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RELATIONSHIP BETWEEN CORE MUSCLE ENDURANCE, FUNCTIONAL CAPACITY AND FALL IN OA KNEE PATIENTS WITH COMORBIDITIES

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ABSTRACT

Background:

Osteoarthritis (OA) is a degenerative joint disease involving the cartilage and many of its surrounding tissues. Symptoms of OA include joint pain, stiffness, muscle weakness and limitation of movement. In 2017, 303.1 million cases of Osteoarthritis were reported worldwide with 181 standardized years lived with disability, (95% UI 162.6 to 202.4) for every 100,000 population. In India the prevalence of osteoarthritis is 22% to 39%, among which nearly 45% of women above 50 years have symptoms of OA and 70% aged above 55 years have radiological evidence of OA. The patho-mechanical changes alter the function of core muscle, factors such as aging, degenerative effects of OA, reduced joint mobility & muscle functions may have a prominent effect on the postural stability, balance and functional capacity of an individual.

Methodology:

This was a prospective observational study. 46 participants with OA Knee between 35 to 65 years were assessed for Core muscle strength, functional capacity of lower limb and fallrisk. The

influence of core muscle strength on lower limb function and risk of fall was analyzed among OA patients with and without co morbidities using Pearson's correlation coefficient.

Conclusion:

Patients with KOA along with co morbidities showed significantassociation of trunk flexor endurance with lower limb functions and fall risk.

Keywords: Core Muscle Endurance, Core Muscle stability, Osteoarthritis, Functional Capacity, fall

INTRODUCTION

The knee plays an important role in stabilization of the body in erect position. The function of the knee joint primarily depends upon its static and dynamic stability which comes from the ligaments, and muscles. Osteoarthritis (OA) is multifactorial progressive degenerative disease. It affects the both articular cartilage and subchondral bone. It is the most common cause of pain and functional problems especially seen in aged people. It produce thinning and destruction of the hyaline cartilage of joints, followed by remodeling of underlying bony surfaces. Gradually, they have difficulty in ADL such as walking, squatting, etc. It often happens in weight bearing joints including hip, knee, ankle and rarely in spine, in that the knee joint is most commonly affected in Osteoarthritis. According to recent report there were 303.1 million cases of OA worldwide as of 2017; the new cases of OA Kneereported 181 standardized Years lived with disability, 203 for every 100,000 population [1]. The global prevalence of OA knee was higher in women and increased with age, compared to men. [2][3]. In India the prevalence of osteoarthritis was 22% to 39%, in this nearly 45% of women of 50 over the age of 65% years have symptoms while radiological evidence is found in 70% of those over 55 years [3].The progression of the disease is usually slow but can ultimately lead to joint failure with pain and atrophy of the lower limb muscles. The patho-mechanical changes alter the function of core muscle, onset factors such as aging, degenerative effects of OA, reduced joint mobility & muscle functions may have a prominent effect on the postural stability, balance and functional capacity of an individual.

Need of the study: Osteoarthritis is multifactorial progressive degenerative disease. It typically occurs in older individuals. Symptoms of OA include joint pain, stiffness, muscle weakness and limitation of movement. The core is the central link which provides linkages between upper and lower extremities function. All hip musculatures have their

origin in pelvic and lumbar regions hence compromised core can be responsible for an unstable proximal base which mainly works to influence higher centers to elicit appropriate combinations and quality muscles recruitment for stability as well as mobility. In OA knee the individual will develop the atrophy of the lower limb muscles with gradual changes in core muscle endurance, ultimately controlling lower extremity functional movements, proning for risk of falls. Few literatures show association of core muscle endurance on lower limb functional capacity in OA, however the influence of the foresaid measures on falls with co morbidities and bilateral knee OA were not found within the context of our literature search. Hence it was hypothesizedthattrunk muscle endurance changes affects the functional capacity in OA knee and lead to increased risk of fall.This study aimed to analyze the relationship between core muscle endurance, functional capacity and falls risk in patients with Knee Osteoarthritis.The objectives were to find the association between core muscle endurance and functional capacity in patients with unilateral and bilateral OA knee with and without co morbidities, and to find the association between core muscle endurance and falls risk in patients with OA knee.

METHODS

This was a prospective observational study on Knee Osteoarthritis patients at a tertiary care Centre. After obtaining ethical clearance from the institutional Ethics Committee, patients who volunteered were recruited in the study. Male and female patients between 35-65 years diagnosed as Unilateral and bilateral knee OA, primary or secondary Osteoarthritis, with or without co morbidities like cardio vascular diseases, pulmonary disorders, obesity, diabetic neuropathy were included in the study using convenient sampling technique. The study sample size of 46 was calculated using Western Ontario McMasters University (WOMAC) mean and standard deviation of 0.05 at 95% power of study with $p<0.05$ from previous literature. The study was conducted for a period of 4 months. Knee OA was diagnosed using the Diagnostic criteria committee of the American Rheumatism Association. Patients with altered lower limb length, recent lower limb surgery and lower limb disability were excluded. WOMAC Scale and Falls Efficacy scales were used to measure the functional capacity of lower limb and risk of fall respectively among the participants.

The study was conducted at Department of Physiotherapy, SDUAHER, and Kolar.Demographic data, medical history,

associated medical condition, drug history, clinical presentation of OA like type, grades of OA and associated co morbidities like diabetes mellitus, cardio vascular disease were collected. Further functional capacity was assessed using WOMAC scale.WOMAC osteoarthritis Index is a disease specific, tri-dimensional self-administered questionnaire, for assessing health status and health outcomes in osteoarthritis of the knee joint. The scale has high test-retest reliability with intra-class correlation coefficients of 0.92.[4].WOMAC consists of 24 items divided into 3 subscales on pain, stiffness and physical functions. Disability index is sum of all the index scores with highest score as higher disability[5]. Fall Efficacy Scale (FES) is a questionnaire to assessthe possibility of falling when performing 16 activities. The FES had excellent internal validity (Cronbach's alpha=0.96) as well as test-retest reliability (ICC=0.96)[6]. Core Muscle Endurance was measured, using McGill protocol which included Trunk flexion and extension Test and bilateral side bridge Tests.[7][8]·The therapist demonstrated the various trunk positions required for the test with clear instructions about the performance. Then the participants performed a trail session for each core stability component, to familiarize with the proper technique and procedure. This was followed by warm up activities with mobilityexercise and stretching of major lower limb muscles, which prepared the muscle and joints for a good contraction. The participants performed core stability test with rest period of five minutes between each test components. The participants were encouraged to put maximum effort to hold the specific static position as long as possible and the hold timing was recorded.

For the trunk flexion endurance test, the participantswere in a crook-lying position on the plinth with 60 degrees of trunk flexion,90 degrees of hips and knee flexion, arms crossed over the chest and feet on the plinth. To test endurance, trunk support was removed and the participant was asked to hold the position as long as they can and thehold timing was noted in seconds. For the trunk extension endurance test, the participants were in prone-lying position while pelvis and knees were stabilized to the plinth by stabilization belts. The trunk and upper extremities were supported using a vestibular ball directly in front of the body. Then, the participants were asked to hold a horizontal body position as long as possible with arms crossed over the chest after the vestibular ball was removed and the hold the timing was noted. For the bilateral Side bridge endurance test, the participants were in side-lying position on

the plinth with a lower foot placed behind the upper one with extended knees. The participants held the torso off the plinth supported at elbow and feet. They were asked to maintain the position of the torso and if the hip dropped to the mat, the timing noted.

RESULTS

The data obtained on functional capacity, trunk endurance and falls risk were analyzed at 0.01 level of significance using SPSS statistical software. Descriptive statistics was used to analyze the demographic data, Mean and standard deviation of the above said parameters.(Table 1&2).Pearson's correlation coefficient was used to find the relationship of trunk endurance on lower limb functional capacity and fall risk in patients with unilateral and bilateral knee OA with and without co morbidity. (Table3)Patients with bilateral OA knee showed significant association of trunk endurance withlower limb functional capacity. However the functional capacity of bilateral OA knee patients was in the low risk category.All the OA knee participants showed poor trunk side flexion hold time of less than 20 secs compared to trunk flexion/extension endurance. All the components of trunk endurance were poor in patients with comorbidities.In bilateral OA knee patients trunk flexion and extension endurance was significantly associated with lower limb functional capacity with p value as 0.02 and 0.03, significant at $p<0.05$.Further risk of falls was significantly associated with patients with unilateral OA knee and presence of comorbidities. In bilateral OA knee patients trunk flexion endurance was significantly associated with risk of falls, with p value as 0.003 significant at $p<0.01$.

Table 1: Mean and S.D. of age and frequencies of male and female. (N=number)

Mean (age) ± SD	Male N (%)	Female N (%)
51.28 ± 11.15	27 (59%)	19 (41%)

Table 2: Mean and standard deviation of functional capacity, trunk endurance and falls risk in Knee OA patients. (* secs)

Parameters measured	Knee OA without co morbidity N=23	Knee OA with co morbidity N=23	Bilateral knee OA N=14	Unilateral knee OA N=32
	Mean ± S.D			
Functional capacity	29.30±17.08	36.82± 17.98	44.78± 15.30	27.93 ± 16.43
Trunk flexion Endurance*	49.56± 12.60	34.39± 22.24	41.85± 17.75	42.03 ± 20.42
Trunk extension Endurance*	33.21± 17.54	18.82± 11.9	24.14 ± 19.56	27.12 ± 19.35
Trunk right side flexion Endurance*	21.56 ±13.87	13.52 ±13.64	15.21 ± 14.72	18.56 14.08
Trunk left side flexion Endurance*	20.34 ±12.78	10.52 ±11.48	14.78 ± 13.94	16.03 ± 12.54
Fall risk	31.21± 8.28	37.69± 17.22	41.14± 19.15	31.53 ± 9.59

Table 3: correlation of trunk muscle endurance with lower limb functions and fall risk in patients with Knee OA without co morbidity. *Significant at p<0.01

Outcome measures	Knee OA without co morbidity N=23	Knee OA with co morbidity N=23	Bilateral knee OA N=14	Unilateral knee OA N=32
	P value			
Functional capacity vs trunk endurance	0.29	0.002*	0.06	0.14
Risk of falls Vs trunk endurance	0.10	0.007*	0.08	0.000*

DISCUSSION

The initial stages of Knee osteoarthritis cause pain and the disease progressively leads to severe joint degeneration with swelling, locking of the knee and reduced the lower limb functional abilities. In patients with knee OA, quadriceps and hamstring muscles may gradually get weak with progressive core muscle diffuse atrophy and this eventually affects the core muscle endurance. [9]. The core regulates the movement and stability of trunk and the associated pelvic and hip joint motions. This facilitates the promotion, transmit and manage the kinetics and kinematics of lower limb joint linkages. The co-ordination and stability of the core, pelvis and the lower limb joints demands the functions of lumbo-hip complex and knee peri-articular muscles.[10]. Lack of core muscular endurance might lead to raise in knee joint reaction forces with greater stress during joint motions.Patella femoral arthritis and pain was related to altered trunk stability and patho-mechanical changes in pelvic and hip joint, further influencing knee joint reaction forces [11]. Due to the clinical presentation of OA knee the patients progressively show low physical activity participation. This will potentially cause disuse atrophy resulting in reduced muscle function abilities. [7] .Studies reported that association of diabetes or musculoskeletal, neurological and cardio vascular diseases increase the chance of falls on a greater extent in people with lower limb OA. This impact of falls in older adults with OA has debilitating effects on the health costs of the country [12].

The present study with 46 knee osteoarthritis patients showed significant association with trunk flexor endurance and lower limb functional performance, along with marked risk of fall. A similar studyanalyzed the association of core muscle strength with hip muscle work among knee OA patients and related it to functional activity. It concluded that bilateral knee OA people have weaker core muscle strength as compared to the patients with unilateral involvement.[13].However in the present study significant changes were noted in knee OA patients with

comorbidities like diabetes and cardio vascular disease. The number of bilateral OA knee were only 14 compared to the 32 unilateral knee OA participants in the study group, which could be the probable reason for the poor association between the tested parameters. Besides this, it's evident that patients with knee OA show altered biomechanics of lower extremity and trunk functions due to poor muscle coordination, strength and endurance of the associated muscles in that region. This would elicit more functional declines and increased risk of fall, which is appreciable from the results of this study. The stability of core musculature is responsible for optimizing the functioning of lower extremity. Having sufficient proximal stability would reduce the stress or load over the knee joint. Individuals with good proximal trunk-postural control will automatically reduce loading on the knee joint.[7]. As a result, the core strength ensures strong and co-ordinated movement of the lower limbs. An exercise program aimed at augmenting core muscle activation reduced pain and improved physical function in patients with knee OA and also reported decreased lower limb functional performance leading to fall risk.[10].A study reported that activation of core muscles followed by hip joint agonist contraction reduced trunk flexor and extensor muscle functions leading to lower limb joints dysfunction. Changes in the postural alignments was related to poor paraspinal muscle, abdominal and proximal hip joint muscles resulting in altered kinematics and kinetics of knee joint.[14].

In the present study, patient with bilateral knee OA with co morbidities like hypertension and diabetes mellitus demonstrated significantweak core muscles, reduced functional capacity andgreater risk of fall. From the premise that pain, stiffness, movement restriction are reported with structural changes in OA knee patients the paradigm shift to focus on postural instability, decreased functional independence and falls are being evidenced.[15]. This suggests the need for screening the OA knee patients for associated muscle declines for preventing and controlling the associated functional declines and poor mechanics at an early stage. Inclusion of balance and falls assessment during presentation of OA symptoms becomes inevitable with the evidences from the literature.[16].With the supporting literature resources and from the outcomes of the present study it was found that patients with knee OA progressively attains functional declines. The reason is due to degenerative changes in knee joint, impact of associated medical conditions like hypertension and diabetes mellitus and its functional complications. Future study

can focus on Cross-sectional study to understand the cause effect relationship across various disease stages, analyze the effect of intervention on the other related parameters and confounding factors.The study had limitations, as diverse OA knee population and their associated influences were not studied, given the context of the present study. Instrumental methods for trunk muscle endurance measurement were not used.

CONCLUSION:

The relationship between core muscle endurance, functional capacity and fall risk was analyzed in 46 knee OA patients using MC gill proforma, WOMAC scale and FES. The study showed significant association with trunk flexor endurance and lower limb functional capacity,risk of falls in knee OA patients with co morbidities. This would be due to adverse changes in lower limb proprioception, joint kinematics,posture, balance and muscle functions resulting from clinical presentations and complications of knee OA.

The authors declare no conflict of interests.

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