

KKU Knee Compression-Rotation Test for Detection of Meniscal Tears: A Comparative Study of Its Diagnostic Accuracy with McMurray Test

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Objective: The purpose of the present study was to compare the sensitivity, specificity and diagnostic accuracy of a new test, named "KKU Knee Compression-Rotation Test", with the most widely used examination, McMurray test.

Material and Method: Sixty-eight patients aged 18 to 39 years old were included in the present study. All of these patients were interviewed for their knee injury histories and examined with both KKU knee compression-rotation and McMurray tests preoperatively. For these clinical examination tests, the sensitivity, specificity, false positive, false negative and diagnostic accuracy rates were calculated and compared with the arthroscopic findings of these patients.

Results: The KKU knee compression-rotation test had sensitivity, specificity, and diagnostic accuracy for detection of meniscal tear as 86.27, 88.23, and 86.76% respectively, which superior to McMurray test that was 70.59, 82.35, and 73.53%. In addition, the KKU knee compression-rotation test had false positive and false negative rates of 11.76 and 13.73% less than the 17.65 and 29.41% of McMurray test. The combination of these two tests had diagnostic sensitivity of 90.20% and positive result of both tests suggested torn meniscus with the probability of 97.14%.

Conclusion: The KKU knee compression-rotation test for detection of torn meniscus had better rates of diagnostic sensitivity, specificity, and accuracy than McMurray test. Therefore, the KKU knee compression-rotation test can be the first line screening examination for detection of torn meniscus. However, if the patient is tested by both the KKU knee compression-rotation and the McMurray tests, it will be a better screening test because a high sensitivity and positive result of both tests suggests a diagnosis of torn meniscus accurately.

Keywords: Meniscal tear, McMurray test, Accuracy

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Meniscal injuries are common among athletes and accidents, causing disabilities to many patients⁽¹⁾. The evaluation of such injuries is not always easy and requires thorough clinical examinations. The history alone can suggest meniscal tears in 75% of the patients⁽²⁾, whereas initial diagnosis can be made by physical examination. There are several physical tests for meniscal tear including the palpation elicits tenderness that is the McMurray test and the rotation produces pain that is the Apley's test⁽³⁾. However, both

types of these clinical tests had been reported to have low diagnostic sensitivity and specificity values. Therefore, the authors developed a new clinical test using the combination of these two principles of palpation and rotation to elicit pain or clicking for diagnosis of meniscal tear, named "Khon Kaen University knee compression-rotation test (KKU knee compression-rotation test)".

In the present study, the authors present the comparative study of diagnostic accuracy of the KKU knee compression-rotation test, for detection of meniscal tears, with the diagnostic accuracy of the most widely used test, the McMurray test.

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Material and Method

Patients

Between July 2005 and July 2006, the 68 knee injured patients between the ages of 18 to 39 years old were examined in Srinagarind Hospital. All of these patients had preoperative planning of knee arthroscopy. All of these patients had no intra-articular fracture, previous knee surgery, or neurological or degenerative disorders. The historical data were collected and the patients were examined using the McMurray test and KKU knee compression-rotation test. All of the patients had their knee examined using the arthroscopic technique and the definite diagnosis from knee arthroscopy were collected.

Clinical Evaluation

All patients were examined by both the McMurray test and KKU knee compression-rotation test.

KKU knee compression-rotation test

The patient lay supine and the knee was passively flexed. The thumb and index fingers of one examiner's hand were placed along the joint line whereas the other hand grasped the patient's ankle. The knee compression was created by pushing the tibia onto the femur, then the tibia was rotated on the femur both internally and externally while the examiner's hand sensed for patient's pain by verbal communication, facial expression, or clicking sound (Fig. 1). This maneuver was made repeatedly when the knee was flexed in 120°, 90°, 60°, 30°, and 0°.

McMurray test

The patient lay supine and the knee acutely and forcibly flexed, one of the examiner's hand was placed on the knee so that the thumb and index fingers were along the joint line of the knee, while the other hand grasped the patient's ankle and externally rotated the tibia on femur as far as possible and then the knee was slowly extended to check the medial meniscus⁽⁴⁻⁶⁾ (Fig. 2). For the lateral meniscus, the maneuver was repeated in the position of internal rotation of tibia on femur.

The accuracy in clinical diagnosis of meniscal tears was assessed in 68 knees. Arthroscopy was performed in each case to establish the diagnosis.

Statistical Analysis

Sensitivity, specificity, false positive, false negative, and diagnostic accuracy⁽⁷⁾ values were cal-

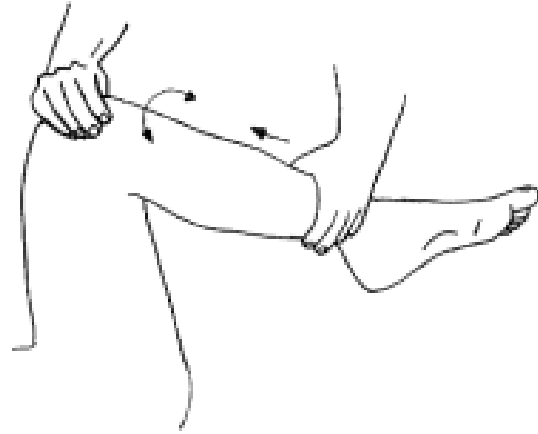


Fig. 1 The KKU knee compression-rotation test at the position of 120° of knee flexion

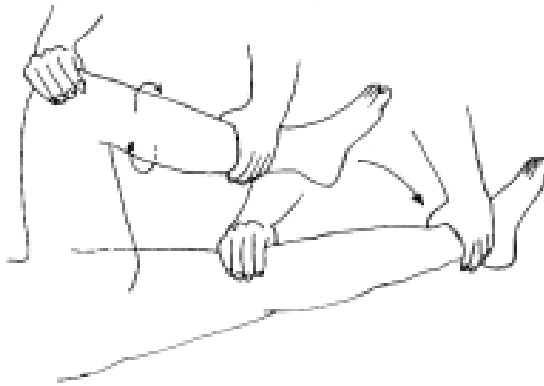


Fig. 2 McMurray test was performed by rotation and extension of a flexed knee

culated for the clinical tests comparing with the arthroscopic diagnosis.

Ethical aspects

The study design was approved by Ethical Committee of Khon Kaen University. All patients were informed and signed a consent form for participation in the present study.

Results

The arthroscopic findings of 68 knee injured patients included isolated anterior cruciate ligament tears in 11 patients, a combination of anterior cruciate ligament and medial meniscal tears in 24 patients, a combination of anterior cruciate ligament and lateral meniscal tears in 2 patients, isolated medial meniscal

tears in 5 patients, isolated lateral meniscal tears in 9 patients, a combination of anterior cruciate ligament and both meniscal tears in 11 patients and miscellaneous lesions (chondral injuries or plicae) in 6 patients. Fifty-six patients sustained the sport injuries and 12 sustained them from traumatic events. KKU knee compression-rotation test was positive in 46 of 51 torn menisci, McMurray test was positive in 39 of 51 torn menisci and 35 cases had positive both of KKU knee compression-rotation and McMurray tests, 34 of these 35 cases had torn menisci.

The results of KKU knee compression-rotation test and arthroscopic diagnosis, McMurray test and arthroscopic diagnosis and combined KKU knee compression-rotation test and McMurray test and arthroscopic diagnosis are shown in Table 2, 3, and 4, respectively.

The sensitivity, specificity, false positive, false negative, positive predictive value, negative predictive value, and diagnostic accuracy for meniscal tear of the KKU knee compression-rotation test were 86.27, 88.23, 11.76, 13.73, 95.65, 68.18, and 86.76% respectively, superior to the 70.59, 82.35, 17.65, 29.41, 92.31, 48.28, and 73.53% of McMurray test (Table 5). For detection of medial meniscal tear, the KKU knee compression-rotation test had sensitivity, diagnostic accuracy, and negative predictive value as 82.50, 70.59, and 68.18% more than 70.00, 66.18, and 58.62% of McMurray test. However, the KKU knee compression-rotation had specificity of 53.57 but false positive rates of 46.43% less than the 60.71 and higher than the 39.29% of McMurray test. For detection of lateral meniscal tear, the sensitivity, specificity, false positive, false negative, positive predictive value, negative predictive value, and diagnostic accuracy for meniscal tear of the KKU knee compression-rotation test were 100, 47.83, 52.17, 0, 47.83, 100, and 64.71%, superior to 68.18, 47.83, 52.17, 31.82, 38.46, 75.86, and 54.41% of McMurray test. When the patients were examined by both of KKU knee compression-rotation and McMurray tests, a positive result of at least one test improved the sensitivity, false negative, and accuracy to 90.20, 9.80, and 86.76% respectively, while specificity and false positive were 76.47 and 23.52 more than each test (Table 5).

The likelihood ratio⁽⁸⁾ of KKU knee compression-rotation test, McMurray test and combined test were 7.34, 4.00, and 3.83 respectively (Table 5).

Discussion

Meniscal tears occur as a result of injury. Most patients report an acute onset of sharp pain

Table 1. Demographic data on the patients (n = 68)

Age (years)	26.04 ± 5.51 (18-39)
Gender: male	61
female	7
Side: right	29
left	39
Cause of injuries: sport injuries	56
accidents	12

Table 2. Results of KKU knee compression-rotation test and arthroscopic diagnosis

Both Menisci	Menisci		Total
	Torn	Intact	
KKU knee compression-rotation test: positive	44	2	46
negative	7	15	22
Total	51	17	68

Table 3. Results of McMurray test and arthroscopic diagnosis

Both Menisci	Menisci		Total
	Torn	Intact	
McMurray test: positive	36	3	39
negative	15	14	29
Total	51	17	68

Table 4. Results of combined KKU knee compression-rotation and McMurray tests and the arthroscopic diagnosis

Both Menisci	Menisci		Total
	Torn	Intact	
Both tests: positive	46	4	50
negative	5	13	18
Total	51	17	68

following a twisting injury with the knee flexed and foot planted on the ground^(9,10). The pain typically subsides after a period of time, and the patient usually reports pain and discomfort in the affected part of the

Table 5. Value for diagnostic parameter of KKU knee compression-rotation test and McMurray test

Test	Meniscal tears %	Medial meniscal tears %	Lateral meniscal tears %
KKU knee compression-rotation test			
Sensitivity	86.27	82.50	100
Specificity	88.23	53.57	47.82
False positive	11.76	46.43	52.17
False negative	13.73	17.50	0
Positive predictive value	95.65	71.74	47.83
Negative predictive value	68.18	68.18	100
Accuracy	86.76	70.59	64.71
Likelihood ratio	7.34		
McMurray test			
Sensitivity	70.59	70.00	68.18
Specificity	82.35	60.71	47.83
False positive	17.65	39.29	52.17
False negative	29.41	30.00	31.82
Positive predictive value	92.31	71.79	38.46
Negative predictive value	48.28	58.62	75.86
Accuracy	73.53	66.18	54.41
Likelihood ratio	4.00		
Combination of both tests			
Sensitivity	90.20	87.50	100
Specificity	76.47	46.43	39.13
False positive	23.52	53.57	60.87
False negative	9.80	12.50	0
Positive predictive value	92.00	70.00	44.00
Negative predictive value	72.22	72.22	100
Accuracy	86.76	70.59	58.82
Likelihood ratio	3.83		

joint. Recurrent effusions are common and, occasionally, a locking sensation is felt. Physical examination of the knee with a torn meniscus reveals joint line tenderness with a palpable click or snap. The range of motion may be limited secondary to displacement of a meniscal tear.

Several provocative tests have been described to elicit symptoms from a torn meniscus. The McMurray test is the most widely used. In the present study, the sensitivity was 70.59%, which is lower than 86.27% of KKU knee compression-rotation test sensitivity. Like the other recent studies, the McMurray test sensitivity rarely exceeds the level of 80%⁽¹¹⁻¹³⁾. Their diagnostic accuracy does not improve with the examiner's experience⁽¹⁴⁾ or anterior cruciate ligament conditions⁽¹⁵⁾, therefore, it seems to have limited value of McMurray test in current clinical practice. Thus, in order to improve diagnostic accuracy in meniscal tear detection, arthroscopy was initially proposed^(16,17). This procedure

has high cost, invasive, and subjects the patient to the risks of a surgical procedure. More recently, despite the substantial cost, magnetic resonance imaging (MRI) scans have been widely used as a screening tool for meniscal tears. On the basis of the high predictive value of negative findings on MRI studies, it has been suggested that MRI can be used with thorough clinical evaluation to exclude patients from unnecessary arthroscopy⁽¹⁸⁻²⁰⁾. Relying on MRI alone without using clinical judgment may lead to inappropriate treatment in a high percentage of cases (35.1%)⁽²¹⁾. A recent study, the Thessaly test⁽²²⁾, had a high rate of diagnostic accuracy (94-96%). This test must be done only in the standing posture of the patient, whereas in many circumstances of meniscal tear the patients have significant discomfort in their knees and they cannot stand or walk, that is the limitation of this clinical test. The authors developed the KKU knee compression-rotation test for detection of meniscal tear base on

both the principle of palpation to elicit clicks and the principle of pain with rotations, whereas this test can be done in patients who cannot stand or walk. The authors calculated and compared the diagnostic accuracy with the most widely used, McMurray test.

Conclusion

The authors found that this test has a higher diagnostic accuracy than the McMurray test. When examining the patient with both of the KKU knee compression-rotation and McMurray test, the sensitivity for detection of a torn meniscus is increased to 90.20%, so the authors concluded that the KKU knee compression-rotation test can be used for detection of meniscal tears. When combined with McMurray test, they also detect the meniscal tear more sensitively, and with the positive result of both tests, the probability of meniscal tear is 97.14%, when negative in both tests, the probability of intact meniscus is 70.59%. These results can be the first line of clinical screening for detection of meniscal tears and should help the surgeon be aware of the meniscal tears in the knee of the injured patient thus, give the right diagnosis and right surgical procedure.

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**การตรวจอัด-หมุนข้อเข่าแบบมหาวิทยาลัยขอนแก่นเพื่อการวินิจฉัยหมอนรองกระดูกข้อเข่า
ฉีกขาด: การศึกษาเปรียบเทียบความแม่นยำการวินิจฉัยกับการตรวจแมคเมอร์เรย์**

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วัตถุประสงค์: เพื่อศึกษาเปรียบเทียบความไว ความจำเพาะ และความแม่นยำในการวินิจฉัยหมอนรองกระดูกข้อเข่าฉีกขาดของการตรวจอัด-หมุนข้อเข่าแบบมหาวิทยาลัยขอนแก่นกับการตรวจแมคเมอร์เรย์

วัสดุและวิธีการ: ศึกษาในผู้ป่วยอายุตั้งแต่ 18 ถึง 39 ปี ทั้งหมด 68 ราย ที่ข้อเข่าได้รับบาดเจ็บ ผู้ป่วยทุกรายได้รับการสัมภาษณ์ประวัติ และตรวจร่างกาย ทั้งการตรวจอัด-หมุนข้อเข่าแบบมหาวิทยาลัยขอนแก่น และการตรวจแมคเมอร์เรย์ตั้งแต่แรกเริ่ม จากนั้นผู้ป่วยได้รับการตรวจ และผ่าตัดผ่านกล้องส่องข้อ นำผลการตรวจอัด-หมุนข้อเข่าแบบมหาวิทยาลัยขอนแก่น และการตรวจแมคเมอร์เรย์ เปรียบเทียบกับผลตรวจวินิจฉัยจากกล้องส่องข้อ คำนวณค่าความไว ความจำเพาะ และความแม่นยำในการวินิจฉัยหมอนรองกระดูกข้อเข่าฉีกขาดของการตรวจทั้งสองวิธีเปรียบเทียบกัน

ผลการศึกษา: การตรวจอัด-หมุนข้อเข่าแบบมหาวิทยาลัยขอนแก่น มีค่าความไว ความจำเพาะ และความแม่นยำในการวินิจฉัยหมอนรองกระดูกข้อเข่าฉีกขาดร้อยละ 86.27, 88.23 และ 86.76 ตามลำดับ ซึ่งดีกว่าการตรวจแมคเมอร์เรย์ ที่มีค่าความไว ความจำเพาะ และความแม่นยำร้อยละ 70.59, 82.35 และ 73.53 ทั้งการตรวจอัด-หมุนข้อเข่า แบบมหาวิทยาลัยขอนแก่น มีค่าผลบวกเท็จร้อยละ 11.76 และผลลบเท็จร้อยละ 13.73 น้อยกว่าการตรวจแมคเมอร์เรย์ ที่มีค่าผลบวกเท็จร้อยละ 17.65 และผลลบเท็จร้อยละ 29.41 หากทำการตรวจผู้ป่วยด้วยการตรวจทั้งสองวิธีรวมกันมีค่า ความไวในการวินิจฉัยหมอนรองกระดูกข้อเข่าฉีกขาดร้อยละ 90.20 รวมถึงถ้าผลการตรวจผู้ป่วยให้ผลบวกทั้งสองวิธี ผู้ป่วยมีโอกาสที่หมอนรองกระดูกฉีกขาดถึงร้อยละ 97.14

สรุป: การตรวจอัด-หมุนข้อเข่าแบบมหาวิทยาลัยขอนแก่น เป็นวิธีการตรวจใหม่ที่มีค่าความไว ความจำเพาะและความแม่นยำในการวินิจฉัยหมอนรองกระดูกข้อเข่าฉีกขาดที่ดีกว่าวิธีการตรวจแมคเมอร์เรย์ที่เป็นวิธีการตรวจที่นิยมตรวจแพร่หลายในปัจจุบัน การตรวจอัด-หมุนข้อเข่าแบบมหาวิทยาลัยขอนแก่นนี้สามารถใช้ในการตรวจกรองผู้ป่วยที่มีข้อเข่าบาดเจ็บในการวินิจฉัยหมอนรองกระดูกข้อเข่าฉีกขาดที่ดี อย่างไรก็ตามหากทำการตรวจร่วมกับการตรวจแมคเมอร์เรย์พบว่าค่าความไวของการตรวจกรองหมอนรองกระดูกข้อเข่าฉีกขาดดีมาก โดยเฉพาะอย่างยิ่งหากผลการตรวจเป็นบวกทั้งสองวิธีสามารถวินิจฉัยการฉีกขาดของหมอนรองกระดูกข้อเข่าผู้ป่วยได้อย่างแน่นอน