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Evaluation of Anterior Knee Pain by Magnetic Resonance Imaging

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ABSTRACT

Background: Anterior knee pain (AKP) is the commonest cause of knee complaints. It represented about 25% of all adult knee problems and its non-specific complaint has multiple causes and risk factors.

Objective: This study aims to evaluate the role of magnetic resonance imaging (MRI) in diagnosing different diseases that cause pain in the front of the knee.

Patients and methods: A cross sectional study of forty eight patients with history of anterior knee pain. All patients were referred from the outpatient clinic of orthopedic surgery, Zagazig University Hospitals. This work was performed at the MRI unit of Radiodiagnosis Department, Zagazig University Hospitals.

Results: The mean age of the studied group was 37.35±13.78 years. Visual Analog Scale (VAS) was (4.62±1.16) with more than half (56.2%) of cases having right sided pain. Most presenting symptoms was isolated anterior knee pain (62.5%). The frequency distribution of all MRI findings in all patients showed that 58.3% of the studied group had patellar tilt, 33.3% had patellar chondromalacia or patellofemoral instability, and 20.8% of cases had patellofemoral osteoarthritis.

Conclusion: MRI is proven to be the technique of choice in differentiation between various knee pathologies that cause AKP in different age groups due to its safety. Also, MRI has the ability to detect the different grades of some knee pathologies as trochlear dysplasia, chondromalacia patella or factors that may predispose to them.

Keywords: Anterior knee pain, Chondromalacia patella and trochlear dysplasia, MRI.

INTRODUCTION

Anterior knee pain (AKP) is a very common knee complaint affecting adults and young individuals. It was recorded that about a quarter of attendants to sports injury clinics suffer from AKP [(1)]. This pain can be acute or chronic and increases by physical activity such as climbing up and down the stairs, squatting or kneeling [(2)]. Since the anterior part of the knee contains multiple structures such as cartilage, subchondral bone, synovial plica, patellar fat pads, retinacula, capsule and tendons, any of these structures can be affected alone or together to cause AKP [(3)].

The majority of the cases with AKP can be improved with conservative treatment using medications and physical therapy. Nevertheless, the most difficult challenge is to localize the exact origin of AKP only by physical examination [(4)]. Imaging options for anterior knee pain include X-ray, CT, and MRI. X-ray is usually the first modality used to evaluate AKP due to its wide availability, rapidity, and low cost. X-rays can be used to detect various disorders of the knee such as fractures, osteoarthritic degenerative changes, and joint effusions [(5)].

Nevertheless, it is quite limited because it cannot detect the pathology in soft tissues and cartilage, and has the added risk of exposure to radiation. This means it may not be suitable for all patients, especially pregnant women and children [(6)]. CT can also be used to accurately detect bony pathologies and measure the TT-TG distance, which is important in the detection of patellofemoral instability. The main limitation of CT is the low soft tissue contrast, which makes it insensitive in evaluation of periarticular ligaments and insertions, joint capsule and menisci.

Furthermore, accurate TT-TG distance measurements need special image protocol techniques, patient position and overlay of images requiring specific software capabilities and a high dose of ionizing radiation [(7, 8)]. Therefore, the aim of the present study was to evaluate the role of magnetic resonance imaging in diagnosing different diseases that cause pain in the front of the knee.

PATIENTS AND METHODS

This study included 48 patients (26 males and 22 females) with history of anterior knee pain. Their ages ranged from 12 to 60 years (average age 37 years). The period of study was 6 months. All patients were referred from the outpatient clinic of orthopedic surgery, Zagazig University Hospitals. This work was performed at the MRI unit of Radiodiagnosis Department, Zagazig University Hospitals.

Inclusion criteria: Any patient with a pain at the anterior knee. All age groups were included.

Exclusion criteria: Patients with contraindication to MRI examination e.g. implanted pacemaker, ocular implants, aneurysmal clips, and any orthopedic device incompatible with MRI. Patients with isolated pain in other compartments (posterior or lateral compartments).

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All patients were subjected to the proper assessment including: full clinical history taking for analysis of patient complaint (knee pain): site, onset, course, duration, and the relationship to posture. Degree of pain was also graded based on a subjective Visual Analog Scale (VAS). All patients subjectively gave a number for their degree of pain (0 being the best and 10 being the worst). All patients were enrolled for clinical examination to find out objective decrease in range of motion or laxity by imaging including**:** plain X-ray of the affected knee joint (anteroposterior, lateral) and MRI of the affected knee.

MRI Protocol for Knee Examination:

Patients were instructed to remove any metallic object before entering the examination room. MR examination was performed at (1.5 tesla) super conducting MR magnet (Philips Achieva system, UK) in the MRI Unit, Zagazig University Hospital. Patients were placed supine with the knee extended and slightly externally rotated (10-15 degrees) in an extremity coil to optimize the signal to noise ratio. Images were obtained in the axial, sagittal and coronal planes. These sequences were obtained using a field of view of 14-16 cm, a slice thickness of 4-5 mm, and an interslice gap of 0.5 to 1 mm. MRI evaluation included standard evaluation of ligaments, menisci, joint space, and articular cartilage. Specific evaluation of the patellofemoral joint space included evaluation of patellofemoral articular surfaces and cartilage, and measurements of patellofemoral and patellotibial alignment.

The femoral trochear depth was evaluated on axial views. When found a trochlear dysplasia was classified into four types by using Dejour classification (A: normal trochlea, B: flattened or convex trochlea, C: asymmetric trochlear facets with an obliquely oriented articular surface with the patella, D: cliff-like step-off between the medial and lateral trochlear facets) **(9).**

The patellar cartilage was evaluated according to Outerbridge grading system including a grade from 0 to 4 (0= normal, 1= an increase in T2 signal intensity of morphologically normal cartilage, 2=a superficial partial-thickness cartilage defect involving <50% of total articular surface thickness, 3= a deep partial-thickness cartilage defect involving >50% of total articular surface thickness, and 4=a full thickness cartilage defect with subchondral defect. Several MRI measurements were performed to evaluate various aspects of patellofemoral joint malaligement.

In cases of suspected longitudinal displacement of the patalla,the Insall-Salvati index was used to calculate the ratio between the lengths of patellar tendon from its origin at apex of patella to its insertion at tibial tuberosity divided by the longest superoinferior diameter of the patella. An upper limit of 1.3 was used to confirm patella alta, while a lower limit of 0.8 was used to confirm patella baja **(1).**

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee.

Every patient signed an informed written consent for acceptance of sharing in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis

All data were analyzed using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as the mean ± SD, and range and qualitative data were expressed as absolute frequencies (number) and relative frequencies (percentage). Independent samples Student's t-test was used to compare quantitative variables. Chi-square test was used to compare qualitative data. P-value < 0.05 was considered statistically significant.

RESULTS

The mean age of the studied group was 37.35 years with range of (12-60) years. More than half of them were males. About a quarter of patients worked as employees (Table 1).

Table (1): Demographic characteristics of the studied participants (n=48)

Variable	Value	
Age (years):		
• Mean± SD • Range	37.35±13.78 (12-60)	
Variable	**No**	**%**
Gender:		
• Male • Female	26 22	54.2 45.8
Occupation		
• Employee • Student • House wife • Teacher • Worker • farmer • Engineer • Pharmacist • Athlete • Military	12 9 8 4 4 4 3 2 1 1	25.0 18.8 16.5 8.3 8.3 8.3 6.3 4.2 2.1 2.1
Total	48	100

The mean level of the pain assessed by Visual Analog Scale (VAS) was 4.62±1.16 with more than half of cases having right sided pain. Most presenting

symptoms included isolated anterior knee pain (Table 2).

Table (2): Clinical characteristics of the studied group (n=48)

Variable	Value	
Duration of pain (month):		
• Mean± SD	14.34±11.39	
VAS (pain score):		
• Mean± SD	4.62±1.16	
Variable	**No**	**%**
Laterality:		
• Right • Left	27 21	56.2 43.8
Presenting symptom:		
Anterior knee pain Anterior knee pain plus giving away Anterior knee pain plus difficult kneeling Anterior knee pain plus limited range of motion	30 10 6 2	62.5 20.8 12.5 4.2

About 58.3% of the studied group had patellar tilt, 33.3% had patellar chondromalacia or patellofemoral instability, and 20.8% of cases had patellofemoral osteoarthritis. Concerning, Insall/Salvati index, sulcus angle, trochlear depth, and TT/TG ratio was measured in all patients, the results are shown in table 3.

Table (3): Different measurements of patellofemoral instability in the study group (n=48)

Variable	Value Mean± SD
Insall/Salvati index	1.15±0.19
Sulcus angle degree	134.47±13.48
Trochlear depth (mm)	5.77±1.83
TT/TG distance (mm)	10.1±8.9

Using the defined upper and lower limits of normal for each measurement, we found that 58.3% had abnormal patellofemoral angle, 33.3% had abnormal TT/TG distance, 20.8% of patients had abnormal Insall/Salvati index, 12.5% had abnormal sulcus angle degree, and 12.5% had trochlear dysplasia (Table 4).

Table (4): Interpretation of MRI measurements of the studied group

Variable	No	%
Insall/Salvati index • Normal (0.8-1.3) • Abnormal (<0.8 or >1.3)	 38 10	 79.2 20.8
Total	**48**	**100.0**
Lateral patellofemoral angle • Normal • Abnormal	 20 28	 41.7 58.3
Total	**48**	**100.0**
Sulcus angle degree • Normal (<=144) • Abnormal (>144)	 42 6	 87.5 12.5
Total	**48**	**100.0**
Trochlear depth • Normal (>3) • Dysplasia (<=3)	 42 6	 87.5 12.5
Total	**48**	**100.0**
TT/TG distance • Normal (<=15mm) • Abnormal (>15mm)	 32 16	 66.7 33.3
Total	**48**	**100.0**

On comparison between patellar and non-patellar causes of knee pain no significant differences were found regarding age, sex, or degree of knee pain among both groups. Furthermore, no significant differences were found between male and female patients with respect to degree of knee pain (Table 5).

Table (5): Comparing patellar and non-patellar causes of knee pain with VAS

Age groups	Patellar causes (n=39)	Non patellar causes (n=9)	P value
	No %	No %	
12-24 **25-47** **48-60**	8 (20.5) 20 (51.3) 11 (28.2)	1 (11.1) 6 (66.7) 2 (22.2)	0.684
Male (n=26) **Female (n=22)**	20 (51.3) 19 (48.7)	6 (66.7) 3 (33.3)	0.404
VAS	4.66±1.17	4.44±1.13	0.612

DISCUSSION

MRI has more recently been used in the evaluation of either acute or chronic causes of AKP, as it can detect the pathology causing pain either in the bones, cartilage or soft tissues [10]. MRI can also be used for calculation of TT-TG distance and other measurements such as trochlear angle, trochlear depth and patellar height, which are important in diagnosis of patellofemoral instability and can detect any associated soft tissue or articular cartilage abnormalities without the need for further evaluation with CT scan. This allows MRI to act as one step modality for the evaluation of patellofemoral instability, detection of associated internal joint derangement, without exposing the patient to the danger of ionizing radiation [11]. In this study, we aimed to evaluate the role of MRI in diagnosis of various pathologies causing anterior knee pain.

The main finding of our study was that after MRI, 42 out of 48 patient with initial diagnosis based on clinical and X-ray findings (about 87.5%) had additional findings on MRI. In addition, twenty seven patients with normal X-ray findings had added osseous findings, soft tissue findings or both osseous and soft tissue findings only detectable by MRI. This agreed with a study by **Fahmy *et al.*** [10], who found an additional value of MRI in detection of bony, cartilage and soft tissue findings in AKP and findings by **Diederichs *et al.*** [12], who reported that up to 60% of osteochondral lesions of the knee may go unnoticed on X-rays. Furthermore, we found that ten patients with X-ray findings of osteoarthritis had additional osseous findings or both osseous and soft tissue findings only detectable by MRI. Nine patients with X-ray findings of isolated longitudinal displacement of the patella had additional soft tissue findings or osseous and soft tissue findings only detectable by MRI. Only six patients had similar X-ray and MRI findings.

Regarding demographics, patient ages ranged between 12 to 60 years with a peak incidence of presentation in the fourth followed by the third decade. This could be explained by the age related deterioration of ligament elasticity and cartilaginous health. The mean±SD of age in our study was 37.4 ± 13.8 years similar to a recent study by **Ye et *al.*** [13], who reported a mean age of 33.8 ± 9.4 years. The number of males suffering from AKP was more than females (26 versus 22). This could be explained by higher physical activity and higher incidence of sports injury in males. **Fahmy *et al.*** [10] reported a similar male predominance, but **Diederichs *et al.*** [12] stated a majority of female patients in their study. This study was based on a previous study by **Fithian *et al.*** [14], in which a larger sample size, lower mean of age of patients, and different study design was used.

Regarding clinical data, 62.5% of patients complained of anterior knee pain alone, 20.8% complained of anterior knee pain plus giving away, 12.5% complained of anterior knee pain plus difficult kneeling, and about 4.2% complained of anterior knee pain plus limited range of motion. Mean of duration of pain (in months) was 14.3 ± 11.4. This was slightly longer, but similar to the duration (9 ± 6.7 months) reported by **Kang *et al.*** [2]. In our study, the mean ± SD pain score (by VAS) was 4.6 ± 1.2. This agreed with findings by **Kang *et al.*** [2], who reported mean ± SD VAS scores of 4.7 ± 1.9. The majority of symptoms (56.2%) were on the right side, and the remaining symptoms were on the left side (43.8%). This agreed with results of **Fahmy *et al.*** [10] who reported that 56% of complaints were on the right side and 44% were on the left.

Regarding the prevalence of various pathologies causing AKP on MRI, patellar tilt had the highest prevalence (58.3%), followed by chondromalacia patella and patellofemoral instability (33.3%), patellofemoral osteoarthritis (20.8%). Highest prevalence of patellar tilt agreed with results reported by **McNally *et al.*** [15] but disagreed with **Baz *et al.*** [16] who reported highest prevalence of chondromalacia patella (43%). Difference in prevalence between our and the latter study might have been due to difference in sample size, lower mean age and a female predominance. To further analyze the severity of the two most prevalent MRI findings in our patient population, chondromalacia patella (CP) was classified using the Outerbridge grading system [1].

In our study, the majority of patients were given a grade IV (81%) followed by grade I (13%) then grade III (6%). No cases had grade II CP. he High prevalence of grade IV CP agreed with results of a study by **Mattila et *al.*** [17], which reported that the diagnostic accuracy of MRI is higher in the lesions of chondromalacia patella with high grades such as III or IV. We also found that trochlear dysplasia and patellofemoral malalignment were commonly associated (56.25%) with CP. This agreed with findings of **Özdemir and Kavak** [18] who reported that patellofemoral malalignment is an important predisposing factor in the development of chondromalacia patella. Thus, we recommend MRI technique in evaluation and diagnosis of different pathologies and risk factors causing AKP as it is the best available, safe and accurate technique.

CONCLUSION

MRI is proven to be the technique of choice in differentiation between various knee pathologies that cause AKP in different age groups due to its safety. Also, MRI has the ability to detect the different grades of some knee pathologies as trochlear dysplasia, chondromalacia patella or factors that may predispose to them.

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