Ultrasonographic Identification of the Anterolateral Ligament of the Knee

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Purpose: To determine ultrasonography's sensitivity for identifying the anterolateral ligament (ALL). **Methods:** A descriptive study of 18 cadaveric knees was performed. Ultrasonography was used to locate any anterolateral structures at the knee that could correspond to the ALL. The structure's length and relation with other notable anatomic landmarks (fibular head, Gerdy tubercle, joint line, lateral femoral epicondyle, popliteus tendon insertion) were quantified. The ultrasonography measurements were validated by dissecting each knee. The sensitivity of ultrasonography for detecting the ALL and the agreement between the ultrasonographic and cadaveric measurements (Cohen κ) were determined by statistical analysis. **Results:** The ALL was found in all 18 cadaveric knees and corresponded anatomically to the ultrasonographic descriptions. Ultrasonography had 100% sensitivity for detecting the presence of the ALL. The ALL's insertion on the lateral femoral condyle was, on average, 12.08 mm (SD, 4 mm; range, 7 to 15 mm) proximal and posterior to the lateral femoral epicondyle and 20.5 mm (SD, 3 mm; range, 16 to 24 mm) proximal to the middle of the popliteus tendon insertion. The ALL inserted onto the tibia, midway between the Gerdy tubercle and the fibular head; the distance between the midpoint of the tibial insertion and middle of the Gerdy tubercle was 19.05 mm (SD, 2.1 mm; range, 15 to 25 mm), and the distance was 19.13 mm (SD, 2.3 mm; range, 14 to 23 mm) to the tip of the fibular head. The agreement between the ultrasonographic and cadaveric findings was excellent (Cohen κ coefficient between 0.88 and 0.94). **Conclusions:** Ultrasound imaging is a suitable tool for identifying the ALL of the knee, and it allowed for a detailed analysis of the entire ALL in all 18 knees. However, its ability to evaluate any injuries to the ALL must still be shown. **Clinical Relevance:** Ultrasonography can be used to confirm the integrity of the ALL.

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The (re)discovery of the anterolateral ligament (ALL) in the knee resulted in an unusual level of media attention.[1] Several articles on this topic have been published in the past year.[1-16] The ALL appears to play a role in rotational stability.[15,17-19] Evidence of an ALL injury could indicate that a rotational stabilization procedure[20] (e.g., extra-articular lateral tenodesis[21]) is required.

However, positively identifying the anterolateral structure with imaging modalities has been challenging. Claes et al.[11] reported that the ALL could be identified by magnetic resonance imaging (MRI) in only 76% of cases. Helito et al.[6] reported identifying the ALL with a 1.5-T MRI unit in only 71.7% of cases. In another study the ALL was fully visible on MRI in only 11% of cases.[2] In its current state, MRI is not sensitive enough to locate the ALL.

Ultrasound imaging was used to identify the ALL in 1 case report.[13] The objective of our study was to determine ultrasonography's sensitivity for identifying the ALL. Our hypothesis was that the ALL could be fully visualized by ultrasonography.

Methods

Materials

This was a descriptive study involving 20 cadaveric knees (13 women and 7 men). The donors had a mean age at death of 84 years (range, 77 to 90 years). The cadavers were stored at 4°C. The 20 cadaveric knees

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The authors report that they have no conflicts of interest in the authorship and publication of this article.

Received January 19, 2015; accepted July 10, 2015.

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0749-8063/1559/$36.00

http://dx.doi.org/10.1016/j.arthro.2015.07.015

were evaluated for signs of arthritis and restrictions by the lead author (E.C.). Any knees meeting 1 of the following exclusion criteria were not used:

- Wounds or macroscopic signs of intra-articular lesions (Outerbridge grade III or IV, osteophytes in intercondylar notch)
- No anterior cruciate ligament (ACL)
- Signs of cruciate or collateral ligament instability
- Less than 130° of passive flexion as measured with a goniometer

As a consequence, 2 specimens were excluded because of macroscopic signs of intra-articular lesions and lack of an ACL. This resulted in 18 knees (12 women and 6 men) being used in the study.

Ultrasonographic Evaluation

A radiologist (M.F.) with experience in musculoskeletal ultrasound imaging performed all the measurements. A 12-MHz superficial probe was used with a Sonosite ultrasonographic unit (General Electric, Milwaukee, WI). The knee was flexed during the examination and then internally rotated as requested by the radiologist to place tension on the ALL[12] (Fig 1). This allowed the radiologist to look for an anterolateral structure at the knee that could correspond to the ALL and was distinct from other anatomic structures in this area. Given that the location of the tibial ALL insertion—but not that of the femoral insertion—is well defined,[15] the radiologist started by identifying the likely tibial (distal) insertion about halfway between the fibular head and Gerdy tubercle. Once this insertion had been located, the ALL was followed to its femoral (proximal) insertion. Once the ALL was identified, the radiologist inserted metal needles into the bone at the ALL's proximal and distal insertions under ultrasound guidance. The length, diameter, and distance between the ALL's insertions and notable local landmarks (Table 1) were determined using the ultrasonographic system's software. This resulted in a topographic map that was compared with published ALL data.[9,14,15] The tip of the fibular head, middle of the Gerdy tubercle, and middle of the popliteus tendon insertion on the femur were used as reference points.[12]

Cadaveric Validation

After the ultrasonographic portion of the study, the cadaveric knees were dissected to validate the ultrasonographic findings. Special care was taken to preserve the placement of the metal landmarks inserted under ultrasound guidance (Fig 2).

The ALL was identified by dissecting the cadaveric knees according to the protocol described by Claes et al.[12] A rectangular skin flap was made over the lateral aspect of the knee. Once the iliotibial band was identified, it was separated from the biceps femoris and then cut transversely 10 cm proximal to the lateral femoral epicondyle and reflected to the Gerdy tubercle. A varus stress was placed on the knee to locate the lateral collateral ligament (LCL), which was then separated from the capsule. The knee was internally rotated to place tension on the ALL and make it easier to identify; it was then separated from the joint capsule. The ALL was dissected toward its tibial insertion and then its femoral insertion. The landmarks required for ALL mapping were identified: middle of the Gerdy tubercle, tip of the fibular head, tibiofemoral joint line, middle of the popliteus tendon insertion on the femur, lateral femoral epicondyle, and LCL insertion. Relevant lengths and distances were measured using a digital caliper with an accuracy of 0.02 mm (Mit500 196-20; Mitutoyo, Kawasaki, Japan).[12]

Fig 1. Setup for ultrasonographic portion of study. Once the knee is flexed, an assistant can internally rotate it as needed. A right knee is shown.