

Research Article**A DESCRIPTIVE STUDY OF RELATIONSHIP BETWEEN POST TIBIAL SLOPE AND ANTERIOR-CRUCIATE LIGAMENT INJURY (ACL)****Dr Rohit Madhup Lal^{1*}**

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Abstract

Introduction: The knee is the largest hinge joint in the body. This joint is easily injured in both athletes and non-athletes. In a traumatic knee, the most common ligament to be torn is the anterior cruciate ligament. There have been numerous risk factors proposed for anterior cruciate ligament (ACL) injuries. These factors are typically categorized into four categories: environmental, anatomical, hormonal, and neuromuscular. Identifying anatomic risk factors is crucial for developing prevention measures and treatment options for these injuries, despite their difficulty to modify. PTS, or posterior tibial slope, may increase the risk of ACL injury. Biomechanical investigation suggests that the degree of PTS can impact the knee's AP stability.

Materials and methods: This is Descriptive and systemic random sampling study is conducted patients attending OPD with knee trauma in the Dept. of Orthopaedics in Samford Hospital, Ranchi, Jharkhand, India.

No history of osteoarthritis, No history of rheumatoid arthritis, No history of prior surgery on the knee of interest were included in the study. Diagnosis of patellofemoral syndrome were excluded from the study. All patients undergo following Radiograph: digital X-RAY (AGFA TXD-600) of affected knee to be taken in 100% magnification. True lateral view is identified by merging both condyles of femur as well as tibia. For measurement, we follow dejour and bonnin 1994 described method. The diaphyseal axis of tibia was drawn between two points equidistant between the anterior and posterior border of tibia. The 1s one just below the tibial tubercle and the other one 10 cm below that, one reference line was drawn perpendicular to this at the level of tibiofemoral joint. The inclination of tibia drawn from the most superior point of the tibial plateau. The angle of this inclination line to the reference line is defined as radiological tibialslope.

Results: The range of age of patient is 15 yrs-55 yrs with mean age 30.2 ± 9.1 yrs. unpaired t-test showed no significant difference in these patients. There are 12 females and 60 males in the study with male to female ratio 5:1. Chi-square test showed no difference in distribution among male and female patients. The mean duration of illness (time between trauma and reporting of MRI to be done) was 7 ± 3.3 months with minimum 2 and maximum of 12 months. This is because many patients have treated outside before attending our tertiary care institution and mainly those who are unsatisfied with outside treatment, attended our institution and also because of tertiary care center hospital MRI is free so waiting time is usually very long.

Conclusion: Increased posterior tibial slope (x-ray measured), medial posterior slope (MPS), lateral posterior slope (LPS) and average slope (MRI measured) all are potential risk factors of ACL injury. Age and sex of individuals are not risk factor.

Key words: Knee, medial posterior slope, lateral posterior slope, anterior cruciate ligament (ACL) injuries.

INTRODUCTION

The knee is the largest hinge joint in the body. This joint is easily injured in both athletes and non-athletes. In a traumatic knee, the most common ligament to be torn is the anterior cruciate ligament. There have been numerous risk factors proposed for anterior cruciate ligament (ACL) injuries. These factors are typically categorized into four categories: environmental, anatomical, hormonal, and neuromuscular. Identifying anatomic risk factors is crucial for

developing prevention measures and treatment options for these injuries, despite their difficulty to modify. PTS, or posterior tibial slope, may increase the risk of ACL injury. Biomechanical investigation suggests that the degree of PTS can impact the knee's AP stability.¹

Past studies have found a correlation between Increased PTS and increased anterior translation of the knee in cadaver models. These findings are corroborated by kinematic evidence demonstrating that larger PTS results in increased anterior Tibial translation and ACL force in active gait. The medial and lateral PTS are not necessarily identical in one given knee and differences of as much as 27 have been reported in cadaveric studies. The slope varies widely, It may vary with age, squatting habit, between sexes, or there may be no sexual dimorphism Slope of medial and lateral plateau may differ significantly and slope also differs on radiograph due to change in measurement methods.² A recent study recommended separate assessment of the medial and lateral plateau PTS because patients with ACL rupture were seen to have a greater slope on the lateral plateau. The PTS is defined on a lateral radiograph by the angle between perpendicular to the longitudinal axis of the bone and tangent to the medial and the lateral plateaus.³

Although the biomechanical importance of the PTS is known the studies that have using plain radiographs only to Characterize PTS examined the relationship between PTS and ACL injury have Provided inconclusive and sometimes contradictory results. Various longitudinal axes have been defined and the mean angle is reportedly between 4° - 14° .

However, in Indian population the mean radiographic angle 6° to 24°. A high error in measurement resulting from a rotated tibia during lateral radiograph imaging may be misleading. The lateral PTS has been considered an important anatomic reference landmark and guide for restoration of the natural PTS in TKA, but discrimination between the plateaus is difficult with radiography and methods using three-dimensional computed reconstructions are time-consuming and complex.⁴

Studies that have used magnetic resonance imaging (MRI) to more thoroughly characterize tibial geometry, found that PTS on the lateral tibial plateau, but not on the medial tibial plateau, may be correlated with ACL injury. A recent meta-analysis showed that both medial and lateral PTS are associated with ACL injury regardless of sex. An increased Posterior tibial slope is associated with ACL rupture.⁵ A higher pivot-shift grade is associated with an increased degree of posterior tibial slope and also anterior tibial translation. One recent study measured the differences between the medial and lateral PTS on MRI in patients with ACL rupture, but an additional radiograph was needed for the longitudinal axis determination.

MATERIALS AND METHODS

This is Descriptive and systemic random sampling study is conducted patients attending OPD with knee trauma in the Dept. of Orthopaedics in Samford Hospital, Ranchi, Jharkhand, India.

Inclusion criteria: No history of osteoarthritis, No history of rheumatoid arthritis, No history of prior surgery on the knee of interest.

Exclusion criteria: Diagnosis of patellofemoral syndrome.

All patients undergo following Radiograph: digital X-RAY (AGFA TXD-600) of affected knee to be taken in 100% magnification. True lateral view is identified by merging both condyles of femur as well as tibia. For measurement, we follow dejour and bonnin 1994 described method. The diaphyseal axis of tibia was drawn between two points equidistant between the anterior and posterior border of tibia. The 1s one just below the tibial tubercle and the other one 10 cm below that, one reference line was drawn perpendicular to this at the level of tibiofemoral joint. The inclination of tibia drawn from the most superior point of the tibial plateau. The angle of this inclination line to the reference line is defined as radiological tibial slope.

MRI: MRI images (GE HEALTHCARE SURT 1000 XL1 1.5 tesla) from patients were analyzed using imaging software (all measurements are made using DIACOM image viewer software and jivex DIACOM image viewing software). Tibial slope measurements are obtained using the method previously described by Hudek et al in 2009.

Statistical Analysis

Data of all patients were tabulated in Microsoft excel 2016 sheet and statistical analysis was done using IBM SPSS version 25. Normality testing was done for all continuous data like age, duration of illness, posterior tibial slope using Shapiro-Wilk test.

Continuous data were summarized with mean and standard deviation for parametric data and median and interquartile range for

non-parametric data. Categorical measures like sex and presence or absence of ACL tear was summarizing with proportions. The continuous variables were compared between the ACL injury present and absent group using unpaired t-test. Association between X ray and MRI slope values were tested by paired t-test. Statistical significance was defined at $P < .05$ and all tests were 2 -sided. Cut-off value for tibial

slope for predicting ACL tear was calculated by ROC analysis using Youden index.

RESULTS

The range of age of patient is 15 yrs-55 yrs with mean age 30.2 ± 9.1 yrs. unpaired t-test showed no significant difference in these patients. There are 12 females and 60 males in the study with male to female ratio 5:1. Chi-square test showed no difference in distribution among male and female patients.

S.No	Gender	N (%)
1	Male	60 (83.33%)
2	Female	12 (16.66%)

Table 1: Gender distribution

S.No	Parameter	Value
1	Mean age	30.2 ± 9.1
2	Mean duration of illness	7 ± 3.3 months
3	MRI confirmed ACL tear	46 (64%)
4	No tear	26 (34%)
5	Injury to left side	31(43%)
6	Injury to Right side	41(57%)

Table 2: mean and mean duration of illness

The mean duration of illness (time between trauma and reporting of MRI to be done) was 7 ± 3.3 months with minimum 2 and maximum of 12 months. This is because many patients have treated outside before attending our tertiary care institution and mainly those who are unsatisfied with outside treatment, attended our institution and also because of tertiary care center hospital MRI is free so waiting time is usually very long. Among those 72 subjects 46 (64%) had MRI confirmed ACL tear and 26 (34%) subjects had no tear. Rudresh S Halwar et al showed incidence of MRI confirmed ACL tear in 111 patients to be 68.5%. In those 72 subjects 31(43%) had injury to left side and 41(57%) had injury to right side, among the left sided injured knee 24 patients had MRI confirmed ACL tear, and on right side injured patients 22 patients had MRI confirmed ACLtear.

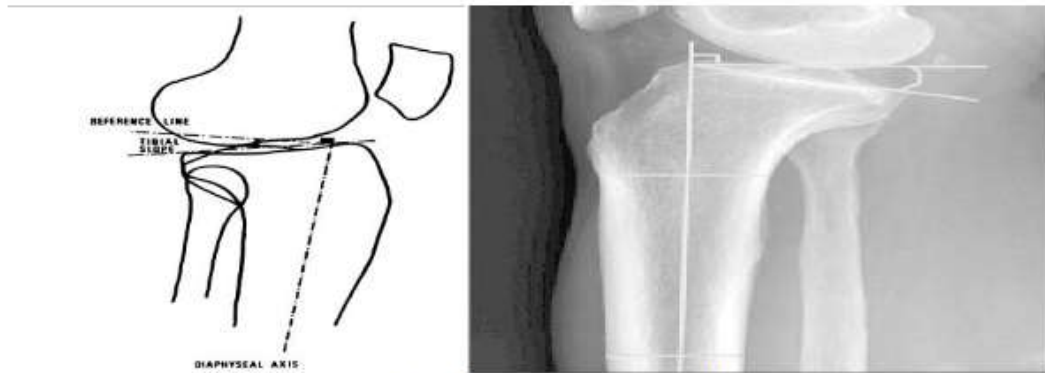


Fig 1: X - ray angle determination

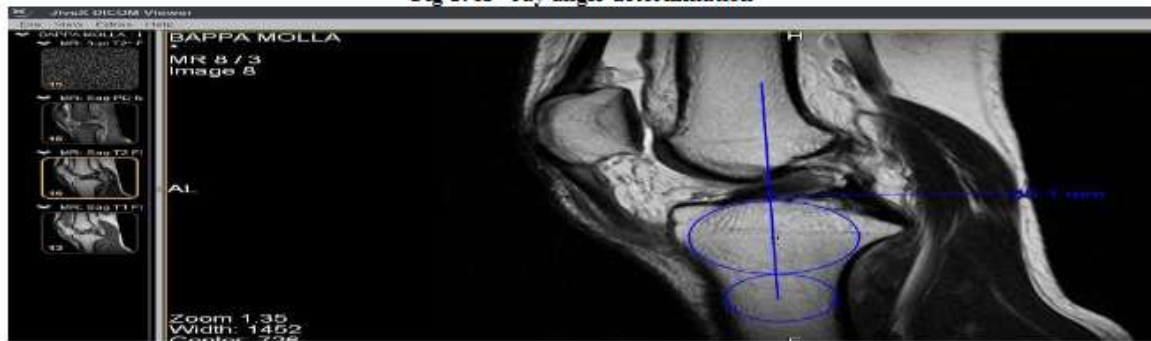


Fig 2: Tibial axis determination

DISCUSSION

The posterior tibial slope measured in digital x-ray. Though defining posterior tibial slope on digital x-ray is a tough job and not free from errors many studies using only x-ray have contradicting results. The mean Posterior tibial slope on X-ray was 12.1 degrees and mean difference was 3.7 degrees between ACL tear (13.4°) and non-tear groups (9.7°) which was found to be significant by t-test. Cut-off for of >9.3 degrees on X-ray was found to be predictive of ACL injury with sensitivity of 93.5% and 53.2% specificity Brandon et al found female ACL-insufficient patients had a significantly greater Posterior-inferior tibial slope (PITS) ($12.0^{\circ} \pm 3.5^{\circ}$) than their negative controls ($8.6^{\circ} \pm 2.7^{\circ}$).⁶ Male ACL insufficient patients had a significantly greater PITS ($10.8^{\circ} \pm 3.9^{\circ}$) than their negative controls ($8.4^{\circ} \pm 3.4^{\circ}$). In the

isolated ACL- insufficient patients, the high-grade pivot-shift patient group had a statistically significantly greater PITS ($11.10^{\circ} \pm 3.85^{\circ}$) than the low- grade pivot-shift patient group ($9.19^{\circ} \pm 3.58^{\circ}$). Hohman et al showed mean for non-injured male and female mean PITS 5.80 ± 3.1 , 5.0 ± 3.4 respectively and mean PITS of injured male and female are 5.5 ± 3.4 and 6.7 ± 3.7 .⁷

Sonnery-Cottet B et al mean PTS was significantly higher in case group than in control 10.1° (SD 3.3) versus 7.52° (SD 2.13), respectively; $p < 0.001$. todd et-al showed subjects in the noncontact ACL group had significantly greater slope angles ($9.39^{\circ} \pm 2.58^{\circ}$) than did control subjects ($8.50^{\circ} \pm 2.67^{\circ}$) ($P = .003$) The posterior tibial slope measured in MRI had three parameters (1). Medial posterior tibial slope (MPS), (2). Lateral posterior tibial slope (LPS) and (3).

Average slope, which is the average of MPS and LPS.⁸

MPS: The mean medial posterior slope was 8.3 degrees and it was significantly less for non-ACL tear (6.1 degrees) than for ACL tear (9.5 degrees), cutoff value 5.6 degrees was found to be differentiating between presence and absence of ACL tear in MRI with 92.9% sensitivity and 53.8% specificity. Aswini T et al found positive correlation between mps and Acl injury, with mps without tear $7.2 \pm 3.7^\circ$ and mps in Acl injury patients to be $9.3 \pm 3^\circ$.

LPS: The mean lateral posterior slope was 7.3 degrees and it was significantly less in those without ACL tear in MRI than those with tear (4.1 vs 9.2 degrees) cutoff value 6.4 degrees was found to be differentiating between presence and absence of ACL tear in MRI with 84.8% sensitivity and 87.7% specificity. Aswini T et al found positive correlation between LPS and ACL injury, with LPL without tear $5.7 \pm 2.5^\circ$ and LPS in ACL injury patients to be $7.09 \pm 3.47^\circ$.

Hasemi et al showed mean for non-injured male and female mean lps 5.40 ± 2.77 , 7.03 ± 3.07 respectively and mean lps of injured male and female are 7.22 ± 2.71 and 8.44 ± 2.82 . stijk 1 2007 comparison of the tibial slope on lateral tibial plateau in both the groups (case and control) conclude that the difference was significant ($P < 0.01$). The tibial slope on the medial tibial plateau in the two groups was not significant. The average tibial slope on lateral tibial plateau in the examined group was 7.52° (from 0 to 13°), and the medial was slightly lower at 5.24° (from -1 to 12°). The value of the tibial slope on lateral tibial plateau in the control group was 4.36° (from -2 to 9°),

whereas the tibial slope on the medial tibial plateau had a value of 6.58° (from 0 to 13°). In comparison to mps with lps correlation with ACL tear found more with lps than mps by roc curve analysis.¹⁰

CONCLUSION

Increased posterior tibial slope (x-ray measured), medial posterior slope (MPS), lateral posterior slope (LPS) and average slope (MRI measured) all are potential risk factors of ACL injury. Age and sex of individuals are not risk factor.

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