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COMPARATIVE EVALUATION OF MAGNETIC RESONANCE ARTHROGRAM WITH ARTHROSCOPY IN KNEE PATHOLOGIES

Radio-Diagnosis

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ABSTRACT

Background: Magnetic Resonance Arthrogram (MRA) has emerged as a supplement to non-contrast MRI, especially in identification of meniscal and chondral pathologies. It has increased the diagnostic efficacy of MRI in evaluation of knee pathologies. The present study was carried out to evaluate the role of Magnetic Resonance Arthrogram in the diagnosis of various knee pathologies and to correlate its findings with arthroscopy. **Material and methods:** A total of 56 patients with knee pain scheduled to undergo arthroscopic evaluation were enrolled in the study and were assessed using Magnetic Resonance Arthrography (MRA) prior to arthroscopy. MRA findings were correlated with arthroscopic findings. Level of agreement was measured using kappa-statistics. Diagnostic efficacy was assessed in terms of sensitivity, specificity, positive predictive value and negative predictive value. **Results:** Cartilage involvement (48.2%), ACL tear and medial meniscus tear (37.5% each), bony injury (n=12; 21.4%), chondral defect (n=11; 19.6%), PCL tear (n=10; 17.9%) and lateral meniscus tear (n=8; 14.3%) were the knee pathologies confirmed by arthroscopy. MRA had a sensitivity and specificity of 100% for pathologies like ACL tear, lateral meniscus tear, medial meniscus tear and bony injury. It was 100% specific for all the pathologies with no false positive detection. Its sensitivity for cartilage involvement, PCL tear and chondral defects was 55.6%, 70% and 72.7% respectively. There was a strong to perfect agreement between MRA and arthroscopic findings for different knee pathologies. **Conclusion:** The present study found MRA to be a highly specific diagnostic tool for diagnosis of different knee pathologies and it is useful in reducing the burden of undesired invasive arthroscopies.

KEYWORDS

MR Arthrogram, Arthroscopy, Meniscal injury, Chondral pathology.

INTRODUCTION

Knee pain is amongst the most common musculoskeletal problem having a huge impact on the quality of life[1,2]. It is one of the most common causes of disability among adults[3,4]. At a particular time, nearly 25% of adult population has complaints of knee pain for various reasons[5]. Assessment of knee pain and knowing the exact underlying etiology is important for deciding appropriate treatment. Skillful physical examination has to be done. This has to be followed by imaging viz. standard radiography, ultrasound, bone scintigraphy, CT scan, arthroscan, MRI, arthro-MRI. Each of these modalities has its own advantages as well as disadvantages. Conventional radiography is useful in ruling out serious knee pathologies like fractures, advanced degenerative changes and neoplasms. However, it is not an imaging modality of choice for evaluation of the cruciate and collateral ligaments, the menisci, and the hyaline cartilage of the knee. USG is highly efficient in evaluation of periarticular soft tissue. However, it is highly operator-dependent[6].

Computed tomography detects the fractures and helps to provide better details. However, its usefulness is limited to traumatic bony injuries and it is considered less informative for evaluation of degenerative pathologies involving soft tissue[7,8]. MRI has proven high efficiency in evaluating suspected meniscal and ligamentous injuries.Apart from being non-invasive, MRI, unlike CT, does not use ionizing radiation, provides multiplanar images, and it provides illustrative images of soft-tissue structures that are difficult to obtain using other imaging modalities. Direct Magnetic Resonance Arthrography is an imaging examination that combines the injection of a saline or dilute gadolinium solution into an articulation, followed by MR imaging of that articulation. MRA has increased the diagnostic efficacy of MRI in evaluation of knee pathologies. It is a superior alternative for assessment of underlying knee pathologies with results more or less comparable to arthroscopic evaluation which is an invasive one.Hence, the present study was planned to compare Magnetic Resonance Arthrogram with arthroscopy in the diagnosis of various knee pathologies.

MATERIAL AND METHODS

Patients above 18 years of age presenting with the history of knee pain to orthopedics OPD and planned for arthroscopy, were enrolled and MRA was performed in them. Patients who had previously undergone arthroscopy with repair of the menisci and ligaments, and also patients with any previous surgery to the knee were excluded.MR arthrography was performed with approximately 25 ml of a dilute gadolinium solution and saline, to prepare a contrast mixture by dissolving 0.15 ml of gadolinium in 20 ml of normal saline. A 22-gauge needle was placed beneath the center of the articular surface of the patella. MR Arthrography was performed in all patients immediately after conventional MR imaging. All injections were placed successfully within the joint space. After injection of the contrast mixture into the knee joint, the knee was exercised. All patients exercised the knee by actively extending and bending the knee continuously for 5 min while seated before repeat imaging. Before and after exercise, T1-weighted, fat saturated coronal, sagittal, and axial MR images were obtained for comparison. MRA imaging of that joint was performed using a 1.5 Tesla MRI machine. Features such as cartilage involvement, Anterior cruciate ligament (ACL) tear, Posterior cruciate ligament (PCL) tear, Lateral meniscus involvement, Medial meniscus involvement, bony injury and chondral defects were noted and compared with the findings of arthroscopy done later on, in that same joint in orthopedics department.

RESULTS

In total 56 patients, age of patients ranged from 19 to 68 years. Mean age of patients was 44.93±15.68 years. Majority (55.4%) of patients were ≤50 years of age.More than two third (69.6%) patients were males. The sex-ratio (M: F) of study population was 2.29:1.Majority of patients had traumatic injury (83.9%).Proportion of those having traumatic etiology was higher in males (n=35/39; 89.7%) as compared to that in females. However, no significant difference in age and injury type was observed between the two sexes.Majority of patients had acute complaints (<6 weeks) (71.4%).Comorbidities were seen in 25 (44.6%) cases. Hypertension (26.8%) and diabetes (12.5%) were the most common comorbidities which is not of any significance.On MR

arthrography, ACL tear and medial meniscus tear (n=21; 37.5% each) were the most common underlying pathologies followed by cartilage involvement (n=15; 26.8%), bony injury (n=12; 21.4%), chondral defect and lateral meniscus tear (n=8; 14.3% each) and PCL tear (n=7; 12.5%) respectively. (Table 1)

Table 1: MR Arthrogram Findings

SN	Finding	No. of cases	Percentage
1.	Cartilage involvement	15	26.8
2.	ACL tear	21	37.5
3.	PCL tear	7	12.5
4.	Lateral meniscus tear	8	14.3
5.	Medial meniscus tear	21	37.5
6.	Bony injury	12	21.4
7.	Chondral defect	8	14.3

On arthroscopy, cartilage involvement (n=27; 48.2%) was the most common finding followed by ACL tear and medial meniscus tear (n=21; 37.5% each), bony injury (n=12; 21.4%), chondral defect (n=11; 19.6%), PCL tear (n=10; 17.9%) and lateral meniscus tear (n=8; 14.3%) respectively. (Table 2)

Table 2: Arthroscopic Findings

SN	Finding	No. of cases	Percentage
1.	Cartilage involvement	27	48.2
2.	ACL tear	21	37.5
3.	PCL tear	10	17.9
4.	Lateral meniscus tear	8	14.3
5.	Medial meniscus tear	21	37.5
6.	Bony injury	12	21.4
7.	Chondral defect	11	19.6

For pathologies like ACL tear, lateral meniscus tear, medial meniscus tear and bony injury, MR arthrography had same detection rate as for arthroscopy.MR arthrography under-detected 12 cases with cartilage involvement and 3 cases each with PCL tear and chondral defects respectively.MR arthrography was 100% sensitive and 100% specific for diagnosis of ACL tear, lateral meniscus tear, medial meniscus tear and bony injury respectively.

For cartilage involvement the sensitivity, specificity, positive predictive and negative predictive values of MRA were 55.6%, 100%, 100% and 70.7% respectively. For cartilage involvement, MRA was 78.6% accurate.

For PCL tear the sensitivity, specificity, positive predictive and negative predictive values of MRA were 70%, 100%, 100% and 93.9% respectively. For PCL tear, MRA was 94.6% accurate.

For chondral defects the sensitivity, specificity, positive predictive and negative predictive values of MRA were 72.7%, 100%, 100% and 93.8% respectively. For chondral defects, MRA was 94.6% accurate. (Table 3)

Table 3: Difference in Number of different pathologies between MRA and Arthroscopy

SN	Finding	MRA	Arthroscopy	Difference	Direction of MRA findings
1.	Cartilage involvement	15 (26.8%)	27 (48.2%)	12 (%)	Under
2.	ACL tear	21 (37.5%)	21 (37.5%)	0	Same
3.	PCL tear	7 (12.5%)	10 (17.9%)	3 (%)	Under
4.	Lateral meniscus tear	8 (14.3%)	8 (14.3%)	0	Same
5.	Medial meniscus tear	21 (37.5%)	21 (37.5%)	0	Same
6.	Bony injury	12 (21.4%)	12 (21.4%)	0	Same
7.	Chondral defect	8 (14.3%)	11 (19.6%)	3 (5.4%)	Under

DISCUSSION

In the recent years, magnetic resonance arthrogram that employs the use of intra-articular contrast during magnetic resonance imaging helps to provide a superior alternative for assessment of underlying knee pathologies with results almost comparable to arthroscopic evaluation. However, there are limited studies highlighting its clinical significance against invasive diagnostic modalities like arthroscopy. Hence, the present study was planned to compare Magnetic Resonance Arthrogram with arthroscopy in the diagnosis of various knee pathologies.

The age of patients enrolled in the study ranged from 19 to 68 years. Mean age of patients was 44.93±15.68 years (Median age 45 years). High variability in age and sex profile of patients has been shown in different studies. Most of the previous studies similar to the present study showed a dominance of males. Cellár *et al*[9] in their study reported the mean age of patients as 41.7 years which is close to that in the present study, however, they had an equal representation of both males as well as females. Orlando Júnior *etal*[10], on the other hand reported a relatively younger age profile (mean age 34 years) and a higher dominance of males (84.7%). In the present study, majority of patients had knee trauma (83.9%). There are previous studies that have exclusively included traumatic knee injury patients[11,12,13]. Some other workers have assessed the usefulness of MRI/MRA in post-surgical follow-up cases[14].

In the present study, most common MRA finding was ACL tear and medial meniscus tear (37.5% each) followed by cartilage involvement (26.8%), bony injury (21.4%), chondral defect and lateral meniscus tear (14.3% each) and PCL tear (12.5%). Siddiqui *et al*[12], who included all the cases with traumatic knee injury reported medial meniscus, lateral meniscus and ACL injury as the most common pathologies. Gupta *et al*[15], found joint effusion, cruciate ligament tear and medial meniscus tear as the most common pathologies diagnosed on MR evaluation. Khan *et al*[13], found ACL injury and medial meniscal injury as the most common pathologies in his study. In the present study, cartilage injuries were seen in 26.8% cases. Jandaghi *et al*[16], in their study also found cartilage damage in 30% of the cases which is comparable to the findings of the present study.

In the present study, on arthroscopy, cartilage involvement (48.2%) was the most common finding followed by ACL tear and medial meniscus tear (37.5%), bony injury (21.4%), chondral defect (19.6%), PCL tear (17.9%) and lateral meniscus tear (14.3%) respectively.

In the present study, on MRA the most common abnormality was ACL tear and medial meniscus injury in 21 cases each but on arthroscopy cartilage involvement was the most common pathology seen in 27 cases.Although medial meniscus tears have also been reported to have degenerative etiology in elderly[17], however in the present study, the profile of the patients was generally reflective of young and mature adults. In the study by Khan *et al*[13] on arthroscopy ACL injury was the commonest pathology (61.5%), however, on MRI, meniscus injury was the common diagnosis (76.9%). In the present study, we found huge gap between MRA and arthroscopy for cartilage involvement. The reason for poor performance of MRA for detection of cartilage defects may be owing to occurrence of cartilage defects at some specific locations where contrast distribution would not have been even. Jandaghi *et al*[16], however, did not find a gap between MRA and arthroscopy for cartilage damage. Wong *et al*[18], in their study despite reporting MRI to be reliable for assessment of meniscus tears and cartilage defects found that cartilage injuries affecting the medial femoral condyle or medial patella facet were often missed by MRI. With respect to chondral defects, the findings in the present study are in agreement with the observations of Mathieu *et al*[19], who also found MRA to be highly specific (99%) but less sensitive (75%) for detection of chondral defects. In the present study, we also found that cartilage involvement and chondral defects were more common in older as compared to younger population. The role of age associated degenerative changes as the possible etiology in these cases can thus not be ruled out.

In ACL tear, lateral meniscus tear, medial meniscus tear and bony injury MRA had same detection rate as for arthroscopy, however for pathologies like cartilage involvement, PCL tear and chondral defects, MRA was found to have under-detection. It was the cartilage involvement for which the under-detection was maximum (21.4%). For PCL tear and Chondral defects, the under-detection was only for 5.4% of cases.As far as evaluation of bone is concerned, they are reliable even in conventional radiography or computed tomography[7,8]

It could be seen that while almost all the studies find MRA to be a highly specific yet with respect to sensitivity, the performance of MRA

has been found to be slightly less accurate for certain pathologies that do not follow a specific trend.However, MRA was effective in diagnosing most of the pathologies with absolute accuracy which is in agreement with the observations of Jandaghi *et al*[16].The present study had a limitation of sample size. There are few other studies having a smaller sample size, that have highlighted the role of MR imaging[20].However, a study with a larger sample size could thus help to compensate for the slight differences in detection rate accounted for huge sensitivity or specificity loss.

CONCLUSION

MR arthrography showed a perfect agreement with arthroscopy for detection of ACL tear, lateral meniscus tear, medial meniscus tear and bony injuries. For other pathologies, its sensitivity ranged from 55.6% (cartilage involvement) to 72.7% (chondral defects). For all the pathologies, MR arthroscopy was 100% specific and did not have any false positive case.The findings of the study thus show that MR arthrography is a very useful non-invasive measure to assess the knee pathologies. Further studies with a larger sample size and a proper representation of atraumatic etiology cases are recommended in improvising the diagnostic value of MRA.

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