THE INFLUENCE OF TIBIAL ROTATION ON ANTERIOPosterior KNEE STABILITY – A ROBOT-AIDED IN-VITRO STUDY

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Introduction
Anterior Cruciate Ligament (ACL) rupture is one of the most common sport injuries [1]. While the importance of the cruciate ligaments for stabilization of the knee in anteroposterior (AP) direction is evident, their influence on rotational knee stability is still discussed controversially, especially since the double-bundle technique for ACL replacement claims the advantage of improved rotational stability [2,3]. Patients after ACL rupture often report symptomatic knee instability and giving way, especially during fast cutting and pivoting activities. During these activities, enhanced internal and external rotations occur in addition to anterior and posterior loading of the knee. Therefore, the aim of the current study was to systematically analyze the influence of tibial rotation on AP stability of the knee, comparing different conditions of the cruciate ligaments.

Methods
Ten cadaveric human knee specimens were examined using a KUKA robot. Initially, rotational ranges (internal and external rotation) were determined applying torques of 4Nm around the tibial shaft axis. Subsequently, anterior and posterior displacement of the knee during application of ±80N was measured in 5° steps of tibial rotation within the rotational range of each knee. Measurements were carried out in 20°, 60° and 90° of flexion. The native knee was compared to the knee after ACL resection, after ACL replacement as well as after resection of the ACL and posterior cruciate ligament (PCL).

Results
For all knee conditions and flexion angles, significant influence of tibial rotation on AP displacement was measured (p<0.001). In the ACL deficient knee, differences of up to 12mm of anterior tibial translation (ATT) were measured in 5° steps of tibial rotation within the rotational range of each knee. Measurements were carried out in 20°, 60° and 90° of flexion. The native knee was compared to the knee after ACL resection, after ACL replacement as well as after resection of the ACL and posterior cruciate ligament (PCL).

Discussion
A significant influence of tibial rotation on ATT was demonstrated with maximal ATT at a slightly externally rotated position of the tibia. This could be a possible explanation for the symptomatic instability patients with ruptured ACL report during pivoting activities. As the influence of the cruciate ligaments on AP stability is strongly dependent on tibial rotation, enhanced attention on tibial rotation is recommended during clinical application of the Lachmann and drawer tests.

References

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