ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

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Sensitivity and Specificity of Anterior Cruciate Clinical Examination in Acute Setting Before and After Hemarthrosis Aspiration

Akut Hemartrozis Aspirasyonu Öncesi ve Sonrasında Anterior Cruciate Bağın Klinik İncelenmesinin Duyarlılık ve Özgünlüğü

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ABSTRACT Objective: To define the accuracy of the clinical test for assessing anterior cruciate ligament (ACL) tears on the acute setting before and after hemarthrosis aspiration. ACL is among the most commonly injured ligament of the knee in sports injuries.The most frequently used physical examinations to diagnose an ACL injury are the Lachman test, anterior drawer test, and pivot shift test. After acute complete ACL injury patients present to clinics with hemarthrosis in the knee joint. It was hypothesized that sensitivity and specificity of Lachman test, anterior drawer test, and pivot shift test increases after hemarthrosis aspiration. **Material and Methods:** 62 patients consulted due to twisting knee injury with hemarthrosis were enrolled in the study. Patients were examined by an emergency physician and a senior orthopedic consultant. All three tests were performed before and after hemarthrosis aspiration and sensitivity, and specificity of tests was recorded after MR imaging. Visual analog scala (VAS) scores for pain before and after aspiration were recorded. **Results:** Hemarthrosis aspiration significantly reduced VAS scores. Aspiration improved sensitivity of all three diagnostic tests but did not affect specificity Lachman test has best diagnostic accuracy to detect ACL rupture in acute conditions. **Conclusion:** Hemarthrosis aspiration improved the sensitivity of all three tests both for orthopedic consultants and emergency physicians but did not affect specificity.

Keywords: Lachman; pivot shift; anterior drawer; hemarthrosis, anterior cruciate ligament; injury

ÖZET Amaç: Akut hemartroz aspirasyonu öncesi ve sonrasında anterior cruciate ligaman (ACL) yırtıklarını değerlendirmek için yapılan klinik testin hassasiyetini tanımlamak. ACL, spor yaralanmalarında en sık rastlanan diz ligaman hasarıdır. ACL hasarının tanısında en fazla kullanılan fiziksel tetkikler Lachman testi, anterior bölme testi ve pivot şift testidir. Akut komplet ACL yaralanması olan hastalar kliniğe, diz ekleminde hemartrozis şikayeti ile başvururlar. Hemartrozis aspirasyonu sonrası Lachman, anterior bölme ve pivot şift testlerinin duyarlılık ve özgünlüğünün arttığı hipotez olarak ileri sürülebilir. **Gereç ve Yöntemler:** Hemartrozisli diz yaralanması (bükülme sonucu) olan 62 hasta çalışmaya alınmıştır. Hastalar önce acil doktoru, sonra uzman ortopedist hekim tarafından muayene edilmiştir. Aspirasyon öncesi ve sonrasında her 3 test yapılmıştır. MR görüntüleme sonrası bu testlerin etkinliği kaydedilmiştir. Ağrı değerlendirmesi için aspirasyon öncesi ve sonrası VAS skorları kaydedilmiştir. **Bulgular:** Hemartrozis aspirasyonu VAS skorlarını önemli ölçüde azaltmıştır. Aspirasyon her 3 tanı testinin de hassasiyetini arttırdı fakat Lachman testinin özgünlüğünü etkilemedi; Akut ACL yaralanmalarında bu test tanısal değerini korumuştur. **Sonuç:** Hemartrozis aspirasyonu ortopedist ve acil doktorları için her 3 testin duyarlılığını arttırmış fakat özgünlüğü etkilememiştir.

Anahtar Kelimeler: Lachman; pivot şift; anterior bölme; hemartrozis, anterior cruciate ligaman; hasar

Complete anterior cruciate ligament (ACL) rupture is a frequent sports trauma. Three commonly applied physical examinations to diagnose ACL injury are Lachman test, anterior drawer test and pivot shift test.[1,2,12,13,14] Meta-analysis of previous studies showed that these tests have variable sensitivity and specificity especially in acute injuries.[3,4] Unreliable and inaccurate clinical examination makes clinician uncertain of the diagnosis and compel to make unnecessary, expensive MRI imaging or misdiagnose an ACL tear.

A study by Perera et al. stated that there has been at best only minor improvement in the diagnostic rate and delays, certainly of acute ACL injury, since a study in 1996. The overall clinical diagnostic rate remains disconcertingly low as does the delay to consulting a soft-tissue knee specialist.[9,10]

Patients with acute ACL injury from sports trauma always have some amount of hemarthrosis. Hemarthrosis tensions the joint capsule more as knee flexion increases and the patient becomes more uncomfortable. Three classic diagnostic tests to diagnose an ACL injury forces knee to flexion or performed in flexion. Even in some circumstances, patients do not allow the clinician to do these tests because of pain.

We evaluated the effect of hemarthrosis aspiration on the sensitivity and specificity of Lachman, pivot shift and anterior drawer tests in acute ACL tears.

MATERIAL AND METHODS

62 patients who referred to emergency service with twisting knee trauma enrolled in the study. All patients in the study later referred to radiology for MR imaging to confirm diagnosis. After patients full conset was recieved they were first examined by an emergency physician becouse in our medical centre patients firstly evaluate by emergency service physicians. Lachman, pivot shift and anterior drawer tests were performed and then consulted to orthopedic surgeon as suspected ACL injury. After orthopedic consultant examination, hemarthrosis aspirated and with patient permission Lachman, pivot shift and anterior drawer tests were repeated by both emergency physician and orthopedic consultant. VAS scores for pain before and after aspiration were recorded. Patients were asked to choose which diagnostic test was most painful and uncomfortable before and after aspiration. Data were collected for later evaluation.

For the anterior drawer test, the patient's knee is flexed to 90 degrees, and the hip is flexed to 45 degrees. The patient's foot is held on the table by the examiner's body with the examiner sitting on the patient's forefoot and the foot in neutral rotation. The examiner's hands are placed around the tibia to ensure that the hamstring muscles are relaxed. The tibia is then drawn forward on the femur. The normal amount of movement that should be present is approximately 6mm according to the International Knee Documentation Committee (IKDC 2000).[5]

The pivot shift test is performed with the patient supine. Hip is flexed at 20 to 30 degrees, knee is extended while maintaining a valgus stress at the knee and in some cases an anterior force on the fibula head and the proximal aspect of tibia while flexing knee and in first 10 to 20 degrees of flexion the tibia will sublux posteriorly caused by the iliotibial tract indicates a positive pivot shift test.[6] The IKDC 2000 knee examination form grades the pivot shift test as equal, glide (+), clunk (++), or gross (+++).[5]

The Lachman test is performed with the patient lying supine and with the involved extremity on the side of the examiner. The examiner holds the patient's knee between full extension and 30 degrees of flexion. The patient's femur is stabilized with one of the examiner's hands while the proximal aspect of the tibia is moved forward with the other hand. Increased anterior tibial translation with a soft end point more than 5 mm compared to the other side constitutes a positive test, indicating disruption of the ACL. As described by the IKDC 2000.[5]

RESULTS

38 of 62 patients diagnosed with ACL rupture after MR imaging.

Specificity of tests before and after hemarthrosis aspiration did not differ. The sensitivity of tests improved after hemarthrosis aspiration both for emergency physician and ortho consultant (Table 1 and 2). Paired t-test showed a significant decrease in VAS score after aspiration of hemarthrosis ($P < 0.0001$) (Table 3). Patients selected anterior drawer test as the most discomforting test before hemarthrosis aspiration. Among 62 patients 8 selected Lachman test (12.9%), 22 selected pivot shift test (35.4%) and 32 selected anterior drawer test (51.6%).

Patients selected pivot shift test as most discomforting test after hemarthrosis aspiration. Among 62 patients 6 selected Lachman test (9.6%), 42 selected pivot shift test (67.7%) and 32 selected anterior drawer test (22.5%).

DISCUSSION

Our study showed that Lachman test has the best diagnostic accuracy to detect ACL rupture in acute conditions. The test is performed between 20 to 30 degrees of flexion, so it is less painful than anterior drawer test. Also, no valgus stress is applied like pivot shift test which can cause pain when ligamentous injury present. Moreover, the secondary restraints do not contribute much to stability in this test position.[7] Disadvantage of the test is, it is hard to perform appropriately to male patients with high body mass index due to large thigh girth.

Pivot shift test is a complicated maneuver, and there is a learning curve to perform this test properly. Studies showed that sensitivity of this test might increase with experience.[8] Also, this test needs to be performed to an ACL intact knee. An ACL deficient knee may produce false negative results for this test. Our experience showed that orthopedic residents could perform this test more efficiently after several trials on anesthetized patients. This study also showed us that patients are very uncomfortable when they feel the tibial subluxation posteriorly and begin to resist this maneuver. İn our

TABLE 1: Sensivity and specifity of diagnostic tests before and after aspiraton.

Emergency Physician	TP	FP	FN	TN	Sensivity [95% CI] before aspiration	Specifity [95% CI] before aspiration	Sensivity [95% CI] after aspiration	Specifity [95% CI] after aspiration
Lachman Test	14	4	24	20	0.36 [0.22, 0.54]	0.83 [0.61, 0.94]	0.44 [0.2, 0.61]	0.81 [0.7, 0.98]
before after	17	2	21	22				
Pivot shift Test	8	2	30	22	0.21 [0.10, 0.37]	0.91 [0.71, 0.98]	0.31 [0.1, 0.48]	0.91 [0.7, 0.98]
before after	12	2	26	22				
Anterior drawer	10	6	28	18	0.26 [0.13, 0.43]	0.75 [0.52, 0.89]	0.36 [0.2, 0.54]	0.83 [0.6, 0.94]
before Test after	14	4	24	20				

Abbrevations: TP: true positive; **FP:** false positive; **FN:** false negative; **TN:** true negative; **CI:** confidence interval.

TABLE 2: Sensivity and specifity of diagnostic tests before and after aspiraton.

Ortho Consultant	TP	FP	FN	TN	Sensivity [95% CI] before aspiration	Specifity [95% CI] before aspiration	Sensivity [95% CI] after aspiration	Specifity [95% CI] after aspiration
Lachman Test	22	1	16	23	0.57 [0.40, 0.73]	0.95 [0.76, 0.99]	0.68 [0.5, 0.81]	0.91 [0.7, 0.98]
before after	26	2	12	22				
Pivot shift Test	16	1	22	23	0.42 [0.26, 0.59]	0.95 [0.76, 0.99]	0.55[0.3,0.71]	0.91[0.7,0.98]
before after	21	2	17	22				
Anterior drawer	12	4	26	20	0.31 [0.18, 0.48]	0.83 [0.61, 0.94]	0.47 [0.3,0.63]	0.87[0.66,0.96]
before Test after	18	3	20	21				

Abbrevations: TP: true positive; **FP:** false positive; **FN:** false negative; **TN:** true negative; **CI:** confidence interval.

TABLE 3: VAS scores before and after aspiration.

Parameter	VAS score before	VAS score after
Mean	8.11	5.98
Std deviation	1.34	1.18
Minimum	6	3
Maximum	93	35
Median	8	6
Lower 95% CI	7.83	5.56
Upper 95% CI	8.52	6.28

Abbrevations: **C:** confidence nterval.

study, the sensitivity of this test was extremely low when it is performed by emergency physicians.

Anterior drawer test is known to show low sensitivity in an acute setting. There is three noted possible low sensitivity for this test.First hemarthrosis that prevents knee flexion to 90 degrees. Second, resistant muscle action of the hamstrings secondary to joint pain produces a vector force opposite to the anterior translation of the tibia. Third, the posterior horn of the medial meniscus becomes buttressed against the posterior margin of the medial femoral condyle and may prevent anterior translation of the tibia.[11,12,14] Present study also showed that aspiration of hemarthrosis increases the sensitivity of anterior drawer test on the acute setting. Patients selected anterior drawer test as most painful and discomforting before hemarthrosis aspiration and pivot shift test after aspiration. Aspiration decreased VAS score and improve knee flexion.

CONCLUSION

Hemarthrosis aspiration improved the sensitivity of all three tests both for orthopedic consultants and emergency physicians but did not affect specificity. Aspiration of knee joint significantly reduced pain and VAS scores in patients and allowed doctors to perform diagnostic tests more accurately. Lachman test has the best diagnostic accuracy to detect ACL rupture in acute conditions. In suspected ACL injury it is recommended to perform diagnostic tests after hemarthrosis aspiration.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

All authors contributed equally while this study preparing.

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