

Diagnostic accuracy of joint line tenderness in medial meniscal tears using magnetic resonance imaging as gold standard

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Abstract:

Introduction: The menisci are wedge-shaped, semilunar (C-shaped), fibrocartilage structures composed of thick collagen fibers primarily arranged circumferentially, with radial fibers extending from the capsule, between the circumferential fibers. The menisci cover 50% of the medial and 70% of the lateral surface of the tibial plateau. Typically, the medial meniscus is larger, has a wider posterior horn, and is more “open” toward the intercondylar notch, with the lateral meniscus typically smaller and more “closed” toward the notch. In adults, the vascularized area, commonly known as the “red zone,” involves the outer 10% to 30% of the meniscus.

Objective: To determine the diagnostic accuracy of joint line tenderness in medial meniscal tears using magnetic resonance imaging as gold standard.

Material and Methods: This study was conducted at Department of Orthopedics, Khyber Teaching Hospital, Peshawar. Study design was cross sectional (Validation) study. Duration of study was 6 months from 25 July 2013 to 24 January 2014 in which 147 patients were observed by using 60% sensitivity, 60% specificity and 44% proportion of meniscal tears with 10% margin of error under WHO software. More over non probability consecutive sampling was used for sample collection.

Results: In this study 65% patients were in age range 20-30 years follow by 28% patients were in age range 31-40 years. Mean age was 30 years with $SD \pm 1.35$. Ninety percent patients were male while 10% patients were female. Diagnostic accuracy of Joint Line Tenderness (JLT) test was 77.55%, Sensitivity 76.59%, Specificity 81.25%, Positive predictive value 97.11%, Negative predictive value 29.54%.

Conclusion: Our study concluded that diagnostic accuracy of joint line tenderness (JLT) test is 77.61%. Joint line tenderness (JLT) test is a useful and important diagnostic technique as MRI to diagnose meniscal tears. We recommend the use of joint line tenderness (JLT) test as well as MRI for more doubtful, difficult and complex knee injuries.

Keywords: diagnostic accuracy, joint line tenderness, medial meniscal tears, magnetic resonance imaging.

Introduction:

The menisci are wedge-shaped, semilunar (C-shaped), fibrocartilage structures composed of thick collagen fibers primarily arranged circumferentially, with radial fibers extending from the capsule, between the circumferential fibers. The menisci cover 50% of the medial and 70% of the lateral surface of the tibial plateau. Typically, the

medial meniscus is larger, has a wider posterior horn, and is more “open” toward the intercondylar notch, with the lateral meniscus typically smaller and more “closed” toward the notch. In adults, the vascularized area, commonly known as the “red zone,” involves the outer 10% to 30% of the meniscus.¹

Meniscal tears represent one of the most com-

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mon injuries to the knee and the most common indication for knee surgery in the adult patient. Meniscal Tears may be medial or lateral and further divided into traumatic tears and degenerative tears.² The medial meniscus is firmly attached to the tibia at the posterior horn; this firm attachment allows the medial meniscus to serve as a knee stabilizer. The incidence of medial meniscal tears found by Lee JJ et al. was 44%.³ Meniscal tears typically occur as a result of twisting or change of position of the weight-bearing knee in varying degrees of flexion or extension. The overall male-to-female incidence of meniscus injuries is 2.5:1 and its prevalence has been estimated at 61 per 100,000 in United States while double of this number world wide. In males, it occurs usually in the age of 31-40 years, while in females it is in age 11-20 years. Swelling, clicking, catching, locking, pinching, a sensation of giving way and pain in joint line are the common complaints reported by the patients in such cases.⁴

Physical tests may not always be diagnostic of Meniscal tears⁵; therefore magnetic resonance imaging (MRI) is used as a standard tool in the diagnosis of meniscal tears. MRI is useful, but should be reserved for situations in which an experienced clinician requires further information before arriving at a diagnosis.⁸ It has significant diagnostic performance for detecting meniscal tears within the knee joint.⁹ MRI is reported in 96% cases for detecting meniscal tears⁵ and is also recommended for more doubtful, difficult and complex knee injuries.⁶ Kijowski R. et al. showed in their research study 97.1% sensitivity, 65.6% specificity and 82.0% accuracy of MRI for detecting medial meniscal tears within the knee joint.⁹

The current study is designed to find the accuracy as well as sensitivity of joint line tenderness test in diagnosing medial meniscal tears in our local population at present, keeping magnetic resonance imaging (MRI) as a gold standard. As described earlier, joint line tenderness has been considered as an accurate clinical sign for signifying meniscal tears in knee injuries. It has high effectiveness and can be easily reproduced

therefore it may be taken as the basis of the clinical examination. On the other hand, MRI also has significant performance in finding the problems of meniscal tears, but it should be reserved for more difficult and complex situations. Fewer studies have been found over the accuracy of joint line tenderness in medial meniscal tears in which no study was conducted over this issue in our region. This study will give us the local statistics about accuracy and sensitivity of joint line tenderness test for diagnosing the medial meniscus tears in knee injuries. The auspicious result of this study will be shared with numerous health care bodies for bringing improvements in diagnosing the problems with medial meniscal in order to prompt better treatment and to avoid complications. The guidelines will be suggested regarding joint line tenderness in case of negative findings in our study.

Operational definitions means, joint line tenderness test was deemed positive if there is intolerable pain on palpation of tibiofemoral joint line in patients with suspected meniscal tear sitting with knee bent at 90 degree

Medial meniscal tears on MRI, meniscus was considered torn on MRI if there is altered signals activity with loss of its normal anatomical contours.

Diagnostic Accuracy, was measured in terms of sensitivity, specificity, positive and negative predictive values.

Sensitivity, was the ability of joint line tenderness to identify those patients who have meniscal tears, out of total patients with meniscal tears (confirmed by MRI) and will be determined as follows:

$\text{Sensitivity} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Negative}} \times 100$

Specificity, was the ability of joint line tenderness to correctly identify those patients who do not have meniscal tears out of total patients not having meniscal tears (confirmed by MRI) and will be determined as follows:

$\text{Specificity} = \frac{\text{True Negative}}{\text{True Negative} + \text{False Positive}} \times 100$

tive + False Positive)

Positive predictive value, was the proportion of patients who fulfill the criteria of Joint Line Tenderness and have evidence of meniscal tear on MRI and will be determined as follows:

positive predictive value = $\frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}} \times 100$

Negative predictive value, was the proportion of people who do not have meniscal tear and have not evidence of meniscal tear on MRI and will be determined as follows:

negative predictive value = $\frac{\text{True Negative}}{\text{True Negative} + \text{False Negative}} \times 100$

True positive: Patients with meniscal tears (confirmed on MRI) who were classified as having meniscal tears by joint line tenderness.

True Negative: Patients who were classified as having no meniscal tear (confirmed on MRI) by joint line tenderness.

False Positive: Patients who were misclassified as having meniscal tear (confirmed on MRI) by joint line tenderness.

False Negative: Patients who were misclassified as having no meniscal tear (confirmed on MRI) by joint line tenderness.

Material and methods:

This study was conducted at Department of Orthopedics, Khyber Teaching Hospital, Peshawar. Study design was cross sectional (Validation) study. Duration of study was 6 months. In which a total of 147 patients were observed by using 60% sensitivity, 60% specificity and 44% proportion of meniscal tears with 10% margin of error under WHO software. Non probability consecutive sampling technique was used for sample collection. More over all young adult patients of age between 15 years to 50 years, presenting with symptoms suggestive of meniscus tears (Pain, clicking, locking, giving way and feeling instability at knee joint. Patients of either gender were included. While all patients with fracture in or around knee joint evident on plain digital radiographs was excluded because of extreme pain to patients and falls result of joint line tenderness. Patients with heart pacemaker

or implants due to any illness were excluded by known clinical records and history because of contradiction to MRI, Patients with any sign of knee infection evident by history, clinical examination and complete blood count with erythrocyte sedimentation rate (ESR) because of extreme pain while performing joint line tenderness test, patients with open injuries to knee joint evident of clinical examination, Patients with cerebral palsy by known clinical records and examination because of spasticity around the joints, which was give false results of joint line tenderness, patients with knee joint surgery were excluded.

This study was conducted after approval from the ethical board and research committee of the hospital. All admitted patients as well as out department's patients meeting the inclusion criteria was included in the study. Strict exclusion criteria had followed to control the confounders and bias in the study. The diagnosis of medial meniscal tears in knee injuries was based upon joint line tenderness test. The purpose and benefits of study and complete procedure of joint line tenderness test was explained to the patients and a written informed consent was obtained. All patients were subjected to detailed history and examination.

The causes for meniscus tears were gained whether it is traumatic or not. Importance was given to note the timing and specific event when the tears occurred. The severity of symptoms like clicking, catching, locking, pinching and a sensation of giving way assessed using clinical and physical examinations. Joint line tenderness test was performed under the supervision of a senior consultant orthopedic surgeon having experience of more than 10 years in orthopedics, who was the fellow of college of physicians and surgeons Pakistan. The test result was properly recorded and then MRI of the involved knee was carried out to confirm the findings of joint line tenderness test. All the results were found and recorded by myself and the above mentioned information including name, age, gender and address was recorded in the study proforma. SPSS latest version available was used for sta-

MRI (Meniscal Tear)

	+	-
+	A	B
-	C	D

a – True Positive*b* – False Positive*c* – False Negative*d* – True NegativeSensitivity = $a / a + c \times 100$ Specificity = $d / b + d \times 100$ Positive predictive value = $a / a + b \times 100$ Negative predictive value = $d / c + d \times 100$ Diagnostic efficacy = $a + d / a + b + c + d \times 100$

tistical analysis of data collected through pre-designed proforma. Mean and Standard Deviation was calculated for continuous variable like Medial Meniscal Tears and categorical variable like gender and age. The former was expressed as percentages and the later was expressed as frequencies. Joint Line Tenderness and MRI were stratified among the age and sex to see the effect modification.

Results:

Age distribution among 147 patients was analyzed as 96(65%) patients were in age range 20-30 years, 41(28%) patients were in age range 31-40 years, 10(7%) patients were in age range 41-50 years. Mean age was 30 years with SD \pm 1.35. (Table 1) Gender distribution among 147 patients was analyzed as 132(90%) patients were male and 15(10%) patients were female. (Table 2) Diagnostic accuracy of Joint Line Tenderness (JLT) Test among 147 patients was analyzed as joint line tenderness (JLT) findings were positive in 103(70%) patients and was negative in 44(30%) patients. (Table 3) Diagnostic accuracy of MRI among 147 patients was analyzed as MRI findings were positive in 131(89%) patients and was negative in 16(11%) patients. (Table 4) Diagnostic accuracy of Joint Line Tenderness (JLT) Test was 77.55%, Sensitivity 76.59%, Specificity 81.25%, Positive predictive value 97.11%, Negative predictive value 29.54%. (Table 5)

Discussion:

Although major advances have taken place in the field of non-invasive diagnostic tools such as MRI, clinical diagnosis remains important and reliable. Expensive investigation could be avoided if clinical diagnosis is as reliable as MRI. This study was conducted to determine the reliability of clinical diagnosis of meniscal tears as compared to MRI scan results. There are various tests described to diagnose meniscal tears such as joint line tenderness, McMurray test and Apley compression test. We have used joint line tenderness in our study. The advent of arthroscopy of the knee has revolutionised the diagnosis and treatment of meniscal tears. It is routinely carried out as a day case procedure. It

facilitates rapid rehabilitation. The clinical diagnosis was confirmed or refuted during this procedure. The accuracy, sensitivity and specificity were calculated based on the arthroscopic findings.

Our study shown that majority of the patients 65% were in age range 20-30 years followed by 28% patients were in age range 31-40 years Mean age was 30 years with $SD \pm 1.35$. Ninety percent patients were male and 10% patients were female. Joint Line Tenderness (JLT) Test findings were positive in 70% patients while MRI findings were positive in 89% patients. So the Diagnostic accuracy of Joint Line Tenderness (JLT) Test was 77.55%, Sensitivity 76.59%, Specificity 81.25%, Positive predictive value 97.11%, Negative predictive value 29.54%. Similar findings were observed in other studies as Joint Line Tenderness test is an accurate clinical sign indicating injury in 77-86% of patients with Meniscal tears.⁴ Joint Line Tenderness has been 60% to 90% sensitive and specific, and it is chosen as the basis of the clinical examination because of its high efficiency and easy reproduction. This test has a superior diagnostic accuracy of 81% for medial Meniscal tears.⁵ Mohan BR et al.⁷ clinically diagnosed 150 patients in a period of one year for meniscal tears; 88% patients were clinically confirmed by Joint Line Tenderness test to have medial meniscal tears. The test of Joint Line Tenderness alone is not recommended to be used in the clinical decision making process to guide treatment. The study by Mohan BR et al.⁷ demonstrates that clinical diagnosis of Meniscal tears is reliable for magnetic resonance imaging (MRI) scan.

Eren¹⁰ reported on accuracy of joint line tenderness in meniscal tears in 104 knees, which was 74% for medial meniscal tears and 96% for lateral meniscal tears. The study group had a mean age of 19.2 years (range: 18–20 years) with definite history of injury. The average age of 49 years (range: 19–79 years) had definite history of injury in 40% of patients. Although we have a wide range of age in our group, we had a better accuracy for medial meniscal injuries. Use of two diagnostic tests has certainly improved the reliability

for medial meniscal tear evaluation but has not improved lateral meniscal tear accuracy rates.

Similar findings were observed in study done by Eren OT¹⁰ in which 104 knees were observed and the diagnosis was correct in 71 (68%) and incorrect in 33 (32%) knees. A total of 37 medial meniscal tears and 27 lateral meniscal tears were identified at arthroscopy. Other pathology included 11 anterior cruciate ligament (ACL) tears, 5 medial femoral chondral lesions, 4 chondromalacia patellae, and 1 medial plica. No discernable abnormalities were seen in 21 knees. A preoperative diagnosis of a medial meniscal tear was made in 54 knees and 32 were confirmed at arthroscopy. A lateral meniscus tear was suspected in 27 knees and confirmed in 25. Five medial meniscus and 2 lateral meniscus tears were seen at arthroscopy. These had not been suspected with tenderness over the joint line. The accuracy of the test was lower with the presence of ACL lesions and chondromalacia patella. it concluded that joint line tenderness as a test for lateral meniscal tears is accurate (96%), sensitive (89%), and specific (97%).

Miller GK et al.¹¹ found overall clinical diagnosis accuracy of meniscal tears of 80.7% and the corresponding accuracy for MRI was 73.7%. We had an accuracy of 90% for the clinical diagnosis test. Rose and Gold¹¹ found the clinical examination to be correct more often than MRI diagnosis. They stated that most often MRI just confirms the clinical diagnosis and adds a little more information about the injury pattern. They suggested that negative clinical examination eliminates the need for MRI as a screening tool. They found no significant difference in accuracy between clinical examination and MRI in both medial and lateral meniscal tears or anterior cruciate ligament (ACL) tears. The accuracy of MRI in their study for medial meniscal tears was 75% and 76% for lateral meniscal tears which is lower than our accuracy rates. Munk et al.⁷⁵ recommended MRI as a clarifying tool to reduce the number of normal arthroscopies. They had MRI sensitivity of 84%, specificity of 75% and clinical accuracy of 79% for meniscal tears. We have a clinical accuracy of 88% for medial

meniscal tears and 92% for lateral meniscal tears.

Ryzewicz M et al.⁹ showed that it would be cost effective to bypass MRI and proceed directly to arthroscopy based on their mathematical formula. They showed that up to 78% of knees scanned require arthroscopy for treatment. Kocabey Y et al.¹² stated that clinical examination is as accurate as MRI in the skilled orthopaedic surgeon's hands and MRI should be reserved for more complicated and confusing cases. Bohnsack M et al.¹³ also concluded that an experienced examiner can diagnose adequately by clinical examination alone. Miller GK et al.¹⁴ suggested that the accuracy of clinical diagnosis of a meniscal tear is decreased by the presence of an ACL tear and the presence of both these injuries requires more frequent magnetic resonance imaging. Similar findings were observed in other studies conducted by McMurray TP¹⁵, Rose NE¹⁶.

Conclusion:

Our study concluded that diagnostic accuracy of joint line tenderness (JLT) test is 77.61%. Joint line tenderness (JLT) test is a useful and important diagnostic technique as MRI to diagnose meniscal tears. We recommend the use of joint line tenderness (JLT) test as well as MRI for more doubtful, difficult and complex knee injuries.

Conflict of Interest: None

References:

1. Michael G. Fox. MR Imaging of the Meniscus: Review, Current Trends, and Clinical Implications. *Radiol Clin N Am*. 2007;45:1033-53.

2. Rimington T, Mallik K, Evans D, Mroczek K, Reider B. A Prospective Study of the Nonoperative Treatment of Degenerative Meniscus Tears. *Orthoped*. Aug 2009;32(8):1-9.
3. Lee JJ, Choi YJ, Shin KY, Choi CH. Medial Meniscal Tears in Anterior Cruciate Ligament-Deficient Knees: Effects of Posterior Tibial Slope on Medial Meniscal Tear. *Knee Surg Relat Res*. Dec 2011;23(4):227-30.
4. Meniscus Injuries.[Online].[Cited on Oct 3, 2012]. Available at <http://emedicine.medscape.com/article/90661-overview#a0199>
5. Konan S, Rayan F, Haddad FS. Do physi diagnostic tests accurately detect meniscal tears? *July 2009;17(7):806-11*.
6. Mohan BR, Gosal HS. Reliability of clinical diagnosis in meniscal tears. *International Orthoped*. Feb 2007;31(1):57-60.
7. Shelbourne KD, Benner RW. Correlation of joint line tenderness and meniscus pathology in patients with subacute and chronic anterior cruciate ligament injuries. *J Knee Surg*. 2009;22(3):187-90.
8. Ryzewicz M, Peterson B, Siparsky PN, Bartz RL. The Diagnosis of Meniscus Tears: *ClinOrthopRelat Res*. Feb 2007;455:123-33.
9. Eren OT. The accuracy of joint line tenderness by physical examination in the diagnosis of meniscal tears. 2003;19(8): 850-4
10. Munk B, Madsen F, Lundorf E, Staunstrup H, Schmidt SA, Bolvig L, Hellfritzsch MB, Jensen J. Clinical magnetic resonance imaging and arthroscopic findings in knees: a comparative prospective study of meniscus anterior cruciate ligament and cartilage lesions. *Arthroscopy* 2000;14(2):171-5.
11. Kocabey Y, Tetik O, Isbell WM, Atay OA, Johnson DL. The value of clinical examination versus magnetic resonance imaging in the diagnosis of meniscal tears and anterior cruciate ligament rupture. *Arthroscopy* 2004;20(7):696-700.
12. Bohnsack M, Ruhmann O, Sander-Beuermann A, Wirth CJ. Comparison of clinical examination with NMR spectroscopy in the diagnosis of meniscal lesions in daily practice. *Z Orthop Ihre Grenzgeb* 2005;137(1):38-42
13. Miller GK. A prospective study comparing the accuracy of the clinical diagnosis of meniscus tear with magnetic resonance imaging and its effect on clinical outcome. *Arthroscopy* 2002;12(4):406-13
14. McMurray TP. The semilunar cartilages. *Br J Surg* 2000;29:407
15. Rose NE, Gold SM. A comparison of accuracy between clinical examination and magnetic resonance imaging in the diagnosis of meniscal and anterior cruciate ligament tears. *Arthroscopy* 2001;12(4):398-405