Dynamic ultrasonography in the diagnosis of acute anterior cruciate ligament injury – a case report

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Abstract
In the reported case of acute grade 3 anterior cruciate ligament injury, clinical examination and magnetic resonance imaging findings were in conflict, leading to confusion. Ultimately, dynamic ultrasound imaging proved to be the decisive test. The article describes the steps taken to reach the diagnosis. In addition, possible future diagnostic improvements are discussed. Dynamic ultrasound imaging, performed as part of the physical examination, is a valuable supplement to medical documentation. It provides appreciable diagnostic performance for the detection of anterior cruciate ligament insufficiency. Physical examination combined with magnetic resonance imaging, even though they represent the current diagnostic standard, have their limitations.

Introduction
In cases of acute anterior cruciate ligament (ACL) injury, standard diagnostic methods have their limitations. When findings vary, or worse, are contradictory, a clinical problem arises, and decisions about necessary operative treatment might be compromised.

The estimated sensitivity (SE) and specificity (SP) levels of physical examination (PE) and diagnostic tests are as follows: Lachman test 87.1%, 97%; pivot-shift test 49%, 97.5%; anterior drawer test 72.5%, 92.7%; magnetic resonance imaging (MRI) 87%, 90%[1]. Arthroscopy remains the reference standard.

In the reported case of acute grade 3 ACL injury, clinical examination and MRI failed to provide a clear basis for determining the patient’s treatment, and the decisive test proved to be dynamic ultrasound (US) imaging.

Case report
A 32-year-old male wrestling athlete presented to the clinic with acute complaints including right knee pain resulting from a traumatic valgus force with a “pop” sensation that occurred the night before. There was no previous medical history. The patient was ambulating on a slightly bent knee with full-weight-bearing gait. Clinical examination revealed an active range of motion from 10 to 90°, 2 cm of swelling measured at the joint line, and a negative Lachman test. Pain in the knee was too severe to perform the anterior drawer or pivot shift tests. An MRI scan was ordered and performed.

The patient appeared for the follow-up visit on the 11th day after the injury. He reported a decrease in pain and a symptom of “giving way” with weight bearing. The results of the MRI examination stated “ACL in continuity with increased signal strength.” (Fig. 1).

The patient’s clinical examination revealed an active range of motion from 10 to 100° with passive full extension, 1 cm of swelling measured at the joint line, and a positive Lachman test. Increased muscle defense made it impossible to conduct the anterior drawer and pivot shift tests properly.

Dynamic US examination was performed (Fig. 2). Side-to-side asymmetry was visualized with anterior tibial translation on the affected side. Additionally, the so-called “soft endpoint” sign was elicited[3,4].

Anterior instability was confirmed, and the patient was referred for surgical treatment. Later, a second radiologist was requested to provide an MRI description, stating grade 3 anterior cruciate ligament injury.
The surgery took place on the 24th day after the injury. Clinical tests were conducted with anesthesia. A positive anterior drawer test (Fig. 3) and positive Lachman and pivot shift tests were obtained. Arthroscopic findings confirmed ACL tearing (Fig. 4).

Discussion

In this case, the orthopedic surgeon found himself in a problematic situation. During the second visit, the PE and the patient’s history were consistent with anterior knee instability. This condition, in a young, active person routinely engaging in sports, is an indication for surgery. At the same time, however, a radiology specialist left no room for interpretation, stating that the patient’s ACL had a continuity. Luckily, dynamic US could be performed during the patient’s visit. It showed clear symptoms of anterior instability, providing a basis for surgical treatment.

In doubtful cases, dynamic US has a double value. Firstly, it can be easily archived. Secondly, measurements of the...
experience-related. Improvements in imaging technology including sequences, specific knee coils, scanning technique as well as the radiologist’s familiarity with MRI over time will result in even greater accuracy. One of such improvements seems to be using oblique-sagittal MRI in addition to the orthogonal MRI protocol. Also, flexion imaging of the ACL is useful to distinguish between a high-grade tear and complete tear. There is no good evidence that higher magnetic field intensity results in better diagnostic accuracy. Some future advancement may be also possible due to Machine-Learning-Assisted Detection. Weight-bearing and dynamic MRI are potentially useful options as well.

Dynamic US imaging seems to be a valuable imaging point-of-care test. Unlike the PE, it can be easily archived, and reevaluated, if needed. It is characterized by good accessibility and low cost, and allows dynamic testing with quantitative measurements and real-time comparison between the traumatic and nontraumatic sites. Dynamic examination seems to have an advantage in the diagnosis of ACL insufficiency over MRI.

Dynamic US imaging for ACL tears has SE of 88%, and SP of over 82%. However, further research is required to establish the most accurate signs, preferably based on quantitative measurements.

Also, new alternative diagnostic tools arise, such as needle arthroscopy.

Conclusions

Physical examination with MRI is the current standard in the diagnostic work-up of acute ACL tears. There is limited room for further improvements of SE and SP levels in PE. Advancements in technology and clinical techniques will undoubtedly change the way MRI is used in the future.
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For the time being, dynamic US performed as part of the physical examination is accessible, inexpensive and non-invasive, and offers a valuable supplement to medical documentation.

In conclusion, DU is able to provide appreciable diagnostic performance for the detection of ACL injury, ensuring high SE and SP levels.

Conflict of interest
The author does not report any financial or personal connections with other persons or organizations which might negatively affect the contents of this publication and/or claim authorship rights to this publication.

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