Section: Miscellaneous

Original Research Article

MRI-BASED EVALUATION OF INTERCONDYLAR NOTCH WIDTH RATIO IN PATIENT WITH AND WITHOUT ANTERIOR CRUCIATE LIGAMENT INJURY: A COMPARATIVE STUDY

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ABSTRACT

Background: The anterior cruciate ligament is the most often injured ligament in sports injuries, with the knee being the most frequently involved joint. According to certain theories, a narrow intercondylar notch could make anterior cruciate ligament (ACL) injuries more likely. The purpose of this study was to determine whether a narrow intercondylar notch width increases the incidence of ACL injuries.

Materials and Methods: A group of 100 people was selected.50 ACL deficient and 50 Non ACL deficient. 1. Patients presenting to the Orthopaedics OPD of SDM Medical college, Dharwad, with knee joint complaints who were diagnosed to have ACL deficiency based on clinical tests(Lachman and Anterior drawer tests) were identified 2. The second group were those patients who on clinical examination did not demonstrate ACL pathology based on Lachman and Anterior test were identified. In these groups who underwent MRI for knee evaluation were included.

Results: In our study comprising of 100 patients, 50 patients are ACL deficient with mean age of 31.74yrs and remaining 50 are NON ACL deficient with mean age of 36.66yrs. Males were more frequently involved than females. We found mean ICNWR in ACL deficient patients to be 0.29 and in Non ACL deficients to be 0.32 with a p value of 0.0001 which was statistically significant.

Conclusion: Through our study, we conclude that the intercondylar notch width ratio is significantly narrower in patient with ACL deficiency when compared to non ACL deficient patients. Also the notch width is wider in males than females.

Keywords: Anterior Cruciate Ligament, Intercondylar Notch WIDTH RATIO.

INTRODUCTION

The knee joint is the most frequently injured joint in sports and as competition in modern sports increases, more intricate patterns of knee joint injuries are emerging. Because the joint lacks bony support, its stability depends heavily on the ligamentous structures that support it. As a result, ligament and meniscal injuries are very common, especially in active people like sportsmen, laborers, and soldiers.

Anterior cruciate ligament is an intra-articular, extra synovial structure present in the central complex of knee joint. It functions in concert with all other anatomical structures in the knee joint to control and limit motion and to maintain both static and dynamic equilibrium.

A number of investigators have studied the epidemiology of anterior cruciate ligament–deficient knees and have implicated gender and femoral intercondylar notch width as factors contributing to injury of the anterior cruciate ligament.

The intercondylar notch is the area of posteroinferior aspect of the distal femur between its condyles. Within it are the main intrinsic ligaments – ACL, PCL, meniscofemoral ligaments and other central

fibrous attachments of the menisci and the pericruciate fat.[1]

Numerous investigators have reported that athletes sustaining noncontact anterior cruciate ligament tears have statistically significant intercondylar notch stenosis.

Intercondylar notch width index is defined as the ratio of the width of the intercondylar notch to the width of the distal femur at the level of the popliteal groove as measured on coronal view of MRI.

Souryal and Freeman formulated the notch width index, which is the ratio of the width of the intercondylar notch to the width of the distal femur at the level of the popliteal groove measured on a tunnel view radiograph of the knee. Initially it was calculated using radiographs but with advances in the technology, MRI is the most appropriate modality to calculate the index. The normal intercondylar notch ratio was 0.231+-0.044.

In this study, we shall correlate incidence of ACL tear with the ICNWR and evaluate if it's a risk factor for the ACL injury. Also we have tried to evaluate if men have wider ICNWR than women or not, to predict risk of ACL injury in each gender.

Objectives: To determine the relationship between the intercondylar notch width index and anterior cruciate ligament insufficiency in skeletally mature patients aged between 20 to 50.

MATERIALS AND METHODS

Inclusion Criteria

Patients with knee joint issues who visited the orthopaedics outpatient department of SDM Medical college were clinically examined and evaluated using MRI. One group of patients was found to have ACL deficit, whereas the other group did not exhibit ACL pathology.

Exclusion Criteria

Patients of age group less than 20years and more than 50years

Fresh fractures /Old malunited fractures around knee joint

Infections of knee joint

Tumours

Malalignment of lower limb

Degenerative disorders like Rheumatoid Arthritis, Osteoarthritis

Haemophilia

Sample Size: The study included a minimum of 100 cases (50 with and 50 without an ACL injury) that met the inclusion and exclusion criteria and were reported between the period of October 2016 and September 2018.

Evaluation

All patients with knee joint pathology who satisfy the inclusion criteria were examined clinically for stability of knee joint and radiologically by MRI. Patients were evaluated by a Siemens 1 Tesla MRI. The intercondylar notch width index was measured for each patient.

Intercondylar notch width index is defined as the ratio of the width of the intercondylar notch to the width of the distal femur at the level of the popliteal groove as measured on coronal view of MRI.

Appropriate statistical test were applied to see if there was a correlation between intercondylar notch width index and ACL injuries.

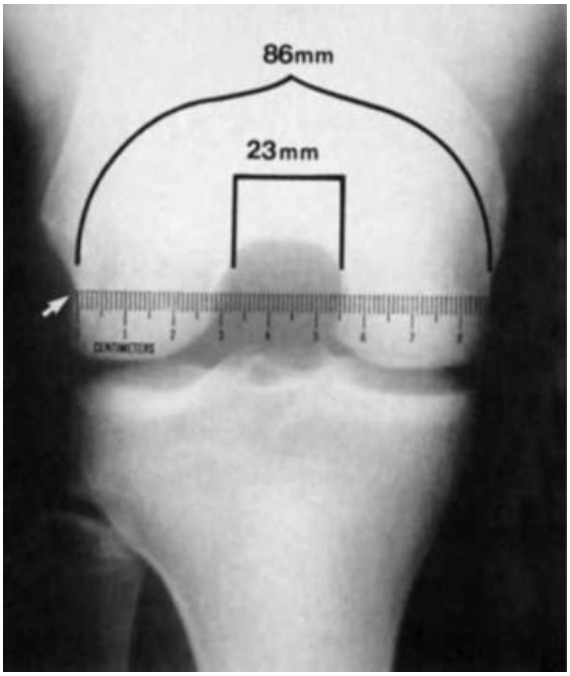

Figure 1: Assessment of intercondylar notch width ratio on a radiograph

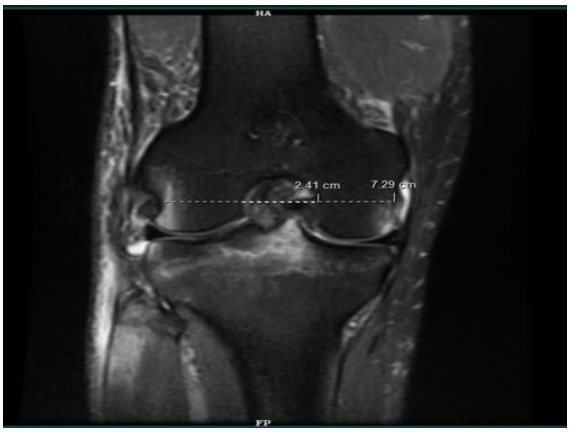

Figure 2: Assessment of intercondylar notch width ratio on coronal sections of MRI.

RESULTS

In our study comprising of 100 patients, 50 patients are ACL deficient with mean age of 31.74 yrs and remaining 50 are NON ACL deficient with mean age of 36.66yrs. In both the groups, the number of male patients are more than female patients. [Figure 3,4]. Mean ICNWR in patients with ACL deficient is 0.29 with SD of 0.04 and Mean ICNWR IS 0.32 with SD OF 0.03. The p value is 0.0001 which is statistically significant which suggests that ACL injuries are more common in patients with narrow ICNWR. [Figure 5].

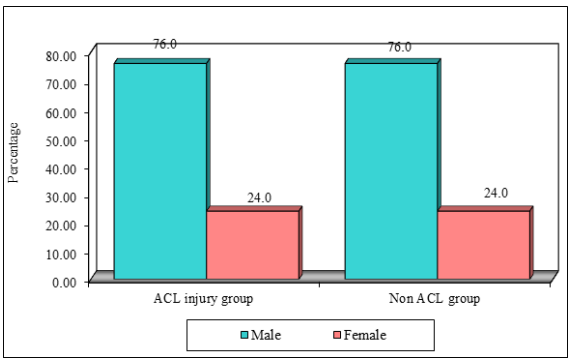

Figure 3: Distribution of male and females in two study groups

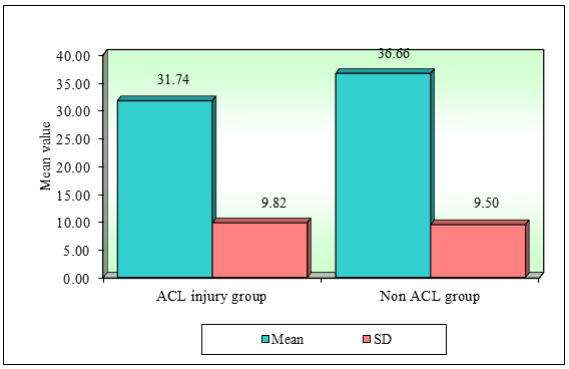

Figure 4: Comparison of two study groups with mean age

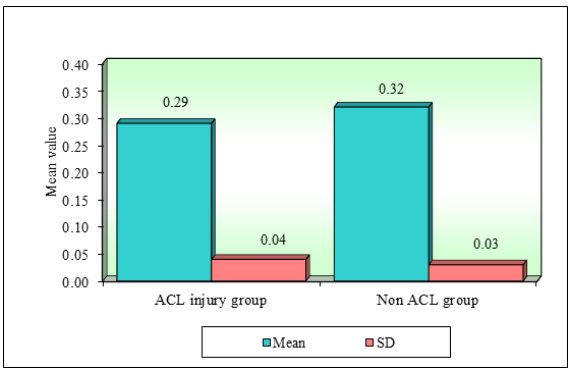

Figure 5: Comparison of two study groups with mean inter condylar notch width ratio

DISCUSSION

ACL is one of the important ligament of the knee joint and the most frequently injured ligament. It is attached proximally to the posterior part of the intercondylar surface of the lateral femoral condyle and distally just anterolateral to the anteriortibial spine. It ranges from11-24 mm in diameter. As these fibers approach tibial insertion, they fan out. ACL consist of two major fibre bundles, namely anteromedial (AM) bundle and posterolateral bundle (PL). While the AM bundle is primary restraint against anterior tibial translation, the posterior lateral bundle tends to stabilize the knee near full extension, particularly against rotatory loads.

The ACL is one of the important ligament responsible for stability of knee joint. It provides 80% of the resistance to the anterior translation of tibia and 30% resistance for the varus and valgus stress test. It helps in fine tuning of the screw –home movement towards the end of full knee extension and also controls the internal rotation and hyper extension.

ACL injury commonly occurs in sports like football, volleyball, basketball etc and is usually caused by deceleration, twisting, cutting and jumping maneuvers or by hyperextension of the knee. Broadly the mechanism of injury can be classified into two categories- contact and noncontact type. In India both of these types of mechanisms are involved in injuries in nonsporting personnel resulting from sudden stepping down from bus, train, fall from stairs etc, and in individuals who is participating in traditional, sports like kabaddi, rural wrestling, kho-kho with cricket.[2]

The factors such as lower extremity malalignment, posterior tibial slope, intrinsic ACL material properties, patellar tendon tibia shaft angle, ACL elevation angle, hormonal variation, neuromuscular control related biomechanical factors and intercondylar notch size have been suggested as possible intrinsic risk factors for ACL injury in the literature.[3]

A number of investigators have studied the epidemiology of anterior cruciate ligament–deficient knees and have implicated gender and femoral intercondylar notch width as factors contributing to injury of the anterior cruciate ligament.

Various studies have been postulated based on the relationship between intercondylar notch width ratio and ACL deficiency in the west. Rita di Cássia de Oliveira Angelo et al in his study “Morphometric study of the femoral intercondylar notch of knees with and without injuries of anterior cruciate ligament (A.C.L.), by the use of software in digitalized radiographic images” suggested the use of software in digitalized radiographic images to morphometric analysis of the intercondylar notch and the femoral condyles.[4]

The local population has been the subject of relatively few investigations.

The risk of ACL injury is increased by a narrow ICNW ratio, as has been demonstrated. There are not many research that support this claim. It was first suggested by Palmer et al. in 1938 that a narrow NW is associated with an increased incidence of ACL tears.[5]

Using direct radiographs, Souryalet al. later in 1988 found a strong correlation between a narrow NW and bilateral ACL injuries. The mean notch width index (NWI) of the group with bilateral ACL injury was compared to the mean NWI of 50 consecutive patients with "normal" knees and 50 consecutive patients with acute ACL ruptures. The average NWI was 0.2338 for the normal group, 0.2248 for the acute ACL group, and 0.961 for the group with bilateral ACL injury. They found that the group with bilateral ACL injury differed from the normal and acute ACL groups in a statistically significant way ($P < 0.0001$, respectively). Along with explaining the idea of the

notch width index (NWI), the authors recommended using it to prevent ACL damage.[6]

According to Chung et al., a narrow notch width may be considered an intrinsic risk factor for ACL injury. He utilized radiographs to compare the notch width index of ACL-deficient knees with normal knees. Compared to ACL-intact knees, the notch width index was considerably lower in ACL-deficient knees (0.26 vs. 0.29, p=0.02).[7]

However, not all authors concur with the aforementioned assertion. Using MRI and direct radiography, Herzog et al. assessed NWI in athletes with chronic ACL injuries and a healthy control group. Two indicators were measured during the 328 patients that participated in the trial. MRI was used to measure the intercondylar distance and the femoral notch. The mean notch width index (NWI) in patients with (0.296) and without (0.298) an ACL tear did not differ significantly (P>0.05).[8]

On standard notch view radiographs of 31 patients' knees—30 with bilateral injury, 30 with unilateral injury, and 30 without any ACL injury—Schinkendantz et al. computed NWI. They concluded that intercondylar notch measurements from radiographs may not be accurate indicators of anterior cruciate ligament injury because they did not find any significant differences between patients with unilateral or bilateral complete ruptures of the ligament.[9]

Its also been noted that males have a wider notch compared to females. Stijak et al in his study "Correlation between the morphometric parameters of the anterior cruciate ligament and the intercondylar width:gender and age differences" concluded that males have significantly wider notch width index ratio compared to females. Apart from notch width, following anatomical parameters of the ACL were also measured: the length of anteromedial and posterolateral bundle, the mean length and the width of the ligament, the length and width of tibial insertion, the length and width of femoral insertion. This study was conducted on cadavers.[1]

Our study was conducted on a local population with a sample size of 100. The notch width index was calculated on coronal image of knee joint at the level of popliteal fossa using MRI. Direct indications of ACL rupture under MRI examination included ACL disappearance or shrinking, discontinuity, abnormal contour, edema and thickening. Indirect indications of ACL rupture included lateral and posterior tibial contusions, femur lateral condyle contusions, kissing bone contusions, lateral meniscus posterior horn exposure, anterior disc displacement of tibia, PCL curvature, posterior PCL line and patellar tendon tortuosity, decrescent angle between ACL and tibial plateau, Segond fracture, trigonum effusion and medial collateral ligament injury.[10]

Our study included 100 individuals, of whom 50 had ACL deficiency (mean age: 31.74) and the other 50 did not (mean age: 36.66).

There are more male patients in both groups than female patients.

Patients with ACL deficiency have mean ICNWRs of 0.29 with SD of 0.04 and 0.32 with SD of 0.03. At 0.0001, the p-value is statistically significant.

We hope to draw the conclusion from our research that ACL injury and a narrow intercondylar notch width index are related. Our research also indicates that young people with a female preponderance are more likely to sustain an ACL damage.

Limitations: We admit that there are certain limitations to our study. With a small sample size of 100, this study was limited to a local community inside a specific geographic area, which reduces the variability and generalizability of the findings. Other factors that may affect ACL injury, such as age and degree of exercise, were not taken into account in addition to the narrow NW. Our study's use of one Tesla MRI images with a 5mm slice is another flaw; other study methodologies, such as 1.5/3 Tesla and 3mm slice MR, produce superior results.

CONCLUSION

Based on our research, we have determined that patients with ACL deficit had a much narrower intercondylar notch width ratio than patients without the condition. Additionally, males have a broader notch than females.

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