

Case Report

Do scarring of the anterior cruciate ligament rupture to posterior cruciate ligament influences anterior drawer, lachman and pivot shift test results?

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ABSTRACT

ABSTRAK

Anterior drawer, Lachman and pivot shift tests are commonly used for assessing anterior cruciate ligament (ACL). Relying only on a single test may result in missed diagnosis because some ACL scarring pattern may provide some degree of anterior stability. We present a 20-year old male with complete ACL rupture but positive pivot shift test only, MRI shows total ACL rupture and confirmed during arthroscopic reconstruction with scarring to posterior cruciate ligament. Thorough physical examination may help raise suspicion to ACL remnant scarring pattern in order not to miss ACL rupture in arthroscopy.

Pemeriksaan anterior drawer, Lachman dan pivot shift umum dilakukan untuk memeriksa ligamentum cruciatum anterius (anterior cruciate ligament/ACL). Hanya mengandalkan salah satu pemeriksaan saja dapat menyebabkan terlewatnya diagnosis karena beberapa jenis jaringan parut ACL dapat memberikans tabilitas anterior. Kami membawakan kasus seorang laki-laki berumur 20 tahun dengan rupture komplrit ACL tetapi didapatkan hanya pemeriksaan pivot shift saja yang positif. MRI menunjukkan rupture komplrit ACL, kemudian dipastikan saat dilakukan rekonstruksi artroskopik dan ditemukan jaringan parut ACL menempel pada ligamentum cruciatum posterius (posterior cruciate ligament/PCL). Pemeriksaan fisik yang teliti dapat meningkatkan kecurigaan terhadap jaringanparut ACL, sehingga diagnosis rupture ACL tidak terlewatkan.

Keywords: anterior cruciate ligament, rupture, scarring pattern, physical examination, arthroscopy

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INTRODUCTION

Anterior cruciate ligament (ACL) is originated from the posteromedial aspect of lateral femoral condyle and inserted to the fossa located anterior and lateral to the medial tibial ridge. It consists of 2 bundles, anteromedial bundle (AMB) and posterolateral bundle (PLB), and functions as primary restraint to anterior tibial translation and major secondary restraint to tibial internal rotation.¹ ACL size has been reported to vary in size with length between 22 to 41 mm and midbody width between 7 to 12 mm.²

Several tests are available for diagnosing ACL rupture. Pivot shift is the most specific test (sensitivity 18-79%, specificity 81-98%), while Lachman is the most sensitive (sensitivity 81-89%, specificity 81-94%).³⁻⁶ Studies show that negative results may be caused by scarring of ACL remnant to posterior cruciate ligament (PCL), femoral notch or lateral femoral condyle.⁷ Relying on a single test only and unfamiliar with ACL scarring pattern during surgery may both result in misdiagnosis. The purpose of this study was to stress the importance of knowing ACL remnant scarring pattern and its significance to various ACL stability tests. Moreover, careful arthroscopic examination is crucial to identify ACL rupture and scarring pattern.

Case Report

A 20-year old male presented to our clinic with left knee instability after futsal injury 2 months before. He walked normally but felt unstable during exercise and running.

On physical examination, there were no deformity, effusion and tenderness. Range of motion was full. Pivot shift, Lachman and anterior drawer tests were performed and positive result was only found in pivot shift test (grade 1). Other tests for assessing knee instability were found negative and other physical examinations were unremarkable. Knee joint magnetic resonance imaging (MRI) showed near total ACL rupture with no other damaged structures.

Patient underwent arthroscopic examination. ACL was completely torn with empty wall sign (Figure 2B). ACL was found scarring the anterior aspect of the PCL (Figure 2C), tension was tight during probing and small loose attachment to the lateral wall of intercondylar notch was observed (Figure 2D). ACL remnant was resected and arthroscopic ACL reconstruction was done using

graft taken from gracilis and semitendinosus of the same side.

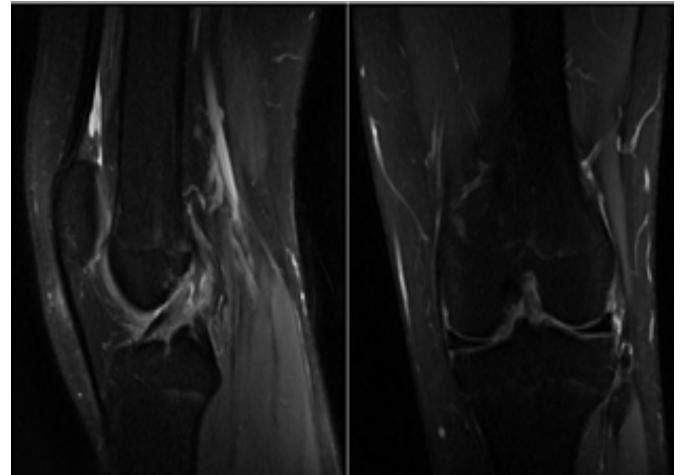


Figure 1. Knee joint MRI showing near total ACL rupture.

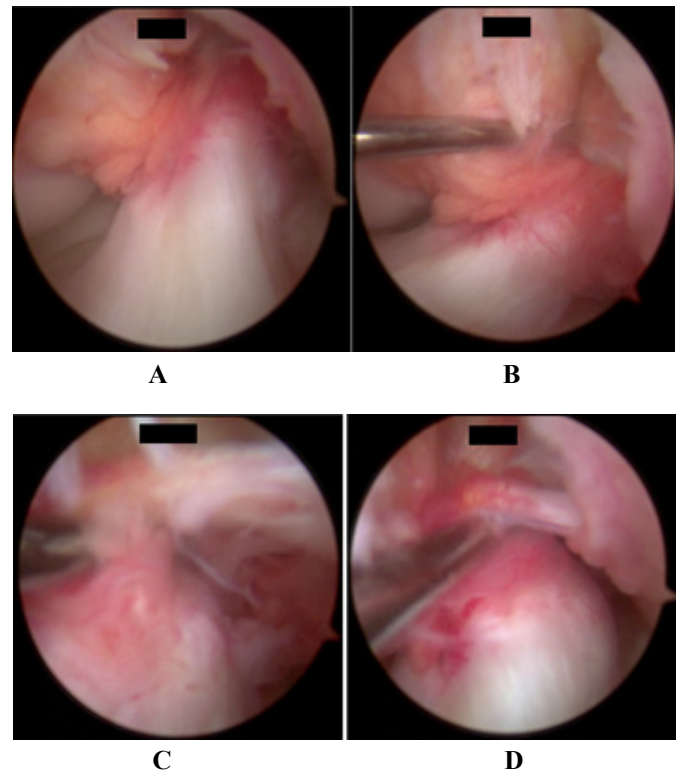


Figure 2. Arthroscopic findings of total ACL rupture with scarring to PCL. (A) ACL seems intact, (B) empty wall sign which means ACL rupture, (C) scarring to PCL, and (D) small loose attachment to the lateral wall of femoral intercondylar notch.

DISCUSSION

Diagnosing ACL rupture is often challenging and requires thorough physical examination to raise suspicion for further investigation. False negative test could be caused by pain or unrelaxed patient. As in our patient, a 20-

year old male complaining instability of left knee during exercise and running, we found negative Lachman and anterior drawer tests but positive pivot shift test. This negative test results may be caused by partial ACL rupture or ACL remnant scarring. Relying on a single ACL stability test only is not wise and has high chance of missed diagnosis. The most utilized ACL stability tests are anterior drawer test, Lachman test and pivot shift test.

To perform anterior drawer test, foot should be rested well on the examination table and knee flexed between 60° and 90°. Positive result is interpreted as increasing tibia's forward displacement with foot in neutral position. Based on the amount of displacement, severity is graded from 1 to 3: Grade 1 = 5 mm; Grade 2 = 5 to 10 mm; and Grade 3 > 1 cm.⁸ Positive anterior drawer test may rule in an ACL injury, but negative result may not be used to rule out an ACL injury.⁹ Anterior drawer test has 38-55% sensitivity and 88-92% specificity.³⁻⁶ Our patient had negative anterior drawer test, indicating maintained anterior stability possibly due to partial ACL rupture or ACL rupture with scarring.

Lachman test is performed with the examiner on the side of the involved extremity side and the patient lying in supine position. With knee held in 15° flexion, femur is stabilized single-handedly while attempting to translate the proximal tibia by applying firm pressure anteriorly. Positive result is interpreted as proprioceptive and/or visual anterior translation of tibia related to femur with a characteristic “mushy” or “soft” end point. “Hard” end point is found in intact ACL.¹⁰ Lachman test has the highest sensitivity according to several studies (range: 81-89%) with 81-94% specificity.³⁻⁶ Lachman test is recommended for both ruling in or out an ACL injury due to its high diagnostic value.⁹ Despite its high sensitivity and specificity, Lachman test alone cannot be used to rule out the possibility of partial ACL rupture or ACL rupture with scarring. As we found in our case that the patient had negative Lachman test, which indicates possibility of partial rupture or scarring.

Pivot shift test is done by subluxation and reduction of a loaded joint to test anterolateral rotary instability. Knee is positioned in 10° to 20° flexion, torque is placed on tibia while internally rotating it and applying valgus stress to knee joint. Positive result is represented as anterior subluxation of lateral tibial plateau underneath femoral condyle. Knee flexion to 40° tightens the iliotibial band, reducing the knee spontaneously.⁸ Severity is graded

from 1 to 3: Grade 1 = small and gentle sliding reduction; Grade 2 = definite clunk; and Grade 3 = abnormal movement with pronounced clunk.¹¹ Although pivot shift test has the lowest sensitivity (ranging from 18-79%), it has the highest specificity (81-98%).³⁻⁶ Positive result can be used to rule in ACL injury.⁹ In our case, our suspicion is confirmed with the help of positive pivot shift test which explains the instability experienced by the patient. Partial ACL tear of PLB or scarring pattern may result in positive pivot shift test.

Studies show that attachment of the ACL remnant to the femur of PCL may still provide some degree of anterior stability.^{7,12,13} Scarring patterns of ACL are categorized into 4 groups according to Crain, *et al.* in their study (Figure 1). The first group shows scarring to the PCL (Figure 1A), either to the anterior margin or wrapped around. Group 2 shows scarring to the roof of intercondylar femoral notch (Figure 1B). Group 3 shows attachment to the lateral wall of intercondylar femoral notch (Figure 1C). While the fourth group shows no identifiable attachment, no tissue at femoral origin (Figure 1D). The first three groups provide some degree of anterior movement constraint. The laxity increase after ACL remnant resection is as follows: average of 4.3 mm (0.63 to 7.9 mm) in group 3, average of 3.4 mm (1.33 to 5.5 mm) in group 2, average of 1.3 mm (0.49 to 2.1 mm) in group 1, and average of 0.2 mm (0.29 to 0.74 mm) in group 4. Attachment across the joint to the femur provides more effective stabilization in anterior translation of tibia.⁷

In agreement with a study by Takahashi, *et al.*, anterior stability is still maintained in Crain type 2 and 3, so do Crain type 1 but only in the group of age younger than 40 years old. However, anterior stability is less maintained in patient above 40 years old with Crain type 1.¹² Nagai, *et al.* also assessed rotational stability by performing pivot shift test manually and then measuring it using electromagnetic measurement system. Rotational stability was not preserved in any Crain type scarring patterns. The study showed anterior stability was preserved only in Crain type 2 and 3.¹³

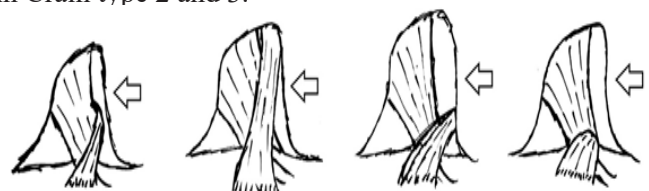


Figure 3. Crain type scarring patterns of ACL remnant. (a) type 1, (b) type 2, (c), type 3, and (d) type 4. Arrow shows the anatomical origin of ACL.

Findings of physical examination in our case showed that only pivot shift test, which has high specificity to rule in ACL rupture, gave positive result that this raised our suspicion and required further investigation through MRI. Knee joint MRI showed near total ACL rupture with no other damaged structures. Based on this, arthroscopic examination and ACL reconstruction were planned.

Distinguishing scarring patterns from normal ACL is very important during arthroscopy, since some ACL remnant scarring looks normal and may result in missed diagnosis. When in doubt, empty wall sign should come into mind. In this study, easily visible intercondylar wall and minimal evidence of ACL tissue are noted as positive empty wall signs.^{14,15} Additionally, probing is important to determine the tension and assess the attachment.¹⁵ If reconstruction is not planned, ACL scarring must be examined carefully and resection is not advised as it may decrease stability after resection. In our case, the ACL looked intact during arthroscopy, except for positive empty wall sign and scarring to PCL, which means total ACL rupture needed to be reconstructed. Attachment of ACL to PCL is thought to not provide anterior stability due to PCL's nature that loosen during anterior translation. But Takahashi, *et al.* found that scarring to PCL in patients younger than 40 years old still provided anterior stability,¹² which explains the negative result in Lachman and anterior drawer tests in this patient. Considering the age of the patient is younger than 40 years old, this finding is consistent with the study by Takahashi *et al.*¹². Pivot shift test was found positive in our patient, which is in agreement with Nagai *et al.*¹³.

Based on the above, all three tests to assess ACL function must be utilized to thoroughly examine patients in order to avoid missed diagnosis of ACL rupture due to the presence of ACL remnant scarring. On top of that, arthroscopic examination should be done thoroughly to assess the ACL, scarring pattern and tension.

CONCLUSION

Physical examination in diagnosing ACL rupture should be done thoroughly. Relying on a single physical examination method is not recommended. All three tests: anterior drawer, Lachman and pivot shift tests should be done in daily practice to avoid missed diagnosis of ACL rupture and suspicion of scarring presence. ACL scarring to femoral intercondylar notch or PCL may provide some degree of anterior stability. During arthroscopy, when ACL reconstruction is not planned, ACL remnant and

scarring must be carefully examined and resection is not advised as it may decrease stability after the resection and alter the previously preserved stability. Further studies should continue to evaluate the degree of stability provided by different ACL remnant scarring pattern in different population.

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