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The Correlation of Subtalar Varus Angle with Balance, Physical Function and Activities of Daily Living (ADL'S) in Females with Stage 2 or 3 Unilateral Medial Compartment Knee Osteoarthritis (OA)

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Abstract

Context: Osteoarthritis is a non-inflammatory degenerative disorder of joints characterized by progressive deterioration of the articular cartilage and formation of new bone i.e., osteophytes. As knee OA is very common in India especially in females and if we are able to correlate balance, physical function and ADL'S with subtalar angle deviation, a better physiotherapy protocol can be designed. *Aims:* The main objective of this study was to investigate the correlation of balance, physical function and ADL'S with subtalar varus angle (STVA) in females with unilateral medial compartment knee OA. *Settings and Design:* Correlational study design. *Methods and Material:* 30 females with stage 2/3 unilateral medial compartment knee OA, aged in between 40-65 years participated in the study. Assessments were made by the stair climbing test, timed up and go test, WOMAC scale, and goniometric assessment for subtalar varus angle. *Statistical analysis used:* Statistical analysis was done with the help of SPSS software by calculating the Pearson's correlation coefficient. Level of significance accepted is $p < 0.05$. *Results:* The Pearson's correlation coefficient between STVA and physical function is r=0.3830, between STVA and balance is r=0.0632 and between STVA and ADL'S r=0.1438. *Conclusions:* There is a low correlation present in between STVA, physical function, balance and the ADL'S.

Keywords: Subtalar Varus Angle; Balance; Physical Function; ADL'S; Medial Compartment; OA.

Introduction

Osteoarthritis is biomechanical, morphological and molecular changes of both cells and matrix which lead to fibrillation, softening, ulceration and lose of joint cartilage, sclerosis and eburnation of subchondral bone, osteophytes and subchondral cysts [1, 2].

Knee OA is chronic painful state affecting considerable number of old age people in all over the world. Because many physical changes occur with age and structures of body become more rigid and tightened, so the possibility of more wear and tear occurs very easily. Due to the balancing problems, bad posture frequently occurs because of which more deformity arises [1, 2].

People with OA of knee joint suffering from pain and disability are not able to perform their activities of daily living (ADLs). OA in Medial compartment of knee is very common and has been attributed to increase load transmitted across medial compartment of knee joint [3].

Many factors are related with occurrence and succession of knee OA; the cause of knee OA is not very clear. Many researches are going on but there is much confusion regarding the aetiology of knee OA. Knee OA is a commonly encountered pathological joint affection that leads to pain, problem in balance and physical function [4].

OA in particular causes degeneration of the knee joint, affecting the integrity of the joint arrangement and further disturbing the joint mechanics. This leads to the adjustment of the whole limb system in an alternate manner leading to pathogenesis [5].

Important factors such as physical function, balance and ability to perform ADL's can help clinicians in designing rehabilitation protocols for patients with knee OA. Physical function in people with OA knees may be affected when if there is balance dysfunction because balance is essential for daily activities. Furthermore static and dynamic balance may also affect the ADL activities [6].

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Subtalar varus or rear foot varus or calcaneal varus alignments may be contributed to medial compartment knee OA. In the presence of subtalar varus angle, knee adduction moment is exaggerated, so there are more rotations on tibia and femur and more medial joint loading. Bio-mechanical factors related with joint loading have been the focus of advanced researches as an important element in the progression and severeness of knee OA. As we know body biomechanics is the only important factor because of which the changes occurs in body alignments or misalignments [7].

Musculoskeletal problems are painful and may affect life style of patients in the society, hampering their activities of daily living. Prevalence of knee OA in India is higher in urban community being 5.5% and lower in rural community being 3.3%. Knee osteoarthritis is a very serious problem in females; the probability is more in females because of factors related to the physiology and metabolism of body [8].

The pathomechanics further aggravates in females because of their daily routine work which includes knee bending positions leading to more wear and tear of articular surfaces and more inflammation and deformity. Also faulty walking patterns of individual increases the knee adduction moment which may lead to more medial line joint forces and more medial knee joint pain and varus deformity [9].

However because of increased medial joint loading in case of subtalar varus misalignments there may be exaggerated load in the medial compartment of the knee, leading to a greater and faster degeneration compromising the balance, physical function and ADLs.

Knee involvement occurs less frequently than hand OA, although similarly it is more common in women, with female-to-male ratios varying between 1.5:1 and 4:1. Prevalence rates for knee OA, based on population studies in the U.S.A., are comparable to those in Europe.

Osteoarthritis is a common problem in India which has a probability of 22-39%, and has percentage of 30% among all joint diseases. It is commonly occurs in fourth and fifth decades of life [11].

As the probability of knee OA is very high and it causes disability at a large scale in the society. Thus there arises a need to ever improve the treatment. Further if correlation can be established between the studied variables the treatments can focus on corrective measures for subtalar angle misalignments.

This study aimed to investigate the relationship between subtalar varus angle and balance, physical function and ADLs in female patients with stage 2 or 3 unilateral medial compartment knee OA.

Subjects and Methods

Thirty female patients with unilateral medial compartment knee OA referred by physicians at Aruna Asif Ali Hospital, Delhi for outpatient physiotherapy participated in this study, which was conducted between December 2014 and March 2015. Consecutive female patients with complaints of knee pain with or without difficulty to walk were screened for eligibility. Out of 55 patients screened for enrolment in the study, 15 were excluded (Fig 1.). Patients meeting the eligibility criteria (Tab. 1) filled the informed consent form.

Table 1: Inclusion and Exclusion Criteria

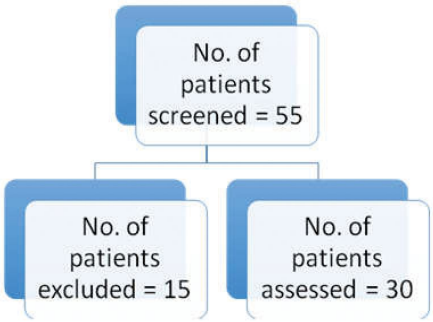
Inclusion Criteria [7]	Exclusion Criteria [7]
Age – 40 to 65 years	Related diagnosis of pre patellar bursitis or Tendonitis
Gender – females	Any previous knee surgeries, ligamentous knee injury or laxity
Clinicallyd iagnosed patient of knee OA with unilateral medial compartment involvement.	Sinding Larsen's disease
Stage of OA – Stage 2 or 3	Plica syndrome
	Osgood Schlatter's disease
	Any Infections
	Any Malignancy
	Patellar or tibiofemoral dislocation
	Any other orthopaedic condition which affect balance, PF and ADLs except unilateral medial compartment knee OA
	Any neurological or cardiac problem

Assessments

Following this all the 30 female participants were assessed for:

a. Balance by the stair climbing test [6] which was performed by the participants by ascending and descending a flight of three stairs bare footed.

Fig. 1: Flow diagram for patient participation



A wooden staircase that had three steps of 20 cm height on the ascending side and four steps of 15 cm height on the descending side was used for the test. On the command "Go", subject commenced the test, ascending and then descending the flight of stairs at a self selected comfortable pace.

The participants score was calculated as the time between instances when the first foot was off the floor to ascend the flight of stairs and when both feet were on the floor after completing the descent. The dependent variable was time taken in seconds to complete the test.

The SCT has shown to have test-retest reliability of 0.88 [6].

b. Physical performance by the Timed Up and Go test [6] was performed bare footed. Participants were asked to sit on a chair with arm rests and instructed to rise immediately from the chair without using the arms for support on hearing the command "Go". Participants then walked at a self-paced, comfortable speed for a distance of 3 meters on a marked, level corridor and returned through same distance to sit on the chair. The scores of the dependent variable for the test was the time in seconds taken to complete the task. The reliability (intra-class correlation coefficient= 0.99), content validity and predictive validity of the TUG test have been established [6].

c. The WOMAC (Westren Ontario and McMaster Universities) index uses 24 parameters to assess patients with osteoarthritis of the hip or knee. It can also be used to monitor the course of the disease or to determine the effectiveness of anti-rheumatic medications. 17 parameters come under ADLs or Physical function component. Other components are of pain and stiffness [15].

d. Subtalar angle is measured in the standing position with a goniometer as the angle between the lower leg and the calcaneus. The stationary arm of goniometer was aligned with line bisecting lower leg and moving arm is aligned on the bisecting line of calcaneus. (The intra-class correlation coefficient ICC 2, k was selected where 'k' denoted as the reliability of the mean of 'k' measurements.) The coefficient for standing rear foot angle is 0.960 as yielded by ICC (2, k) [13] (Fig. 2).

Fig. 2: Subtalar angle measurement with goniometer

Results

Pearson correlation coefficient [12] was calculated to study the relationship between various variables, using the SPSS software. Thirty female patients in the age group of 40 to 65yrs with unilateral medial compartment knee OA of grade 2 or 3 participated in the study. This study has 30 female subjects aged in between 40 to 65 years & have grade 2 or 3 unilateral medial compartment knee OA (Fig. 3).

The values (Mean+/-SD) of the four factors considered in the study are Subtalar varus angle 6.10+/-1.42, Balance 20.93+/- 4.04, physical performance 12.30+/- 5.40 and ADLs 46.10+/- 4.16.

A positive low correlation (r= 0.3830, p<0.05) was seen between subtalar varus angle and physical function with the help of goniometric readings and Timed Up and Go Test readings. A positive little correlation (r= 0.0632, p<0.05) was seen between subtalar varus angle and balance with the help of goniometric readings and stair climbing test readings. A positive little correlation (r= 0.1438, p<0.05) present in between subtalar varus angle and ADLs with help of goniometric readings and WOMAC scale readings (Table 2, Fig. 4).

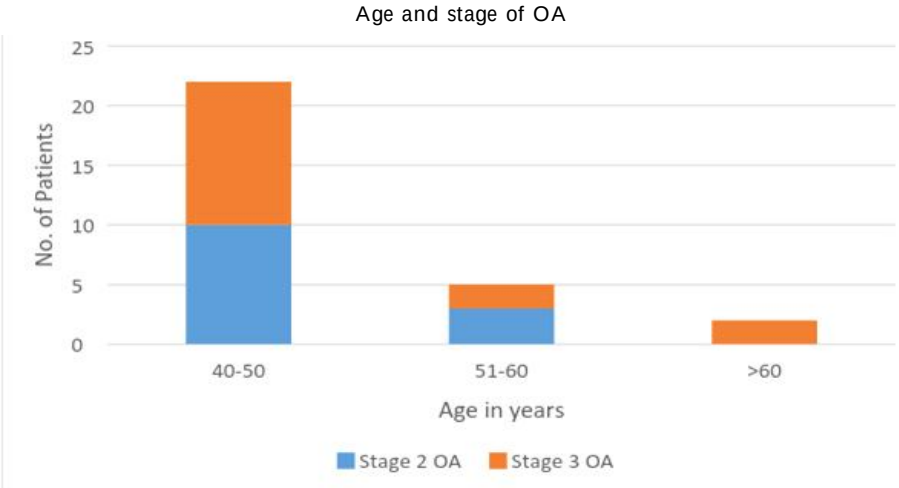


Fig. 3: Age and stage of OA

Table 2: Correlations matrix for participants with unilateral knee OA

		STVA	TUG	OD SCT	WOMAC
STVA	Pearson Correlation	1	.385 *	.063	.144
	Sig. (2-tailed)		.036	.740	.448
	N	30	30	30	30
TUG	Pearson Correlation	.385 *	1	.367 *	.146
	Sig. (2-tailed)	.036		.046	.442
	N	30	30	30	30
SCT	Pearson Correlation	.063	.367 *	1	.268
	Sig. (2-tailed)	.740	.046		.152
	N	30	30	30	30
WOMAC	Pearson Correlation	.144	.146	.268	1
	Sig. (2-tailed)	.448	.442	.152	
	N	30	30	30	30

*. Correlation is significant at the 0.05 level (2-tailed).

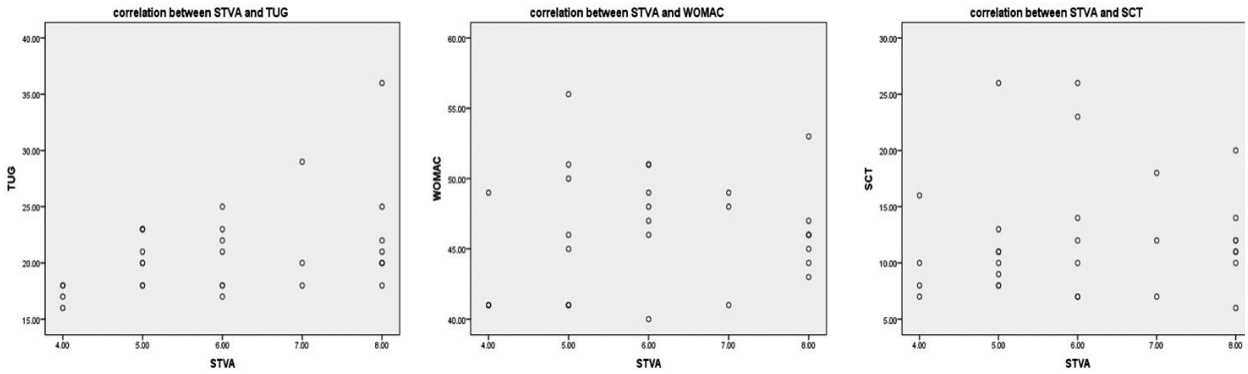


Fig. 4: STVA: Subtalarvarus angle; TUG: Timed up and go test timings (in sec.); WOMAC: Western Ontario Macmaster Osteoarthritis Index score; SCT: Stair climbing test timings (in sec.)

Discussion

The aim of this Paper was to study the relation between balance, physical function and ADLs with Subtalar varus angle (STVA) in females with stage 2 or 3 unilateral medial compartment knee OA.

A positive little correlation was seen between STVA and balance. It is indicative that STVA alone cannot affect balance in population of medial compartment knee OA, some other factor should be considered in conjunction. In a study by Babatunde O.A. Adegoke et al., (2012) [6], it is stated that in patients with knee OA, ageing process has a direct correlation with balance dysfunction i.e., more the age more will be the balance dysfunction but in our study, we have taken wider age range (40- 65 years), which could be a reason why there is little correlation between STVA and balance [6].

Another factor for balance impairment is the quadriceps muscle strength studies have shown that balance impairment decreases with improvement in the quadriceps muscle strength as it plays a significant role in opposing the knee adduction moment which is the major factor governing the medial knee joint loading [3, 6]. Also the STVA is an important contributing factor for producing knee adduction moment [14]. Thus along with STVA, quadriceps muscle strength is an important factor to be studied in knee osteoarthritis patients with balance impairment [14].

A positive low correlation is present between STVA and physical function. As known with ageing process the knee joint synovial fluid is gradually reduced leading to increased cartilage wear and tear. Thus this increases the physical dysfunction experienced by the patients [6].

Patel Birenkumar Jagdishbhai et al (2009) [7], in their study found a significant correlation between STVA and disability in patients with patellofemoral arthritis. The author used WOMAC scale for disability and discussed about the excessive subtalar joint pronation, which is a compensatory mechanism for rear foot varus and subtalar joint pronation is required to compensate any bony deformity but if this subtalar pronation is prolonged and excessive, then it prevents the supination of subtalar joint which is required for external rotation of tibia in mid- stance but a constant tibial internal rotation is present because of excessive subtalar pronation, so to compensate this lack of tibial external rotation as a result of abnormal pronation, the femur is internally more predisposed for patellofemoral pain [7]. But, in the medial compartment knee OA, knee adduction moment which is generated by the combination of the ground reaction force, which passes medial to the centre of knee joint, and the perpendicular distance to this force from the centre of the joint, is the main factor which is balanced or eliminated by the quadriceps muscle, so thus the quadriceps muscle strength must be considered [3].

Further studies can group patients according BMI, quadriceps strength and narrow age group to better correlate the subtalar varus angle with the factors. In addition, the study can be replicated with a larger sample size with inclusion of male population, utilizing sophisticated and advanced instruments for balance, physical function and ADLs assessment.

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