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Correlation Between Tibial Torsion With Knee Extensors Strength In Osteoarthritis Of Knee Joint: An Observational Study.

SUBMITTED TO

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INTRODUCTION

Osteoarthritis is a condition which is also referred to as 'Degenerative Joint Disease'. It causes thinning and erosion of articular cartilage. Two predominant pathological features once defined OA: the progressive destruction of articular cartilage and the formation of bones at the margins of joint. OA is now recognized as a disease involving the entire joint including the periarticular musculature. Accordingly, the impairment, activity limitation, and participation restrictions related to OA extend far beyond the perimeters of synovial joint.[1]

The prevalence of O.A increases with age, increasing the original load across the articular cartilage and or affecting the material properties and the remodeling process of the cartilage and thereby its ability to

withstand load. In daily activity, a moving knee often encounters impulsive loading repetitively, a condition that requires great stability to protect the joint. During normal functional activities, this stability is primarily provided by bony geometry and active muscle contraction whereas passive stabilizing forces largely at the extremes of the joint motion.[2]

Among all OA categories, medial compartment knee OA has accounted for 67.8% in the eastern population and 85.8% in western population. Torsional deformities of tibia are often associated with advanced (OA) of the knee. The more vulnerability of developing knee OA in the medial compartment was linked to higher joint load on the medial than the lateral part of the knee. Joint malalignment, besides being a risk factor associated with knee joint load distribution during weight bearing activities, was also regarded as predictor to cartilage loss and knee OA progression.[3]

Torsional deformities of the tibia are often associated with advanced osteoarthritis of the knee. Also, tibial torsion has been suggested as the etiological factors of osteoarthritis. Tibial torsion has been suggested as the etiologic factors of Osteoarthritis. Staheli reported that very few of the torsional deformities, which are common in childhood, continue in adult life. There is evidence to suggest that it is associated with OA of the knee, with respect to certain ethnic groups and genders.[4]

Sometimes the external torsion is smaller in some individuals, but they would have an increased malalignment as the disease progressed in the medial compartment. [5] The successful treatment of rotational deformities of the lower limb must be based on accurate diagnosis. Current management of knee osteoarthritis (OA) is predicted on symptom resolution and restoration of the mechanical axis. Tibial torsion has been shown to differentiate knee OA subjects from controls and was associated with knee OA disease progression. Tibial torsion is thought to increase compressive and shear load in the medial compartment of knee. [6]

The unstable patellofemoral joint has also been associated with either a primary or secondary lateral tibial torsion.[7] The internal knee varus moment compresses the medial knee joint and adducts the tibia during gait resulting in contracted medial compartment compressive load. This has been associated with medial knee osteoarthritis progression.[8]

According to Jennifer hicks, Allison Arnold et.al. have postulated that excess tibial torsion reduces the ability of muscles to extend the joint. Also, they concluded that excess tibial torsion may affect the dynamic capacity of muscles to extend the joints during gait. The multiarticular nature of the body means that tibial torsion can affect the capacity of other lower limb muscles to extend the knee joint. [9]

In people having symptomatic osteoarthritis of the knee, quadriceps muscle weakness is common and is widely believed to result from disuse atrophy secondary to joint pain. Even exercises to strengthen the quadriceps may relieve joint pain in persons with osteoarthritis of knee the role of periarticular muscle weakness in the pathogenesis of joint pain and disability in these persons is poorly understood. Also, the

possibility that muscle weakness is an etiologic factor underlying the pathologic changes of osteoarthritis has seldom been considered. [10]

One of the factors contributing to knee pain other than radiographic knee osteoarthritis maybe quadriceps muscle weakness. By far strength has been used as a great clinical marker of sarcopenia. [11]

In individuals with knee osteoarthritis, decreased quadriceps strength is frequently observed and has been associated in cross sectional studies with both greater knee pain along with impaired physical function. Reduced quadriceps strength was also associated with increased incidence radiographic knee OA in women, but not among men. Although, in women with established knee OA, quadriceps strength did not affect the risk of radiographic progression. [12]

Knee extensor muscle strength is one of the factors which can be modified in case of knee osteoarthritis, as low knee extensor strength has been commonly seen in individuals with knee OA. According one meta-analysis low knee extensor strength has shown incidence of radiographic disease.[13]

NEED FOR STUDY

Osteoarthritis is one of the major condition causing thinning and erosion of articular cartilage. Also, in osteoarthritis there is regular wear and tear of articular cartilage causing formation of osteophytes in and around the knee joint.

But in aged individuals due to advance ageing, occupation, abnormal pattern and ADLs will lead to excessive loading of knee joint. Because of this increased loading people may experience crepitus, swelling, knee pain reduced ranges, etc. External forces acting on the knee are increased causing excessive loading resulting in tibial torsion and malalignment of lower limb. One of the factors contributing to knee pain other than radiographic knee OA may be quadriceps weakness.[11]

Also, in some studies they have stated that quadriceps muscle weakness is the leading cause for development of knee OA. Persistent quadriceps weakness will lead to osteoarthritis of knee joint which if not prevented may result in tibial torsion. Previous researchers have postulated that excess tibial torsion reduces the ability of muscles to extend the joint. [9]

So, the need arises to find out correlation of tibial torsion with knee extensors strength among OA patients.

REVIEW OF LITERATURE

1. **Huang c, Chan PK, Chiu KY, Yan CH, Lai CW conducted a study on knee joint loadings are related to tibial torsional alignments in people with radiographic medical knee Osteoarthritis and** concluded that this study investigated the associations between knee torsional alignments and kinetic properties during early stance in people with medial compartment KOA. Although the finding revealed an association between tibial torsion and KAM in subjects with moderate KOA, the results did not support our hypothesis that tibiofemoral rotation would affect external knee movements.

2. **Yagi T, Sasaki TE, conducted a study on tibial torsion in patients with medial-type osteoarthritic knee** and concluded that Computed tomography measurements of tibial torsion were evaluated in 85 patients with medial type osteoarthritic knees and in 24 normal adults. Although there was no difference in degrees of femoral torsion or knee joint rotation, external tibial torsion was observed to have a mean value of 11.3 degrees, significantly smaller than the 23.5 degrees observed in the normal adults ($p<0.01$).

3. **Akalin Y, Ozcelik A, Kose NU, Seber S. conducted a study on Rotational alignment of the lower extremity in adults: no relationship with osteoarthritis of knee was proved** and concluded that although valgus and varus deformity of knee joint investigated enough 85 patients were evaluated for measurement of acetabular anteversion, femoral torsion, rotation of knee and tibial torsion and femoro-tibial alignment. The study was not able to show any association between knee osteoarthritis and rotational alignment of the lower limb.

4. **Mullaji AB, Sharma AK, Marawar SV, Kholi AF, conducted a study on Tibial torsion in non- arthritic Indian adults: a computed tomography study of 100 limbs and** concluded that Indian limbs have less tibial torsion than Caucasian limbs, but was comparable to Japanese limbs. 100 non arthritic limbs of 50 Indian adults were included. No significant difference was found in male and female subjects. Value of tibial torsion was less than in Caucasian limbs but was comparable to Japanese limbs when studies using similar measurement technique were compared.

5. **Malekafzali S, Wood MB, conducted a study on Tibial torsion- a simple clinical apparatus for its application to a normal adult population and** concluded that a new simple goniometric device, designed for the measurement of tibial torsion provides simple and reliable means of quantitative tibial torsion. Data comparing values obtained by this apparatus are comparable to values obtained by roentgenographic methods.

6. **Heidari B. conducted a study on Knee Osteoarthritis prevalence, risk factors, pathogenesis, and features** and concluded that incidence of knee OA is raising by increasing average age of general population. 2282 elderly Japanese people aged >60 years were investigated and found high prevalence of radiographic of knee OA.

7. **Pai YC, Rymer WZ, Chang RW, Sharma L. conducted a study on Effect of age and osteoarthritis on knee proprioception, and** concluded proprioception declines with age and is further impaired in elderly patients with knee OA. 30 patients with bilateral knee OA were included and found that Poor proprioception may contribute to functional impairment in knee OA.

8. **Charles Slemenda, DrPH Kenneth D. Brandt, MD conducted a study on Quadriceps weakness and Osteoarthritis of the knee, and** concluded quadriceps weakness exists in some persons who have osteoarthritis in the absence of either detectable muscle atrophy or joint pain. 462 subjects were included and found that knee extensor weakness may be a risk factor for the initiation and progression of damage to articular cartilage and other tissues in knee with osteoarthritis.

9. **Jenifer Hicks, Allison Arnold, Frank Anderson, conducted a** study on The effect of excessive tibial torsion on the capacity of muscles to extend the hip and knee during single limb stance and concluded

the capacity of both soleus and posterior gluteus medius to extend the knee decreased by 50% with a 60% external deformity. 821 patients were examined and found subjects with external tibial torsion deformity of 30° or larger had a greater likelihood of walking with a crouch gait.

10. **M. S. Turner, I. S. Smillie conducted a study on**, The effect of tibial torsion on the pathology of he knee and concluded that the relation of torsion to panarticular disease of the knee remains the most significant observation.

AIM AND OBJECTIVES

Aim:

To find out the correlation between tibial torsion with knee extensors strength in knee osteoarthritic patients.

Objectives:

Primary Objectives:

To assess tibial torsion using goniometry.

- To assess the strength of knee extensors in osteoarthritic patients.
- To find out correlation between tibial torsion along with knee extensor strength in patients affected with knee osteoarthritis.

Secondary Objectives:

- To find out which compartment of knee joint is more affected using radiographic images.

MATERIALS AND METHODOLOGY

Methodology:

- Study Design- Observational Study.
- Sampling Method- Purposive Sampling.
- Sample Size (n)= 47.
- Study Area- In and around Latur and Physiotherapy OPD.
- Study Duration- 6 months.

Materials:

plinth

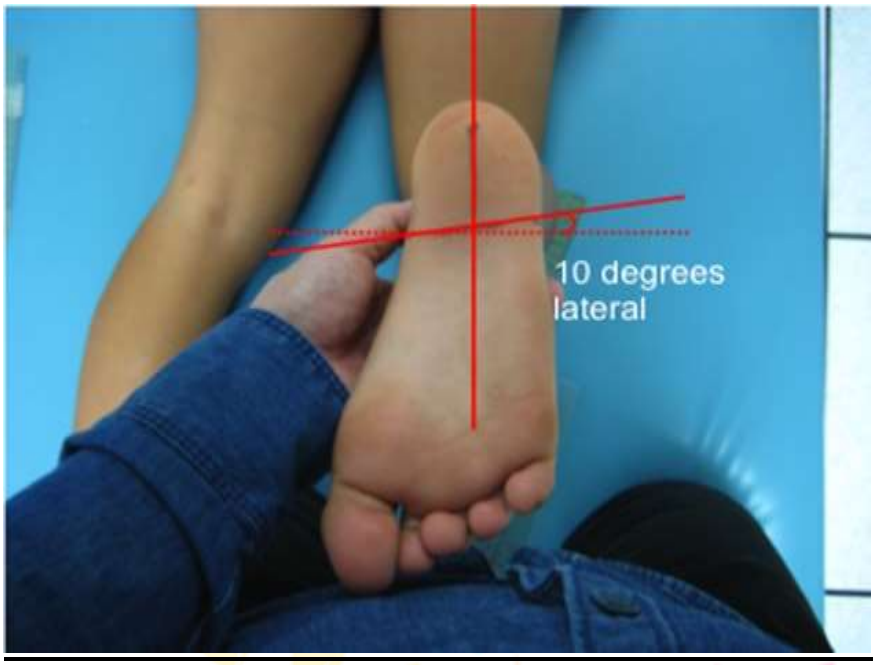
Recording sheet, goniometer, pen

OUTCOME MEASURE:

DEGREE OF TIBIAL TORSION. USING GONIOMETER

Patient should be in comfortable position. And should be Positioned in a prone lying. The knee of the patient should be flexed to 90°. Now, draw an imaginary line along the tibial bone i.e., tibial axis. Take another imaginary line perpendicular to or passing from both malleoli. Measure the torsional angle obtained.

- Sensitivity – 94%
- Specificity – 93%
- Reliability – 0.98
- Validity – 0.97-0.98



Assessment of tibial torsion using goniometer

Inclusion And Exclusion Criteria

Inclusion Criteria:

- Age group 60 to 80 years.[10]
- Both male and female.[4]
- Diagnosed case of OA knee.[13]
- Stage 2,3 OA knee patients (according to Kellgren and Lawrence plain radiographic classification) (Stage 2- definite osteophytes and possible joint space narrowing, Stage 3- moderate osteophytes, definite joint space narrowing, some sclerosis, possible bone-end deformity).4
- Subjects who are able to place their knee in 90 degrees.
- Haemodynamic stable of patient.
- Functionally independent patient.

Exclusion criteria:

- History of recent knee surgery.[9]
- Hyperextension of knee joint.
- Deformities of lower limb (e.g., Knee joint flexion contracture).
- Deficit in balance control related to neurological problem (e.g., Ataxia, Parkinsonism)

HYPOTHESIS

- **Null Hypothesis:**

There is no correlation between tibial torsion with knee extensors strength in patients with knee osteoarthritis.

- **Alternative hypothesis:**

- There is correlation between tibial torsion with knee extensors strength in patients with knee osteoarthritis.

PROCEDURE

The study was approved by institutional ethics committee of SVSS Latur College Of Physiotherapy for the use of human subjects in research. Informed consent was taken from all the participants. The subjects who were referred to physiotherapy department also from other hospitals in and around Latur were screened according to Inclusion and exclusion criteria. These subjects were a diagnosed case of OA and they had been informed about the study and procedure.

The procedure was explained to the subjects who fulfilled the inclusion criteria. Before proceeding to task a written consent had been taken from them. Tibial Torsion of both the knees were measured using a goniometer. Patient was asked to lie down in prone position on mat or couch. Patient's knee was flexed to 90°. Then an imaginary line was drawn along the tibial bone i.e. tibial axis. Another imaginary line which was perpendicular to or was passing across both the malleoli was drawn. The angle obtained was measured. MMT of knee extensors were assessed using manual muscle testing. The patient was in high sitting position such that the knee was flexed to 90° and was asked to extend the knee against gravity for grade 3. Radiographic images were assessed. Data was collected and analyzed and statistical analysis was done.

Image 1: Measurement of tibial torsion in female subjects.

Image 2 : Measurement of tibial torsion in males subjects.

Image 3: Assessment of MMT for knee extensors.

STATISTICAL ANALYSIS AND INTERPRETATION

Table 10.1: Age wise distribution of patients

Age Group(yrs)	No of patients	Percentage
60-69 yrs	38	80.85
70-79 yrs	7	14.89
80-89 yrs	2	4.26
Total	47	100
Mean±SD	65.19 ± 5.78(60-85 yrs)	

Graph 10.1: Age wise distribution of patients

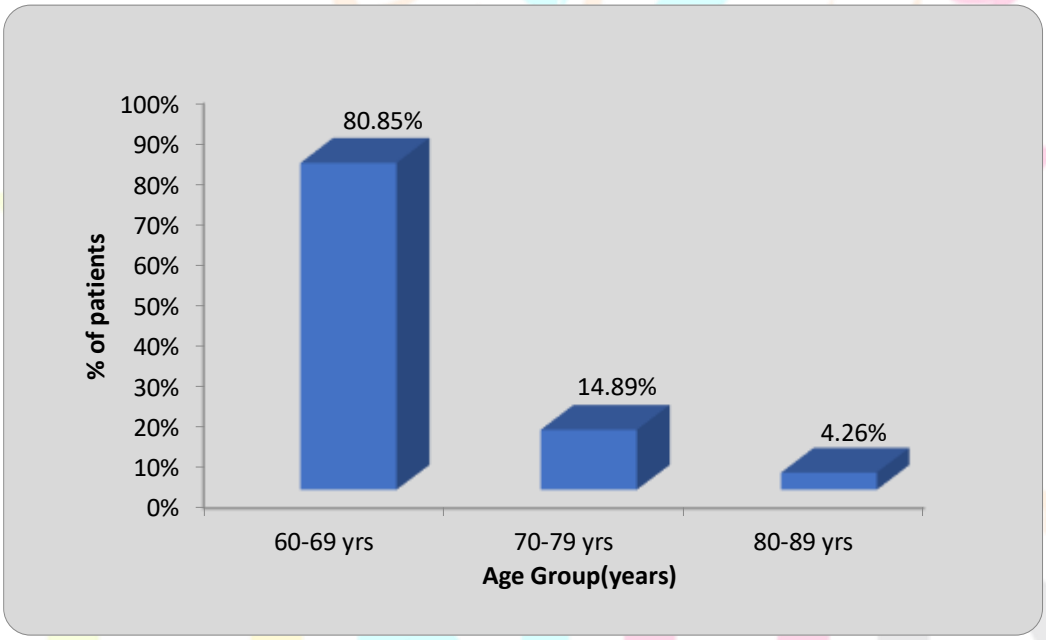


Table 1 and graph 1 shows age wise distribution of patients with knee OA which shows that 38 patients from 60 – 69 age group had knee OA, 7 patients from 70 – 79 years of age group had knee OA and 2 patients from 80 – 89 years of age group had knee OA.

Table 10.2.1: Gender wise distribution of patients

Gender	No of patients	Percentage
Male	24	51.06
Female	23	48.94
Total	47	100

Graph 10.2.1: Gender wise distribution of patients

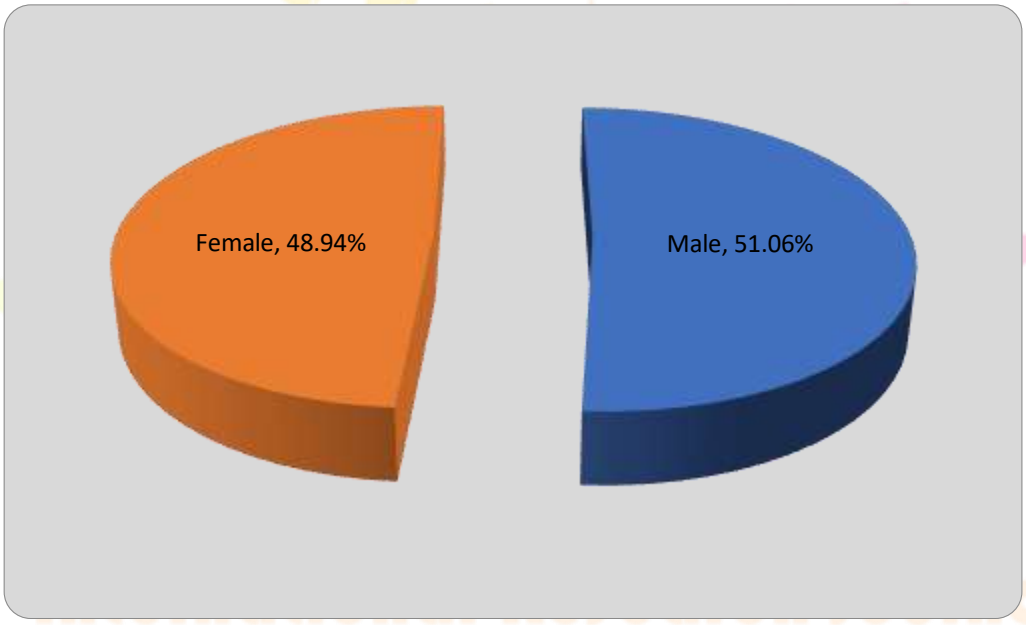


Table 2 and graph 2 shows gender wise distribution of patients with knee OA out of which number of males were 24 and their percentage was 51.06 %. Number of females were 23 and their percentage was 48.94 %.

Table 10.3.1: Assessment of Torsion using Goniometer

Graph 10.3.1: Assessment of Torsion using Goniometer

Ranges	Tibial Torsion			
	Right	Percentage (RT)	Left	Percentage (LT)
8°	1	2.12%	4	8.51%
9°	2	4.25%	2	4.25%
10°	7	14.89%	11	23.40%
11°	4	8.51%	5	10.63%
12°	8	17.02%	12	25.53%
13°	13	27.65%	6	12.76%
14°	8	17.02%	5	10.63%
15°	4	8.51%	2	4.25%
Total	47	100%	47	100%

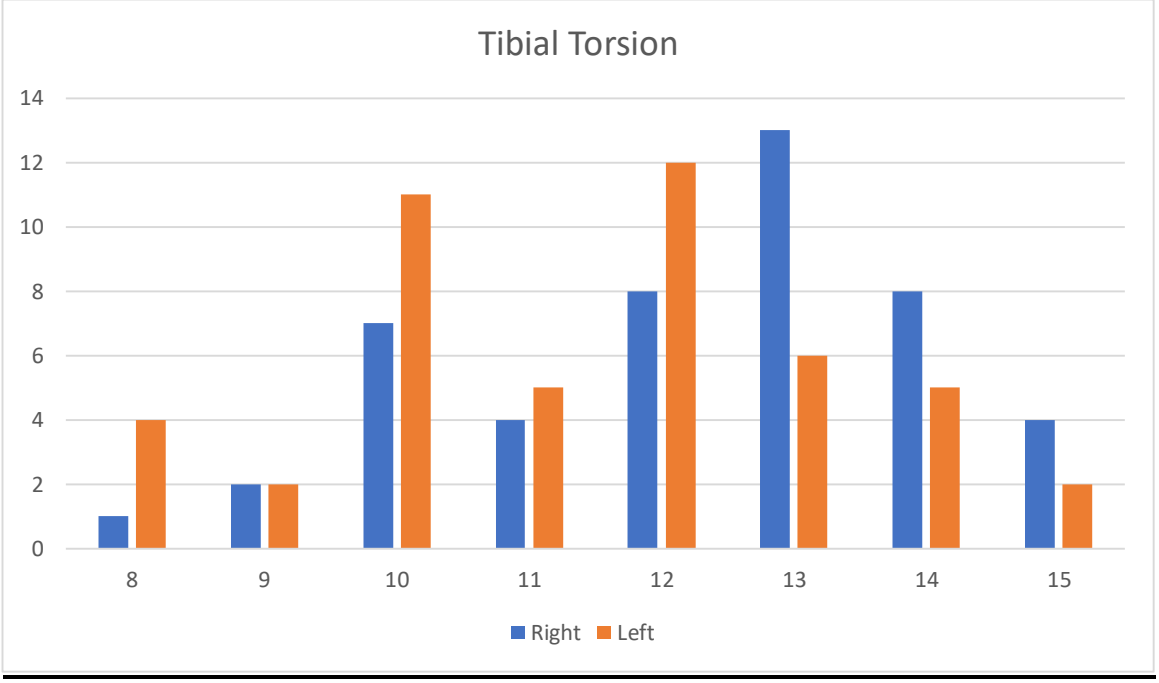


Table 10.3.1 and graph 10.3.1 shows the assessment of tibial torsion using goniometer of both right and left knee.

Table 10.4.1 Assessment of MMT for knee extensors.

Grades	Manual Muscle Testing			
	Right	Percentage (RT)	Left	Percentage (LT)
3	25	53.19%	14	29.78%
4	18	38.29%	17	36.17%
5	4	8.51%	16	34.04%
Total	47	100%	47	100%

Graph 10.4.1: Assessment of MMT for knee extensors

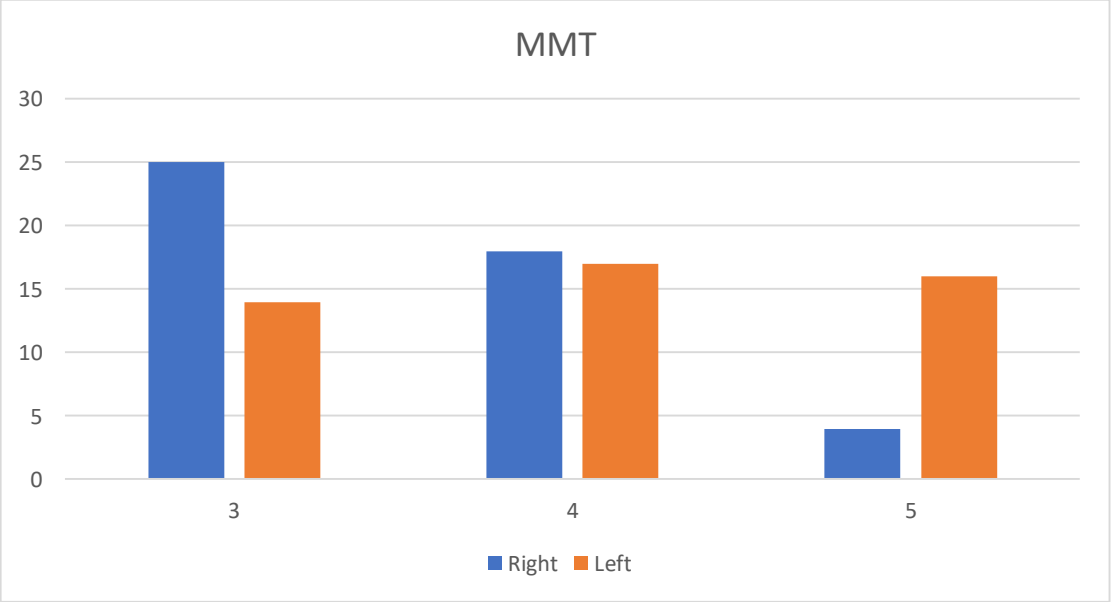


Table 10.4.1 and graph 10.4.1 shows the assessment of MMT for knee extensors.

Table 10.5.1: Assessment of compartment of knee joint more affected using Radiological images

Compartment Affected	Right Knee	Left Knee	Total
Lateral	12(25.53%)	7(14.89%)	19(20.21%)
Medial	35(74.47%)	40(85.11%)	75(79.79%)
Total	47(100%)	47(100%)	94(100%)

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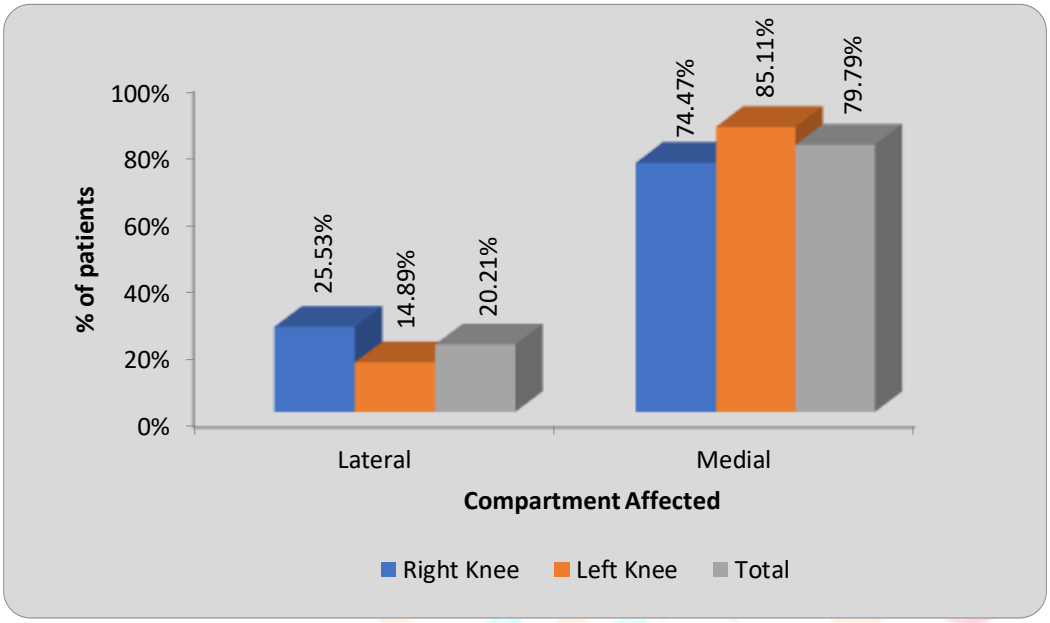
Graph 10.5.1: Assessment of compartment of knee joint more affected using Radiological images

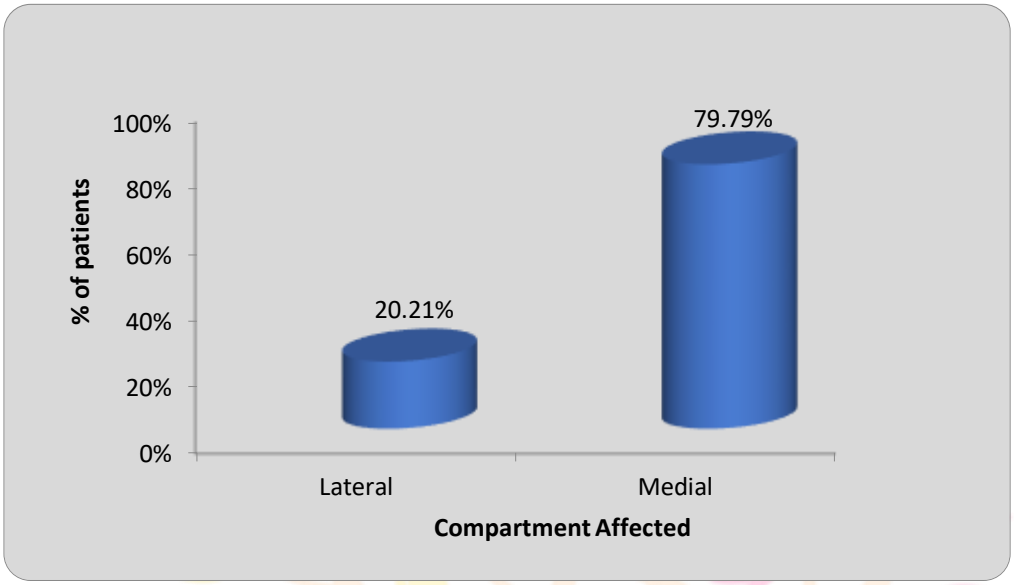


- Table 10.5.1 and graph 10.5.1 shows assessment of compartment of knee joint more affected using radiological images shows that in both right and left knee lateral compartment was affected in (12) patients and (7) patients respectively. Also, in both right and left knee medial compartment was affected in (35) patients and (40) patients respectively.

Table 10.6.1: Assessment of compartment of knee joint more affected using Radiological images

Compartment Affected	No of patients	Percentage
Lateral	12	14.89%
Medial	35	85.11%
Total	47	100%

Graph 10.6.1: Assessment of compartment of knee joint more affected using Radiological images

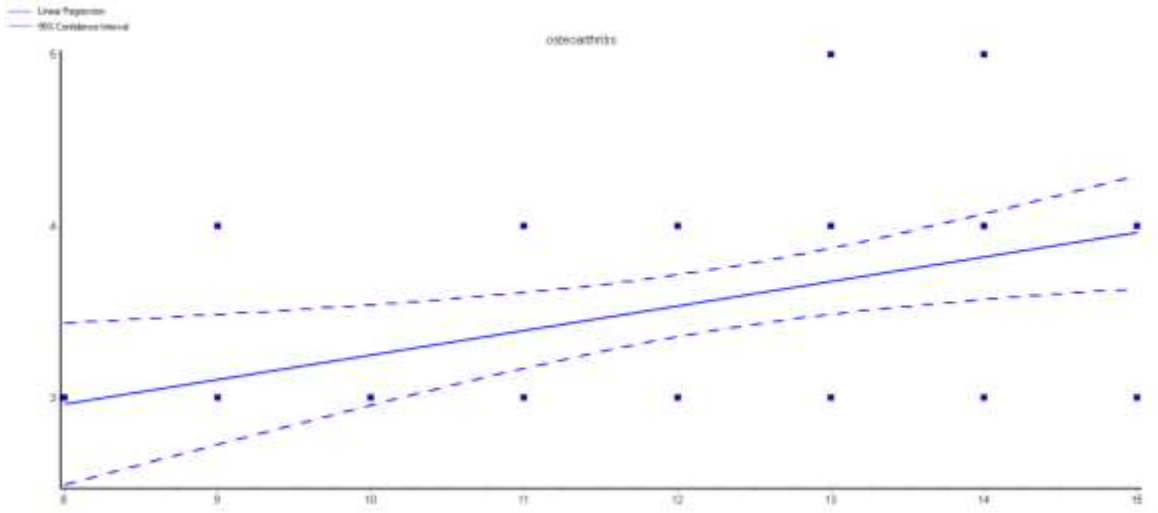


RESULT

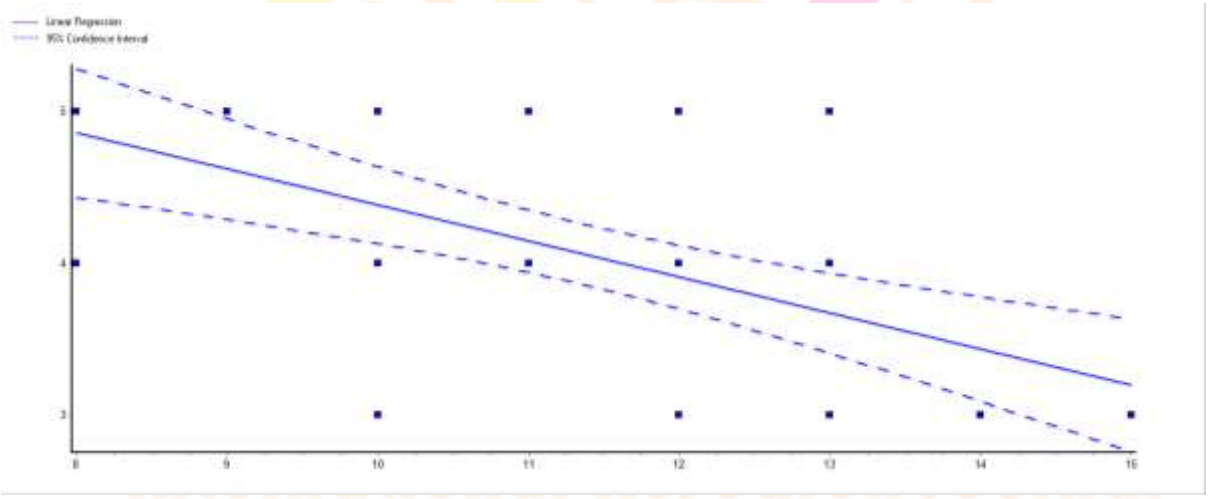
- A total number of 47 samples were included which comprises 24 male patients and 23 female patients between the age group of 60 – 80 years who have been diagnosed with knee osteoarthritis.
- In the assessment of tibial torsion 20 patient were affected with 11° because they were in their initial phase for development of stage 2 and 3 osteoarthritis comparatively less prevalence in 12°, 13°,14° and 15° of tibial torsion were reported.
- Prevalence of grade 3 MMT was found highest in this current study.
- Thus, the present study provided the correlation between tibial torsion and knee extensors strength in patient with osteoarthritis and the results were highly significant.
- Linear regression was used to find the association.

DATA ANALYSIS AND INTERPRETATION

The data was analyzed and presented in graphical tables. Linear regression test was used to analyze the correlation between tibial torsion and knee extensor strength in patients with osteoarthritis of knee joint. Statistical analyses has shown the right sided $P < 0.0001$ with (r) – 0.3884 and left sided $P < 0.0001$ with (r) – 0.07261 which was highly significant and implies a positive result for finding the correlation.



Correlation of tibial torsion with knee extensors (right) / correlation coefficient (r) – 0.3884



Correlation of tibial torsion with knee extensors left / correlation coefficient (r) – 0.07261

DISCUSSION

Osteoarthritis (OA) is a common disease of aged population and one of the leading cause of disability. Incidence of knee osteoarthritis is rising by increasing average age of general population. Osteoarthritis being a progressive disease causes a wear and tear of articular cartilage due to daily living activities. Daily living activities like bending, squatting, cross leg sitting causes a progressive load on knee joint. Because of such activities it produces pain, stiffness, swelling, reduced range of motion of affected joint.[1]

Medial compartment of knee osteoarthritis is more common as compared to lateral compartment due to factors such as excess weight, joint trauma, quadriceps weakness etc.

[19]. So, the current study suggest that the medial compartment of knee is more affected in osteoarthritis due to quadriceps muscle weakness.

Ethnic and gender differences have been found in the value of tibial torsion. It has been found that varied lifestyles and postures adopted among different ethnic groups leads to changes in rotation of tibia between them. Indians sit on the ground in cross-legged position. This cross-legged sitting in Indian fashion is thought to increase the external rotational force on tibia.[7]. Our study reveals that cross-legged sitting among Indian population is one of the significant factors causing tibial torsion in subjects with knee osteoarthritis.

Females are more commonly affected by osteoarthritis as compared to males because of wider pelvis and thus higher Q – angle. Wider pelvis alters the biomechanics of hip, knee joints, leading to increased stress and wear on the cartilage. Additionally, the higher Q – angle places greater stress on knee joint during activities such as walking and running. Also, hormonal changes during menopause may also play a role in the development of osteoarthritis in females. Other leading factors such as femoral anteversion, coxa vara, genu valgum etc. may also contribute. [19]

Rotational deformities may cause early onset of osteoarthritis. Patella-femoral arthritis is not only affected by tibial torsion but also other factors such as genu valgum and varum. Abnormal torsion subsequently causes gait adaptation that increases the load on the knee joint resulting in the development of knee OA. The study conducted by Hasan Bombaci, Gamze Kilicoglu, et.al. suggest that osteoarthritis is the factor that causes excessive tibial torsion, which increases with the progression of the disease. [4]

The study conducted by Charles Slemenda, DrPH; Kenneth D. et.al. revealed that in women affected with isolated tibiofemoral osteoarthritis, weakness of extensor compartment was present even among those without knee pain. Also, this weakness did not involve any other muscle like hamstrings but was only confined to quadriceps indicating that disuse atrophy was not primarily responsible. Hence, participants with osteoarthritis in this study exerted less force with muscle mass equivalent to or greater than that in participants without osteoarthritis. After appropriate adjustment of body weight, age, and sex, lesser quadriceps strength continues to remain strongly predictive of both radiographic and symptomatic osteoarthritis of knee.[10] So the study shows that weak

quadricep muscle can be one of the major factor causing osteoarthritis and thus, resulting in tibial torsion of knee joint. The quadriceps muscle is one of the prime dynamic muscle stabilizers of knee joint; thus, weakened quadriceps muscle may leads to instability of knee, which may be one of the reasons for knee pain. Which also means that knee pain can be prevented by exercising the quadriceps muscle. Even in some subjects the association of muscle mass with quadriceps muscle strength was weak. Furthermore, various other studies reported greater thigh adiposity is known to be associated with lower strength, and worse mobility. [11]

Our study was based on finding out7 the correlation between tibial torsion with knee extensors in osteoarthritis patients with grade 2 and 3 according to kellegren and Lawrence grading. Our study revealed that knee extensor weakness led to osteoarthritis in patients which further exacerbated in tibial torsion with a $P < 0.0001$ / (r) value of right – 0.3884 / (r) value of left – 0.07261.

ABSTRACT

Background: Osteoarthritic patients mainly have problems of knee pain, crepitus, and reduced strength. Our inclusion criteria was focused on diagnosed cases of OA grade 2 and 3 according to kellegren and Lawrence grading. There's influence of tibial torsion and knee extensor strength on OA. So, the goal of the study was focused on finding the correlation between tibial torsion and knee extensor strength in osteoarthritic patients.

Methodology: A total of 47 subjects were included for the study, between the age group of 60-80 years both male and female as per the inclusion and exclusion criteria. The study group was formed by purposive sampling method. Tibial torsion was measured in subjects using goniometer and knee extensor strength was assessed using MMT.

Results: Linear regression was used to find the correlation between tibial torsion with knee extensor strength. The result was highly significant for right side with a $P < 0.0001$ and (r) value of -0.3884. Also, the result was highly significant for left side with a $P < 0.0001$ and (r) value -0.07261.

Conclusion: There is a high correlation between tibial torsion with knee extensor strength in osteoarthritic patients.

Conflict of interest: There's no conflict of interest.

Keywords: Osteoarthritis, knee pain, quadriceps, tibial torsion, knee extensor strength, goniometer, MMT,

Summary and Conclusion

Osteoarthritis is one of the major conditions of knee joint causing knee pain, swelling, crepitus and reduced knee strength. Tibial torsion has been suggested as an etiologic factor for OA. Total 47 subjects were included with the age group of 60-80 years in the study both male and female according to inclusion and exclusion criteria. Tibial torsion was measured using goniometer and knee extensor strength was assessed using MMT. The study concludes that the medial compartment tends to be more affected than the lateral compartment and also, there's a strong correlation between tibial torsion and knee extensor strength with OA patients. Tibial torsion has been thought to increase compressive and shear load in the medial compartment of knee. Also, tibial torsion reduces the ability of muscles to extend the joint. One of the factors contributing to knee pain other than radiographic knee osteoarthritis maybe quadriceps muscle weakness. In individuals with knee OA, decreased quadriceps strength is frequently observed in cross sectional studies with both greater knee pain along with impaired physical function.

CONCLUSION:

The study concludes with stating a strong correlation between tibial torsion with knee extensors in osteoarthritic patients.

LIMITATIONS

- The sample size was small thus the result cannot be generalized.
- The age group was kept between 60 – 80 due to availability of sample size.

FUTURE SCOPE AND RECOMMENDATION OF STUDY

The osteoarthritis patients face problems with reduced mobility, reduced strength, instability etc. Future studies could be directed in setting up a treatment protocol for OA. Finding out an appropriate muscle or a muscle group which results in torsion and its preventive measures.

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APPENDIX 1

SCREENING FORM

- Name:
- Age:
- Gender:
- Occupation:
- Address:
- Chief Complaints:
- Goniometric Measurement:

Range of motion of right knee	Range of motion of left knee

- Radiographic Findings:

COMPARTMENT AFFTECTED	
RIGHT	LEFT

MMT		
Grades	Right	Left
0		
1		
2		
3		
4		
5		

APPENDIX 2

CONSENT FORM

I_____am willing to participate voluntarily as a subject, for the dissertation entitled "Correlation of Tibial torsion with Osteoarthritis of knee joint: An Observational Study" conducted by Sayed Al-Urusa Riyaz.

I have been informed regarding the nature and duration of the examination. I have no objection to undertake the required examination pertaining to the study.
The researcher has already assured me that, I would be examined well, without any untoward effects and rights of confidentially protected.

Name and signature of participant:

Name and signature of investigator:

Date:

APPENDIX 3

मैं _____ **सैयद अल-उरुसा रियाज़** द्वारा आयोजित "**घुटने के जोड़ के पुराने ऑस्टियोआर्थराइटिस के साथ टिबियल मरोड़ का सहसंबंध: एक अवलोकन अध्ययन" शीर्षक वाले शोध प्रबंध के लिए स्वेच्छा से एक विषय के रूप में भाग लेने के लिए तैयार हूं**।

मुझे परीक्षा की प्रकृति और अवधि के बारे में सूचित किया गया है। मुझे अध्ययन से संबंधित अपेक्षित परीक्षा करने में कोई आपत्ति नहीं है।
शोधकर्ता ने पहले ही मुझे आश्वासन दिया है कि, किसी भी अप्रिय प्रभाव और गोपनीय रूप से संरक्षित अधिकारों के बिना मेरी अच्छी तरह से जांच की जाएगी।

प्रतिभागी का नाम और हस्ताक्षर:

अन्वेषक का नाम और हस्ताक्षर:

दिनांक:

APPENDIX 4

CONSENT FORM

मी _____ सय्यद अल-उरुसा रियाझ यांनी केलेल्या **"गुडघ्याच्या सांध्याच्या ऑस्टिओआर्थरायटीसशी टिबियल टॉर्शनचा सहसंबंध: एक निरीक्षणात्मक अभ्यास" या शोधनिबंधासाठी मी एक विषय म्हणून स्वेच्छेने भाग घेण्यास तयार** आहे.

परीक्षेचे स्वरूप आणि कालावधी याबाबत मला माहिती देण्यात आली आहे. अभ्यासाशी संबंधित आवश्यक ती परीक्षा घेण्यास माझी हरकत नाही.

संशोधकाने मला आधीच आश्वासन दिले आहे की, कोणत्याही अनुचित परिणामांशिवाय आणि गोपनीयपणे संरक्षित अधिकारांशिवाय माझी चांगली तपासणी केली जाईल.

स्पर्धकाचे नाव व स्वाक्षरी:

अन्वेषकाचे नाव व स्वाक्षरी:

तारीख:

MASTERCHART

Sr.No.	Age	Gender	Tibial torsion Measurement		MMT of Vastus Medialis Oblique	
			Right knee	Left knee	Right knee	Left Knee
1	75 Y	Male	12°	10°	3	3
2	61 Y	Female	14°	12°	3	4
3	60 Y	Female	12°	12°	4	4
4	66 Y	Male	13°	12°	3	4
5	60 Y	Female	10°	8°	4	5
6	75 Y	Male	14°	15°	3	3
7	65 Y	Male	12°	12°	4	4
8	62 Y	Female	11°	10°	3	3

9	60 Y	Male	10°	8°	4	5
10	60 Y	Female	8°	8°	4	4
11	63 Y	Female	13°	12°	3	5
12	60 Y	Male	10°	10°	4	4
13	65 Y	Male	14°	12°	3	3
14	70 Y	Female	15°	13°	3	3
15	60 Y	Female	12°	12°	4	5
16	62 Y	Female	13°	12°	5	5
17	70 Y	Male	13°	13°	3	4
18	60 Y	Male	9°	9°	5	5
19	75 Y	Female	14°	14°	3	3
20	60 Y	Male	10°	9°	4	5
21	62 Y	Male	10°	10°	4	4
22	60 Y	Female	12°	10°	3	4
23	60 Y	Male	13°	12°	3	3
24	65 Y	Male	13°	14°	3	3
25	75 Y	Male	14°	13°	3	4
26	63 Y	Male	10°	10°	4	5
27	65 Y	Female	15°	14°	3	3
28	62 Y	Female	13°	12°	4	5
29	63 Y	Male	11°	11°	5	5
30	72 Y	Male	13°	13°	3	3
31	65 Y	Female	15°	14°	3	3
32	64 Y	Male	12°	10°	4	5
33	68 Y	Female	14°	14°	3	3
34	62 Y	Female	13°	11°	3	5
35	65 Y	Male	11°	10°	4	5
36	85 Y	Male	14°	13°	3	3
37	67 Y	Male	13°	11°	3	4
38	61 Y	Male	10°	10°	5	5
39	65 Y	Female	13°	11°	4	4
40	80 Y	Female	15°	15°	3	3
41	66 Y	Female	12°	10°	3	4
42	60 Y	Male	9°	8°	4	4
43	67 Y	Female	14°	12°	3	4
44	60 Y	Female	11°	10°	4	4
45	65 Y	Female	13°	11°	3	5
46	62 Y	Female	12°	12°	4	4
47	66 Y	Male	13°	13°	4	5