



RESEARCH PAPER

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The efficiency of MRI scan for the evaluation of ligament tear in Synovial Joints

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Abstract

Bones are connected in the body through flexible and strong tissues called ligaments. Sudden falls and extreme force on joints can cause ligament tears. To treat this problem, early detection is very important. MRI (magnetic resonance imaging) is considered the best technique for the detection of ligament tears. So, the study was conducted to check the efficiency of MRI in the detection of ligament tears. A study was carried out in King Khalid Hospital on 50 patients with a ligament tear. The causes and most common types of ligament tears were diagnosed by using MRI. Results showed that males (68%) had more ligament tears than females (32%). The age group of 21-30 years had high frequency and the most frequent ligament tear was found in knee joints. MRI has the ability of accurate and clear imaging. That's why it is considered gold standard imaging to assess ligament injuries in synovial joints.

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Introduction

The point where two bones meet is called a joint. Joints can be functionally classified based on their movement and histologically based on the tissues present in them (Cope *et al.*, 2019). The main and important functional joints of the body are Synovial joints which show free movement (diarthrosis). A cavity is present in this type of joint which is surrounded by an articular capsule. This capsule is a fibrous connective tissue that is attached to every bone just beyond the articulating surface. The synovium (synovial membrane) secretes synovial fluid is present in the joint cavity. On the basis of their movement, synovial joints are further classified into six types, i.e., hinge (elbow), pivot (atlantoaxial joint), ball and socket (shoulder joint), saddle (carpometacarpal joint), condyloid (metacarpophalangeal joint), and planar (acromioclavicular joint) (Juneja *et al.*, 2022). Cells of the Synovial membrane produce hyaluronate, which is the main component of synovial fluid and can maintain the normal exchange of different substances between the blood and synovial fluid.

A ligament is a band of flexible and strong tissue which connects bone to bone in the body. The movement of fingers is due to the ligament that allows bone movement and enables us to do things like flex the foot. A ligament tear can occur when these ligaments are strained or stretched beyond their capacity. The extreme force on a joint or sudden fall can also cause ligament tears. The most common ligament tears are knee, back, neck, wrist, ankle, and thumb ligaments. The anterior cruciate ligament (ACL) is the most common ligament tear with an average of 3000/year in the US. The mid-portion of the ligament experienced high ACL tears (Potter *et al.*, 2002).

To acquire appropriate therapy, an accurate assessment of the nature of these types of injuries is necessary. To avoid irreversible injury of the joint, early imaging and diagnosis of a ligament tear in the synovial joint are very important. For the detection of synovial lesions and in follow-up procedures, US

(joint high-frequency ultrasonography), conventional radiography, and MRI (magnetic resonance imaging) are commonly used (Naganna *et al.*, 2017; Turan *et al.*, 2017). Magnetic resonance imaging (MRI) is often performed before arthroscopic procedures, and the findings of the MRI decide the management plans (Dash *et al.*, 2016). With a sensitivity range of 87 to 94 percent, MRI is considered the most noninvasive technique for the detection of an ACL tear in the knee joint (Delin *et al.*, 2016). Imaging tests are performed for decisive diagnosis, and for this purpose, the least invasive and most reliable technique is MRI. It has been reported that MRI has a high accuracy for the diagnosis of ligament tears and intra-articular pathologies (Oei *et al.*, 2003; Ng *et al.*, 2011).

MRI techniques possess a high capacity to evaluate the surface and internal structure of ligaments. Hence, it can be said that MRI is significant for the imaging of joints (Sarath *et al.*, 2018). It can also be very helpful for the proper management of joint pain. Beneficial characteristics of MRI, i.e., enhanced resolution, short imaging time, improvement in signal-to-noise ratio, reduced artefacts, high accuracy, and new sequences, made it more desirable (Alshoabi *et al.*, 2020). MRI has improved the invasive approach toward joint pain management. Old procedures (that have high morbidity) have been replaced by MRI. Because of MRI, imaging of ligament tear is possible without any invasiveness (Liu *et al.*, 2019). So, the study was conducted to evaluate the efficiency of MRI in the detection of ligament tears.

Material and methods

Study design

After getting IRB clearance from the General Directorate of Health Affairs, Najran (IRB Log Number-2022-06 E), a retrospective descriptive study was carried out on 50 patients who had ligament tears. This study was performed from September 2022 to November 2022 in the King Khalid Hospital in Najran province.

Sampling and study population

A total of 50 patients (34 males and 16 females) of

different age groups were included in this study. All the patients had torn ligaments or tendons and underwent an MRI scan (Fig. 1, MRI scan for different join).

Collection of data and statistical analysis

The data of patients were collected from the PACS based on patients' records. All MRI images were evaluated by radiologists and Microsoft Excel was used for the statistical analysis.

Instruments

The following instruments were used during the study

MRI scanners

GE 3.0 Tesla discovery 750.

GE 1.5 Tesla exit signa 450.

Coil

8-channel knee array coil

8-channel wrist array coil

1.5t and 3t shoulder coil

Musculoskeletal flex coil

MRI Technique

The techniques which were used during the MRI scan are as follows:

T1-weighted: technique: T1-fast spin echo- planes: coronal oblique, sagittal oblique

T2-weighted: technique: T2-fast spin echo- plane: coronal oblique

PD weighted: technique: PD fast-spin echo- plane: sagittal, coronal, axial (optional)

PD weighted (fat-saturated) technique: PD FS fast-spin echo-plane: sagittal, coronal (optional), axial (optional).

Results

A total number of 50 patients data whose ages are between (10- 70 years), were diagnosed previously with Ligaments and tendons, including 34(68%) men and 16(32%) women in the King Khalid Hospital in Najran used for the current study (Fig. 2).

The MRI findings are read by different radiologists and the results are obtained from the MRI reports.

Table 1. Distribution of different types of ligament tears in relation to gender.

	Sex		Types of ligament tear						Total	P-value
			Upper Limb			Lower Limb				
			WRIST	ELBOW	SHOULDER	HIP	KNEE	ANKLE		
Female	Count	2	1	2	0	10	1	16	0.203	
	%	12.5%	6.3%	12.5%	0.0%	62.5%	6.3%	100.0%		
Male	Count	0	4	4	2	17	7	34		
	%	0.0%	11.8%	11.8%	5.9%	50.0%	20.6%	100.0%		
Total	Count	2	5	6	2	27	8	50		
	%	4%	10.0%	12.0%	4.0%	54.0%	16.0%	100.0%		

P > 0.05 = Non Significant,

P < 0.05 = Significant,

P < 0.01 = Highly significant.

Out of 50 patients, 4% of patients were between the age of 10-20 years, 32% of aged 21-30 years, 28% were of aged 31-40 years, the percentage of 41-years old patients was 20%, of 51-60 years, old 61-70 years old was 6% (Fig. 3). The types of ligament tear tears in the patients were ankle (16%), knee (54%), hip (4%), wrist (4%), elbow (10%), and shoulder (12%) (Fig. 4). The most common ligament tear in patients

was lower limb (74%) and then the upper limb in 26% patients (Table 1). The most common ligament tear found in female patients was knee ligament tear (62.5% females), followed by shoulder and wrist (2%). In male patients, the most common ligament tear observed in males was also knee ligament tear (50% of male patients) and then ankle tear which is found in 20.6% of male patients.

Table 2. Causes of ligament tears in relation to gender.

			Causes for ligament tear				Total	P-value
			INJURY	PAIN	RTA	SPORT		
Sex	Female	Count	6	4	5	1	16	0.047
		%	37.5%	25.0%	31.3%	6.3%	100.0%	
	Male	Count	6	4	9	15	34	
		%	17.6%	11.8%	26.5%	44.1%	100.0%	
Total		Count	12	8	14	16	50	
		%	24.0%	16.0%	28.0%	32.0%	100.0%	

Table 3. Types of ligament tears in relation to the age of patients.

Age Group			Types of ligament tear						Total	P-value
			Upper Limb			Lower Limb				
			WRIST	ELBOW	SHOULDER	HIP	KNEE	ANKLE		
Less than 20	Count	0	1	1	0	0	0	2	0.074	
	%	0.0%	50.0%	50.0%	0.0%	0.0%	0.0%	100%		
21-40	Count	1	4	5	2	10	7	29		
	%	3.4%	13.8%	17.2%	6.9%	34.5%	24.1%	100%		
41-60	Count	1	0	0	0	13	1	15		
	%	3.4%	0.0%	0.0%	0.0%	86.7%	6.7%	100%		
More than 61	Count	0	0	0	0	4	0	4		
	%	0.0%	0.0%	0.0%	0.0%	100%	0.0%	100%		
Total	Count	2	5	6	2	27	8	50		
	%	4.0%	10.0%	12.0%	4.0%	54.0%	16.0%	100%		

The result showed significance at $P > 0.05$ (Table 1). The age group among patients who had the most (29 patients) the ligament tear is 21-40 years and the age group less than 20 years had the least ligament tear (only 2 patients). In 1st age group (less than 20 years), the elbow and shoulder ligament tear (1 patient of

each type) was observed. The patients of age 21-40 years had knee (10 patients) and ankle (7 patients) ligament tears. While the age groups of 41-60 years and more than 61 years had knee ligament tears (13 and 4 patients, respectively). These results were significant at $P < 0.05$ value (Table 3).

Table 4. Causes of ligament tears in different age groups.

Age Group			Causes of ligament tear				Total	P-value
			INJURY	PAIN	RTA	SPORT		
Less than 20	Count	0	0	0	2	2	0.003	
	%	0.0%	0.0%	0.0%	100.0%	100.0%		
21 - 40	Count	4	2	11	12	29		
	%	13.8%	6.9%	37.9%	41.4%	100.0%		
41 - 60	Count	7	3	3	2	15		
	%	46.7%	20.0%	20.0%	13.3%	100.0%		
More than 61	Count	1	3	0	0	4		
	%	25.0%	75.0%	0.0%	0.0%	100.0%		
Total	Count	12	8	14	16	50		
	%	24.0%	16.0%	28.0%	32.0%	100.0%		

When the cause of ligament tear was asked from the patients, 16(32%) said that it was due to sports injury, RTA was a cause for 14(28%) patients, pain for 8(16%), and injury was a cause for a ligament tear in 12(24%) patients (Fig. 5). The main cause of ligament tear in females was injury (37% females) followed by

RTA (31.3% female patients). In contrast, the main causes for a ligament tear in male patients were sports injury (44.1% males) and RTA (26.5% patients). It showed a significant value at $P < 0.05$ (Table 2). The main cause for a ligament tear in patients of age less than 20 years is sports injury. Sports injury (41.4%)

and RTA (37.9%) were the main causes observed in 21-40 years old patients. Injury (46.7%) was the main cause of ligament tear in 41-60 years old and pain

(75%) was the main reason in patients with an age of more than 61 years. The significance of the results was at $P < 0.01$ value (Table 4).

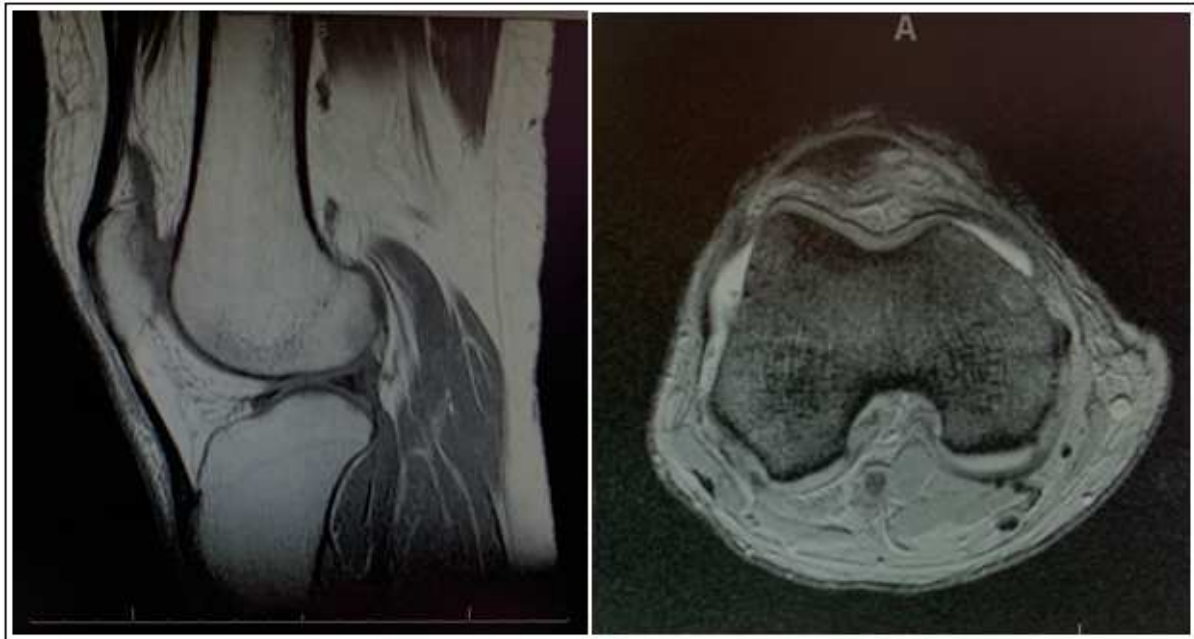


Fig. 1. Shoulder and Knee joint.

Discussion

A total of 50 patients with torn ligaments were included in this study. It has been found that males experienced more ligament tears (68%) than females (32%).

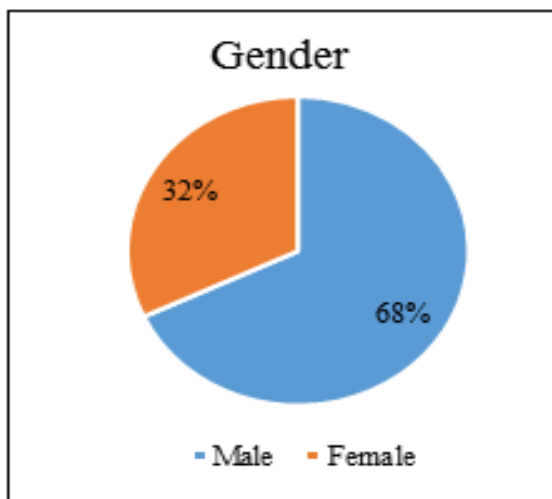


Fig. 2. Gender of patients.

The same findings were reported by Mohey *et al.* (2020), that males were affected more by ligament tears than females. Peixoto *et al.* (2018) also reported the same incidence.

The results of Petersen *et al.* (2013) also showed that women were less (45%) prone to tendon and ligament tears than men (55%).

This could be due to the fact that males were involved in more physical activities like playing football and basketball than females.

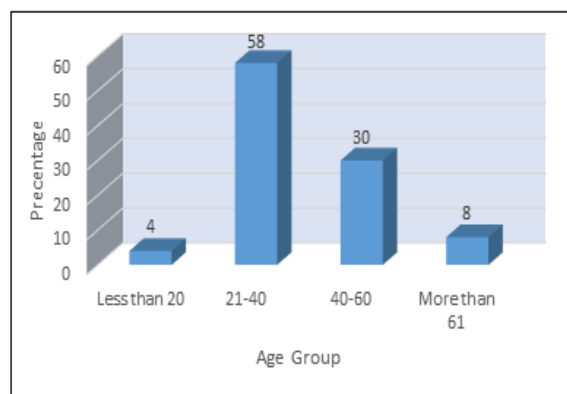


Fig. 3. Age distribution of patients

The age group which is most affected by ligament tears was 21-30 years; however, the least affected group was 11-20 years old. In contrast to our findings, Petersen *et al.* (2013) found that the most affected group is 18-60 years old.

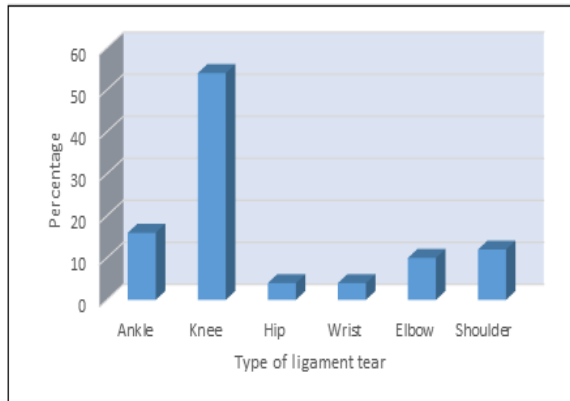


Fig. 4. Types of ligament tears in patients.

The most common joint which is affected by ligament tear is the knee joint (54%) in the current study which is similar to the results of Sheldon *et al.* (2005). However, in the findings of Petersen *et al.* (2013), ankle ligament tear was more common. Sports injury is the most common cause (32%) of ligament tears.

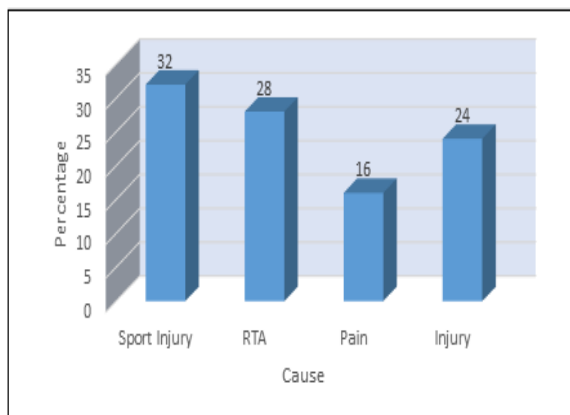


Fig. 5. Traumatic causes for tendon and ligament tear.

Conclusion

The use of the MRI technique is highly informative and plays an important role in the diagnosis of torn ligaments. MRI has the ability of accurate and clear imaging. That's why it is considered gold standard imaging to assess ligament injuries in synovial joints.

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