Radiographic Landmarks for Identifying the Anterolateral Ligament

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Introduction: The anterolateral ligament (ALL) of the knee has recently been shown to be a definitive ligament in anatomic studies (1,4,6). The discovery of the anterolateral ligament explains the etiology of Segond fractures as the insertion of the ligament is located at the site of this bony fragment (3). In addition, the discovery of this ligament has clinical significance because injury to this structure may occur at the time of an anterior cruciate ligament (ACL) injury. Furthermore, injury to this ligament may be an explanation for the residual anterolateral rotational laxity seen following anterior cruciate ligament reconstruction. This residual laxity may be responsible for an increased incidence of osteoarthritic changes (7). For this reason, an ACL reconstruction technique that addresses the anterolateral ligament may be promising.

Recent anatomical studies recommend identifying the anterolateral ligament through superficial anatomical landmarks (4). These same landmarks are now being used in preliminary attempts at anterolateral ligament reconstruction (2). However, there is currently no data regarding the accuracy of identifying the ALL when using these anatomical landmarks. To circumvent this issue, both Rezansoff et al. and Helito et al. propose using radiographic landmarks for identifying the anterolateral ligament (5,8). They suggest that using radiographic landmarks may improve the accuracy of tunnel placement during ALL reconstruction. The purpose of our study is to define radiographic landmarks using a lateral x-ray of the knee to help identify the origin and insertion of the anterolateral ligament.

Methods: Twelve, unpaired, fresh-frozen cadaveric knees were utilized for this study. A dissection of the anterolateral aspect of each knee was performed exposing the fibular head and Gerdy’s tubercle distally. Care was taken during the deep dissection to preserve the fibular collateral ligament, popliteus tendon, and origin and insertion of the ALL. The origin and insertion of the ALL on each cadaver were then tagged using radiopaque beads. True lateral fluoroscopic views of the knees were then obtained, by superimposing the medial and lateral condyles. A radiopaque ruler was placed on the specimens to account for potential magnification. The anterior-posterior condylar length was measured along Blumensaat’s line for each specimen (Figure 1, Line B). Next, the distance from the posterior femoral cortex to the origin of the ALL was measured along this line (Figure 1, Line A), and the anterior-distal distance from this line was also measured. Similarly, the anterior-posterior length of the tibial plateau was measured for each specimen (Figure 1, Line D) along with the distance between the posterior tibial cortex and the insertion of the ALL (Figure 1, Line C). Finally, the distance from the tibial plateau articular surface to the insertion was also measured.

Results: The origin of the ALL was found on average 19.1±4.3mm from the posterior edge of the femoral condyle 8.8±2.2mm below Blumensaat’s line. This origin is located at a distance from the posterior edge of the femoral condyle that is 37.18±9.14% of the total AP diameter of the femoral condyle. Furthermore, the insertion point of the ALL was found on average 34.2±4.7mm from the posterior edge
of the tibia and 13.6±3.8mm below the tibial plateau. This insertion point is located at a distance from the posterior edge of the tibia that is 55.88±6.02% of the total length of the tibial plateau.

**Discussion:** Using fluoroscopy, the origin of the ALL can be reliably found 19.1±4.3mm from the posterior edge of the femoral condyle and 8.8±2.2mm below Blumensaat’s line. Meanwhile, the insertion point can be found 34.2±4.7mm from the posterior edge of the tibia and 13.6±3.8mm below the tibial plateau.

**Significance:** Determining radiographic landmarks for the anterolateral ligament will assist in developing accurate surgical techniques for ALL reconstruction.

**Figure 1:** Lateral radiograph of the Knee. Line A: the distance of the ALL origin from the posterior edge of the femoral condyle. Line B: the anterior-posterior length of the femoral condyle as measured along Blumensaat’s line. Line C: the distance of the ALL insertion point from the posterior edge of the tibia. Line D: the anterior-posterior length of the tibial plateau.
**Figure 2:** Summary of study measurements. AP Tot: the anterior-posterior length of the femoral condyle as measured along Blumensaat's line. AP ALL: the distance of the ALL origin from the posterior edge of the femoral condyle. Dist: the distance of the origin below Blumensaat's line. AP Tot Tib: the anterior-posterior length of the tibial plateau. AP ALL Tib: the distance of the ALL insertion point from the posterior edge of the tibia. Dist Tib: the distance of the ALL insertion point below the tibial plateau.

**Figure 3:** Lateral view of the knee. Note: the iliotibial band has been resected. The origin and insertion of the anterolateral ligament (ALL) are marked by the blue circles. Other structures identified include the lateral femoral epicondyle (LFE), lateral collateral ligament (LCL), fibular head (FH), and patella.
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