Anatomic Anterolateral Ligament Reconstruction Leads to Overconstraint at Any Fixation Angle: Response

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Authors' Response:

We thank Drs Sonnery-Cottet et al for their great interest in our research regarding the biomechanical effect of graft fixation angle on knee joint kinematics for anatomic anterolateral ligament (ALL) reconstruction in the setting of a combined anterior cruciate ligament (ACL) reconstruction.[11] Undoubtedly, there is still more to learn about how to best reconstruct an ACL tear to improve patient function. In fact, debate continues as to whether the ALL has a primary role, or even an important secondary role, in controlling the kinematics that lead to increased anterolateral rotatory motion during the pivot-shift test, and further studies are needed to validate this role.

Currently, the literature provides no consensus regarding the tension force applied during ALL graft fixation, and a wide range of tensioning forces have been reported in biomechanical studies of ALL reconstruction.[9,13] Nitri et al[9] fixed the graft at 75° of flexion with 88 N of applied tension. They reported that the addition of an ALL reconstruction to an ACL reconstruction, in the setting of combined ALL and ACL deficiency, significantly improved rotatory stability. However, nonsignificant (likely due to sample size) overconstraint compared with the intact state observed at high flexion angles raised concern for the authors. Spencer et al[13] applied "minimal" tension during ALL graft fixation at 70° of flexion. They demonstrated that an ALL reconstruction performed with this tension had no significant effect on reducing rotatory laxity compared with the sectioned states. Thus, it is clear that minimal tension during tightening of an ALL graft is not sufficient as an operative tensioning protocol.

The purpose of our study was to evaluate the effect of graft fixation angle; therefore, all other factors (graft choice, tension, reconstruction order, femoral tunnel location) that could have potentially influenced our results were held constant. We acknowledged in our discussion that other potential variables were not investigated in this study, and we recognized this as a limitation. Therefore, it was not our purpose to determine a possible effect of varying graft tension, and we cannot speculate what effect it may have potentially had on our results. Further biomechanical investigation into the effect of different tension forces on knee joint kinematics at the time of graft fixation during ALL reconstruction is necessary to answer this question with certainty.

Our study demonstrated that the combined ACL and ALL reconstruction resulted in 1° to 3.7° of rotational overconstraint compared with the intact state, depending on fixation and flexion angle. However, the clinical implications of this finding can be challenging to ascribe with certainty because tightness of the grafts can result in either laxity, rupture, or altered tibiofemoral contact mechanics, the latter of which has been proposed to lead to osteoarthritis over time.[12]

In a recent systematic review of biomechanical studies of lateral extra-articular tenodesis (LET) procedures, Slette et al[12] reported that in the ACL-deficient knee, LET procedures overconstrained the knee and restricted internal tibial rotation when compared with the native state. In addition, LET procedures were reported to significantly reduce intra-articular graft forces during anterior tibial loading. The reduction of intra-articular graft forces can theoretically explain the low failure rates that are reported in the literature, but, unfortunately, these time zero studies cannot measure or provide the deleterious effects that overconstraint can cause over time (eg, 5, 10, or 20 years).[2]

The clinical effects of overconstraining the knee joint can be best evaluated by long-term follow-up studies. In a systematic review by Hewison et al,[4] the included studies had an "unclear" to "high" risk of bias for most articles when evaluated with the Cochrane Collaboration tool. The meta-analysis of the studies demonstrated a statistically significant difference for the pivot-shift test in favor of ACL reconstruction with LET; however, no difference was reported between the groups for International Knee Documentation Committee scores and KT-1000/KT-2000 arthrometer measurements.[4]

Controlled laboratory studies, by nature, do not fully represent the complexity of injuries observed clinically. Although isolated ACL tears are recognized to be a rare phenomenon and concomitant injuries are often present,[10] an ACL rupture constitutes the single constant variable across injury patterns and therefore was chosen for our protocol. We believe that controlled laboratory studies can best isolate the parameters of interest to avoid the noise of accounting for many factors in a multifactorial model. We recognize that this serves as an inherent limitation to most biomechanical studies; however, we believe that controlled laboratory studies are of high clinical value and have helped many surgeons improve their clinical practice and have clearly led to improved patient care.[1,3,5,7,8] Biomechanical investigations of anatomic procedures have consistently formed the foundation for future clinical studies and have been crucial for the validation and advancement of surgical techniques and reconstructions.

Further research is needed on the anterolateral corner of the knee in order to define the anatomic considerations, to describe the biomechanical role of each structure and the intricate interplay between structures in controlling knee kinematics, and to evaluate the long-term clinical outcomes of reconstructions using well-designed randomized controlled studies.[6] Through such research, the clinical indications for anterolateral reconstructions and procedures will be more clearly defined. This will require a combined effort from both the orthopaedic and research communities, and we encourage other research groups to investigate the variables discussed in our study to help answer the questions regarding rotational knee instability.

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