

Results of Meniscal Injuries on MRI and Arthroscopy and their relationship.

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Abstract

Correlation of Classification of Meniscal Injuries on MRI and Arthroscopy.

The study is a prospective study and 75 patients were studied over a period of one year in the post-graduate department of orthopaedics of SKIMS Medical College Srinagar.

Methodology

The present study was conducted in the post-graduate department of orthopaedics SKIMS Medical College from September 2018 to August 2019. The study is a prospective study and 75 patients were studied over a period of one year. All the patients presenting with meniscal injuries were evaluated by taking detailed history and after thorough examination, MRI of each patient was done and correlation with arthroscopic findings was done.

Results

The present study was concluded in the post-graduate department of orthopaedics, SKIMS-MC from September 2018 to August 2019. All the cases were admitted in the hospital one day prior to surgery.

The mean age was 32.3 years with standard deviation of 9.5. The majority of the patients were males (53%) with 47% representation from females. The left side involvement occurred in 51% and right side was involved in 49%. The medial and lateral meniscus affection was found in 80% and 20% patients respectively. The frequency and percent of tear on MRI was found as horizontal tear (30/40), radial tear (4/5), complex tear (21/28), oblique tear (8/11), longitudinal tear (8/11) and bucket handle tear (9/5) respectively. The frequency and percent of type of tear found on arthroscopy was as horizontal tear (28/37), radial tear (4/5), complex tear (18/24), bucket handle tear (5/7), oblique tear (7/9), longitudinal tear (8/11) and no tear in (5/7) respectively.

Conclusion

By doing correlation between MRI and arthroscopy for meniscal tears we conclude that MRI and arthroscopic surgery for various patterns of meniscal tears, the MRI shows a very close correlation with arthroscopic findings in terms of presence of meniscal tears. The tears are best quantified by arthroscopy.

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I. Introduction

The Knee joint is a common site for sports injury, especially because of sports and trauma injuries.^{1,2,3} The knee joint is a complex joint, consisting of two condylar joints between the corresponding condyles of femur and tibia and a stellar-joint between patella and femur.⁴ The principle intra articular structures in the knee are the two menisci and the two cruciate ligaments. The injury to these intra-articular structures is generally termed as, "Internal derangement of knee" which was first coined by William Hey In 1784.⁵

The menisci develop between 8th and 10th week of gestation with blood supply to the whole of the meniscus initially. Gradually, the collagen content increases and the cellular content decreases and with weight-bearing, the blood supply gets restricted to lateral one-third only. Menisci are known to play important role in complex biomechanics of the knee.⁶ The menisci are commonly injured structures of the knee, and the medial meniscus injury is more common than lateral meniscus injury.³

The main presenting complaints after injury to knee are pain and swelling. Examination includes special tests e.g. McMurray's test, Apley's compression and distraction test, Thessaly test, squat test. These symptoms and signs are helpful for diagnosis but, confirmation of meniscal injury requires radiological imaging with MRI.^{7,8,9}

Meniscal tears usually are caused by a combination of axial loading and rotational force that creates a shearing effect on the meniscus.¹⁰ These injuries can occur in isolation or they may be associated with ligament and/or articular cartilage injury.

The role of MRI in assessing the knee joint was first described by Kean and Moon in early 80's. In the last two decades, MRI has become a reliable, accurate and non-invasive method for diagnosing meniscal pathologies, and thus, the knee has become the most frequently studied articulation.¹¹ The meniscus appear as low intensity signal structure on T1, T2 and proton density sequences. MRI also gives a better soft tissue contrast and has a shorter imaging time with reduced artefacts and allows imaging in multiple planes (coronal, sagittal

and axial) with no radiation hazard to the patient.^{12,17} Injuries of the knee structures like menisci and cruciate are diagnosed with fair accuracy with MRI, when compared with arthroscopy which is regarded as reference standard. The clinical relevance of preoperative MRI is also enhanced by its value to select patients for therapeutic arthroscopy.

The role of arthroscopy as a diagnostic tool and therapeutic tool in management of meniscal injuries has been refined, since early seventies. Arthroscopy is considered as gold standard for diagnosing intra-articular pathologies of knee joint.¹⁸ Arthroscopy is an invasive procedure and needs hospitalization and anaesthesia, which is sometimes associated with complications. Arthroscopy is only recommended for therapeutic purposes, provided that alternative non-invasive diagnostic modality such as MRI is available.

Arthroscopy is more capable of diagnosing small incomplete peripheral tears (<3mm) which are difficult to confirm without arthroscopy. There is always a desire to assess the MRI in more depth and correlate it with surgical findings. Correlating tear types, patterns and cartilage status between arthroscopy and MRI is a work in progress.

This study is aimed at assessing MRI along these parameters and correlating these with surgical findings.

Classification of Meniscal tears:

Currently there is no standard classification system. The most common tear patterns are described below.

- A) Longitudinal tears^{19,20}
- B) Horizontal tears^{21,22}
- C) Radial tears²³
- D) Complex tears.
- E) Bucket Handle tears (vertical longitudinal)^{24,25,26,27-32} and
- F) Oblique tear.

Anatomic variants and shortcomings

Anatomic variants and pitfalls that mimic a tear are

- * Discoid meniscus.³³
- * Meniscal founce.³⁴
- * Meniscal ossicle^{35,36}
- * Chondrocalcinosis^{37,38}

II. Aims & Objectives

To study the correlation of meniscal tears on MRI and Arthroscopy in patients with meniscal injuries of Knee joint.

III. Material and Methods

The present study was conducted in the postgraduate department of orthopaedics of SKIMS Medical College from September 2018 to August 2019. The study is a prospective study and 75 patients were studied over a period of one year. All the patients reporting with signs and symptoms of meniscal injury with MRI correlation were included in study after obtaining ethical clearance.

Inclusion Criteria

- 1) Age - 18 to 60 yrs
- 2) Both Sexes with clinically suspected meniscal injury .
- 3) Symptoms of less than twelve months duration.

Exclusion Criteria

- 1) Any previous surgery on the Knee
- 2) Multiply injured Knee
- 3) Inflammation and infections of Knee Joint
- 4) Doubtful Diagnosis
- 5) Osteoarthritis Knee
- 6) Age less than 18 yrs

History and examination was done and routine investigations were performed.

MRI PROTOCOL

All patients were subjected to magnetic resonance imaging following clinical examination with 1.5-3 Tesla. Patients were positioned supine and feet first in MR imager with the knee to be imaged and centered within 16cm field of vision.

A: Equipment; Whole body magnetic resonance scanner

B: MRI protocol consists of;

C: Interpretation of MRI Data

* Medial meniscus tear; a) present b) absent

If present Anterior horn/posterior horn/body
Type of tear Horizontal/complex/longitudinal/Radial/BHT/Oblique
*Lateral meniscus tear; a)Present b)absent
If present Ant horn/posterior horn/Body
Type of tear Horizontal/Complex/longitudinal/Radial/BHT/Oblique
Arthroscopy Protocol:
Arthroscopy was carried in OT to correlate MRI findings.
a)Equipment: Arthroscope
b)Interpretation of Data;
c)Medial meniscus tear; a)present b) absent
d) If present Anterior horn/posterior horn/Body
e)Type of tear Horizontal/Complex/Longitudinal/BHT/Radial/Oblique
f) Any associated finding
g)Arthroscopic Diagnosis

ARTHROSCOPY TECHNIQUE

After admission in the hospital a written informed consent was obtained preoperatively explaining the procedure,risks and benefits. MRI findings were evaluated by surgeon.Examination under anaesthesia was done to confirm the meniscal tears by a qualified and experienced orthopaedic surgeon.

The operation room was set up for maximum efficiency and comfort.Towards head end of the table anaesthesia team was positioned.A Mayo stand was placed on opposite side for placement of probe,biters and shavers.

The surgical scrub assistant was placed at the foot of the bed usually on the contralateral side.Suction bags and fluid were set up on same side of the bed.Before beginning the procedure ,monitor was turned on,the line flushed,the suction set up,and the power to shaver turned on.The camera was set for the proper number of pictures,and any recording device such as CD-ROM device was connected.

Side determination was checked before start of operation.A post was usually placed 6-8 inches above the joint line.A tourniquet ,was applied in all cases.

To provide maximum mechanical advantage,the leg holder was placed as close to the knee joint as possible.The patient was positioned supine on the table.After spinal anaesthesia,the portal sites were marked with skin marker and injected with 1% lidocaine with epinephrine(1:200,000).An incision was made with a no 11 blade approximately 1 cm above the joint line and in line with lateral border of the patella preferably at soft spot.

Once the joint capsule was incised,a blunt trochar was advanced into the notch.The knee was brought into extension while gently advancing the trochar into suprapatellar pouch.The trochar was removed and the 30-degree camera was placed into the knee.

Prior to establishing the anteromedial portal,a preliminary inspection was done.The patella and trochlea were both inspected for cartilage wear or damage.The medial and lateral gutters were inspected for loose bodies and impinging osteophytes.The medial-sided synovium was inspected for large,engaging plica.

Once this inspection was completed,the arthroscope was passed along the medial femoral condyle and into the medial compartment.To obtain an unobstructed view of anterior aspect,an 18 gauge needle was used to find the most appropriate spot for this portal.The lateral meniscus pathology require clearance of the tibial spine to gain access to the lateral compartment.The leg was slightly flexed(10-30 degree),and a valgus force was applied to the knee joint.The entire medial meniscus was probed and if there was difficulty in getting to posterior horn of the meniscus,the knee was gently brought into extension,with great care taken to avoid scuffing of the condyles with camera.This usually opens up the posterior aspect of the joint and allowed probing of the medial meniscus and anterior capsule.

After noting the findings of medial compartment,cope was inserted into the lateral compartment by placing the knee into figure of four/varus position.A varus force on the leg just above the knee opened the lateral compartment.As on the medial side,the probe was used to inspect rest of the lateral meniscus.The lateral meniscus was usually easier to inspect than medial meniscus.If there was difficulty inspecting anterior horn,whether due to fat pad,ligamentum mecosum,or portal placement,the arthroscope was switched to the medial portal and directed toward the anterior horn.When inspecting the posterior horn of meniscus,the popliteal tendon was noted and the popliteal hiatus/sulcus probed.Lateral meniscus usually has twice as much excursion as the medial meniscus and that popliteus hiatus is a normal occurring interruption in the meniscocapsular ligament.All the findings were compared with MRI findings to confirm the status of menisci,type and pattern of meniscal tear,if any noted.After the procedure was over,thorough irrigation of the knee joint was done.

Intra-operatively the location and length of the tear were noticed. The probe was used to study the tear pattern. All findings were noted.

The portal was closed with simple nylon suture. The tourniquet was released and a dry, sterile compression dressing was put and the patient was brought to the recovery room after checking the vascular status. [Different tear types shown in figs].

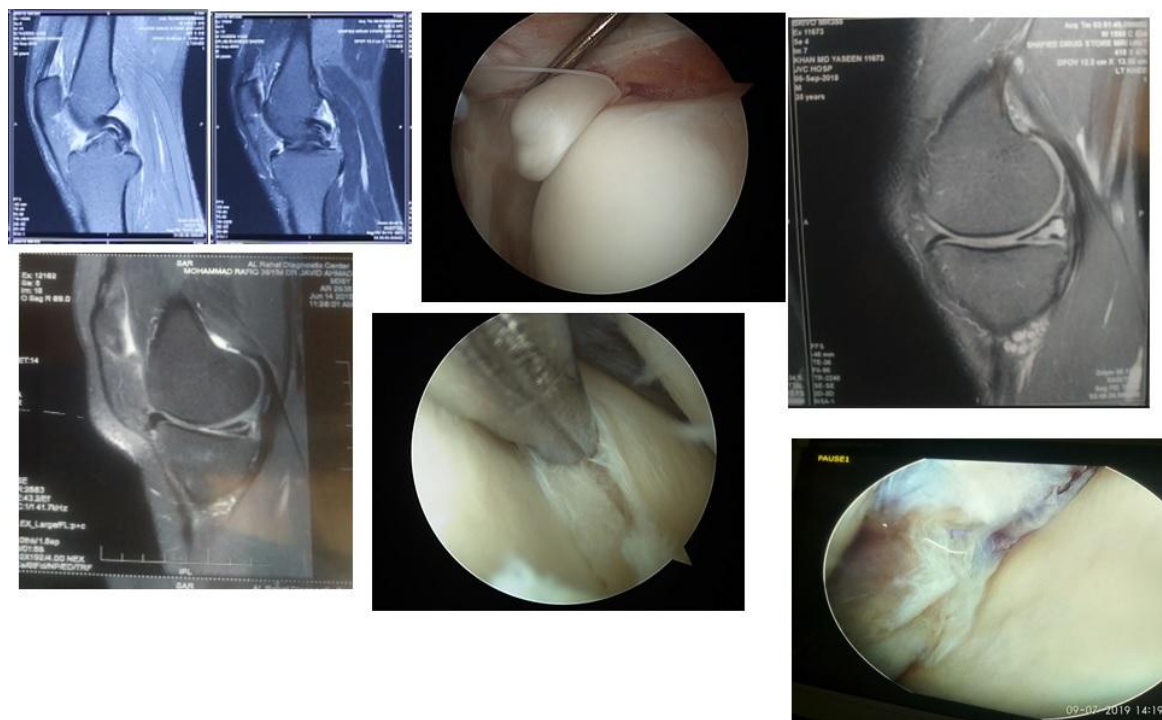


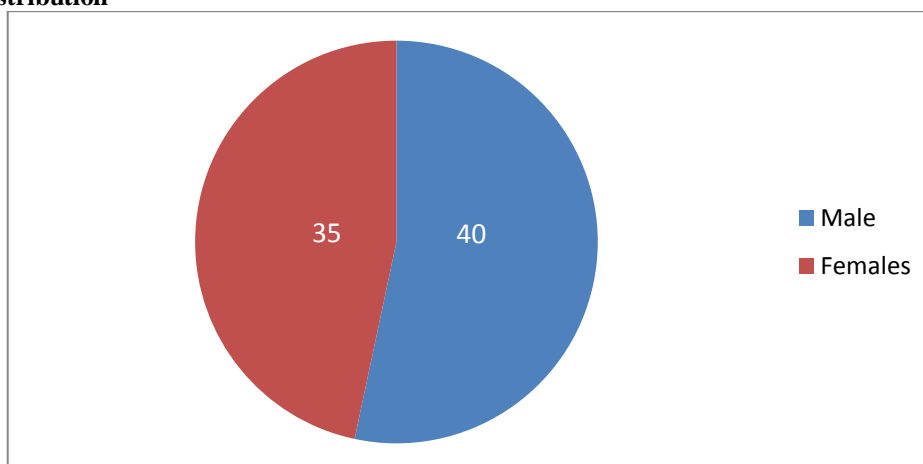
Fig 1-6 Shows Bucket handle tear, Horizontal and Complex tear {MRI as well as Arthroscopic} views

IV. Results :

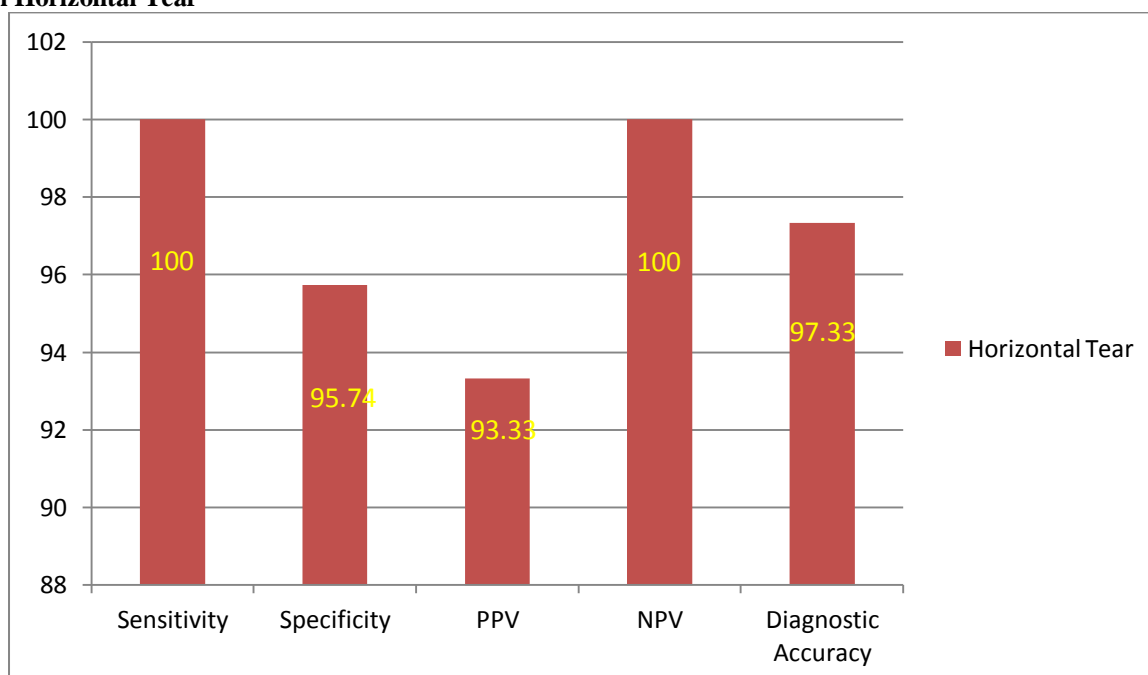
The present study was done in the post-graduate department of orthopaedics, Skims-Mc from September 2018 to August 2019. All the cases were admitted in the hospital one day prior to surgery.

The mean age in our series was 32.3 years and the standard deviation was 9.5. The majority of the patients were males (53%) and females represented 47% in the study. The right side was involved in 49% of the cases and left side was involved in 51% of cases respectively. Mc Murray's test was positive in 45% and negative in 55%. Apley's test was positive in 56% and negative in 44%. Thessaly's test was positive in 71% and negative in 29%. Squat test was present in 40% and negative in 60%. The medial meniscus was involved in 60 patients (80%) and the lateral meniscus was involved in 15 patients (20%). The Zone of meniscus involved on MRI was: Posterior horn was involved in 64 patients (85%), anterior horn in 6 patients (8%) and body of meniscus was involved in 5 patients (7%) respectively. The frequency and type of tear in the present study on MRI was found as horizontal tear (30/40), radial tear (4/5), complex tear (21/28), oblique tear (8/11), longitudinal tear (8/11), and bucket handle tear (4/5) respectively. The frequency and type of tear found on arthroscopy was as, horizontal tear (28/37), Radial tear (4/5), complex tear (18/24), bucket handle tear (5/7), oblique tear (7/9), longitudinal tear (8/11) and no tear in (5/7) respectively. Correlation of classification of horizontal tear on MRI and Arthroscopy showed sensitivity, specificity, PPV, NPV and diagnostic accuracy of 100%, 95.74%, 93.33%, 100%, 97.33 respectively. The confidence interval for horizontal tear was 95%. Correlation of classification of complex tear on MRI and Arthroscopy showed sensitivity, specificity, PPV, NPV and diagnostic accuracy of 100%, 94.74%, 85.71%, 100%, 96% respectively. The confidence interval for complex tear was 95%. Correlation of classification of bucket handle tear on MRI and arthroscopy showed sensitivity, specificity, PPV, NPV and diagnostic accuracy of 100%, 100%, 100%, 100%, 100% respectively. The confidence interval for bucket handle tear was 95%. Correlation of classification of oblique tear on MRI and arthroscopy showed, sensitivity, specificity, PPV, NPV and diagnostic accuracy of 100%, 98.53%, 87.5%, 100% and 98.67% respectively. The confidence interval for oblique tear was 95%.

Gender Distribution



Correlation between the classification of Meniscal Tear in MRI and Diagnostic Accuracy on Arthroscopy in Horizontal Tear



V. Discussion

The present study was conducted in the postgraduate department of orthopaedics, Skims MC, from September 2018 to August 2019. The prospective study consisted of a total of 75 cases with symptomatic meniscal injuries of knee, with two or more than two meniscal injury signs, were sent for MR imaging. MR imaging was analysed and only seventy five patients showed meniscal tear and were included in the study. There is dearth of literature in the study of the correlation of various patterns of tears on MRI and arthroscopy. The results of the study are discussed below.

Age Distribution: The mean age in our series was 32.3 years (18-50), with standard deviation of 9.3. Munk et al in their study of 61 cases found mean age of 31.4 years. Jah AK et al in their study of 70 patients found mean age of 27.9 years. Yaqoob J in their study had mean age of 30.4 years. Kulkarni Op et al had mean age of 35.7 years. Mean age of our study was consistent with the study of Yaqoob J et al.

Comparison of Gender

Majority of the patients in our study were males (56%) and females represented only (44%). The male to female ratio was 1.14 to 1.0. The slight male dominance in the study was because of sports, as well as outdoor activities compared to females. In a study conducted by Yaqoob J et al 56% were males and 44% were

females. In another study of Camanho et al 60% were males and 40% were females. Fabricant et al in their study had 62% males and 38% were females. Our study is comparable to yaqoob J et al.

Side Involvement

The right side was involved in 49% and left in 51% of the patients. Kulkarni et al 2018 had right side affection in 64% and left side was involved in 46%. G Go et al⁴⁸ in their study had 55% involvement of right and 45% left Knee. In another study conducted by Tregonning RJ et al had 49% affection of right and 51% left Knee. This study is comparable with Tregonning RJ et al.

Meniscal Involvement

In our study 80% of the tears happened in the medial meniscus and lateral meniscus was involved in 19% while both menisci were involved in 1%. The medial meniscus is relatively fixed and has lesser range of movement than lateral meniscus, so more liable to injury. Grevitt et al 1992 in their study had 55% medial meniscus involvement and 16% of lateral meniscus. In another study Winter and Tregonning 2005 had 46% medial meniscus involved and 19% lateral meniscus. Our study is comparable with Gravitt et al.

Involvement of meniscal zone

In our study 85% of patients had posterior horn tear and anterior horn was involved in 8% of the patients while the body of the meniscus was involved in 7% of the patients. Our study is comparable to the study of Costa et al.

Types of tear in MRI

In our study 40% were horizontal tear, 28% complex tear, 11% oblique tear, 11% longitudinal tear, 5% radial tear and 4% were bucket-handle tear. Our study is comparable with Dasic et al but not correlating with horizontal, complex and bucket-handle tear. Our study is comparable with Jeevika et al with horizontal and bucket-handle tears.

Clinical and MRI correlation

In our study a total of 90 patients with two or more than two positive clinical signs of meniscal tear were sent for MR imaging and only seventy five patients showed tear on MRI and were included in the study. The positive predictive value of clinical positive patients were 83.33% (CI=95%).

Correlation of meniscal tears on Clinical Examination and MRI

Clinically, 62 patients had suspicion of medial meniscal tear and on MRI only 59 patients had tear while three patients had bilateral tear. The positive predictive value is 95.16% (CI=86.71-98.34%). Jah AK et al⁴⁴ 2005 in their study had clinical examination and MRI correlation of medial meniscus and lateral meniscus of 96.9% and 84.62% respectively. Our study is comparable to Jah AK et al.

Correlation of Meniscal tears on MRI and Arthroscopy

Out of 75 MRI positive patients with tear, only seventy patients showed tear on the arthroscope, five patients had no tear on arthroscopy. Correlation of meniscal tears on MRI and arthroscope was found with a positive predictive value of 93.33% (CI=85.32-97.125). Correlation of meniscal tears on MRI and arthroscopy had a PPV of 93.33% and with a confidence interval of (85.32-97.12)

Correlation Pattern of Meniscal Tears On MRI and Arthroscopy

Sensitivity, specificity, PPV, NPV, DA and CI of Horizontal tear was 100%, 95.40%, 93.33%, 100%, 97.33% and 95.00% respectively. For complex tear the sensitivity, specificity, PPV, NPV, DA and CI was 100%, 94.74%, 85.71%, 100%, 96%, and 95% respectively. Oblique tear had sensitivity, specificity, PPV, NPV, DA and CI of 100%, 98.53%, 87.5%, 100%, 98.67% and 95% respectively. The sensitivity, specificity, PPV, NPV, DA and CI for bucket-handle tear was 100%, 100%, 100%, 100%, 100% and 95% respectively. In the present study there is a good accuracy of correlation of various patterns of tears on MRI and arthroscopy. As the confidence interval of most of tears on MRI and arthroscopy is close to 95.00%.

Correlation of Meniscal Tears on MRI and Arthroscopy

	Arthroscopically Positive	Arthroscopically Negative	Total	PPV	DA
MRI Positive	70 (TP)	5 (FP)	75	93.33% CI=(85.32,97.12)	93.33% CI=(85.32,97.12)
	70	5	75		

Correlation Pattern of Meniscal Tears on MRI and Arthroscopy

Type of Tear	% Tear on MRI	% of Tear on Arthroscopy	Sensitivity	Specificity	PPV	NPV	DA	CI
Horizontal Tear	40%	37%	100%	95.40%	93.33%	100%	97.33%	95%
Complex Tear	28%	24%	100%	94.74%	85.71%	100%	96%	95%
Oblique Tear	11%	9%	100 %	98.53%	87.50%	100%	98.67%	95%
Radial Tear	5%	5%	-	-	-	-	-	
Longitudinal Tear	11%	9%	-	-	-	-	-	
Bucket Handle Tear	5%	7%	100%	100%	100%	100%	100%	95%

VI. Summary

The study entitled correlation of classification of meniscal tears on MRI and arthroscopy was conducted on 75 patients in post-graduate department of orthopaedics Skims Mc Srinagar.

Out of 75 patients 40 were males and 35 females and an average age of 32.3 years(range 18-50).Left Knee was involved in 38 patients while as right knee was involved in 37 patients.

Clinical presentation was,pain in knee 75%,knee swelling in 35%,joint line tenderness in 70%,locking of knee in 60%,Mc Murray’s test was positive in 45%,Apley’s test was positive in 56%,squat test in 40% and Thessaly’s test was positive in 71% of patients.

Medial meniscus was involved in 80% patients,while as lateral meniscus was involved in 20%.

Posterior Horn tear was involved in 85% of patients,anterior horn in 8% and body in 7% of patients on MRI,while on arthroscopy posterior horn was involved in 82%,body in 10% and anteriornhorn in 8%.

The pattern of tear on MRI and arthroscopy was as horizontal tear 40%/37%,complex tear 28%/24%,oblique tear 11%/9%,longitudinal tear 11%/11%,BHT 5%/7% and radial tear 5%/5% respectively.

Strength of this study is that MRI was done from a reputed centre and MRI images were further evaluated by senior faculty member of the Radiology department of this institution.The arthroscopy was conducted by only two qualified orthopaedic surgeons of this institution.

The limitations of this study are that,there is a dearth of literature in correlating various patterns of tears on mri and arthroscopy.The sample size of the study was small for any definite and authoritative conclusions to be drawn.

VII. Conclusion

By obtaining correlation between MRI and arthroscopy for meniscal tears we conclude that MRI and carefully performed arthroscopy for various patterns of meniscal tears,the MRI shows a very close correlation with arthroscopic findings in terms of presence of meniscal tears.The tears are best quantified by arthroscopy. However, the correlation of these parameters is also apparently high.

- The correlation between clinical findings and corroborative MRI findings is high with confidence interval of 95.0%.
- The correlation between MRI and arthroscopic findings is high with confidence interval of 97.12%.
- The correlation of the classification predicted by MRI images with intra-operative findings varies with bucket –handle tears having a correlation of 100%,for horizontal tear correlation tear correlation is 97.33%,for complex tear correlation is 96.0% and for obliue tear correlation is 98.67%.These parameters demonstrate a high sensitivity and specificity.

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