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Magnetic Resonance Imaging Compared to Magnetic Resonance Arthrography in Assessment of Recurrent Meniscal Injury

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ABSTRACT

Background: Arthroscopic knee surgery including partial meniscectomy & meniscal repair are of the world's most performed surgical procedures. Magnetic Resonance arthrography is the cornerstone imaging modality in evaluating postoperative symptomatic patients.

Objective: This study aimed to evaluate the diagnostic value of conventional MR compared to MR arthrography in the diagnosis of recurrent meniscal tear.

Subjects and methods: Our prospective cross-sectional study included 20 patients with postoperative meniscus surgery admitted to Orthopedic Department, Suez Canal University Hospital through the period from April 2020 to September 2021. **Results:** In the meniscus surgery group (total 20 patients), 6 studied cases (30%) were treated with meniscal repair, 13 studied cases (65%) had meniscectomy and one patient (5%) had meniscal transplants. Conventional MRI showed 77% sensitivity, 58% specificity and 67.5% accuracy in the meniscal surgeries group. MRI and MRA showed high agreement (K= 0.66) in meniscal transplant and meniscectomy less than 25%, while MRI has a low agreement (K=0.1 &0.5) with MRA in meniscal repair and meniscectomy more than 25%.

Conclusions: Conventional MRI alone has low sensitivity and specificity in the assessment of recurrent tears in post-meniscal surgeries where MR arthrography is essential in the detection of recurrent meniscal tears in cases of meniscal repair and partial meniscectomy more than 25%. However, when meniscus resection is minimal (less than 25%) conventional MRI is usually enough for diagnosis.

Keywords: MRI, MR arthrography, Meniscal repair, Partial meniscectomy.

INTRODUCTION

Arthroscopic knee surgery is one of the world's most done surgeries. Indications for performing this procedure include surgically correctable pathologies causing functional complaints and also persisting pain [(1)]. Pain is usually the major cause of surgery, and it is also considered to be a critical post-operative complication [(2, 3)]. The main purpose of meniscal surgery is to return the studied case to full function without pain [(4)]. The decision to perform either meniscectomy (partial or complete) or meniscal repair accounts for various factors such as the patient's years old & general condition, the extent & severity of the injury, and probability of success [(5)]. Associated injuries including cruciate ligament injury, loss of cartilage, or fracture must be taken in consideration [(5)].

Magnetic resonance imaging of the knee after the meniscal repair is becoming increasingly common because of the growing number of knee arthroscopic surgeries being done [(6)]. Morphological changes in the post-operative meniscus could mimic or obscure recurrent or residual meniscus tears [(7)].

Signs of post-operative knee in MRI include migration or obvious morphologic variations, circular or linear fine fibrous areas in infra-patellar fat, which are marks of trocar passage throughout arthroscopy, and it is seen on both parts of patellar tendon. Susceptibility artefacts produced by metallic particles, more visualized on gradient echo sequences, are signs of previous surgery too [(8)]. Post-operative meniscus surgery complications include meniscal re-tears [(7)]. Postoperative imaging interpretation is often complicated and difficult; accordingly, an organized, systematic approach is necessary in differentiating between expected post-operative changes and new or already present pathology [(9)]. Conventional MRI, indirect MR arthrography, direct MR arthrography & CT arthrography are presently conducted to assess studied cases with recurrent postoperative knee [(7)].

Direct MR arthrography implies intra-articular injection of about twenty–fifty mL of mixture of diluted gadolinium and saline into knee joint before undergoing MRI examination. Extension of contrast material into meniscus substance indicates recurrent tear or unhealed repair. Advantages of direct MR arthrography contain distention of knee joint capsule, decreased viscosity of synovial fluid & great signal-to-noise ratio on T1-weighted sequences [(7)].

Aim & objective was to measure the diagnostic value of conventional MR compared to MR arthrography in the diagnosis of recurrent meniscal tear.

METHODS

This prospective cross-sectional research contained twenty studied cases with postoperative meniscus surgery admitted to Orthopedic Department, Suez Canal University Hospital from the period April 2020 to September 2021. The study was performed at the Radiology Department, Suez Canal University Hospital in Ismailia.

Inclusion criteria: Adult studied cases years old more than eighteen, patients with meniscal surgery either partial meniscectomy or meniscal repair and patients with multi-ligamentous and meniscal injuries.

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Exclusion criteria: Adult studied cases year's old less than eighteen, patients with MRI-incompatible metallic implants and patients with septic joints (Suspected clinically and radiologically).

Data collection: All patients were subjected to the following:

History and examination: The following points were assessed: Clinical history including Age, gender, type of operation, pain analysis (Onset, course, & duration) and associated symptoms. **MRI scan: Place of the study and machine:** MRI-Unit, Suez Canal University Hospital, Diagnostic Radiology Department, Ismailia.

Knee MRI preparation: The scan was scheduled and any metallic objects were removed.

Knee MRI technique protocol: Performed on 1.5T. Use a 5CH knee coil or 15CH knee coil. Standard knee imaging includes MRI of the knee in coronal, axial, & sagittal planes on 1.5T –T scanner: Sagittal & axial fast spin-echo T2-weighted sequences, coronal fast spin-echo STIR T2-weighted sequences, sagittal & coronal fast spin-echo proton density sequences & sagittal fast spin-echo proton density SPIR sequences.

A field of view of fifteen cm on all images has been used. Slice thickness was three mm with a ten percent interslice gap on all sequences however, it was a 2-mm fast spin-echo proton density sagittal sequence only.

MR Arthrography: MR arthrography was done with about 25 mL of dilute gadopentetate dimeglumine & saline mixture, where 0.15 ml of gadopentetate dimeglumine/20 mL of normal saline were used. Blind injection of contrast material was done through a lateral approach into the patellofemoral joint with a 20-gauge needle. MR arthrography was done for all studied cases under complete aseptic conditions after conventional MR imaging. The researcher performed the injection. After injection of the contrast mixture into the knee joint, all studied cases exercised the knee by consecutive active flexion & extension for approximately 5 minutes in the break time before repeating imaging. After exercise, T1 & T2-weighted (750/10) fat-saturated sagittal & coronal MR images were done. T2-weighted (750/10) fat-saturated sagittal images were also performed before MR arthrography for comparison.

Knee MR Arthrography technique protocol: Performed on 1.5T. Use a 5CH knee coil or 15CH knee coil. Sagittal & axial & coronal fast spin-echo T1 SPIR-weighted sequences. Sagittal & axial & coronal fast spin-echo T2 SPAIR-weighted sequences. A field of view of fifteen cm on all images was used. All sequences showed a slice thickness of three mm and a ten percent interslice gap.

Image interpretation: All MR images were reviewed by 2 expert radiologists by consensus reading. Conventional MR images were reviewed by the same radiologists in a different setting to avoid bias. Conventional MR examinations were evaluated for meniscal retears. MR criteria used to diagnose meniscal retear on conventional MR were abnormal high signal within the meniscus reaching the articular surface, abnormal morphology of meniscus, or displaced meniscal fragment. MR arthrography criteria for diagnosis of meniscal retear was abnormal contrast material extending to meniscal substance as shown in **Figures (6) & (7)**, which is considered the gold standard for diagnosis. 2 reviewers then did compromised review of conventional MR & MR arthrogram examinations combined together for each studied case. This was also completed in separate sitting from above 2 reviews in order not to bias reviewers. The results were compared and sometimes a second look arthroscopic data was available, results were then interpreted to calculate sensitivity of conventional MR in recognition of meniscal retears compared to MR arthrography.

Ethical Approval: research was approved by the Ethics Board of Suez Canal University and the patients were given all the information they need about the trial. Informed written consent was obtained from each case in the research. This work has been done according to the Code of Ethics of World Medical Association for researches involving humans.

RESULTS

This cross-sectional study included 20 patients with post-operative knee pain admitted to Orthopedic Department, Suez Canal University Hospital. Table (1) and figure (1) showed that patients in meniscal surgeries group had mean age of 33.2 ± 10.3 years ranged from 19 to 50 years old. There were three women studied cases (15%) & seventeen men studied cases (85%). Six studied cases (30%) were treated with meniscal repair, 13 patients (36.7%) had meniscectomy and one patient (5%) had meniscal transplant.

Table (1): Baseline data of meniscal surgeries patients (n=twenty)

	N=twenty
Years old	
Mean ±SD	33.2±10.3
Median(Range)	35(19-50)
Gender	
Male	17(85%)
Female	3(15%)
Management	
Meniscal repair	6(30%)
Meniscectomy	13(65%)
less than 25%	7(35%)
more than 25%	6(30%)
Meniscal transplant	1(5%)

Data was presented as mean ±SD when it was quantitative and number (percentage) when it was ??

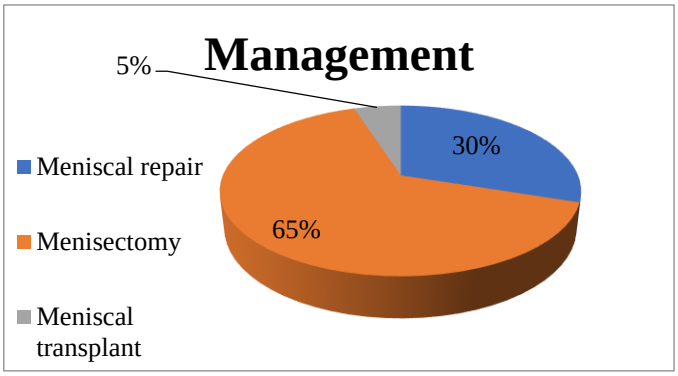

Figure (1): Management distribution among meniscal surgeries group.

In this table, among meniscal repair group, MRI diagnosed recurrent meniscal tear in 3 cases where there was high intensity signal reaching the articular surface in PHMM of 2 cases and in one case the PHMM showed abnormal meniscal morphology and considered torn. In three cases no abnormality could be detected in PHMM, PHLM & AHLM as shown in figure (2).

meniscectomy, less than 25% group, MRI diagnosed recurrent tear in 5 cases where there was high intensity signal reaching articular surface in PHMM of 3 cases & PHLM of two cases and in two cases no abnormality could be detected in PHMM & AHLM. Among meniscectomy, more than 25% group, MRI diagnosed recurrent tear in 3 cases where there was high intensity signal reaching articular surface in PHMM of one case & PHLM of one case. It showed abnormal meniscal morphology in PHMM of one case & in three cases no abnormality could be detected in PHMM, AHMM & AHLM. In the patient with meniscal transplant, no abnormality was detected by MRI.

Table (2): MRI findings of meniscal surgeries group (n=20)

	Positive (recurrent tear)	Negative (No tear)
Repair (n=6)		
PHMM	3(15%)	1(5%)
AHLM	0(0%)	1(5%)
PHLM	0(0%)	1(5%)
Meniscectomy <25% (n=7)	3(15%)	1(5%)
PHMM	2(10%)	0(0%)
PHLM	0(0%)	1(5%)
AHLM		
Meniscectomy >25%(n=6)	2(10%)	1(5%)
PHMM	1(5%)	0(0%)
PHLM	0(0%)	1(5%)
AHMM	0(0%)	1(5%)
AHLM		
Transplant (n=1)		
MM	0 (0%)	1 (5%)

Data was presented as number (percentage) when it was qualitative. Abbreviations: PHMM; posterior horn medial meniscus, AHMM; anterior horn medial meniscus, PHLM; posterior horn lateral meniscus, AHLM; anterior horn lateral meniscus.

Table (3) showed that among meniscal repair group, MRA confirmed recurrent tear seen as contrast passing through the meniscus in 2 cases (PHMM & AHLM) as shown in figure (2) and no tear was found in 4 cases (in PHMM of 2 cases, AHLM of one case & PHLM in one case) as shown in figure (3). Among meniscectomy, less than 25% group, MRA confirmed recurrent tear seen as contrast passing through the meniscus in 2 cases (in PHMM) as shown in Figure (1). No tear was found in 4 cases (in PHMM, PHLM & AHLM of one case each). Among meniscectomy, more than 25% group, MRA confirmed recurrent tear seen as contrast passing through the meniscus in 4 cases (in PHMM of 3 cases & PHLM of 1 case) and no tear was found in 3 cases (in PHMM, PHLM, AHMM & AHLM of one case each). In the patient with meniscal transplant, MRA detected no abnormality.

Table (3): MR arthrography findings of meniscal surgeries group (n=20)

	Recurrent tear	No retear
Repair (n=6)		
PHMM	1(5%)	2(10%)
AHLM	1(5%)	1(5%)
PHLM	0(0%)	1(5%)
Menisectomy <25% (n=7)	3(15%)	1(5%)
PHMM	1(5%)	1(5%)
PHLM	0(0%)	1(5%)
AHLM		
Menisectomy >25% (n=6)	2(10%)	1(5%)
PHMM	0(0%)	1(5%)
PHLM	0(0%)	1(5%)
AHMM	0(0%)	1(5%)
AHLM		
Transplant (n=1)		
MM	1(5%)	1(5%)

Data was presented as number (percentage) when it was qualitative. Abbreviations: PHMM; posterior horn medial meniscus, AHMM; anterior horn medial meniscus, PHLM; posterior horn lateral meniscus, AHLM; anterior horn lateral meniscus.

In this table, MRI and MRA showed high agreement in meniscal transplant and meniscectomy less than 25% (k=1 and 0.667, respectively), while MRI has low agreement with MRA in meniscal repair and meniscectomy more than 25% (k=0.143 and 0.500, respectively) (Table 4).

Table (4): MRI versus MR arthrography findings of meniscal surgeries group (n=20)

	Method	Tear	Intact	P-value	Kappa
Repair (n=6)	MRI	3(50%)	3(50%)	1.00	0.143
	MRA	2(33.3%)	4(66.7%)		
Meniscectomy <25% (n=7)	MRI	5(71.4%)	2(28.6%)	0.08	0.667
	MRA	4(57.1%)	3(42.9%)		
Meniscectomy >25% (n=6)	MRI	3(50%)	3(50%)	0.242	0.500
	MRA	2(33.3%)	4(66.7%)		
Transplant (n=1)	MRI	0(0%)	1(100%)	-----	1.00
	MRA	0(0%)	1(100%)		

Data was presented as number (percentage) when it was qualitative. Abbreviations: PHMM; posterior horn medial meniscus, AHMM; anterior horn medial meniscus, PHLM; posterior horn lateral meniscus, AHLM; anterior horn lateral meniscus. Fisher exact test was used. Kappa agreement test was used.

In figure (2), MRI had 50% sensitivity and 50% specificity in diagnosing meniscal tear in meniscal repair group with 50% accuracy.

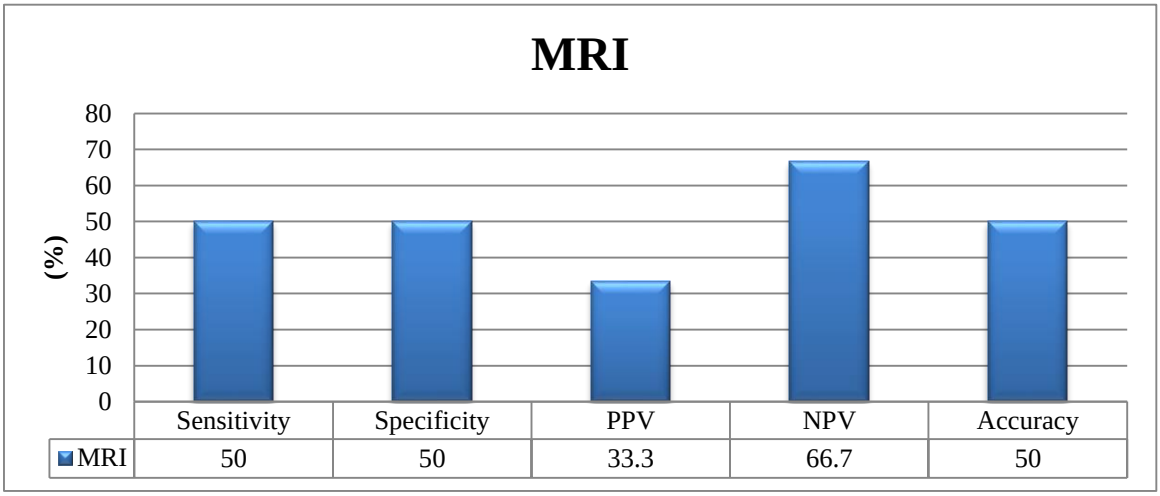

Figure (2): Validity of MRI in diagnosing meniscal tear in meniscal repair group (n=6).

In figure (3), MRI had 100% sensitivity and 66.6% specificity in diagnosing meniscal tear in Meniscectomy <25% group with 85.7% accuracy.

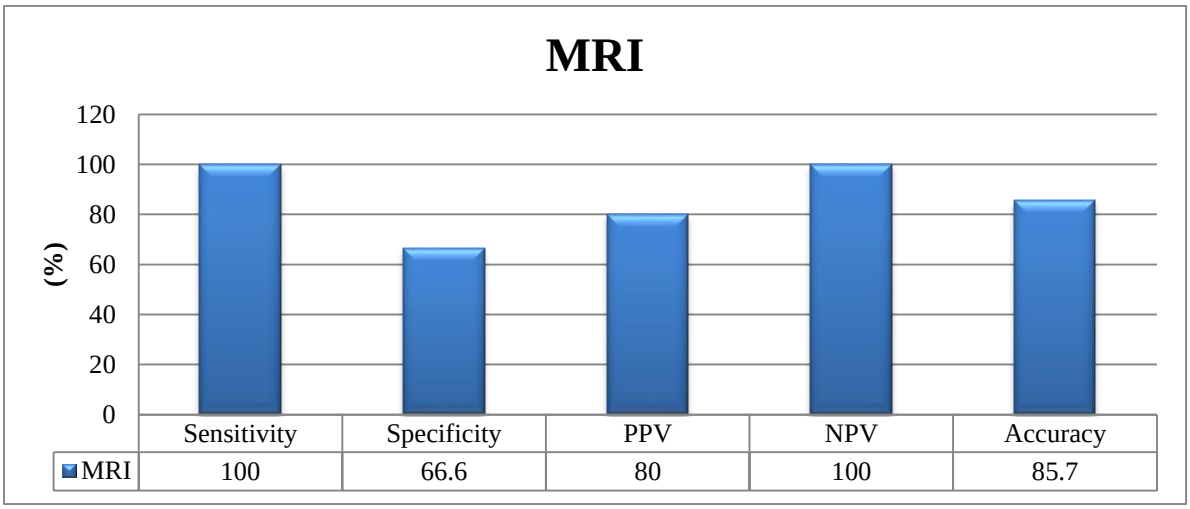

Figure (3): Validity of MRI in diagnosing meniscal tear in menisectomy <25% group (n=7).

In figure (4), MRI had 50% sensitivity and 50% specificity in diagnosing meniscal tear in Meniscectomy >25% group with 50% accuracy.

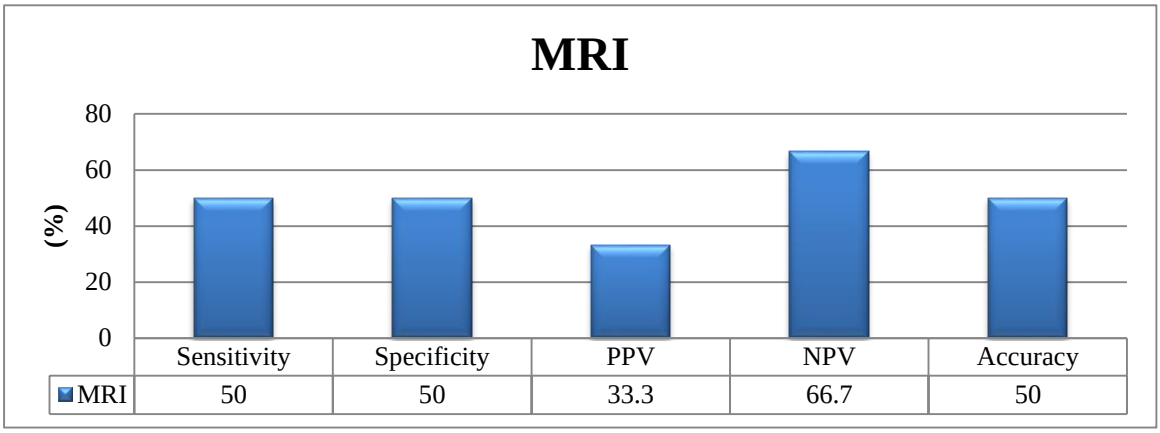

Figure (4): Validity of MRI in diagnosing meniscal tear in menisectomy >25% group (n=6).

In figure (5), MRI had 77% sensitivity and 58% specificity in diagnosing meniscal tear in all meniscal surgeries group with 67.5% accuracy.

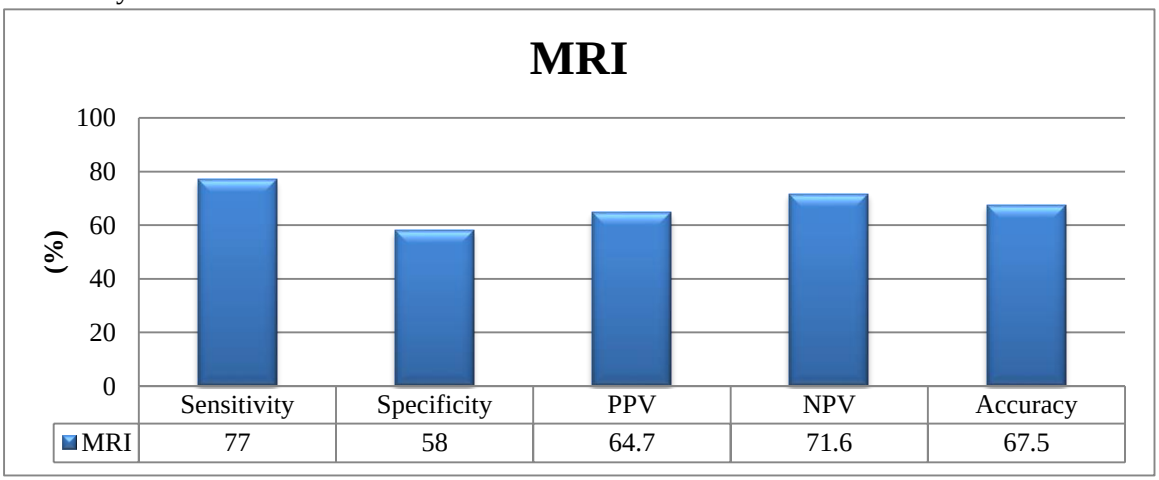

Figure (5): Validity of MRI in diagnosing meniscal tear in all meniscal surgeries group (n=20).

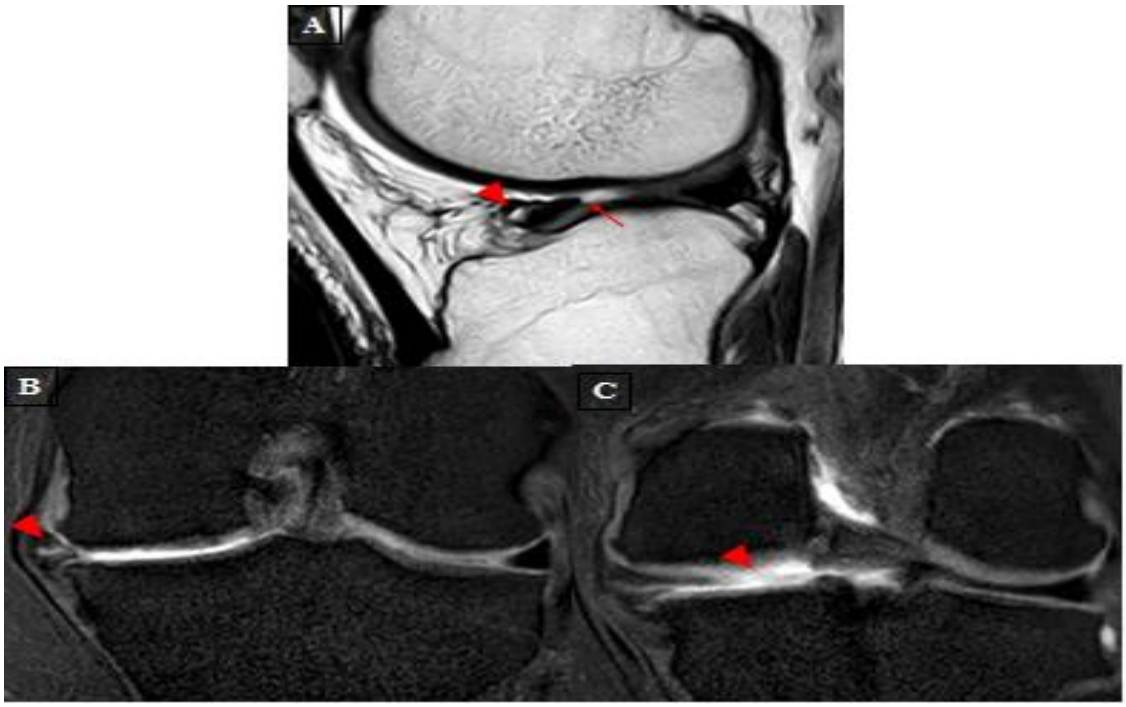

Figure (6 A, B & C): Anterior horn recurrent meniscal tear & root tear. A): Sagittal T2 weighted images showed diminished irregular free edge of medial meniscus after meniscectomy (arrow) with high linear signal in meniscus (arrowhead). B & C): Coronal MR arthrogram T1-weighted fat suppressed images found linear high signal (arrowhead in B) more prominent with extension to the anterior root (arrowhead in C) indicating a recurrent meniscus tear.

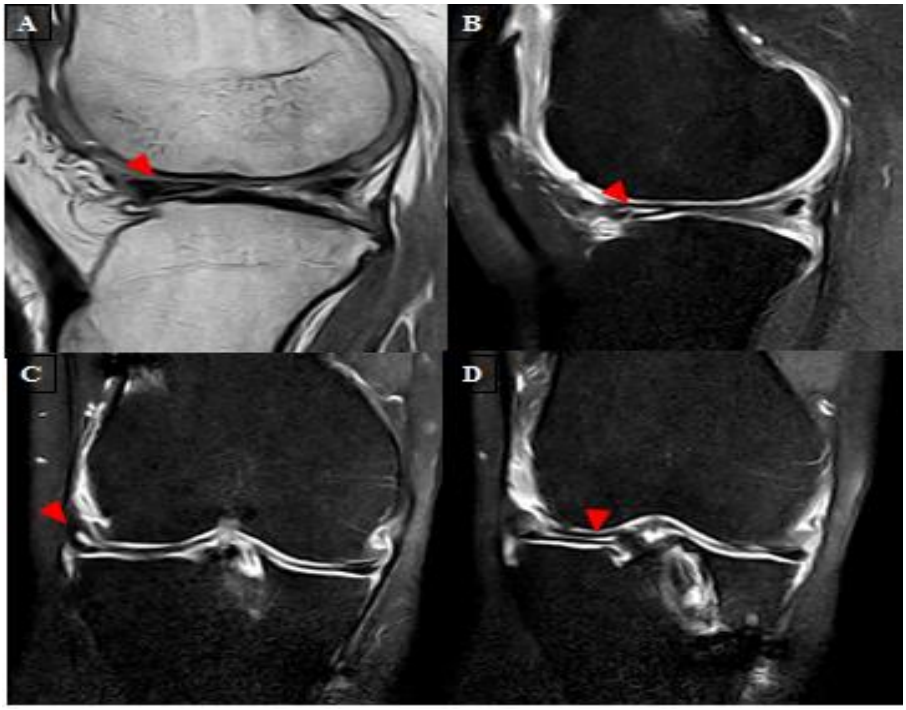

Figure (7 A, B, C & D): Recurrent anterior horn lateral meniscus tear in patient with partial meniscectomy. A): Sagittal proton-density MR images found faint linear signal not reaching articular surface. B & C): Sagittal & coronal T1-weighted, fat-suppressed, post-contrast sagittal MR images found contrast material extending through the meniscus (arrowheads) in keeping with recurrent tear D): Coronal T1 fat-suppressed post-arthrogram image found extension to meniscal root (arrowheads).

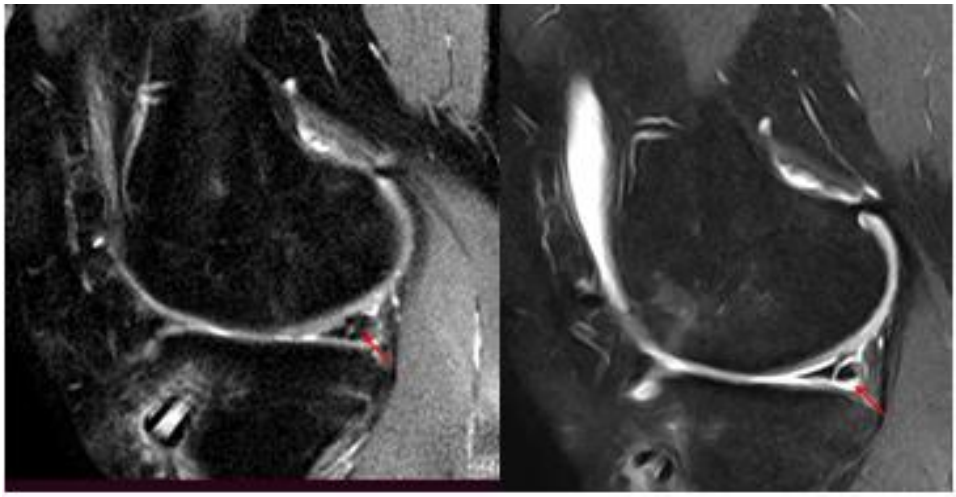

Figure (8 A & B): Meniscal re-tear. **A):** Sagittal proton density–weighted image found linear signal hyperintensity (arrow) query reaching the articular surface of medial meniscus posterior horn. **B):** Sagittal fat-suppressed image of MR arthrogram of same patient revealed contrast extension into posterior horn at the site of repair (arrow), which is diagnostic of recurrent vertical meniscus tear.

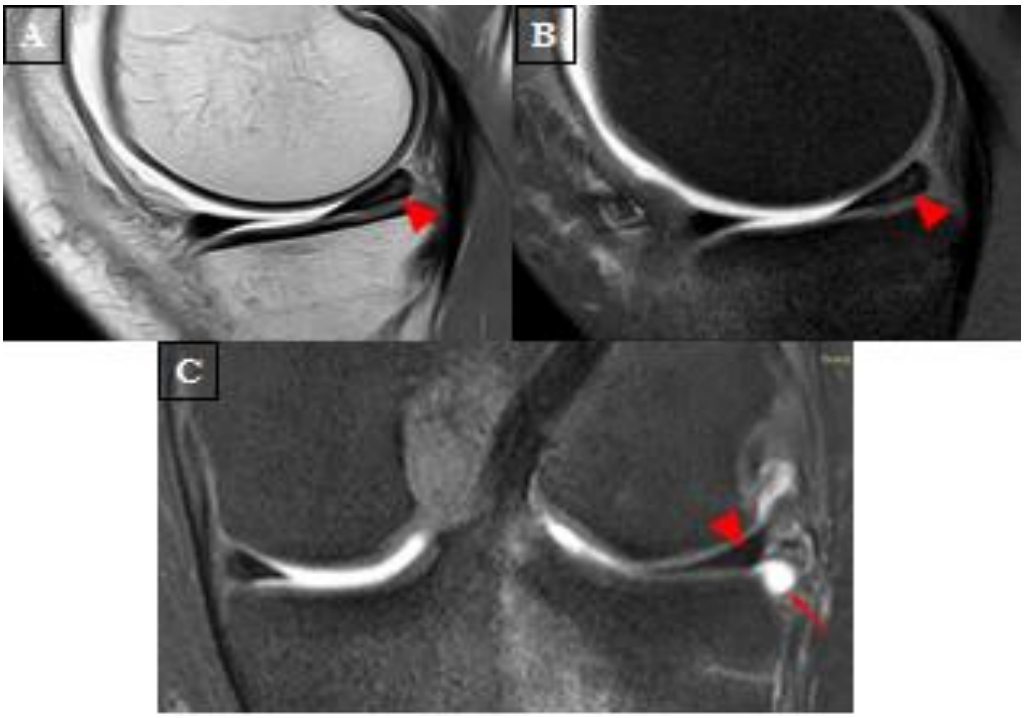

Figure (9 A, B & C): Meniscal re-tear. **A):** Sagittal proton density–weighted image showed globular signal intensity within posterior horn of medial meniscus suggestive of meniscal repair signal. **B & C):** Sagittal fat-suppressed post contrast images of same case showed contrast material extension through posterior horn at the place of repair (arrow), which is diagnostic of recurrent horizontal meniscus tear.

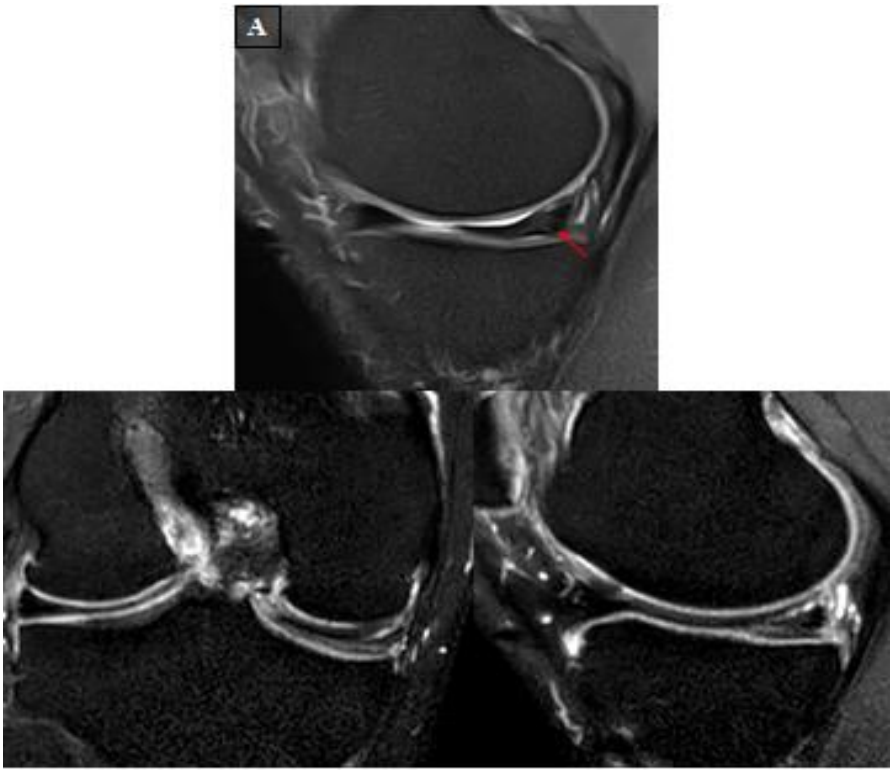

Figure (10 A, B & C): Meniscal scar & parameniscal cyst. **A):** Sagittal proton density–weighted image showed linear signal intensity within posterior horn of medial meniscus likely meniscal repair signal. **B & C):** Sagittal & Coronal fat-suppressed images of MR arthrogram of same patient revealed no contrast passing through the posterior horn at repair area (arrowhead), which is diagnostic of meniscal scar, a parameniscal cyst was noted (arrow).

DISCUSSION

Our cross-sectional study included 20 patients with post-operative knee pain who were admitted to Orthopedic Department, Suez Canal University Hospital. As for meniscal injuries, in our study, we reviewed 20 patients with meniscal surgeries. They had mean age of 33.2 ± 10.3 years ranged from 19 to 50 years old. 11 recurrent tears were noted where occurrence of recurrent meniscal tears in study group was 55% (11/20 tears). Study group included 13 (65%) medial and 7 (35%) lateral menisci. There were three women studied cases (15%) & seventeen men studied cases (85%). Six studied cases (30%) were treated with meniscal repair, 13 patients (65%) had meniscectomy, 7 cases (35%) had less than 25% of meniscus resected and 6 cases (30%) had more than 25% of meniscus resected and only one patient (5%) had meniscal transplant. So, the most common group was the partial meniscectomy less than 25%. In **Ciliz** [(10)] study 72 postoperative menisci were evaluated. In agreement with our study, 37 recurrent meniscal tears were identified. Prevalence of recurrent meniscal tears in this study group was 68% (37/72 tears). Study group consisted of fifty (69%) medial & twenty two (31%) lateral menisci. In thirty-three studied cases (45%), smaller than twenty five percent of meniscus is removed, which was the most common group as in our study. In twenty one studied cases (29%), more than 25% of meniscus & in 18 studied cases (25%), meniscal repair was done. No meniscal transplant patients**.**

Also **Magee** [(11)] reviewed 100 consecutive MR and MRA studies in patient who had prior knee surgery. In 61 patients (61%) greater than twenty five percent of meniscus resected, & this was the most common study group in contrast to our study and in 23 patients (23%), less than twenty five percent of meniscus removed, & in 16 studied cases (16%), meniscal repair was done.

In another study done by **Magee** [(12)] 11 years after the previously mentioned study, reviewed 100 knee MR arthrograms in studied cases with prior knee surgery. Study group was different showing partial meniscectomy patients only, no surgical repair cases were involved in this study, The 100 successive patients (32 female & 68 male and patients; age range, 13–72 years and mean age, 37 years) were referred to radiology department by 3 orthopedic surgeons. All one hundred studied cases had previous partial meniscectomy. 96 (96%) of studied cases had fewer than twenty five percent of meniscus resected & 4 (4%) studied cases had more than twenty five percent of meniscus removed [(12)]**.** Similarly, **Kijowski** [(13)] studied 148 case of partial meniscectomy, 76 patients (51.3%) had meniscal tears by arthroscope. The medial meniscus post-operative tears were seen in 45 (59.2%) of cases and lateral meniscus post-operative tears were seen in 31 (40.1%) of the cases. No tears were seen in 72 (47.9 %) of cases in the second look arthroscope.

In our study meniscus we considered torn in conventional MRI images if high T2 signal was seen contacting an articular surface. This is in agreement with **Ali** [(14)] that concluded that the findings of abnormal meniscal morphology, high-signal-intensity extending into substance of meniscus with fragmentation in T2-weighted images or reaching to articular surface or displaced meniscal fragment are specific marks of a meniscal re-tear**.** Also, this is in agreement with **Chapin** [(15)] with who stated that using high fluid signal intensity within linear signal in meniscus on T2-weighted images as a criteria for diagnosing meniscal tear was found to provide great specificity (eighty eight percent– eighty two%) and low sensitivity (forty one percent–sixty nine%)**.** In our study we found that MRI had 50% sensitivity & 50% specificity in diagnosing meniscal tear in meniscal repair group with 50% accuracy. It showed 100% sensitivity and 66.6% specificity in diagnosing meniscal tear in Meniscectomy <25% group with 85.7% accuracy, and 50% sensitivity & 50% specificity in diagnosing meniscal tear in Meniscectomy >25% group with 50% accuracy and overall MRI had 77% sensitivity & 58% specificity in diagnosing meniscal tear in all meniscal surgeries group with 67.5% accuracy. This agrees with **Ciliz** [(10)] study, which showed that overall conventional MRI had 54% sensitivity and 75% specificity in diagnosing meniscal tear in all meniscal surgeries group with 57.7% accuracy. Accuracy of conventional MRI researches was less than that of MR arthrography group ($P < .05$)**.** In agreement with our results, **Magee** [(11)] compared conventional MRI to MR arthrography in every studied case & showed that conventional MRI had 52% sensitivity in the detection of tears in studied cases with resection of more than twenty five percent of meniscus, whilst MR arthrography had 100% sensitivity. In studied cases with meniscal resection of less than twenty five percent, Conventional MRI had 100% sensitivity in diagnosing tears. Accordingly, MR arthrography was not necessary. Also, no determinable cases were detected showing meniscal retear after meniscal repair (sensitivity for detection of tears in repair group was zero% compared with 50% in our study). The study showed that the overall all sensitivity & specificity of conventional MRI for detection of meniscal retears is 78 % & 85 % respectively).

Performing both conventional MR & MR arthrography in same studied case using T1-weighted & fat-suppressed MR imaging have been found to increase the sensitivity for detection of meniscal retear reaching (99 % sensitivity) [(12)]. So it became a reliable method to consider as a gold standard in our study.

Miao [(16)] study reviewed 81 studied cases (eighty-nine menisci), the mean years old was 25.4 (range, fifteen-fifty), who performed just arthroscopic meniscal repair, consisting of sixty-five medial menisci & twenty-four lateral menisci and it was found that conventional MRI have a sensitivity and specificity about 60% and 90% in detecting meniscal retear after repair and these showed agreement with our study. More recently, **Kijowski** [(13)] showed sensitivity &

specificity of 40% & 96% respectively, for showing a high T2-weighted signal reaching the articular surface in the diagnosis of re-tear after partial meniscectomy**.**

In our study, MRI and MRA showed high agreement in meniscal transplant and meniscectomy less than 25% (k=1 and 0.343, respectively), while MRI had a low agreement with MRA in meniscal repair and meniscectomy more than 25% (k=0.167 for both). Similar to our findings **Chapin, [(15)]** study concluded that MR arthrography has been used as an alternative to conventional MR imaging in studied cases with more than twenty-five percent meniscectomy. Conventional MR imaging was highly accurate for the diagnosis of tears in all studied cases with less than twenty-five percent meniscectomy, but MR arthrography was essential in diagnosing recurrent tears in sixteen of sixty-one studied cases with the previous meniscectomy of greater than twenty-five percent**.**

Ciliz [(10)] showed higher accuracy of conventional MR in detecting recurrent tears in minimal meniscal resection reaching 85% compared to 50% in meniscal resection of more than 25%. It was concluded that when meniscal resection is minimal, the right diagnosis could be reached with a conventional MRI. MR arthrography is essential for studied cases with meniscal resection of greater than twenty-five per cent & who do not have significant joint effusion. In contrast, **White [(17)]** reported that there was no significant variation in yield among conventional MR imaging & MR arthrography. Sensitivity, specificity, & combined accuracy of MR imaging were 86%, 67%, & 80%, respectively, compared to 90%, 76% & 85% for MR arthrography. In agreement with our study, an evidence-based review was done using PubMed and a search of the literature for articles written in English from January 1990 till October 2017. It contained all research that assessed the performance of conventional MRI, direct or indirect MR arthrography, or CT arthrography using arthroscopy as a gold standard tool for evaluating knee after meniscus surgery. There were 2802 articles, and it showed that the diagnostic performance of post-operative imaging research relies on the amount of meniscus resected. Conventional MRI & direct MR arthrography had near equal accuracy (89%) in partial meniscectomy less than twenty-five percent. However, after the removal of greater than 25% of the meniscus, direct MR arthrography had higher accuracy of 89% compared to an accuracy of 65% for conventional MR. Also, it showed that direct MR arthrography is better than conventional MRI in detecting recurrent tear in studied cases after meniscus repair [(7)].

CONCLUSION

MRI imaging provided an excellent anatomical and morphological assessment of the knee joint after surgical intervention, especially in cases of meniscal repair and resection of more than 25% of the meniscal substance being time-saving, non-invasive and readily available.

RECOMMENDATIONS

MR arthrography is necessary for detection of recurrent tear in cases of meniscal repair and partial meniscectomy more than 25%. However, when meniscus resection is minimal conventional MRI may be enough for diagnosis.

Limitations of our study included a relatively small sample size with overlap between causes of postoperative knee pain. No previous studies were done comparing the accuracy of MRI to MRA. Also, a second arthroscopic look wasn't applicable in most cases.

DECLARATIONS

- **Consent for publication:** I attest that all authors have agreed to submit the work.
- **Availability of data and material:** Available
- **Competing interests:** None
- **Funding:** No fund
- **Conflicts of interest:** No conflicts of interest.

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