Challenges in Data Interpretation of Biomechanical Studies on the Knee Anterolateral Complex

Kritische Dateninterpretation von biomechanischen Studien am Beispiel des Anterolateralen Komplexes

EDITORIAL

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Injuries to the anterior cruciate ligament (ACL) are frequent and result in an anterolateral rotation instability (1). Despite anatomical reconstruction of the ACL, a low level of anterolateral rotation instability may persist and become symptomatic in many patients (1).

For this reason, especially in the past five years, there have been detailed discussions of the anterolateral complex of the knee and its importance in rotation stability. Despite the renaissance of lateral extra-articular reconstructions, their historical origin must be discussed in this connection. Between 1960 and the late 1980s, ruptures of the ACL were not therapied using such lateral tenodesis procedures, since it was hoped that this would reduce the pivot shift phenomenon (6). Intra-articular reconstruction was not attempted for primarily technical reasons. Only later was an intra-articular ACL replacement performed in addition to a lateral extra-articular tenodesis. However, these lateral extra-articular procedures were later dispensed with due to poor clinical results and sometimes pronounced arthrosis progression over time (4). Some centers in the Benelux countries, France and Italy continued to perform a lateral extra-articular tenodesis in selected cases. This was, however, more historical than scientific.

The Anterolateral Ligament

As so often, history is repeating itself. Since the broadly-published description of the so-called anterolateral ligament in 2013 (2), there have been more than 350 scientific articles up to now on the topic. Despite the apparent evidence, there is still no consensus among experts about the presence of this band, the anatomy, morphology, function and indications for a lateral extra-articular augmentation operation in patients with ACL rupture (9).

One frequent error is to suppose that biomechanical testing, especially on robots, will guarantee maximum objectivity and data consistency. The controversial results with respect to the anterolateral structures clearly show that such data must be viewed critically (10, 11, 13).

Studies on the anterolateral Ligament

The first robot studies on the anterolateral ligament showed a statistically significant influence of this band on the rotation stability of the knee joint (10, 12). The clinical relevance of these studies is, however, very slight due to methodical weaknesses and the fact that tibial internal rotation never increased more than 3° after rupture of the anterolateral ligament.

Moreover, which structures were tested must be taken into account. Many of the articles cited above examined tibial internal rotation after removal of the Tractus iliotibialis and its deep layers (Fig. 1). However, it is known that the Tractus iliotibialis is the stronger inhibitor of tibial internal rotation (8). This results in a greater weighting of the smallest structures, even though these do not correspond mechanically to a traditional band or with respect to the transmitted force vectors (3).

In addition, not only absolute mechanical measuring value should be taken into account. For complete understanding, these values must be analyzed in conjunction with kinematic data. The anterolateral ligament offers the best example of this. A role is ascribed to this only when the tibia plateau was dislocated anterolateral (13). Or the other way to, this means that the anterolateral ligament can only play a role when other band structures, such as the ACL, have completely ruptured. This results in the secondary role of the anterolateral capsule, especially when the Tractus iliotibialis is intact. By contrast, injury to the anterior cruciate ligament and Tractus iliotibialis is seen clinically only rarely and only as part of knee luxations, which makes the question of clinical relevance easy to answer despite statistical significance.

Rotation Instabilities

The fact still remains that many patients have symptomatic anterolateral rotation instability after ACL reconstruction. Should a lateral extra-articular tenodesis be performed in these patients?

There is no clear answer to this question in the current literature. What we do know is that anterolateral rotation instability is multifactorial. All these factors must be therapied before a non- anatomical lateral extra-articular reconstruction can follow. A too-aggressive procedure can lead to increased pressure (7) and potential premature arthrosis in the lateral compartment. In conformity with the Hippocratic Oath „...I will guard against applying them in a damaging ›

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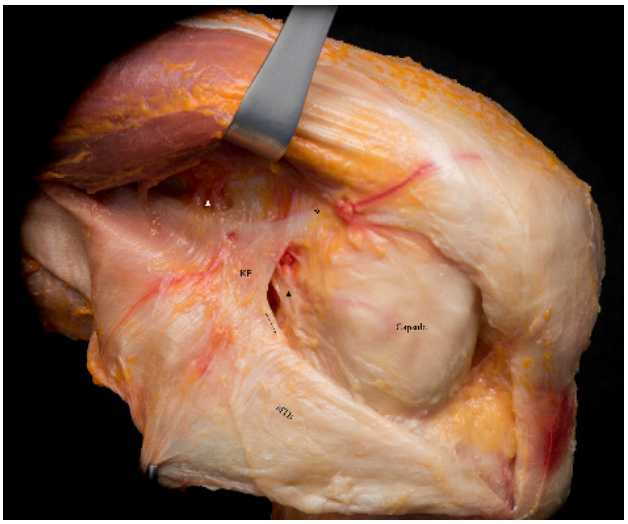

Figure 1

Anatomy of the anterolateral complex. The iliotibial tract (sITB) runs superficially and is connected to the distal femur via the Kaplan fibers (KF). The deep parts of the iliotibial tract are formed by its posterior and medial fibers (black arrow) and the capsulo-osseous layer (black triangle) (from (5) with permission).

or inappropriate way", indications for any procedure at all must be critically examined, especially when the evidence is limited to biomechanical studies.

References

(1) **AYENI OR, CHAHAL M, TRAN MN, SPRAGUE S.** Pivot shift as an outcome measure for ACL reconstruction: a systematic review. Knee Surg Sports Traumatol Arthrosc. 2012; 20: 767-777. doi:10.1007/s00167-011-1860-y

(2) **CLAES S, VEREECKE E, MAES M, VICTOR J, VERDONK P, BELLEMANS J.** Anatomy of the anterolateral ligament of the knee. J Anat. 2013; 223: 321-328. doi:10.1111/joa.12087

(3) **GUENTHER D, RAHNEMAI-AZAR AA, BELL KM, IRARRÁZAVAL S, FU FH, MUSAHL V, DEBSKI RE.** The Anterolateral Capsule of the Knee Behaves Like a Sheet of Fibrous Tissue. Am J Sports Med. 2017; 45: 849-855. doi:10.1177/0363546516674477

(4) **HEFTI F, GACHTER A, JENNY H, MORSCHER E.** Replacement of the anterior cruciate ligament. a comparative study of four different methods of reconstruction. Arch Orthop Trauma Surg. 1982; 100: 83-94. doi:10.1007/BF00462344

(5) **HERBST E, ALBERS M, BURNHAM JM, SHAIKH HS, NAENDRUP J, FU FH, MUSAHL V.** The anterolateral complex of the knee: a pictorial essay. Knee Surg Sports Traumatol Arthrosc. 2017; 25: 1009-1014. doi:10.1007/s00167-017-4449-2

(6) **HEWISON CE, TRAN MN, KANIKI N, REMTULLA A, BRYANT D, GETGOOD AM.** Lateral Extra-articular Tenodesis Reduces Rotational Laxity When Combined With Anterior Cruciate Ligament Reconstruction: A Systematic Review of the Literature. Arthroscopy. 2015; 31: 2022-2034. doi:10.1016/j.arthro.2015.04.089

(7) **INDERHAUG E, STEPHEN JM, EL-DAOU H, WILLIAMS A, AMIS AA.** The Effects of Anterolateral Tenodesis on Tibiofemoral Contact Pressures and Kinematics. Am J Sports Med. 2017; 45: 3081-3088. doi:10.1177/0363546517717260

(8) **KITTL C, EL-DAOU H, ATHWAL KK, GUPTE CM, WEILER A, WILLIAMS A, AMIS AA.** The Role of the Anterolateral Structures and the ACL in Controlling Laxity of the Intact and ACL-Deficient Knee. Am J Sports Med. 2016; 44: 345-354. doi:10.1177/0363546515614312

(9) **MUSAHL V, GETGOOD A, NEYRET P, CLAES S, BURNHAM JM, BATAILLER C, SONNERY-COTTET B, WILLIAMS A, AMIS A, ZAFFAGNINI S, KARLSSON J.** Contributions of the anterolateral complex and the anterolateral ligament to rotatory knee stability in the setting of ACL Injury: a roundtable discussion. Knee Surg Sports Traumatol Arthrosc. 2017; 25: 997-1008. doi:10.1007/s00167-017-4436-7

(10) **NITRI M, RASMUSSEN MT, WILLIAMS BT, MOULTON SG, CRUZ RS, DORNAN GJ, GOLDSMITH MT, LAPRADE RF.** An In Vitro Robotic Assessment of the Anterolateral Ligament, Part 2: Anterolateral Ligament Reconstruction Combined With Anterior Cruciate Ligament Reconstruction. Am J Sports Med. 2016; 44: 593-601. doi:10.1177/0363546515620183

(11) **NOYES FR, HUSER LE, JURGENSMEIER D, WALSH J, LEVY MS.** Is an Anterolateral Ligament Reconstruction Required in ACL-Reconstructed Knees With Associated Injury to the Anterolateral Structures? Am J Sports Med. 2017; 45: 1018-1027. doi:10.1177/0363546516682233

(12) **PARSONS EM, GEE AO, SPIEKERMAN C, CAVANAGH PR.** The biomechanical function of the anterolateral ligament of the knee. Am J Sports Med. 2015; 43: 669-674. doi:10.1177/0363546514562751

(13) **THEIN R, BOORMAN-PADGETT J, STONE K, WICKIEWICZ TL, IMHAUSER CW, PEARLE AD.** Biomechanical Assessment of the Anterolateral Ligament of the Knee: A Secondary Restraint in Simulated Tests of the Pivot Shift and of Anterior Stability. J Bone Joint Surg Am. 2016; 98: 937-943. doi:10.2106/JBJS.15.00344