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Prevalence of Anterior Cruciate Ligament (ACL) Tear Localization Site Role of MRI

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Abstract **Original Research Article**

Background: The knee is one of the complex joints in the human body and consists of several internal structures that may lead to the emergence of symptoms of knee injuries [1]. The anterior cruciate ligament, or ACL, is one of the major ligaments of the knee that is located in the middle of the knee and runs from the femur (thigh bone) to the tibia (shin bone). It prevents the tibia from sliding out in front of the femur. Together with posterior cruciate ligament (PCL) it provides rotational stability to the knee [2]. In the case of ACL injuries of the knee, magnetic resonance imaging (MRI) is used to diagnose the affected knee. From this point of view, this study aims to identify the sites of ACL tears and evaluate the role of magnetic resonance imaging (MRI) in the diagnosis of Anterior Cruciate Ligament (ACL) tears**.** ***Materials and Methods*****:** This study was conducted at the Department of Radiological Diagnostics of Medical Services, Abu Dhabi Police, United Arab Emirates. After getting the institutional approval, the study sample was selected from those with knee injuries. Socio-demographic information about these patients such as gender, age, etc. was recorded. The study sample included 150 patients (113 males and 37 females), their ages ranged between 17 and 52 years, with a mean age of 25 years, and all the patients underwent an initial diagnosis of anterior cruciate ligament injuries. MRI of the knee joint was performed for all cases using different MRI techniques. ***Results:*** MRI results confirmed that among the 155 patients, 68% had an ACL tear (89.33% complete tear, 10.67% partial tear), while 32% had no ACL tear. Also, the prevalence of the location of an ACL tear distributed in the femoral end of the knee (62%), the mid third of the knee (14%) and the tibial end (23%). ***Conclusion*****:** MRI findings have proven to be more effective in assessing complete ACL tear, while the assessment of partial tear requires the use of more developed MRI techniques. All cases of positive complete tear were performed ACL reconstruction, while complete rest and physiotherapy were given for partial tear, and other treatments were provided for cases who did not suffer from cruciate ligament injuries but were diagnosed with other knee injuries.

Keywords: Anterior Cruciate Ligament (ACL), knee injuries, MRI, diagnosis.

INTRODUCTION

In fact, the knee is the largest joint in the human body, and its anatomy is a very complex matter. Several structures that support the knee joint include the medial collateral ligament (MCL), lateral collateral ligament (LCL), anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), quadriceps femoris, and patellar tendons [3]. The medial and lateral meniscus are located within the surface of the knee joint, between the femoral condyles and the tibial plateau. These structures work with the muscles and the wide, relaxed joint capsule to keep the knee stable and supported [4].

ACL failure occurs during overextension with external rotation and direct displacement of the tibia, or internal rotation with the knee fully extended. In the case of varus strain or valgus, ACL injuries occur after collateral ligament failure that disrupts the MCL and medial supporting structures [5].

The Anterior Cruciate Ligament (ACL) injuries can occur, especially during sports activities such as running or playing football and in participating in physical activities carried out by people who work in specific [6] occupations that require some training such as the military and police. These injuries may range from as mild as a small injury/tear to severe when the

ligament is completely torn. Therefore, the Anterior Cruciate Ligament (ACL), which is located in the knee, is the most commonly injured ligament and is reconstructed regularly through an orthopedic procedure. The aim of the ACL reconstruction is to stabilize the knee and prevent further injuries in the future while practicing these motor activities. But before the attending physician decides whether the patient needs to undergo surgery or otherwise, they must direct the patient to the appropriate method.

In the event of anterior cruciate ligament injuries, the patient is subjected to diagnosis by magnetic resonance imaging techniques. The Magnetic Resonance Imaging (MRI) is the approved and reliable method in diagnosing the musculoskeletal system including spinal imaging and in evaluating joint diseases, soft tissue tumors, and tears. Thus, the magnetic resonance imaging (MRI) has become the accepted and widely recognized method as a specific standard for evaluating acute and chronic ACL injuries.

However, the oblique orientation of the anterior cruciate ligament (ACL) may cause slight difficulty in MRI and thus affect the assessment of subsequent images. Furthermore, when diagnosing a partial anterior cruciate ligament (ACL) tear by routine MRI protocols, it is often not possible to reliably detect an isolated AM or PL bundle tear, whereas when using oblique axial and oblique sagittal imaging plans, the results of determining the anterior cruciate ligament are more pronounced and precise [7].

Despite these problems, the dedicated MRI protocols can produce ACL images in great detail at a resolution that leads to near-valid conclusions about ACL injuries.

In accordance with the above, this study seeks to identify the sites of anterior cruciate ligament tears and to reveal the role and efficacy of using magnetic resonance imaging (MRI) in diagnosis. To achieve the objectives of the study, the researcher has chosen 150 patients with ACL injuries.

MATERIALS AND METHODS

After carrying out all the institutional procedures that allow this study to be conducted in the Medical Services of Abu Dhabi Police for patients with ACL injuries, the total sample studied was 150 patients with knee injuries. Relevant socio-demographic data such as age and gender were recorded, clinical examination was done, and MRI was performed, Philips digital broadband ingenia 1.5 tesla, and a dedicated 16 channel knee coil were used.

MRI of the knee joint was performed for all cases involving different MRI techniques. Anterior cruciate ligament reconstruction using a connective tissue graft was performed for all cases of positive complete ACL tear and rehabilitation. Rest and physical therapy were performed for the partial tear. Another treatment was provided for cases that did not suffer from the cruciate ligament, and other knee injuries were diagnosed.

Demographic data on patients were collected in terms of patients' gender (113 males, 37 females), age (17–52 years, median age 25 years), location of tear (femoral end 62.00%, tibial end 23.33%, mid third 14.00%) and cause of ACL injuries (88 while participating in police training sessions, 22 participating in sports activities, 17 has twisting, and 23 with a history of injury and chronic knee pain). Data collection is important in order to make an accurate diagnosis and treatment. For statistical analysis, SPSS v20.0 computer software and PACS system were performed.

The reports by radiologists were screened for the diagnosis of an ACL tear. All cases of positive complete tear were performed ACL reconstruction, while complete rest and physiotherapy were given for partial tear, and other treatments were provided for cases who did not suffer from cruciate ligament injuries but were diagnosed with other knee injuries. ACL tear locations were assessed from MRI images. Routine MRI examination was performed for all cases, including AX PD FAT SAT with a parameter as flow, and the number of slices is 30, and SAG T2 with a parameter as flow, and the number of slices is 28. The sagittal, coronal, and axial planes were viewed in order to assess the ACL tear location.

RESULTS

A total of 150 knee injury cases were selected, of whom 113 (75.33%) were male and 37 (24.67%) were female, aged between 17 and 52 years, with a mean age of 25 years.

Most of the ACL injuries were caused by participating in police training (58.67%), (14.67%) in sports training, while (11.33%) had a sprain, (15.33%) suffered from chronic knee pain.

Among 150 patients, Figure 1 below shows that 80% of those with a history of chronic or acute knee pain had an ACL tear, while only 20% did not have an ACL tear.

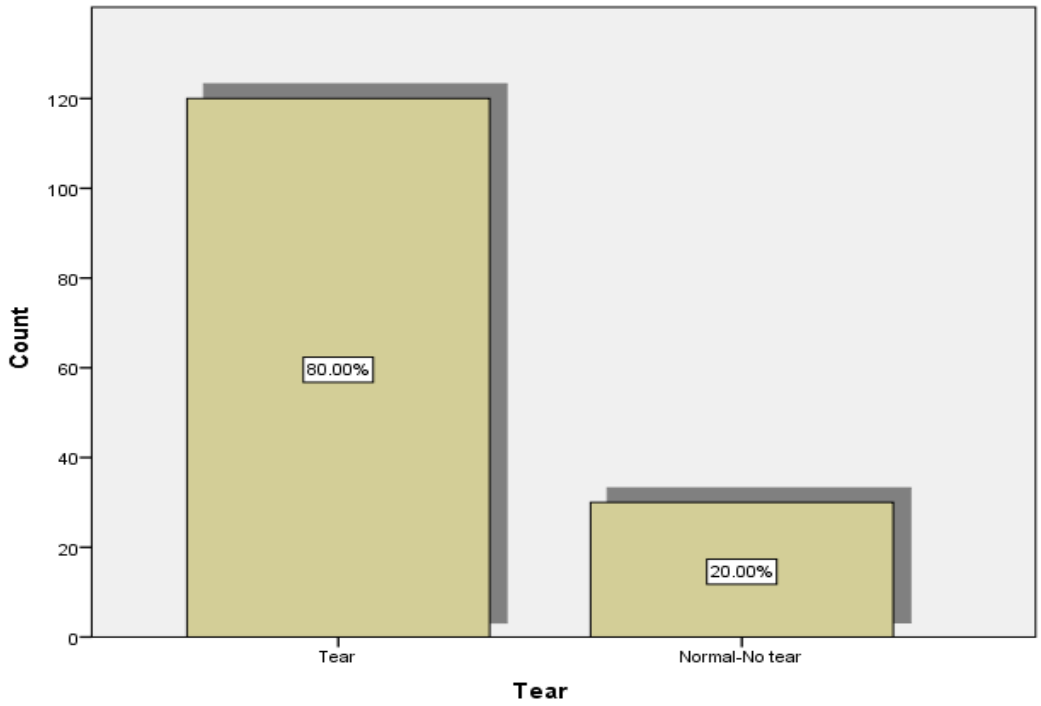

Fig 1: Shows the percentages of ACL tear and normal

The ratios of acute and chronic anterior ligament (ACL) tears were indicated in figure 2 below. The patients with an acute ACL tear had a significantly higher incidence than those with a chronic ACL tear (64.67% versus 35.33%).

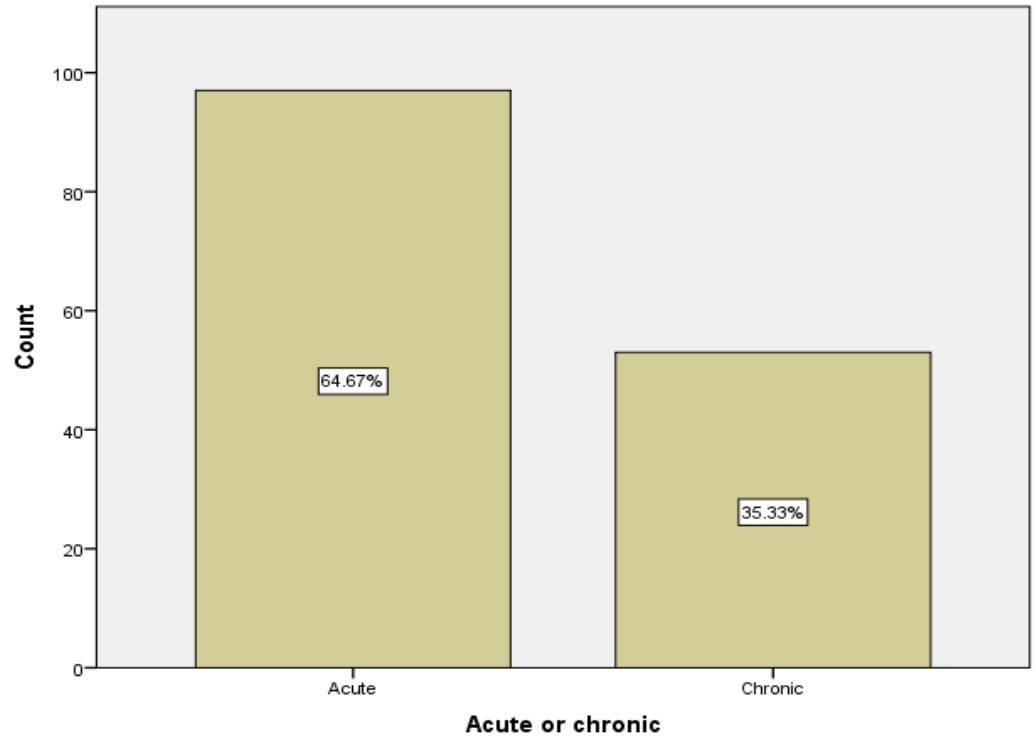

Fig 2: Shows type of tear (chronic vs. acute)

Figure 3 below illustrates the percentages of partial and complete tears of anterior cruciate ligament (ACL). It is seen in the chart that the partial tears only account for 10.67% which is a very small percentage compared to complete tears of the ACL which constitute about 89.33%.

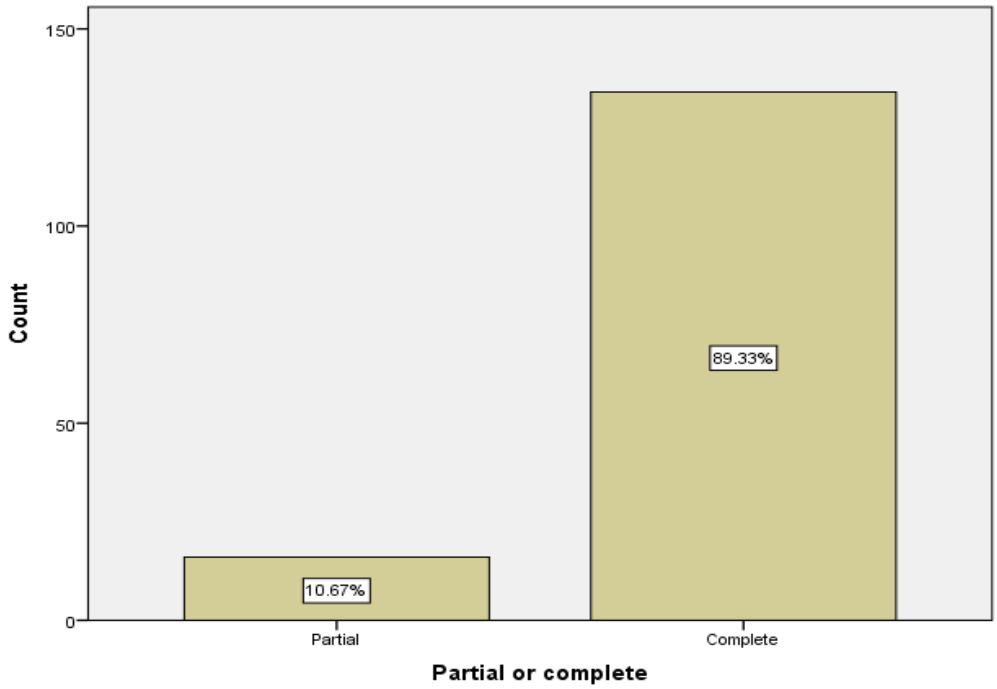

Fig 3: Shows type of tear (partial vs. complete)

The study has also demonstrated the exact locations of tear in the ACL as percentage of frequency. It is noted that the majority of tears were found in femoral end, which accounts for 62.00% of the total ACL tears, while the tibial end accounts for 23.33% of the ligament. Another tear was found to occur in the mid third of the ligament which accounts for 14.00%, while 0.67% has been classified as normal, that is no tears in the ACL, as shown in the Figure 4 below.

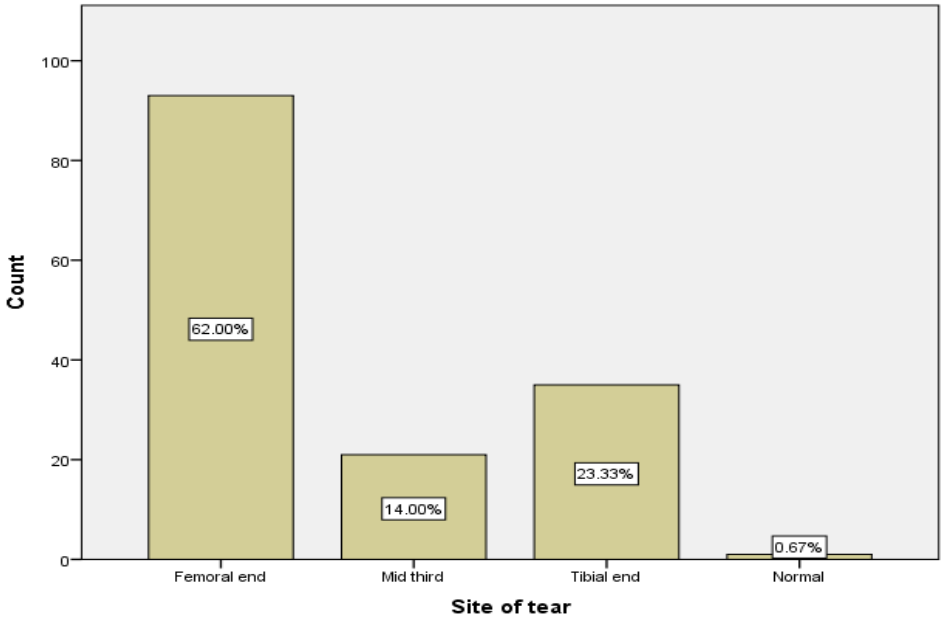

Fig 4: Shows site of tear

MRI findings in the diagnosis of anterior cruciate ligament (ACL) injuries was also spotted regarding the other tear types. As shown in the Figure 5 below, 66.67% of the bone bruise, joint effusion and soft tissue edema are confirmed by MRI detection. The diagnoses for meniscus tear, joint effusion and normal anterior cruciate ligament injury were 12.67%, 14%, and 4.67%, respectively. The figure also articulates the MIR scan for osteoarthritis of the knee which was found in 2%.

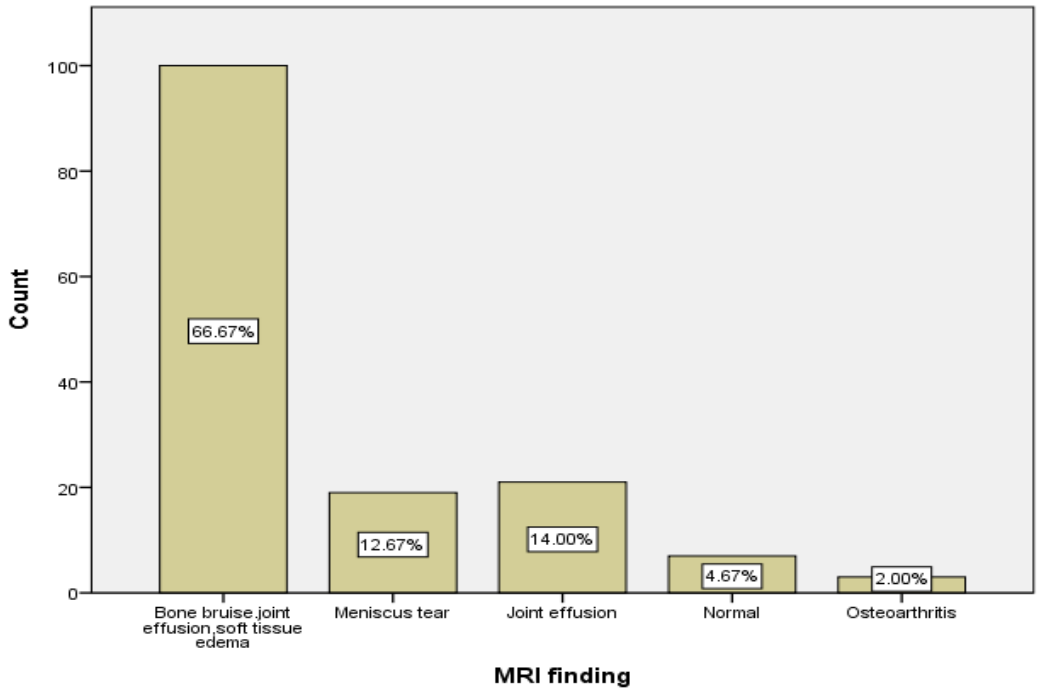

Fig 5: Shows MRI findings

DISCUSSION

Of the total number of 150 patients, 64.67% of the cases were between the ages of 15-30 years, while 35.33% of the patients were between the ages of 31-60 years. It was also found that ACL injuries/ruptures are more common in younger patients (64.67% and 35.33%, respectively) and among males than females (75.33% and 24.67%, respectively). Thus, the majority of patients in the two age groups were younger adult males.

In this study, anterior cruciate ligament injuries of the knee were diagnosed and evaluated by magnetic resonance imaging, and it was noted that the optimal position of the knee is when the knee is flexed 5-10 degrees and externally rotated 15-20 degrees, as shown in the figure below.

Fig 6: Show the position of the knee joint inside the knee coil

Based on the MRI findings in this study, of the 150 patients, 89.33% had a complete ACL tear compared to 10.67% with a partial ACL tear. This indicates that a complete anterior cruciate ligament (ACL) tear was the most common. The most common sites of anterior cruciate ligament tears were found at

the femoral end (62%), the tibial end (23.33%), and the mid-third (14%).

Regarding other types of ACL tears, it is noted that bone bruise, joint effusion and soft tissue edema, and meniscal tears were also common. That is, 66.67% of the bone bruise, joint effusion and soft tissue edema are confirmed by MRI detection. The diagnoses for meniscus tear, joint effusion and normal anterior cruciate ligament injury were 12.67%, 14%, and 4.67%, respectively, whereas the MIR scan for osteoarthritis of the knee was found to be 2% as the least prevailing among the 150 patients.

The main limitation of this study is that the study has provided a sample of patients from one geographical area belongs to a specific job category, Abu Dhabi Police Medical Services. Therefore, this is a limited sample from which the results cannot be generalized. The limited sample cannot generalize the results to the entire population of anterior cruciate ligament tears. Therefore, more studies are needed to confirm the results of this study. Despite this limitation, the results of this study are valuable and may assist radiologists in detecting the sites of ACL tears by using MRI techniques in diagnosis.

Conclusion and Recommendations

This study has strived to detect the incidence and locations of different types of ACL tears in adult patients using all the dedicated MRI techniques. Complete and partial ACL tears were diagnostic with the use of the standard knee MRI protocol. In our study, we were also able to accurately locate the ACL tear at the femoral end, middle third, and tibial end on MRI of all patients in the two study groups. However, the main difficulty in this study is that not all ACL injury types and pain locations can be reliably identified on MRI because the point of accuracy in identifying and distinguishing an ACL tear is significantly affected by the time interval and the time of performing MRI imaging. In addition, 5-10% of the imaged anterior cruciate ligaments (ACLs) are difficult to visualize normally by orthogonal MRI due to their oblique path. Add to all this, popliteal artery artifacts, partial size, osteoarthritis, and post-traumatic fibrotic scarring increase the false-positive diagnosis of an ACL tear. Therefore, the diagnosis of a partial ACL tear is a diagnostic challenge due to the striated appearance of the normal ACL exacerbated by the use of fluid-sensitive sequences that mimic the appearance of the partial ACL. Finally, this study has concluded that magnetic resonance imaging has a high and distinct ability in evaluating anterior cruciate ligament tears, and the results of this study proved that it is very useful in diagnosing these cases.

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