles namely hamstring, gastrocnemius, IT band and adductor muscles were also found to have reduced flexibility contrary to the results of the previous study.[20] The flexibility of quadriceps muscle was found to be reduced greatly which could be due to the reason that in order to prevent pain, the patients have a tendency to flex their knee joint less than 100 degrees. Lack of flexibility in quadriceps has a profound effect on patellofemoral joint alignment and may cause greater stress on this structure and thus predispose individuals to developing symptoms.[29,30] To prevent pain, the patients flex their knee joint less than 100 degrees and this behaviour leads to a decline in quadriceps flexibility, patella alta and recurrent pain- all of which create a vicious cycle.[31] Following quadriceps flexibility, the hamstring muscle flexibility is found to be more affected because the hamstring muscle group have tendency to shorten and the tightening results in increased patello-femoral compressive forces, which may eventually lead to patello-femoral syndrome often associated with osteoarthritis. There is also a possibility that pain, muscular spasm and sedentary lifestyle affected the flexibility of IT band, gastrocnemius and adductors.

Limitation of the study

1. Small sample size.
2. The participants in this study were aged between 40 to 60 years, so the result of the study cannot generalized to other age groups.

Future scope of this study

1. Large sample size may be used.
2. Comparison between male and female may be done.

CONCLUSION

Knee joint muscles flexibility was found to be reduced in patients with knee osteoarthritis as compared to healthy individuals and flexibility of quadriceps muscle was most affected

Conflict of Interest- Author declares no conflict of interest in relation to this paper.

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