

Meniscal Lesions in the Anterior Cruciate Insufficient Knee: the Accuracy of Clinical Evaluation

Chathchai Pookarnjanamorakot MD*,
Thongchai Korsantirat MD**, Patarawan Woratanarat MD*

* Department of Orthopaedics, Faculty of Medicine, Ramathibodi Hospital, Mahidol University

** Department of Orthopaedics, Faculty of Medicine, Srinakharinwirot University

Objective : The purpose of this study was to find out the accuracy of certain symptoms and examination findings that are used to diagnose meniscal injury associated with a torn anterior cruciate ligament.

Study Design : Cross-sectional study.

Material and Method : The authors studied one hundred consecutive patients with anterior cruciate ligament insufficiency who were scheduled for surgery. During preoperative admission, one of the authors (KT) examined the patients and recorded the demographic data, duration of symptoms, and the clinical findings including Ballottement sign, joint line tenderness, Childress' sign, Merke's sign, Steinmann I sign, Mc Murray test, and Apley test. All patients underwent arthroscopically assisted anterior cruciate reconstruction by the senior author (PC). Specific meniscal procedures were performed according to the surgeon's preference at the time of surgery. Predictive results of preoperative examination tests for meniscal tears were compared with the findings at surgery and analyzed using arthroscopic findings as the gold standard.

Results : There were one hundred patients included in the present study. Out of 100 patients, 75% had meniscal tears and 6% had both meniscal and cartilage lesions. The most sensitive test was Childress' sign (68%), which also had the highest accuracy (66%). The most specific tests were Steinmann I sign and Apley test (100%).

Conclusion : Childress' sign was more accurate than other tests for detecting meniscal lesions in anterior cruciate insufficient knees. Steinmann I sign and Apley test had the highest specificity.

Keywords : Meniscus lesions, Anterior cruciate ligament, Childress' sign, Steinmann I test, Apley test

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The exact incidence of anterior cruciate ligament (ACL) injuries is unknown; however, it has been estimated that 100,000 are torn each year, and 50,000 anterior cruciate ligament reconstructions are performed each year in the United States⁽¹⁾. Conservative or operative intervention may be considered for patients with an ACL injury. Surgical indications include ACL injury combined with meniscus injury, patients who are active in sports and related activities, symptoms of giving way and a positive pivot shift test. Moreover, if an associated

meniscal injury is observed, operative treatment for ACL reconstruction and meniscal surgery is indicated to prevent early degeneration of the knee joint⁽²⁾.

In Irvine's study⁽³⁾, 86% of patients with ACL insufficiency had an associated meniscal injury compared with 58% in Binfield's study⁽⁴⁾. In the latter study, 30% of patients with ACL insufficiency had lateral meniscal tears, 21% had medial meniscus tears and 7% had both. Therefore, a patient with a torn ACL should be diagnosed early whether there is an associated meniscal injury or not, the reason being that the patient can be properly and promptly treated to prevent early degeneration of the knee joint.

Assessment of the menisci in an ACL deficient knee is difficult. From the patient's

Correspondence to : Pookarnjanamorakot C, Department of Orthopaedics, Faculty of Medicine, Ramathibodi Hospital, Rama 6 Rd, Phayathai, Bangkok 10400, Thailand. Phone: 0-2201-1589, Fax: 0-2201-1599, E-mail: racpk@mahidol.ac.th

description, the history of injuries, were vague or imprecise, and these injuries remained undefined. The clinical symptoms of this group came with the same presentation such as giving way or feeling unstable or different episodes of swelling. Several diagnostic methods^(5,6) have been described to diagnose meniscal injuries including joint line tenderness, Steinmann I sign, Apley test, McMurray test, Merke's sign, and Childress' sign (squat test). Most of these signs were used in the diagnosis of isolated meniscus injuries. In 1991, Boeree and Ackroyd⁽⁷⁾ reported a study specifically on the McMurray test and joint line tenderness in patients with a torn anterior cruciate ligament. They concluded that confidence in clinical diagnosis must be guarded, especially in evaluation of the menisci.

Based upon specific symptoms, clinical findings and examination test, it may be possible to more accurately diagnose meniscal tears in patients with ACL insufficiency. But If the surgeon can accurately diagnose meniscal tears by relying on medical history and physical examination without using other instruments such as MRI⁽⁸⁾ and diagnostic arthroscopy⁽⁹⁾, the potential benefits may include reduction of expenses, bed occupancy rate, and utilization of medical personnel as well as prevention of complications after application of arthroscopic diagnosis such as RSD, painful neuroma, paresthesia due to injury to infrapatellar nerve, and anesthetic use.

The purpose of this study was to find out the accuracy of certain symptoms and examination findings that are used to diagnose meniscal injury associated with a torn anterior cruciate ligament.

Material and Method

From January 2001 to October 2002, there were one hundred and fifty three Sports-clinic patients consulted for evaluation of knee ligament injuries. One of the authors (KT) examined the patients and recorded the demographic data (sex, age, height, weight, profession), cause of injury, duration of symptoms, and the clinical findings^(7,8) including Ballottement sign, joint line tenderness, Childress' sign, Merke's sign, Steinmann I sign, Mc Murray test, and Apley test. The inclusion criterion were ACL injury with symptoms of instability. The exclusion criteria were patients with contraindications for arthroscopy, or had been operated on that side of knee joint, and associated injuries to other ligaments.

One hundred patients were included in the present study. All patients underwent arthroscopically

assisted anterior cruciate ligament reconstruction with bone patellar tendon bone graft together with resection or repair if the meniscal injury was seen. The location of meniscal injuries, type of meniscus tears and evidence of cartilage injuries were recorded based on Newman's classification⁽¹⁰⁾. The symptoms and clinically findings were compared with arthroscopic results. Furthermore, all data were analyzed for sensitivity, specificity, negative predictive value, positive predictive value, and accuracy.

Examination method^(7, 8)

Apley test: The patient lies prone on the bed while bending the affected knee to 90-degree angle. The examiner holds the patient's thigh close to the bed with one hand while using the other hand to hold and twist the patient's foot in external and internal rotation while applying a compressive force on menisci. If the patient feels pain, meniscal pathology is assumed to be present.

Childress' sign (Squat test): The patient squats and walks like a duck. With a positive test, the patient will feel pain and cannot squat all the way down and will feel a snap or click from the knee joint.

McMurray test: The patient lies supine on the bed while bending the knee and hip. Keeping the heel close to the hip as much as possible, the examiner holds the knee joint with one hand by placing his index finger and thumb along the joint line, and then uses the other hand to hold and twist the foot in external rotation or internal rotation and stretch the knee. The patient will feel pain and hear a noise from the knee joint held by the examiner if the test is positive.

Steinmann I sign: The patient lies supine on the bed while bending his knee and hip. The examiner holds the knee joint with one hand by placing his index finger and thumb along the joint line, and then uses the other hand to hold and force rotation of the foot in external or internal rotation. The Steinmann I sign should be tested in various positions of knee flexion but not move the knee joint while rotating the foot. These actions cause pain along the joint line in a positive test.

Joint line tenderness: The patient lies supine on the bed while bending the knee and hip. The examiner grasps around the knee with one hand while pressing on the joint line with his/her thumb. The patient will feel pain along the joint line in a positive test.

Merke's sign: The patient stands on the affected leg, the one that will be examined, and turns the body left and right. The patient will feel pain along the joint line in a positive test.

To eliminate inter-observer variation, all examinations were performed by the same examiner (TK).

Statistical calculation

From the pilot study, the authors found the prevalence of meniscus injuries associated with ACL injury to be 0.74. Therefore, the number of subjects to be included was 83 patients. The authors used Mean \pm deviation for Continuous data and percentage for calculation of discrete data. The calculation of sensitivity value, specificity value, negative predictive value, positive predictive value, and accuracy value of symptom, clinically findings, and each examination method was compared with arthroscopic results.

Results

A total of 100 patients underwent operative treatment by arthroscopically assisted anterior cruciate ligament (ACL) reconstruction with bone patellar tendon bone (B-PT-B) graft. Of all 100 knees, the number of right and left knees totaled 31 and 49 respectively. The patients included 95 men and 5 women whose age averaged 27.9 years (range: 14-56). The period from the time of the accident until operative treatment averaged 22 months (range: 6-60). Furthermore, 75 patients (75%) had associated meniscal injury. Out of this total, 49 patients (65.5%) had medial meniscal injuries; 36 patients (48%) had lateral meniscal injuries; and 10 patients (13.3%) had

Table 1. Types of meniscal tear associated with torn anterior cruciate ligament

Types of meniscal tear	Medial (%)	Lateral (%)
Bucket handle tear	18 (24)	6 (8)
Horizontal tear	8 (10.7)	11 (14.7)
Complex tear	11 (4.7)	9 (12)
Flap tear	8 (10.7)	5 (6.7)
Vertical tear	2 (2.7)	3 (4)
Radial tear	2 (2.7)	2 (2.7)
Total	49 (65.5)	36 (48)

both. The most common meniscal lesion was a medial meniscal bucket handle tear (24% of tears) as shown in Table 1. Associated injuries to the articular cartilage were seen in 6 patients (6%).

Based on the study, Childress's sign had the highest sensitivity (68%) followed by Merke's sign (54.7%). Ballottement, Steinmann I sign, and Apley test all were 100% specific. Childress's sign had the highest accuracy value for pinpointing a meniscal tear (66%) followed by Merke's sign (62%) as shown in Table 2.

In cases where an associated meniscal tear was observed without an associated cartilaginous injury, Childress's test had the highest sensitivity for determining a meniscal tear (66.7%) followed by Merke's sign (55.1%). Steinmann I sign, ballottement and Apley test remained 100% specific. Childress' sign (61.0%) and Merke's sign (59.0%) again had the highest accuracy as shown in Table 3.

Discussion

Previous studies^(4, 11-19) have demonstrated the incidence of meniscal injuries associated with

Table 2. Symptoms and clinical findings observed in all patients with ACL injuries

Symptom	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy (%)
Swelling	36.0	88.0	90.0	31.4	49.0
Locking	24.0	92.0	90.0	28.8	41.0
Test					
McMurray test	28.0	92.0	91.3	29.9	44.0
Apley test	16.0	100.0	100.0	28.4	37.0
Steinmann I Sign	29.3	100.0	100.0	32.1	47.0
Childress' sign	68.0	60.0	83.6	39.5	66.0
Merke's Sign	54.7	84.0	91.1	38.2	62.0
Joint line tenderness	26.7	96.0	95.2	38.2	44.0

Table 3. Symptoms and clinical findings observed in the patients with ACL injuries (without associated cartilage injuries)

Symptom	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy (%)
Swelling	37.7	88.0	89.7	33.9	48.0
Locking	24.6	92.0	89.5	30.7	40.0
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Test					
McMurray test	29.0	92.0	90.9	31.9	43.0
Apley test	15.9	100.0	100.0	30.1	36.0
Steinmann I Sign	27.5	100.0	100.0	33.3	44.0
Childress' sign	66.7	60.0	82.1	40.5	61.0
Merke's Sign	55.1	84.0	90.5	40.4	59.0
Joint line tenderness	24.6	96.0	94.4	31.6	41.0
Ballottement	32.4	100.0	100.0	35.2	47.0

ACL tears range from 52%-83%. In addition, studies conducted by Bellabarba⁽¹¹⁾ and Cipolla⁽¹²⁾ revealed a higher incidence of lateral than medial meniscus tears in ACL injured patients during the acute period (within 6 weeks). In Duncan's study⁽¹³⁾, 83% of meniscal injuries were lateral meniscus while only 17% involved the medial meniscus. Nevertheless, if patients had not been treated for quite some time, higher incidence of medial meniscal injuries were observed^(14,15). The present study demonstrated 75% of ACL deficient knees having meniscal injuries, 48% and 65.5% occurring to the lateral and medial menisci, respectively. It is possible that the patients might have had different causes of injuries or received rather late treatment. That is why higher incidences of medial meniscal injuries likely were observed.

Patients with ACL injuries can undergo conservative or operative treatment. However, if a torn ACL is observed with associated meniscal injuries, there will be nothing to support and dissipate the load on the cartilage inside the knee joint, resulting in direct force on articular cartilage and become early degeneration of the knee joint⁽²⁾. Thompson⁽¹⁶⁾ observed that the incidence of ruptured medial menisci in patients with torn anterior cruciate ligament in an acute period (within 6 weeks after the accident) increased from 52% to 83% when the patients had chronic instability. In Hart's study⁽¹⁴⁾, the findings were also similar to those of Thompson. Hart discovered that the incidence of torn menisci in the acute period rose from 27% to 90% in chronic instability, indicating that if surgery is not performed to address the anterior cruciate ligament, there is a greater chance that both menisci would be torn. Keene⁽¹⁷⁾ conducted

a study and observed that a certain number of patients with torn menisci in the acute period could undergo surgery to repair the damage (80% and 24% of medial and lateral menisci could be repaired respectively). If meniscal injuries are not attended properly, tear conditions may become more complicated, rendering a surgery less effective in repairing the damage (46% and 14% of medial and lateral menisci could be repaired respectively). Therefore, patients with torn anterior cruciate ligaments should have associated meniscal injuries diagnosed early so that the patients can undergo operative treatment for anterior cruciate ligament reconstruction and concurrent repair surgery of meniscal periphery to alleviate pain and instability of the knee joint as well as to prevent additional tear of menisci and reduce the possibility of early degeneration of the knee joint.

The use of arthroscopy to diagnose meniscal injuries with associated anterior cruciate ligament injuries yields a high accuracy even though the posterior horn of medial menisci because torn anterior cruciate ligament opens up a big enough gap for a camera to peek inside. Therefore, the use of arthroscopy for diagnosis of meniscal injuries is still the gold standard.

Based on the present study, it was found that a single symptom or sign from the special tests (recurrent knee swelling, locked knee joint or positive joint line tenderness, Steinmann I Sign, Apley test, McMurray test) could not indicate whether or not the patients had associated meniscal injuries due to low sensitivity values. Nevertheless, Childress's sign and Merke's Sign tests are useful in examination and can indicate whether a patient also experiences

associated meniscal injury. Childress's sign achieved a sensitivity of 68% in predicting meniscal injuries while its specificity and accuracy were 60% and 66% respectively. Merke's sign sensitivity was 54.7% in predicting meniscal injuries while its specificity and accuracy was 83.6% and 62% respectively. When Childress's sign and Merke's sign were combined as a parallel test, sensitivity in predicting meniscal injuries rose to 89.3% while its specificity and accuracy was 75.0% and 82.0% respectively. These combined tests seem to be ideal clinical examination methods to diagnose meniscal injuries with concomitant ACL tear.

A patient with a torn ACL may have associated injuries to the cartilage with symptoms and clinical findings resembling those seen in patients with meniscal injuries, thus resulting in an inaccurate diagnosis. In the present study, every patient with a torn anterior cruciate ligament and associated injuries to articular cartilage showed associated meniscal injuries. In cases without associated cartilage injury, the sensitivity, specificity and accuracy of the combined tests were 90%, 75% and 77% respectively. The result altered slightly. This may be from the small number of patients in the associated articular cartilage group (6%). The injuries to articular cartilage may be associated with the initial knee joint injuries or due to lack of earlier treatment. Indelicato⁽¹⁵⁾ and Mitsou⁽¹⁸⁾ reported the incidence of articular surface lesions increased from 20-23% in acute cases to 54-78% in chronic cases.

The present study did not differentiate between predicting medial or lateral meniscal tears in ACL deficient knees when it was felt an associated meniscal lesion existed. Because whether medial or lateral meniscal tear exists, whenever tears are evident, operative treatment or repair of menisci should be performed. Boeree and Akroyd⁽⁷⁾ conducted a specific study on McMurray test (medial meniscus: sensitivity 29.3%, specificity 87.3% and accuracy 67.4%; lateral meniscus: sensitivity 25.0%, specificity 89.8% and accuracy 78.3%) and joint line tenderness (medial meniscus: sensitivity 63.8%, specificity 69.4% and accuracy 67.5%, lateral meniscus: sensitivity 27.8%, specificity 86.8% and accuracy 76.4%). The authors found similar sensitivity in this test but the accuracy was lower. Concerning results of joint line tenderness test in the present study, its lower sensitivity and accuracy value in examination were probably attributed to different patient groups and varied experience of the examiner.

It can be considered that diagnosis of meniscal injuries in an ACL deficient knee can rely solely on symptoms and clinically findings, which may be compared to arthroscopic diagnosis. For example, if results of the ballottement are positive and Steinmann I Sign or Apley test are observed, it can be concluded that that patient with ACL deficient knee definitely experiences associated meniscal injury whereby positive predictive value reaches 100% without requiring MRI or diagnostic arthroscopy. Moreover, in the case of ACL injury that did not require operative treatment, the surgeon should examine the patient thoroughly for concomitant meniscus injury. If the diagnosis is missed, the fate of the patient will end up with meniscectomy and degeneration of the knee.

Conclusion

From all the cases, 75% experienced associated meniscal injuries, comprising 48% lateral meniscal injuries as opposed to 65.5% medial meniscal injuries; 13.3% of the patients had both types of injury. The majority of cases were associated with bucket handle tears of the medial menisci. In cases, which had associated meniscal injuries without cartilaginous injuries, Childress's sign yielded the most accurate results for predicting meniscal injuries, registering a sensitivity of 68% and specificity of 66% respectively. Regarding observance of meniscal injuries, the combined examination, comprising Childress' sign and Merke's Sign, could be applied as a combined test for clinical examination that diagnosed meniscal injuries associated with torn anterior cruciate ligament. In conclusion, certain symptoms, clinical findings and specific examination tests can assist with the diagnosis of meniscal injuries in several patients with ACL tears without obtaining MRI examinations or undergoing diagnostic arthroscopy.

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การศึกษาความแม่นยำของอาการแสดง และการตรวจทางคลินิกเพื่อวินิจฉัยการบาดเจ็บของหมอนรองกระดูกข้อเข่าในผู้ป่วยที่มีการฉีกขาดของเส้นเอ็นไขว้หน้า

ชาติชาย ฎฎฎฎฎฎฎฎ, ธงชัย ก่อสันศิริรัตน์, ภัทรวิทย์ วรรณรัตน์

วัตถุประสงค์ : เพื่อหาความแม่นยำของอาการแสดง และการตรวจทางคลินิก ในการวินิจฉัยการบาดเจ็บของหมอนรองกระดูกข้อเข่าในผู้ป่วยที่มีการฉีกขาดของเส้นเอ็นไขว้หน้า

ระเบียบวิธี : cross sectional study

วิธีการ : ได้ทำการศึกษาในผู้ป่วย 100 รายที่ได้รับการวินิจฉัยว่ามีการฉีกขาดของเส้นเอ็นไขว้หน้า (Anterior cruciate ligament) และจะต้องทำการผ่าตัดรักษา บันทึกข้อมูลทั่วไปเกี่ยวกับสาเหตุการบาดเจ็บ, อาการ, อาการแสดง และผลการตรวจทางคลินิกเช่น ballotment, jointline tenderness, Apley test, McMurray test, Steinmann I sign, Childress' sign และ Merke's sign ทำการเปรียบเทียบกับผลการตรวจพบจากการผ่าตัด

ผลการศึกษา : ผู้ป่วยทั้งหมด 100 ราย มีอายุเฉลี่ย 27.9 ปี (14-56 ปี) มีการบาดเจ็บของหมอนรองกระดูกข้อเข่ารวมกับการฉีกขาดของเส้นเอ็นไขว้หน้า 75 ราย (75%) มี 6 ราย ที่พบการบาดเจ็บของกระดูกอ่อนผิวข้อร่วมด้วย พบว่าอาการแสดง childress ให้ความไวในการตรวจพบมากที่สุด (68%) และมีความแม่นยำในการวินิจฉัยมากที่สุด (66%) การตรวจที่ให้ความจำเพาะมากที่สุด (100%) คือ การตรวจ Steinmann I และ Apley

สรุป : อาการแสดงของ Childress เป็นวิธีการตรวจที่มีความแม่นยำที่สุด ในการตรวจหาการบาดเจ็บของหมอนรองกระดูกข้อเข่า ในผู้ป่วยที่มีการฉีกขาดของเส้นเอ็นไขว้หน้าร่วมด้วย
