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The Role of the Anterolateral Structures and the ACL in Controlling Internal Rotational Knee Laxity

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Summary:
The iliotibial tract has a greater role in restraining internal tibial rotation than any other anterolateral structure or the ACL.

Abstract:
Background:
Some ACL reconstructions show unsatisfying functional results. One reason for this is complex rotational instabilities, caused by peripheral capsulo-ligamentous injuries. Recent findings of an anterolateral ligament have drawn attention to anterolateral rotatory instability (ALRI) as one cause for ACL reconstruction failure.
Many anterolateral structures have been related to ALRI. Terry et al. showed that the deep and capsulo-osseus layer of the ilio-tibial tract (dcITT) correlated best with clinical stability tests. They also identified the anterior arm of the short head of the biceps femoris, the mid-third lateral capsular ligament and the dcITT attachment to the Segond avulsion, indicating severe capsulo-ligamentous damage.
The purpose of the present study was to elucidate the contributions of the anterolateral structures of the knee in restraining tibial internal rotation (IR) and the pivot-shift test (PST).
Methods:
Eight knees were tested using a six degree of freedom Stäubli TX90 robot with an ATI Omega85 universal force sensor. The robot automatically defined the path of flexion/extension, while neutralising all remaining forces and moments. The robot could then go to a chosen angle of flexion (0°, 30°, 60°, 90 for IR, and 15°, 30°, 45° for the PST) and perform IR (5Nm) and the PST (4Nm IR and 8Nm valgus rotation). The ACL and anterolateral structures were cut sequentially and the biomechanical testing repeated. For each sectioned state the kinematics of the intact knee was replayed by the robot. Therefore the drop in force/torque reflected the contribution of the resected structure in restraining the laxity test. The cutting sequence was: 1. superficial layer of the ITT (sITT), 2. The dcITT, 3. Anterolateral ligament (ALL) of Dodds et al., 4. The whole anterolateral capsule including the ALL of Claes et al. and Vincent et al. 5. The ACL. Statistical analysis was performed using paired t-tests with Bonferroni correction.
Results:
Internal rotation:
At 0° only the ACL had a significant contribution (20±8%, p=0.004) to restraining internal rotation. At 30°, 60° and 90° the sITT (18±9%, p=0.016; 52±18%, p=0.002; 56±20%, p=0.002) and the dcITT (26±9%, p=0.002; 23±14%, p=0.044; 16 ±8%, p=0.031) restrained internal rotation significantly. The other anterolateral structures had no significant contribution.
Pivot-shift-test:
The sITT provided significant restraint to the PST at 45° (37±14%, p=0.002), whereas the dcITT had a significant contribution at 15° (17±8%, p=0.007) 30° (29±13%, p=0.004) and 45° (36±13%, p=0.002). Neither the ACL nor the other anterolateral structures had a significant contribution in restraining the PST at all flexion angles.

Conclusion:
Contrary to recent speculation, the ALL and the anterolateral capsule had no significant role in restraining IR. The present study demonstrated that the ITT is the primary restraint to IR at 30°, 60° and 90° flexion. Thus, in case of ALRI an ITT injury should be suspected and possibly reconstructed.