Ortopedia Traumatologia Rehabilitacja
© MEDSPORTPRESS, 2020; 6(6); Vol. 22, 421-425
DOI: 10.5604/01.3001.0014.6047

MRI Assessment of Anterolateral Ligament Injury of Knee Joint

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SUMMARY

Background. Clinical diagnosis of the anterolateral ligament (ALL) insufficiency is rather complicated. Accordingly, it is necessary to use MRI for accurate diagnosis in patients with complex anterolateral instability of knee joint. The purpose of our work was to determine the possibilities of MRI in the diagnosis of anterolateral ligament lesions.

Materials and methods. A retrospective analysis of 224 MRI studies of patients with ACL injuries was performed. 107 studies were performed on a 3.0 Tesla device and 117 studies were performed on a 1.5 Tesla device.

Results. In 29 cases (13%), it was impossible to visualize ALL on MRI, so these patients were excluded from the study, while 195 patients (87%) remained in the study. 128 (65.6%) of the 195 remaining patients did not show signs of ALL rupture, while 67 patients (34.4%) had sings of rupture. In the group with ALL lesions, the femoral part was injured in 50.7% (34 patients), the tibial part in 19.4% (13 patients), and the middle part in 29.9% (20 patients).

Conclusions. 1. In our study, we determined that the ALL was visualized in 87% of patients with ACL injury. 2. In our patients' group, the frequency of a concomitant ALL lesion together with an ACL lesion was 34.4%, when an MRI study was performed up to 6 weeks from the moment of trauma.

Key words: anterolateral ligament, knee joint, magnetic resonance imaging

BACKGROUND

Nowadays, it is known that the anterior cruciate ligament (ACL) is a stabilizer for internal rotation, but, in situations where it is injured, the anterolateral ligament (ALL) is the primary stabilizer for knee internal rotation [1,2].

Clinical diagnosis of ALL injuries is difficult enough, since the pivot shift test is a complex maneuver, and the subjectivity of its assessment can affect the results of the examination [3,4]. That is why, in cases of complex knee anterolateral instability, clinical diagnosis should be supplemented by MRI analysis. However, if MRI diagnosis of ACL pathology is clear, there is an ongoing discussion with contradictory data concerning the identification of ALL on MRI.

There are a large number of works concerned with the visualization of ALL in the intact knee joint. Caterine et al. examined 10 cadaveric knee joints and identified ALL in 100% of cases [5]. Using a 1.5T MRI machine, Helito identified ALL in the coronal and axial planes in 97% of cases [6]. On the other hand, Taneja concluded that this ligamentous structure can be visualized only in 51% of cases [7]. As we can see, the frequency of visualization of the ALL in the intact knee joint varies greatly from 51% to 100% of cases.

Similar attempts to determine the presence and pattern of ALL injury have also led to contradictory results. The ability to diagnose rupture of this structure varies from 76% in the Claes study of 351 patients [8] to 100% in 50 patients in Wodicka's work [9]. Regarding determination of the type of ALL injury, some authors say that it is impossible to classify the rupture pattern according to MRI data [10,11], while other authors talk about a clear definition of ALL rupture pattern depending on its location (proximal, median and distal) [12]. In another work, the authors generally question the diagnostic capability of MRI, since in their study they obtained data according to which the frequency of ALL lesions varies from 26% to 62% [13]. When analyzing the literature, it can be concluded that the diagnostic capability of MRI for identifying ALL is quite high and reaches 100% in some studies. However, when trying to determine whether this structure is injured or not in patients with anterolateral instability, radiologists disagree.

The aim of this study was to determine the possibilities of using MRI in the diagnosis of knee anterolateral ligament lesions.

MATERIALS AND METHODS

The study was approved by the Local Institutional Bioethical Committee. Informed consent was obtained from all patients who were included the study. A retrospective MRI analysis was conducted of 224 patients with ACL injury in the period from 2015 to 2017. Among the patients there were 137 men and 87 women with the average age of 33.5 ± 10.4 years, 115 right knees, 109 left knees. 107 patients were examined on a 3.0 Tesla MRI device (Phillips Achieva MultiTransmit, Achieva, Philips Medical Systems, Netherlands), and 117 MRI studies were done on a 1.5 Tesla device (Phillips Achieva, Achieva, Philips Medical Systems, Netherlands).

The MRI examination protocol included the following sequences: coronal T1, sagittal, axial and coronal T2 with fat and sagittal suppression proton density-weighted. The criteria for inclusion in our study were: 1) arthroscopically confirmed ACL injury; 2) no more than 6 weeks had passed between the time of injury and the time of the MRI examination. The study did not include patients with concomitant injuries to the posterior cruciate ligament, structures of the posterolateral corner or the medial collateral ligament.

For the analysis of the MR images, the ALL was divided into three anatomical parts: femoral (from the place of attachment to the femoral epicondyle to the place of its bifurcation), median (from the bifurcation to the point of contact with the lateral meniscus) and tibial (from the lateral meniscus to the point of tibial attachment) (Fig. 1).

Fig. 1. The division of the anterolateral ligament into three parts: white arrow – femoral (proximal); dotted arrow – median; black arrow – tibial part

Each of these parts of the ALL was characterized as "intact", "injured" or "impossible to visualize" (Fig. 2).

The ligament was considered injured when the proximal or distal part of it was avulsed from the bone, the fibers were disrupted, or there was a waviness of its structure accompanied by the presence of soft tissue edema around it (Fig. 3).

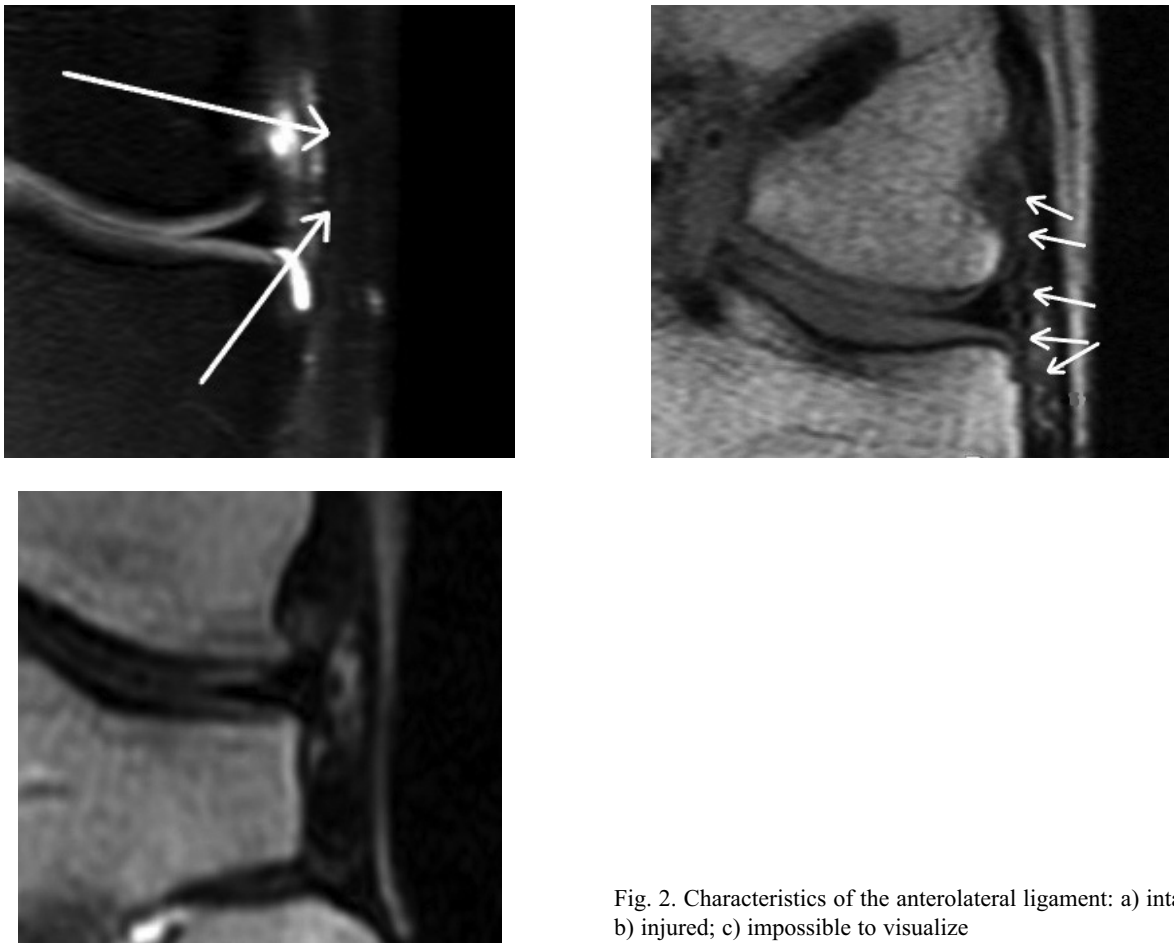

Fig. 2. Characteristics of the anterolateral ligament: a) intact; b) injured; c) impossible to visualize

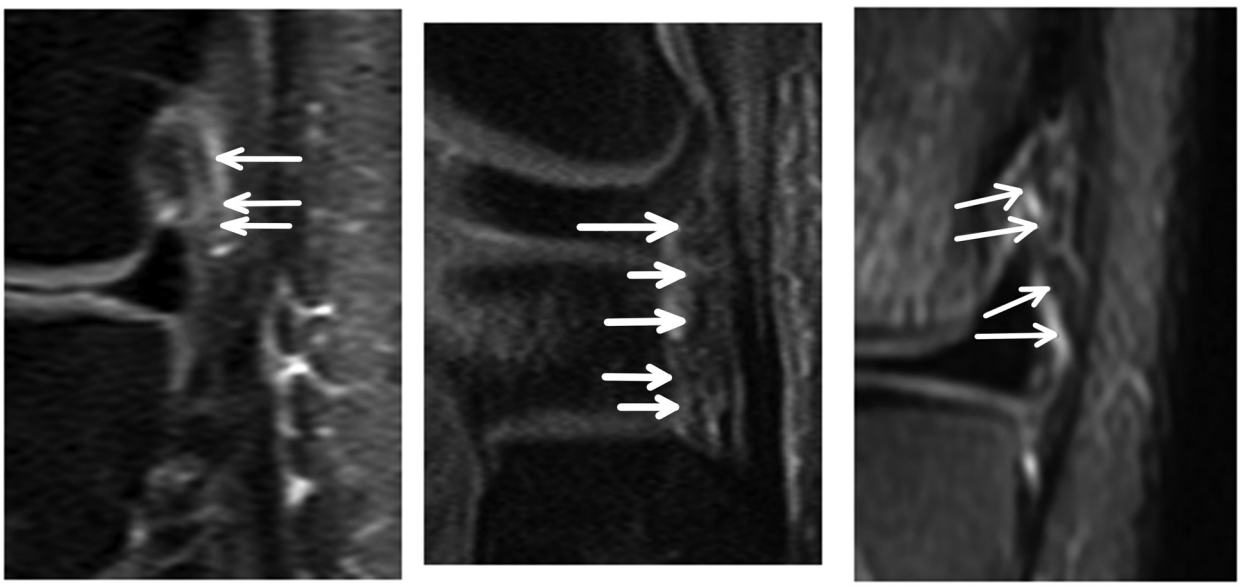

Fig. 3. Patterns of the anterolateral ligament injury: a) proximal tear; b) tear of the middle part and distal avulsion; c) waviness of the structure

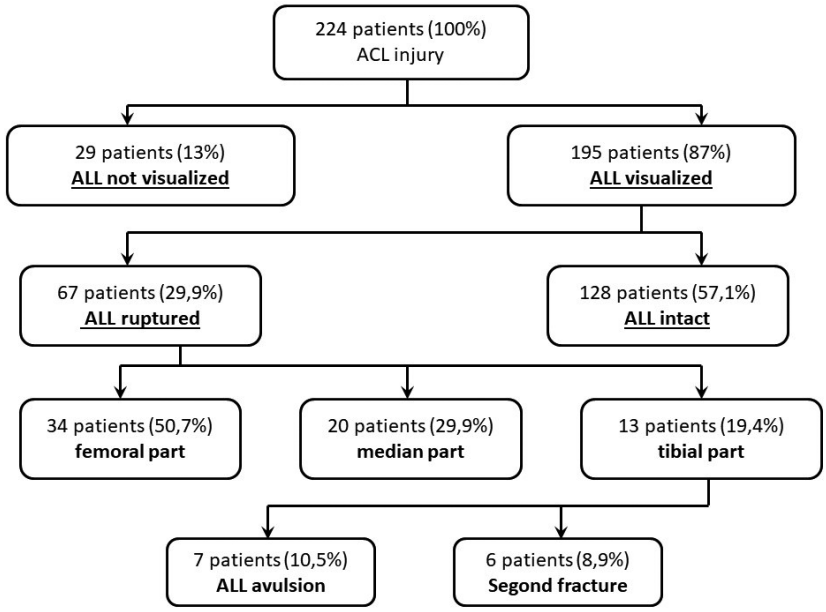

Fig. 4. Distribution of patients depending on the type of anterolateral ligament injury

RESULTS

The distribution of the patients depending on the type of the ALL injury is shown in Fig. 4. It was impossible to visualize the ALL structure on MRI in 29 cases (13%); these patients were excluded from the study, while 195 patients (87%) remained. Of these 29 patients, 9 were examined on a 3.0 Tesla MRI machine and 20, on a 1,5 Tesla MRI machine. Of the remaining 195 patients (100%), 128 (65.6%) had no signs of ALL injury, i.e. the course of the ligament fibers was normal. The criteria of ALL rupture, as described above, were found in 67 patients (34.4%).

In the group of patients where the signs of ALL injury were revealed (67 patients), the femoral part was injured in 50.7% (34 patients), the tibial part in 19.4% (13 patients), and the middle part in 29.9% (20 patients). It should be noted that among the 13 patients with a tibial part rupture, 6 (8.9%) had a cortical plate avulsion injury (Segond fracture), while 7 (10.5%) had only an isolated ligamentous structure rupture.

DISCUSSION

One of the conclusions that can be made from our study is that ALL can be visualized without problems on MRI. As a result of the analysis of 224 MRI studies of patients with ACL injury, we found that it was impossible to visualize ALL clearly only in 29 patients (13%). This is related to the anatomical features of its location. Thus, according to literature data, visualization of the ALL on MRI is not always possible due to the close proximity of such structures as the popliteus tendon, lateral collateral ligament, anterolateral part of the joint capsule and the iliotibial band. These nearby structures can create an overlay effect, which makes it difficult to identify ALL on MRI [14]. In addition, the low thickness and anatomical variability of ALL can also make it difficult to visualize its rupture [7]. In our study, we determined that the ability to visualize ALL on MRI in the knee joint with ACL injury was 87%. Approximately similar data were obtained by Kosy J.D., representing 94% of ALL identification for the knee joint with an intact ACL [13].

In our patient group, the frequency of concomitant ALL injury together with ACL injury was 34.4% (67 patients). Among these patients, rupture of the proximal (femoral) part prevailed in 50.7% of cases, the middle part was injured in 29.9%, and the distal (tibial) part rupture occurred less often, in 19.4%.

Another important factor that should be considered when interpreting these results is the period that passed from the moment of trauma till the MRI investigation. In our work, all patients underwent MRI within 6 weeks from the moment of trauma. There is one study in the literature that demonstrated that the frequency of ALL injury identification on MRI decreases threefold in the period between 6 weeks and 3 months after the injury (18.5% and 5.15%) [15]. Taking this into account, we can say that the number of patients (34.4%) with combined ACL and ALL injury is somewhat overestimated. On the other hand, it is more difficult to visualize ALL rupture after 3 months

due to the disappearance of surrounding soft tissue edema and possible partial healing, which explains the smaller number of patients with ALL injury on MRI in studies with a longer period between the trauma and a MRI investigation. In addition, we do not know how this ligament healed (with or without lengthening) and whether it continues to fulfill its role in stabilizing internal rotation of the tibia or not. Therefore, a lower frequency of ALL rupture identification after 3 months from the moment of trauma does not indicate that this structure has normal function.

CONCLUSIONS

1. Our study determined that the ALL can be visualized in 87% of the patients with ACL injury.
2. In our group of the patients, the frequency of concomitant ALL injury in the patients with ACL rupture was 34.4%, when an MRI investigation was performed up to 6 weeks after the trauma.
3. In our study, the proximal (femoral) part was injured in 50.7% (34 patients), the middle part in 29.9% (20 patients), and distal (tibial) part lesions of ALL occurred less often, in 19.4% of cases.

REFERENCES

1. Rasmussen MT, Nitri M, Williams BT, et al. An in vitro robotic assessment of the anterolateral ligament, part 1: secondary role of the anterolateral ligament in the setting of an anterior cruciate ligament injury. Am J Sports Med 2016;44(3):585-92.
2. Sonnery-Cottet B, Lutz C, Daggett M, et al. The involvement of the anterolateral ligament in rotational control of the knee. Am J Sports Med 2016;44(5):1209-14.
3. Ingham SJM, de Carvalho RT, Martins CAQ, et al. Anterolateral ligament anatomy: a comparative anatomical study. Knee Surg Sports Traumatol Arthrosc 2017;25(4):1048-54.
4. Kittl C, El-Daou H, Athwal KK, et al. The role of the anterolateral structures and the acl in controlling laxity of the intact and acl-deficient knee: response. Am J Sports Med 2016;44(2):345-54.
5. Caterine S, Litchfield R, Johnson M, Chronik B, Getgood A. A cadaveric study of the anterolateral ligament: re-introducing the lateral capsular ligament. Knee Surg Sports Traumatol Arthrosc 2015;23(11):3186-95.
6. Helito CP, Helito PVP, Costa HP, et al. MRI evaluation of the anterolateral ligament of the knee: assessment in routine 1.5-T scans. Skeletal Radiol 2014;43(10):1421-7.
7. Taneja AK, Miranda FC, Braga CAP, et al. MRI features of the anterolateral ligament of the knee. Skeletal Radiol 2015;44(3): 403-10.
8. Claes S, Bartholomeeusen S, Bellemans J. High prevalence of anterolateral ligament abnormalities in magnetic resonance images of anterior cruciate ligament-injured knees. Acta Orthop Belg 2014;80(1):45-9.
9. Wodicka R, Jose J, Baraga MG, Kaplan LD, Lesniak BP. MRI evaluation of the anterolateral ligament of the knee in the setting of acl rupture. Orthop J Sports Med 2014;2(2 Suppl): 2325967114S00042.
10. Musahl V, Rahnemai-Azar AA, van Eck CF, Guenther D, Fu FH. Anterolateral ligament of the knee, fact or fiction? Knee Surg Sports Traumatol Arthrosc 2016;24(1):2-3.
11. Spencer L, Burkhart TA, Tran MN, et al. Biomechanical analysis of simulated clinical testing and reconstruction of the anterolateral ligament of the knee. Am J Sports Med 2015;43(9):2189-97.
12. Daggett M, Ockuly AC, Cullen M, et al. Femoral origin of the anterolateral ligament: an anatomic analysis. Arthroscopy 2016;32(5):835-41.
13. Kosy JD, Mandalia VI, Anaspure R. Characterization of the anatomy of the anterolateral ligament of the knee using magnetic resonance imaging. Skeletal Radiol 2015;44(11):1647-53.
14. Porrino JJr, Maloney E, Richardson M, Mulcahy H, Ha A, Chew FS. The anterolateral ligament of the knee: mri appearance, association with the segond fracture, and historical perspective. AJR Am J Roentgenol 2015;204(2):367-73.
15. Van Dyck P, De Smet E, Lambrecht V, et al. The anterolateral ligament of the knee: what the radiologist needs to know. Semin Musculoskelet Radiol 2016;20(1):26-32.

Liczba słów/Word count: 2152 **Tabele/Tables:** 0 **Ryciny/Figures:** 4 **Piśmiennictwo/References:** 15

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Otrzymano / Received 15.07.2019 r.
Zaakceptowano / Accepted 04.03.2020 r.