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How often do we Visualize Knee Anterolateral ligament and Its Injury on 1.5-T Standard MRI?

Castelli A, Zanon G and Benazzo F*

Clinical Ortopedica e Traumatologica, Università Degli Studi di Pavia - Fondazione IRCCS Policlinico San Matteo, Italy

Abstract

The residual rotatory instability after ACL reconstruction surgery is still a matter of concern among surgeons, although ACL reconstruction provides satisfactory clinical results. Different degrees of ACL tear combined with damage to other intra- and extra-articular structures of the knee result in different patho-laxities. In the last years, the anterolateral compartment of the knee and its ligamentous structures, like anterolateral ligament (ALL), have been advocated as one of the most important restrains for rotational instability. This kind of knee instability is well displayed with the pivot-shift test that correlates with patient's clinical outcomes after ACL reconstruction. In this study we evaluated a population of 65 patients, who sustained ACL tears and underwent ACL reconstruction surgery. We revised their standard 1.5-T knee MRI before surgery and we tried to display the ALL structure and to highlight its tears.

Introduction

Anterior cruciate ligament (ACL) tears are among the most common knee injuries and ACL reconstruction has evolved considerably over the past 30 years. Although ACL reconstructions provide satisfactory clinical results nowadays, regardless of the type of graft or the surgical technique used (out-in vs. in-out or single- vs. double-bundle), the residual rotatory instability is still a matter of concern among surgeons. Different degrees of ACL tear combined with damage to other intra- and extra-articular structures of the knee result in different patho-laxities [1-3]. A detailed understanding of which structures of the knee joint act as secondary restraints to the ACL and how their lesions correlate to clinical tests is necessary to formulate the proper diagnosis.

The anatomy of the lateral knee has been widely studied, but the relationship between these structures and their respective functions, especially during active motion of the knee, have not been completely clarified[4,5].

Recent studies showed ACL reconstruction is often successful in repairing anterior stability, while rotational instability often persists over time [6-14].

The lack of rotational control was thought to contribute to secondary meniscal or cartilaginous problems and this led surgeons to reconsider the ACL anatomy and biomechanics.

The pivot shift test is the most specific test for knee rotational instability and it is the only physical examination test that correlates with the subjective feeling of instability[15].

The neo-ACL failure rate within 5 years after surgery is about 7% (6% in the first 3 years) and it grows up until 17% in the 15 years after surgery. Counter-lateral ACL injury after ACL reconstruction is about 9% after 5 years (6% in the first 3 years) and about 26% 15 years after surgery. Comprehensive ACL injury rate within 5 years after surgery is among 16% (13% after 3 years) and 32% after 15 years. Patient anthropometric criteria, kind of graft (hamstrings or bone-patellar tendon-bone) and femoral or tibial fixation technique did not affect re-injury rate and functional outcomes in current literature. On the other hand, unrepaired secondary stabilizers have been outlined as a reason for reconstruction failure[16]. These data could suggest that knee bio-mechanic and proprioceptive disorders persist after ACL reconstruction surgery and these disorders may occur in meniscal tears, cartilage lesions and neo-ACL re-rupture. New insights into the existence and function of a ligamentous structure on the anterolateral aspect of the knee, the anterolateral ligament (ALL), have refocused attention on the restraints of the rotational laxity of the knee after ACL injury.

The aims of this study are to assess in our study group the prevalence of recognizable ALL on

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Correspondence:
Castelli A, Clinical Ortopedica e Traumatologica, Università Degli Studi di Pavia - Fondazione IRCCS Policlinico San Matteo, Italy,
E-mail: albecastell@libero.it

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standard knee 1,5-Tesla MRI preoperative imaging and to assess the prevalence of ALL lesion associated with ACL lesion.

Materials and Methods

In our clinic 266 patients underwent ACL reconstruction from January 2012 to January 2014. Our retrospective analysis included the 65 patients who provided complete preoperative MRI imaging documentation. In 62 out of 65 patients we could recognize the ALL structure. Exclusion criteria were inveterate ACL lesion (more that 8 months before surgery), other associated ligament lesions, associated fractures, associated systemic diseases, patient age under 15 years old and over 50 years old, associated knee osteoarthritis or cartilage lesion grade III or superior with Outerbridge classification recognizable on MRI images.

Fifty-three out of 62 patients were male (85%) and 9 were female (15%). Mean patient's age was 29,2 years old (range 15-50). The injured knee's side was right in 38 patients (61%) and left in 24 (39%). All patients were not professional sportive and played different kind of sports including pivoting and twisting knee movements. The mean time from injury to surgery was 6 months (range 4-8). All knee surgeries were performed by two senior knee and sport medicine surgeons with the assistance of resident doctors. We reviewed the MRI 1,5-Tesla performed before surgery for all patients. MRI exams came from different radiological services but all were performed with a 1,5-Tesla MRI machine with standard setting to evaluate ACL and menisci with at least one coronal T2-weighted scan with fat-suppression or a PD scan.

Results

The first aim is to assesses the prevalence of displayed/visualized ALL in the preoperative MRI imaging. In 3 (4,6%) out of 65 patients, ALL was not visualized in any MRI scans. In 62 (95,4%) patients ALL was visualized.

In 20 out of 62 patients (32%) ALL was intact, in remaining 42 (68%) patients a well displayed ALL lesion was evident. ALL lesion was localized at the femoral side in 21 (50%) patients, at medium third of the ligament (meniscal side) in 13 (31%) patients, while in 8 (19%) patients it occurred at the distal tibial side in the absence of Segond fracture.

Discussion

1) The first aim of our study was to assesses the prevalence of displayed/visualized ALL in the preoperative MRI imaging. The exams were carried out with different 1,5 Tesla MRI devices, with standard sequence setting for ACL with al least coronal T2 weighted fat-suppression sequences or PD sequences. In 3 (4,6%) out of 65 patients, ALL was not visualized in any sequence. In 62 (95,4%) patients ALL was visualized. The date is in line with the recent literature.In a case series using 1.5-T MRI Helito et al. [18] demonstrated the possibility to visualize the ALL in routine imaging. Partial visualization was possible in 97.8% of cases. The meniscal portion was the easiest to identify (94.8%), followed by the femoral (89.7%) and the tibial (79.4%) portions. Visualization of the thin structure resembling the ALL was most easily achieved in coronal T2-weighed or PD planes[17,18]. These findings were, in large parts, consistent with those of Taneja et al. [19]. LaPrade et al. [20] were able to identify the MLCL (later ALL) with a sensitivity of 93.8% and specificity of 100% in T1-weighed 1.5 T MRI planes. Kosy et al. were able to identify the ALL partially in 94.0% and fully in 57.0% of cases reviewing 1.5-T MRI planes of patients without a known history of ACL ruptures or lateral compartment injuries. Anyway the anatomical studies report an higher rate of ALL identification close to 100% of speciments, from 83% to 100%[21-25].

MRI studies instead show a lower rate of ALL identification. This difference could be due to different causes. Firstly all patients included in our study had sustained a knee injury and had a different degree of joint swelling or hemarthro at the moment of the MRI. The higher pressure in knee joint makes easier ALL identification. On the other hand different MRI studies in literature are carried out on uninjured knee. Moreover the images in coronal planes are suitable for ALL description but the study of the coronal planes is demanding for topographic identification of ALL[26].

Surely a 3-Tesla MRI machine and a MRI study planes tailored on ALL, will improve the ALL identification rate[27].

2) The second aim of our study was to assess the prevalence of ALL lesions associated with ACL lesion in our study group on the preoperative MRI imaging. In 42 (68%) patients a well displayed ALL lesion was evident. ALL lesionswere localized at the femoral side in 21 (50%) patients, in 13 (31%) patients ALL lesions occurred at medium third of the ligament, and in 8 (19%) patients it occurred at the distal tibial side.

Claes et al. [28]showed an ALL lesion rate of 78,8% in a retrospective study carried out on preoperative MRI images of patients who underwent ACL reconstruction. Claes highlighted that ALL lesion occurred at the tibial side in 77,8% of cases. In our study only 50% of ALL lesions occurred at the meniscal and tibial side and the other 50% involved the femoral side of the ligament. Helito highlighted in a bio-mechanical study the ALL rupture pattern and obtained more femoral side than tibial side ALL ruptures with a maximum strength of 204,8 N[29].Kennedy shows a higher incidence of Segond fracture in his cadaveric biomechanical study with a mean maximum load similar to other studies (175 N)[30].

Further biomechanical studies are required to understand the pathogenesis of ALL rupture due to uncover the lesion's patterns.

Limits of the Study

This study has some limits. Firstly it is a retrospective study. For this reason we could not assess clinically the knee rotational instability before surgery. For the same reason we collected MRI scans from different radiologists by using different machines, and this could affects some results.

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