ACL DEFICIENT PATIENTS WITH PASSIVE KNEE JOINT LAXITY HAVE A DECREASED RANGE OF ANTERIOR-POSTERIOR MOTION DURING ACTIVE MOVEMENTS

Heide Boeth[1], Georg N. Duda[1], Markus O. Heller[1,5], Rainald M. Ehrig[2], Ralf Doyscher[3], Tobias Jung[4], Philippe Moewis[1], Sven Scheffler[3], William R. Taylor[1,6]

[1]Julius Wolff Institute, Charité – Universitätsmedizin Berlin, Center for Sports Science and Sports Medicine Berlin, Germany; [2]Zuse Institute Berlin (ZIB); [3]Center for Musculoskeletal Surgery (CMSC), Berlin; [4]Sports Traumatology & Arthroscopy Service, CMSC, Charité Berlin; [5]University of Southampton, England; [6]ETH Zürich, Switzerland

Introduction

Although instability of the knee joint is known to modify gait patterns, the amount that subjects compensate for joint laxity during active movement remains unknown [Andriacchi et al., 2005]. By developing a novel technique to allow assessment of tibio-femoral kinematics, this study aimed to elucidate the role of passive joint laxity on active tibio-femoral kinematics during walking.

Methods

Using motion capture, together with combinations of advanced techniques for assessing skeletal kinematics (including SARA, SCoRE & OCST) [Taylor et al., 2010], a novel non-invasive approach to evaluate dynamic tibio-femoral motion was demonstrated as both reproducible and repeatable. The passive (KT1000) and active (throughout cycles of walking) tibio-femoral joint anterior-posterior (A-P) translation was then examined in 13 patients with MRI confirmed ACL rupture, and compared to their healthy contralateral limbs.

Results

The passive tibial anterior translation was significantly greater in the ACL ruptured knees than in the contralateral healthy controls (Figure 1, left). However, the femora of the ACL ruptured knees generally remained more posterior (approximately 3mm) relative to the tibia within a gait cycle of walking compared to the healthy limbs. Surprisingly, the mean range of tibio-femoral A-P translation over an entire gait cycle was significantly lower in ACL ruptured knees than in the healthy joints (Figure 1, right, p=0.026). A positive correlation was detected between passive laxity and active joint mobility, but with a consistent reduction in the range of tibio-femoral A-P translation of approximately 3mm in the ACL deficient knees.

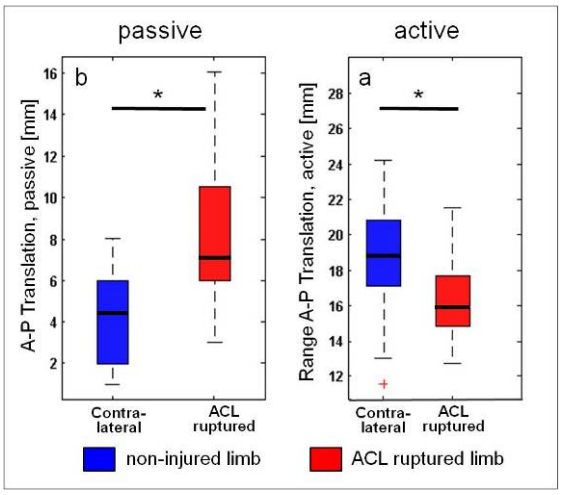

Figure 1: left: A-P translation, passive condition; right: A-P translation during walking

Discussion

It seems that either active stabilisation of tibio-femoral kinematics or anterior subluxation of the tibia reduces joint translation in lax knees. This implies that either a muscular overcompensation mechanism or a physical limitation due to secondary passive stabilisers occurs within the joint, and thus produces a situation that has a reduced range of active motion compared to knees with physiological stability [Li et al., 2006]. The reduced range of active tibio-femoral translation suggests over-loading of the passive structures in passively lax knees, either through excessive muscular action or joint subluxation, and could provide a plausible mechanism for explaining post-traumatic degeneration of cartilage in the joint.

References

Andriacchi et al., J Biomech, 38:293-298, 2005

Taylor et al., Gait & Posture, 32:231-236, 2010

Li et al., J Bone Joint Surg, 88(8):1826-1834, 2006