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Potential Role Magnetic Resonance Imaging in Assessment of Anterior Knee Pain

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ABSTRACT

Background: The knee joint is a hinge joint and is considered as the most commonly injured joint in the body as it may be less stable than other joints of ball and socket pattern. This study aims 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. All Patients were subjected to MRI Protocol for Knee Examination Results: Among 48 patients who performed both X-ray and MRI examinations, 42 patients (87.5%) had additional MRI findings. Among 27 patients with normal X-ray findings, 20 (74%) of patients had osseous findings (patellar tilt, patellofemoral instability, or trochlear dysplasia) associated with a soft tissue finding or an isolated soft tissue findings (chondromalacia patella, ganglion cyst, retinaculum injury, or plica) only detectable by MRI. The remaining 26% (7 patients) only had osseous findings.

Conclusion: MRI is fast, safe and non-invasive imaging technique which has been proven to be the modality of choice for establishing an accurate diagnosis of different knee pathologies that cause anterior knee pain in different age groups. It also allows to know the extent, severity, grades and types of the lesions, what will be necessary to decide appropriate treatment.

Keywords: Magnetic Resonance; Anterior Knee Pain ; x rays

Introduction:

The incidence of knee injury had been increasingly seen with the widespread interest in contact sports. Anterior knee pain (AKP) is by far considered the commonest cause of knee complaints, and it constitutes about 25% of all adult knee problems;

nevertheless, it is commonly encountered in athletes and active subjects, especially the adolescents **(1).**

AKP as a term may be interchangeably used with the term patellofemoral pain syndrome where the patella and the retinaculum constitute the main source of the complaints. It is considered as an incapacitating problem that has an impact on the subject lifestyle; however, its etiology is still not well understood making its treatment to some extent a challenging issue **(2)**

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 **(3)**.

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 **(4).**

Recently, magnetic resonance imaging (MRI) has obtained an eminent role in the diagnosis of different knee diseases, providing a safe imaging modality with multi-planner capabilities and at the same time not exposing the patient to ionizing radiation; moreover, it can help in an accurate assessment of the intra-articular structures like ligaments and cartilage as well as the extra-articular structures like tendons and the peri-articular musculature **(5)**.

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

Patients and Method:

This study included 48 patients with history of anterior knee pain referred from the outpatient clinic of orthopedic surgery, Zagazig University hospitals . we excluded patients with contraindication to MRI examination e.g. implanted pacemaker, ocular implants, aneurysmal clips, and any orthopedic device incompatible with MRI and Patients with isolated pain in other compartments (posterior or lateral compartments).

Patients were subjected to full 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) and assessment of associated swelling, stiffness, and deformity. Imaging including: Plain

X-ray of the affected knee joint (anteroposterior, lateral) and MRI of the affected knee were donr for all patients.

MR examination was performed at (1.5 tesla) super conducting MR magnet (Philips Achieva system) 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.

T1-weighted images were generated with short repetition time (TR) of 400- 600 ms, short echo-time (TE) of 30 ms or less, and a 256 x 256 or 192 mm acquisition matrix. Conventional T2-weighted (first and second echo) images were generated with long repetition time (TR) of 2000 ms, long echo time (TE) of 20 or 80 ms, and a 256 x 192 or 128 acquisition matrix. The use of a short TE (20 ms) provided a proton density weighting, while the use of a longer TE (80ms) provided a T2-weighted image. These sequences were obtained using a field of view of 14-16 cm, a slice thickness of 4-5mm, and an interslice gap of 0.5 to 1mm.

MRI evaluation included standard evaluation of ligaments, menisci, joint space, and articular cartilage. Specific evaluation of the patello-femoral joint space included evaluation of patello femoral articular surfaces and cartilage, and measurements of patello-femoral and patellotibial alignment.

Statistical Analysis:

All data were collected, tabulated and statistically analyzed using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA). Data were represented in tables and graphs, Continuous Quantitative variables e.g. age were expressed as the mean±SD & median (range), and categorical qualitative variables were expressed as absolute frequencies (number) & relative frequencies (percentage).

Results:

The mean age of the studied group was 37.35±13.78 years and 54% of them were males. The mean of Visual Analog Scale (VAS) was (4.62±1.16) .56.2% of cases having right sided pain. isolated anterior knee pain (62.5%) was the most presenting symptoms while other (37.5%) of symptoms were anterior knee pain associated with other complaints. According to x-ray findings, 56.2% of the studied group had no radiographic abnormalities, while 20.8% had osteoarthritis, and 16.6% had radiographic signs of patella alta. When MRI was performed, 58.3% of the studied

group had patellar tilt, 33.3% had patellar chondromalacia or patellofemoral instability, and 20.8% of cases had patello-femoral osteoarthritis **(Table 1).**

Insall/Salvati index, sulcus angle, trochlear depth, and TT/TG ratio was measured in all patients. Mean Insall/Salvati index was 1.15±0.19, mean sulcus angle was 134.47±13.48, mean trochlear depth was 5.77±1.83mm, and mean TT/TG distance was 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. Among 48 patients who performed both X-ray and MRI examinations, 42 patients (87.5%) had additional MRI findings. Among 27 patients with normal X-ray findings, 20 (74%) of patients had osseous findings (patellar tilt, patellofemoral instability, or trochlear dysplasia) associated with a soft tissue finding or an isolated soft tissue findings (chondromalacia patella, ganglion cyst, retinaculum injury, or plica) only detectable by MRI. The remaining 26% (7 patients) only had osseous findings. Among 10 patients with X-ray findings of osteoarthritis, 6 patients (60%) had osseous findings (patellar tilt or patellofemoral instability) associated with a soft tissue finding (chondromalacia patella) only detectable by MRI and 10% (one patient) had additional osseous (patellar tilt, trochlear dysplasia, and patellofemoral instability) findings **(Table 2)**

Among 9 patients with X-ray findings of isolated longitudinal displacement of the patella (patella alta or baja), 3 patients (33.3%) had osseous findings (patellar tilt, patellofemoral instability) associated with a soft tissue finding (chondromalacia patella) or associated soft tissue findings (Chondromalacia patella, bursitis, quadriceps tendon rupture) only detectable by MRI. Five patients (55.6%) had only osseous (patellar tilt, trochlear dysplasia, and patellofemoral instability) findings .Only 6 patients had similar X-ray and MRI findings of which three had isolated patellofemoral osteoarthritis, two had abnormal patellar morphology (one bipartite and one tripartite patella, and one had isolated longitudinal patellar displacement (patella alta) **(Table 3).**

Table (1): MRI findings of the studied group (n=48).

MRI findings	No	%
• Patellar tilt	28	58.3
• Patellar chondromalacia	16	33.3
• Patellofemoral instability	16	33.3
• Patellofemoral osteoarthritis	10	20.8
• Patella alta	8	16.7
• Trochlear dysplasia	6	12.5
• Retinaculum injury	5	10.4
• Ganglion cyst	3	6.3
• Bursitis	3	6.3
• Patella baja	2	4.2
• Bipartite patella	1	2.1
• Tripartite patella	1	2.1
• Tendon injury	1	2.1
• Plicae	1	2.1

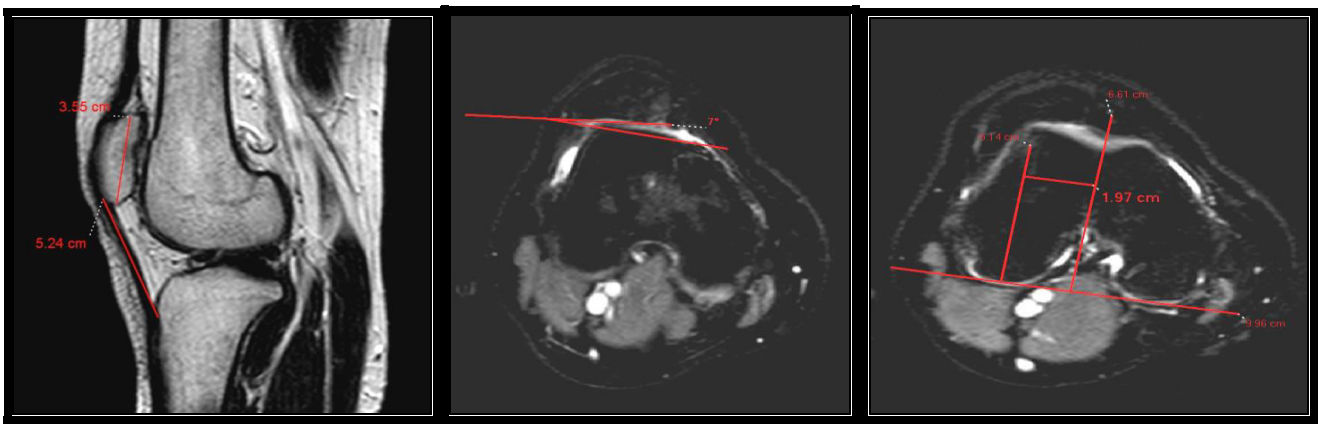
Table (2): Additional MRI findings in patient with osteoarthritic radiographic (x-ray) changes.

No.	X-ray findings	MRI findings
1	Osteoarthritis + patella alta	Patellofemoral osteoarthritis + patella alta + chondromalacia patella (Grade IV)
2	Osteoarthritis	Patellofemoral osteoarthritis + patellar tilt + patellofemoral instability + chondromalacia patella (Grade IV)
3	Osteoarthritis	Patellofemoral osteoarthritis + patellar tilt + patellofemoral instability + chondromalacia patella (Grade III)
4	Osteoarthritis	Patellofemoral osteoarthritis + patellar tilt +chondromalacia patella (Grade IV) + patellofemoral instability
5	Osteoarthritis	Patellofemoral osteoarthritis+ chondromalacia patella (Grade IV)
6	Osteoarthritis	Patellofemoral osteoarthritis+ chondromalacia patella (Grade IV)
7	Osteoarthritis	Patellofemoral osteoarthritis + patellar tilt + patellofemoral instability + trochlear dysplasia (Type A).

Table (3): Additional MRI findings in patient with longitudinal displacement of the patella (patella alta or baja) radiographic (x-ray) changes.

No.	X-ray findings	MRI findings
1	Patella alta	Patella alta + patellar tilt
2	Patella alta	Patella alta + patellar tilt + patellofemoral instability

3	Patella alta	Patella alta + patellar tilt + patellofemoral instability
4	Patella alta	Patella alta + patellar tilt + patellofemoral instability
5	Patella baja	Patella baja + patellar tilt + patellofemoral instability
6	Patella alta	Patella alta + patellar tilt + patellofemoral instability + chondromalacia patella (grade IV)
7	Patella alta	Patella alta + superfacial infra patellar bursitis
8	Patella baja	Patella baja + quadriceps tendon rupture



(A) **(B)** **(C)**

Fig (1): Female student patient of 20 years old complains of right anterior knee pain and giving away (instability) from 18 months ago A Sagittal T2W image demonstrates a high riding patella with Insall salvati index =1.47 denoting patella alta B Axial PDW image demonstrates abnormal patellar tilting with lateral patellofemoral angle =7° and opens medially. C Axial PDW image demonstrates TT_TG distance =19mm denoting patellofemoral instability Diagnosis: patella alta with patellofemoral instability

(A) **(B)** **(C)**

Fig (2): Male teacher patient of 43 years old complains of left anterior knee pain from 18 months ago A Axial PDW image Showing narrowing of patellofemoral joint with thinning, cracking of articular cartilage (white arrows), osteophytes (blue arrow) B sagittal T2W image showing lipping of patella (red arrow) C sagittal T1W

image showing small subchondral pseudo-cystic changes (arrow head) demonstrating patellofemoral osteoarthritis Diagnosis: Patellofemoral osteoarthritis.

3- Discussion:

MRI is considered the best imaging modality for assessing the soft tissues in and around the knee joint for a more precise evaluation of the true cause or severity of anterior knee pain (AKP), thereby affecting decisions about appropriate surgical or conservative management **(6)** .

The purpose of this study is to highlight the role of magnetic resonance imaging (MRI) in the diagnosis and grading of the most common causes of anterior knee pain.

In the present study, the mean±SD of age in our study was 37.4 ± 13.8 years similar to a recent study by Ye et.al who reported a mean age of 33.8 ± 9.4 years **(7)**. 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. reported a similar male predominance, but Diederichs et. al. reported a majority of female patients in their study. This study was based on a previous study by Fithian et al, in which a larger sample size, lower mean of age of patients, and different study design was used **(8)**.

Other important MRI findings included Patellofemoral osteoarthritis and abnormal patellar height. Patellofemoral arthritis was initially diagnosed on 10 X-rays in patient population, of which 7 had additional MRI findings. In our study about 50% of patients initially diagnosed with patellofemoral osteoarthritis had either patellofemoral malalignment, patellar tilt, or abnormal patellar height (patella alta or baja). This finding was also reported by Tsavalas et. al, who found that malalignment of patellofemoral joint is an important predisposing factor in the development of patellofemoral osteoarthritis as it induces excessive stress on the articular surfaces **(9)**. Abnormal patellar height was also initially diagnosed in 10 X-rays of the patients' population using Insall Salvati index and then confirmed by MRI. This agrees with results of Shabshin et al who reported that the most popular method for measuring the patellar position is Insall Salvati index (ISI) which was based on radiography but recently applied to (MRI) **(10)**.

Additional pathologies included trochlear dysplasia, non-patellar causes (such as ligamentous injury and bursae), bipartite and tripartite patella. MRI findings of trochlear dysplasia were classified using Dejour classification **(11)**.

In our study, the majority of cases were classified as type A (50%). These results agreed with Baz et al and Ambra et al, who also report a majority of type A trochlear dysplasia in their studies **(12)**. Bipartite and tripartite patella were classified according to Saupe classification **(11).**

In our study, the most common bipartite patella was Saupe type 2. This did not agree with Kavanagh et al's study who reported that the most common type was Saupe type 3. This difference may be due to a larger sample size and restricted selection to patients with segmented patella **(13)**.

Regarding origin of AKP, 81.2% of patients had a patellar cause of AKP, while 18.8% of patients had non patellar causes of AKP. The most prevalent patellar causes included patellar tilt (71%) followed by chondromalacia patella (41%), patellofemoral instability (41%), patellofemoral osteoarthritis (25%), patella alta (20%), patella baja (5%) and bipartite and tripartite patella (5%). Most common non patellar causes included trochlear dysplasia (66%) Followed by ganglion cyst (33%), bursitis (33%), tendon injury (11%) and plica (11%). In our study, the majority of AKP was of patellar origin. This agrees with **Baz et al's** study who reported that about 70% of cases had patellar causes **(14).** The difference in results between our study and the study performed by Kang et al was the larger sample size, the inclusion of only male soldiers less than 30 years of age with history of atraumatic anterior knee pain only **(15).**

The main finding of our study was that after MRI, 42 out of 48 patients 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.,** which also found an added value of MRI in detection of bony, cartilage and soft tissue findings in AKP **(8).**

Our findings matches those of Berruto et al's study who stated that the three essential predisposing factors leading to patellofemoral instability were trochlear dysplasia, an abnormal patellar height, and a pathological tibial tubercle-trochlear groove TT_TG distance**.** Also Fahmy et al's who stated that the commonest predisposing factors of patellofemoral instability were high patella, trochlear dysplasia and lateralization of the patella **(8, 16).**

Conclusion:

MRI is fast, safe and non-invasive imaging technique which has been proven to be the modality of choice for establishing an accurate diagnosis of different knee pathologies that cause anterior knee pain in different age groups. It also allows to know the extent, severity, grades and types of the lesions, what will be necessary to decide appropriate treatment.

Conflict of Interest: No conflict of interest.

References:

1- **Collado H, Fredericson M (2010)**: Patellofemoral pain syndrome. Clin Sports Med 29:379–398.

2- **Biedert RM, Sanchis-Alfonso V (2002):** Sources of anterior knee pain. Clin Sports Med 21:335–347 Vii.

3- **Skiadas, V., Perdikakis, E., Plotas, A. and Lahanis, S., (2013):** MR imaging of anterior knee pain: a pictorial essay. Knee Surgery, Sports Traumatology, Arthroscopy, 21(2), pp.294-304.

4- **Georgiev, T., Stoilov, R., Penkov, M., Ivanova, M. and Trifonov, A., (2016):** Radiographic assessment of knee osteoarthritis. Revmatologiia (Bulgaria), 24(2), pp.16-24.

5- **Escala JS et al (2006)**: Objective patellar instability: MR-based quantitative assessment of potentially associated anatomical features. Knee Surg Sports Traumatol Arthrosc 14(3):264–272.

6- **Fu Y, Wang G and Fu Q (2011):** Patellar resurfacing in total knee arthroplasty for osteoarthritis: a metaanalysis. Knee Surgery, Sports Traumatology, Arthroscopy, 19(9): 1460-1466.

7- **Ye, Q., Yu, T., Wu, Y., Ding, X. and Gong, X., (2019):** Patellar instability: the reliability of magnetic resonance imaging measurement parameters. BMC musculoskeletal disorders, 20(1), p.317.

8- **Fahmy, H.S., Khater, N.H., Nasef, N.M. and Nasef, N.M., (2016):** Role of MRI in assessment of patello-femoral derangement in patients with anterior knee pain. The Egyptian Journal of Radiology and Nuclear Medicine, 47(4), pp.1485-1492.

9- **Tsavalas, N., Katonis, P. and Karantanas, A.H., (2012):** Knee joint anterior malalignment and patellofemoral osteoarthritis: an MRI study. European radiology, 22(2), pp.418-428.

10- **Shabshin, N., Schweitzer, M.E., Morrison, W.B. and Parker, L., (2004):** MRI criteria for patella alta and baja. Skeletal radiology, 33(8), pp.445-450.

11- **Samim, M., Smitaman, E., Lawrence, D. and Moukaddam, H., (2014):** MRI of anterior knee pain. Skeletal radiology, 43(7), pp.875-893.

12-**Ambra, L.F., Galvão, P.H.S.A.F., Mameri, E.S., Farr, J. and Gomoll, A.H., (2019):** Femoral Trochlear Geometry in Patients with Trochlear Dysplasia Using MRI Oblique Trochlear View. The journal of knee surgery (DOI).

13- **Kavanagh, E.C., Zoga, A., Omar, I., Ford, S., Schweitzer, M. and Eustace, S., (2007):** MRI findings in bipartite patella. Skeletal radiology, 36(3), pp.209-214.

14-**Baz, A., El Shantely, K.M., Hassan, T.A., Mohamed, S.G. and Sakr, S.I., (2019):** Role of magnetic resonance imaging in the evaluation of the anterior knee pain. Egyptian Journal of Radiology and Nuclear Medicine, 50(1), pp.1-15.

15-**Kang, S., Park, J., Kang, S.B. and Chang, C.B., (2016):** MRI findings of young male soldiers with atraumatic anterior knee pain. Scandinavian Journal of Medicine & Science in Sports, 26(5), pp.572-578.

16-**Berruto, M., Ferrua, P., Carimati, G., Uboldi, F. and Gala, L., (2013):** Patellofemoral instability: classification and imaging. Joints, 1(2), p.7.