

Comparison of Clinical Examination, MRI and Arthroscopy Findings in Internal Derangement of the Knee: A Cross-Sectional Study

RB UPPIN, SRINATH M GUPTA, SAUMYA AGARWAL, VV HATTIHOLI

ABSTRACT

Introduction: Walking is one of the prime actions carried out by our body and the knee joint plays a crucial role in its normal functioning. Owing to its anatomical structure and the functional demands, injuries involving the menisci and cruciate ligaments of knee joint are one of the most frequently encountered problems by an Orthopaedic surgeon.

There are different modalities for diagnosing knee joint injuries. A cross-sectional study was done to compare clinical examination and MRI findings with arthroscopy findings of the knee joint.

Aim: To study and compare MRI and arthroscopic findings of meniscal injuries and cruciate ligament injuries. Also to compare findings of clinical examination with that of MRI and arthroscopic findings of meniscal and cruciate ligament injuries.

Materials and Methods: A one-year hospital based cross-sectional study in which all 90 patients admitted were scheduled to undergo arthroscopic surgery of the knee following clinical and radiological evaluation. Findings of MRI and clinical examination were compared with that of arthroscopy findings, which are treated as gold standard, and the analysis was done.

Results: MRI vs. arthroscopy findings: Sensitivity of anterior cruciate ligament, medial and lateral meniscus was 100%, 70% and 72% and the specificity was 90%, 78% and 70% respectively. The accuracy of anterior cruciate ligament, medial and lateral meniscus are as follows 95%, 76% and 71%. The positive predictive value was 93%, 67% and 62%.

Clinical examination vs. arthroscopy findings: Sensitivity of anterior cruciate ligament, medial and lateral meniscus was 100%, 82% and 67% respectively. The specificity was 95%, 78% and 70%. The accuracy of anterior cruciate ligament, medial and lateral meniscus are as follows 98%, 80% and 69%. The positive predictive value was 96%, 70% and 60%.

Conclusion: Following the study, if MRI is positive for anterior cruciate ligament tear then the chances of finding the same on arthroscopy are very high. For medial and lateral meniscus, chances of identifying a normal meniscus are higher than that of detecting a pathological meniscus.

Clinical examination was effective in single lesion injuries. In multiple injuries, the false positive results were more. For menisci, negative predictive value is higher than the positive predictive value which means that the chances of detecting a normal knee are higher than detecting a lesion.

Keywords: Anterior cruciate ligament tear, Haemarthrosis, Knee injury, Knee joint, Meniscal injury

INTRODUCTION

Walking is one of the prime actions carried out by our body and the knee joint plays a crucial role in its normal functioning. Owing to its anatomical structure and the functional demands, injuries involving the menisci and the cruciate ligaments of the knee joint are one of the most frequently encountered problems by an Orthopaedic surgeon.

Injury involving these structures can lead to failure of the

normal functions of the knee joint such as stabilisation and weight bearing of the body, and will affect ones physical functioning which can lead to disruption of the daily activities affecting the patient both physically and economically. Thus it is of prime importance to diagnose the injury, which can involve the meniscus, cruciate ligament or both.

Various imaging modalities used to evaluate the knee include radiography, CT scans for fractures [1] and MRI for soft tissue

injuries in the knee joint [2]. Arthroscopy of the joint can be used for both diagnostic and therapeutic purposes [3].

Clinical examination of the patient is the initial assessment tool used for any patient. In acute cases examination may not be possible because of the pain and swelling involving the joint, MRI in the recent years has been reported to improve diagnostic precision without involvement of ionising radiation. It is non-invasive and has proved consistent and offers many benefits over invasive diagnostic arthroscopy. Thus, reducing the morbidity of the patient.

But there has been many controversies surrounding the comparison of MRI and clinical examination with arthroscopy findings of the knee joint.

The present study was an attempt to compare the efficacy of clinical examination and MRI findings in injuries involving the knee joint with arthroscopy treated as the gold standard.

The results of the study will lead to early diagnosis of the injuries of the patient leading to prompt treatment and relief for the patient.

MATERIALS AND METHODS

A hospital based cross-sectional study was conducted at Dr. Prabhakar Kore Hospital and Research Centre, Belagavi, India. All the patients (18-60 years) presenting to the OPD, Department of Orthopaedics with history of trauma involving the knee and those who were scheduled to undergo arthroscopic surgery of the knee following clinical and MRI findings were included in the study. Clinical examination includes anterior drawers test, posterior drawers test, pivot shift test and McMurray's test.

Duration post injury ranged from four weeks to six months. Patients undergoing knee joint arthroscopy without MRI, those with primary traumatic haemarthrosis of the knee, patients having fractures around the knee joint, active infection in the knee joint and those with degenerative changes in the knee were excluded from the study.

The study was conducted between the period of January 2014 to December 2014 following institutional ethical committee clearance.

After taking the necessary consents, all the patients who fit into the inclusion criteria were subjected to arthroscopy of the knee joint. MRI reporting was done by a single radiologist followed by diagnostic arthroscopy of the knee joint. All the surgeries were performed in an operation theatre under antibiotic cover. Following the diagnostic arthroscopy, the surgeons performed definitive surgeries depending on the findings and the consent given by the patients.

STATISTICAL ANALYSIS

Findings of MRI and clinical examination were compared with that of arthroscopy findings, which were treated as gold

standard, and the analysis was done. Sensitivity, specificity, positive predictive value and negative predictive value was calculated and compared. The level of correlation was assessed using Kappa statistics. Interpretation of Kappa statistics is as follows:- 0 to 0.20 – slight agreement; 0.21 to 0.39 – fair; 0.40 to 0.59 – moderate; 0.60 to 0.79 – substantial and 0.80 to 1 – Almost perfect agreement.

The p-value < 0.05 was considered as significant. The whole data obtained was analysed using Statistical Package for Social Sciences, version 20.

RESULTS

Total 90 patients were part of the study. Mean age of the patients was 32 years with maximum number of the falling within 20-40 years. The most common mode of injury was road traffic accident followed by sports injuries. Anterior cruciate ligament was involved in 52 cases followed by medial meniscus in 34 and lateral meniscus in 36 cases. Correlation between MRI, clinical examination and arthroscopy values for lateral meniscus, medial meniscus and ACL has been depicted in [Table/Fig-1-3].

[Tables/Fig-4-9] shows MRI and arthroscopy images of various lesions in the menisci.

[Tables/Fig-10-13] shows MRI and arthroscopy images of various lesions involving anterior cruciate ligament.

	MRI vs Arthroscopy	Clinical Examination vs Arthroscopy
Sensitivity	72%	67%
Specificity	70%	70%
Ppv	62%	60%
Npv	80%	76%
Accuracy	71%	69%
Kappa Statistics	0.414	0.364
p-value	0.005	0.014

[Table/Fig-1]: MRI, clinical examination and arthroscopy correlation for lateral meniscus.

	MRI vs Arthroscopy	Clinical Examination vs Arthroscopy
Sensitivity	70%	82%
Specificity	78%	78%
Ppv	67%	70%
Npv	81%	88%
Accuracy	76%	80%
Kappa Statistics	0.486	0.589
p-value	0.001	0.001

[Table/Fig-2]: MRI, clinical examination and arthroscopy correlation for medial meniscus.

	MRI vs Arthroscopy	Clinical Examination vs Arthroscopy
Sensitivity	100%	100%
Specificity	90%	95%
Ppv	93%	96%
Npv	100%	100%
Accuracy	95%	98%
Kappa Statistics	0.908	0.954
p- value	0.001	0.001

[Table/Fig-3]: MRI, clinical examination and arthroscopy correlation for ACL.

DISCUSSION

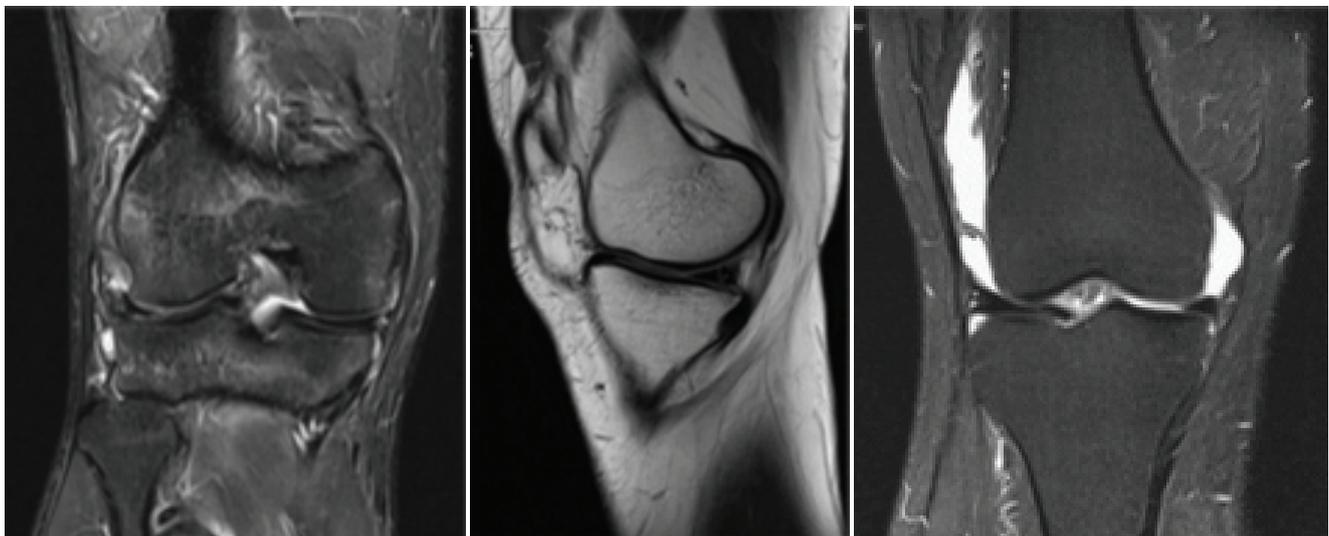
In diagnosing injuries pertaining to the knee joint, clinical examination is the first possible modality. But, the pain and swelling around the joint does not permit correct examination. MRI of the knee joint is a non-invasive investigation and routinely used for internal derangement of the knee joint. But, observer bias and the power of the machine used play a major role in the final diagnosis given out [4].

Arthroscopic examination of the knee is considered as the gold standard. The outcome largely depends on the facilities available at the institute and experience of the operating surgeon. Intra-substance tears are missed on an arthroscopy. Posterior horn of medial meniscus is missed in arthroscopy giving out false positive results.

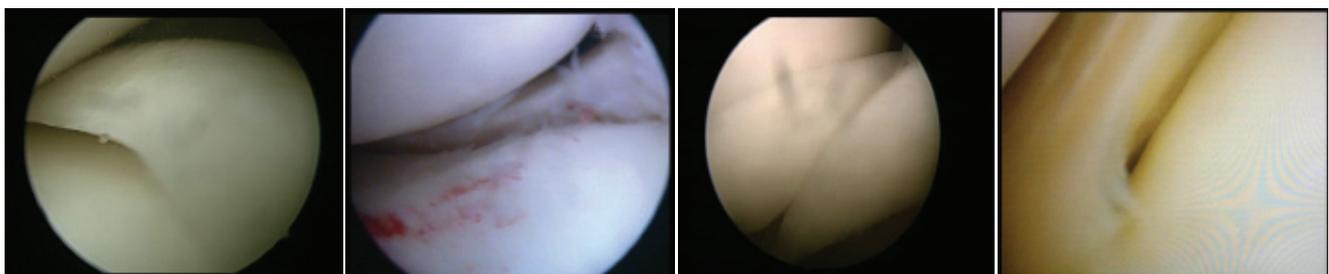
At times, one surgeon can describe a free edge abnormality as a tear, and the other one might interpret it as a tear [5].

In the present study out of 90 patients 78 were males. Maximum numbers of patients were in between 20-40 years. Forty four patients were injured following RTA and the next common cause was sports injuries. Anterior Cruciate Ligament (ACL) was the most frequently injured structure in our study. Multiple injuries were encountered in 42 cases.

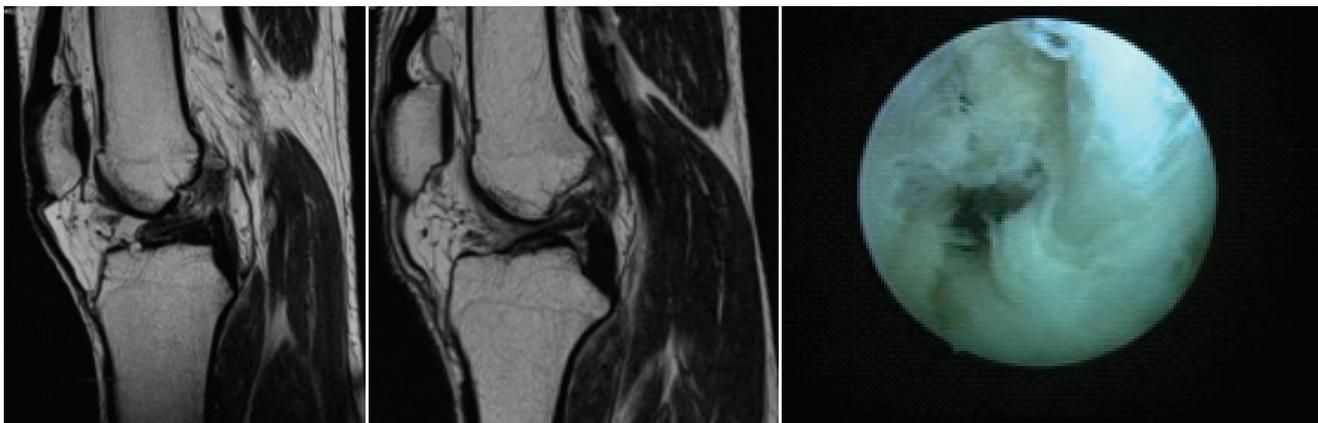
Chang et al., studied findings of 148 patients with figures of 92% for sensitivity and 87% for specificity for meniscal tears [6]. The conclusion was that MRI is a reliable diagnostic tool for displaced meniscal tears. Aydingoz et al., found sensitivity and positive predictive values of 90% in a series of 45 meniscal injuries [7].



[Table/Fig-4]: Horizontal tear in lateral meniscus. **[Table/Fig-5]:** Tear in the posterior horn of medial meniscus. **[Table/Fig-6]:** Bucket handle tear of medial meniscus. (Images from left to right)



[Table/Fig-7]: Arthroscopy image of normal meniscus. **[Table/Fig-8]:** Arthroscopic image showing radial tear in the meniscus. **[Table/Fig-9]:** Arthroscopic image showing bucket handle tear in the meniscus. **[Table/Fig-10]:** Arthroscopic image of horizontal tear in meniscus. (Images from left to right)



[Table/Fig-11]: Complete midsubstance tear of ACL. **[Table/Fig-12]:** Complete tear of ACL at femoral attachment. **[Table/Fig-13]:** Arthroscopic image of ACL tear. (Images from left to right)

In this study medial meniscus tears were 27 compared to 28 of the lateral meniscus.

The results of comparison of MRI and arthroscopy findings for lateral meniscus in our study and different studies are shown below [Table/Fig-14].

Data from various studies shows that the specificity of MRI is higher than sensitivity and NPV is higher than PPV.

It was found that the difference was not significant.

The results of comparison of clinical examination and arthroscopy findings for lateral meniscus in our study and different studies are shown below [Table/Fig-15].

Other than specificity, values in other studies failed to correlate with each other.

Name of study	Sensitivity	Specificity	PPV	NPV	Accuracy
Elevenes et al., [8]	40%	89%	33%	91%	84%
Dutka et al., [9]	44%	93%	50%	91%	86%
Rayan et al., [10]	61%	92%	74%	88%	85%
Navali et al., [11]	56%	93%	65%	70%	86%
Nikolaou et al., [12]	62%	88%	81%	74%	77%
Present Study	72%	70%	62%	80%	71%

[Table/Fig-14]: Results of comparison of MRI and arthroscopy findings for lateral meniscus of our study compared to other studies.

Name of study	Sensitivity	Specificity	PPV	NPV	Accuracy
Dutka et al., [9]	38%	100%	100%	91%	91%
Rayan et al., [10]	56%	95%	78%	87%	85%
Navali et al., [11]	71%	89%	60%	93%	79%
Nikolaou et al., [12]	30%	75%	50%	56%	55%
Present Study	67%	70%	60%	76%	69%

[Table/Fig-15]: Results of comparison of clinical examination and arthroscopy findings for lateral meniscus of our study compared to other studies.

The results of comparison of MRI and arthroscopy findings for medial meniscus in our study and different studies are shown below [Table/Fig-16].

Data from various studies shows that the PPV is less compared to NPV. Compared to other studies, the specificity was better than sensitivity.

The results of comparison of clinical examination and arthroscopy findings for medial meniscus in our study and different studies are shown below [Table/Fig-17].

In this study, all the values for clinical examination were on par with the other studies.

The results of comparison of MRI and arthroscopy findings for anterior cruciate ligament in our study and different studies

Name of study	Sensitivity	Specificity	PPV	NPV	Accuracy
Elevenes et al., [8]	100%	77%	71%	100%	84%
Dutka et al., [9]	88%	64%	60%	90%	73%
Rayan et al., [10]	76%	52%	57%	73%	63%
Navali et al., [11]	84%	71%	73%	83%	78%
Nikolaou et al., [12]	83%	69%	83%	69%	81%
Present Study	70%	78%	67%	81%	76%

[Table/Fig-16]: The results of comparison of MRI and arthroscopy findings for medial meniscus of our study compared with other studies.

Name of study	Sensitivity	Specificity	PPV	NPV	Accuracy
Dutka et al., [9]	65%	87%	76%	80%	79%
Rayan et al., [10]	86%	73%	76%	83%	79%
Navali et al., [11]	95%	76%	79%	94%	85%
Nikolaou et al., [12]	65%	50%	65%	50%	60%
Present Study	82%	78%	70%	88%	80%

[Table/Fig-17]: The results of comparison of clinical examination and arthroscopy findings for medial meniscus of our study compared with other studies.

are shown below [Table/Fig-18].

The results of comparison of clinical examination and arthroscopy findings for anterior cruciate ligament in our study and different studies are shown below [Table/Fig-19].

Name of study	Sensitivity	Specificity	PPV	NPV	Accuracy
Dutka et al., [9]	80%	86%	90%	72%	82%
Rayan et al., [10]	81%	96%	81%	95%	93%
Navali et al., [11]	99%	83%	90%	98%	93%
Nikolaou et al., [12]	83%	89%	90%	86%	86%
Present Study	100%	90%	93%	100%	95%

[Table/Fig-18]: The results of MRI and arthroscopy findings for anterior cruciate ligament of our study compared with other studies.

Name of study	Sensitivity	Specificity	PPV	NPV	Accuracy
Dutka et al., [9]	86%	90%	94%	79%	88%
Rayan et al., [10]	77%	100%	100%	95%	96%
Navali et al., [11]	99%	92%	95%	98%	96%
Nikolaou et al., [12]	68%	77%	80%	68%	72%
Present Study	100%	95%	96%	100%	98%

[Table/Fig-19]: The results of clinical examination and arthroscopy findings for anterior cruciate ligament of our study compared to other studies.

The results obtained from the present study were equal to or better than the results of other studies.

In a study conducted by Nikolaou et al., [12], they concluded that though MRI is useful, there have been countable numbers of false results. Thus, correlation with clinical, MRI and arthroscopy findings is very important.

It is essential to note the efficacy of MRI because it will in turn, effect the treatment of the pathology. In a study done by Adil Ismail Nasir et al., [13] in 2013 it was concluded that MRI is a safe, non-invasive imaging modality as MRI of the knee has been shown to be accurate in the assessment of menisci, ligaments and articular cartilage, i.e., excellent modality for assessment of soft tissue and knee joint derangements. Thus, we must underline a need for MRI before arthroscopy. In the present study, 67% of the patients tested positive by clinical examination, were confirmed by arthroscopy.

In a study conducted by Navali et al., [11], clinical examination and MRI had equal efficacy with clinical examination proving to be slightly better than MRI. In the present study, it was found true with regards to ACL injuries. Also it was found that clinical examination was equal to or better than MRI in single lesion knees when compared to those with more than one structure involved.

In a study conducted by Perera Joel and Bunola [14], they came to a conclusion that despite having typical mechanism of injury of ACL, the diagnosis of ACL tear will be delayed up to 4-6 months, with the mean delay in consulting an orthopaedic specialist being 165 days. In present study the longest delay has been three months.

In a study done by Barile et al., [15], they advocated that weight bearing MRIs showed unstable menisci lesions which are helpful for diagnostic and therapeutic purposes.

In a study conducted by Muhle et al., [16] they concluded that knee MRIs done at 55° of flexion resulted in better diagnosis of ACL tears when compared to MRIs in knee extension. There was not much difference in diagnosis of meniscal injuries. Our hospital didn't have the equipment to perform knee MRIs in flexion. However, the PPV and NPV of ACL was good in our study. A detailed and longer study needs to be done to know the efficacy of MRIs taken with knee in flexion.

LIMITATIONS

The sample size of the study could have been more. Given the positive results, the study can be continued and made into a meta-analysis which could make it more significant.

CONCLUSION

MRI has emerged as the most dependable non-invasive tool to diagnose injuries around the knee joint. In acute cases, both clinical examination and MRI will be non-conclusive. After the swelling settles down, clinical examination is equal to or better than an MRI in injuries involving anterior cruciate ligament. When it comes to injuries involving the meniscus, the MRI was better than the clinical examination. With a high NPV, it is suggested that a negative result on MRI would most probably give a normal result on arthroscopy. But, a positive result should always be correlated with the clinical examination findings before arriving at any final diagnosis. In patients involving injury to only one structure, i.e., either anterior cruciate ligament or medial meniscus or lateral meniscus clinical examination had better results compared to MRI.

An MRI is more useful in detecting peripheral, inferior and intra-substance tears, which are not visualised on the arthroscopy. With the arthroscopy findings turning out to be negative, suspecting these injuries from MRI help in directing the patient to specific management and early relief.

REFERENCES

- [1] Crawford R, Walley G, Bridgman S, Maffulli N. Magnetic resonance imaging versus arthroscopy in the diagnosis of knee pathology, concentrating on meniscal lesions and ACL tears: a systematic review. *Br Med Bull.* 2007;84:05-23.
- [2] Schurz M, Erdoes JT, Petras N. The value of clinical examination and MRI versus intraoperative findings in the diagnosis of meniscal tear. *Scripta Medica (Brno).* 2008;81(1):3-12.

- [3] Vaz CE, Camargo OP, Santana PJ, Valezi AC. Accuracy of magnetic resonance in identifying traumatic intraarticular knee lesions. *Clinics* (Sao Paulo). 2005;60(6):445-50.
- [4] Wong S, Steinbach L, Zhao J, Stehling C, Ma CB, Link TM. Comparative study of imaging at 3.0 T versus 1.5 T of the knee. *Skeletal Radiol*. 2009;38(8):761-69.
- [5] Jee WH, McCauley TR, Kim JM, Jun DJ, Lee YJ, Choi BG, et al. Meniscal tear configurations. Categorisation with MR imaging. *AJR Am J Roentgenol*. 2003;180(1):93-97.
- [6] Chang CY, Wu HT, Huang TF, Ma HL, Hung SC. Imaging evaluation of meniscal injury of the knee joint: a comparative MR imaging and arthroscopic study. *Clin Imaging*. 2004;28(5):372-76.
- [7] Aydingoz U, Firat AK, Atay OA, Doral MN. MR imaging of meniscal bucket-handle tears: a review of signs and their relation to arthroscopic classification. *Eur Radiol*. 2003;13(3):618-25.
- [8] Elevnes J, Jerome CP, Reikeras O, Johansen O. MRI as a screening procedure to avoid arthroscopy for meniscal tears. *Arch Orthop Trauma Surg*. 2000;120(1-2):14-16.
- [9] Dutka J, Skowronek M, Skowronek P, Dutka L. Arthroscopic verification of objectivity of the orthopaedic examination and magnetic resonance imaging in intra-articular knee injury. Retrospective study. *Wideochir Inne Tech Maloinwazyjne*. 2012;7(1):13-18.
- [10] Rayan F, Bhonsle S, Shukla DD. Clinical, MRI and arthroscopic correlation in meniscal and ACL injuries. *Int Orthop*. 2009;33(1):129-32.
- [11] Navali AM, Bazavar M, Mohseni MA, Safari B, Tabrizi A. Arthroscopic evaluation of the accuracy of clinical examination versus MRI in diagnosing meniscus tears and cruciate ligament ruptures. *Arch Iran Med*. 2013;16(4):229-32.
- [12] Nikolaou VS, Chronopoulos E, Savvidou C, Plessas S, Giannoudis P, Efstathopoulos N, et al. MRI efficacy in diagnosing internal lesions of the knee: a retrospective analysis. *J Trauma Manag Outcomes*. 2008;2(1):4.
- [13] Nasir AI. The role of magnetic resonance imaging in the knee joint injuries. *Int Res J Medical Sci*. 2013;1(5):01-07.
- [14] Perera NS, Joel J, Bunola JA. Anterior cruciate ligament rupture: delay to diagnosis. *Injury*. 2013;44(12):1862-65.
- [15] Barile A, Conti L, Lanni G, Calvisi V, Masciocchi C. Evaluation of medial meniscus tears and meniscal stability: Weight-bearing MRI vs arthroscopy. *Eur J Radiol*. 2013;82(4):633-39.
- [16] Muhle C, Ahn JM and Dieke C. Diagnosis of ACL and meniscal injuries: MR imaging of knee flexion versus extension compared to arthroscopy. *Springer Plus*. 2013;2:213-23.

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