TIBIOFEMORAL CONTACT POINT IN THE WEIGHT-BEARING ACL DEFICIENT KNEE

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Introduction

Biomechanical models on anterior cruciate ligament deficiency have previously been validated by the use of invasive techniques, measurements under non-weight-bearing conditions, cadavers, and mathematical theory. All these methods have limitations. It has been shown that magnetic resonance imaging (MRI) can accurately quantify knee kinematics. The present study was thus designed to define the relationship between the tibiofemoral contact point and anterior cruciate ligament deficiency in-vivo, using magnetic resonance imaging in weight bearing.

Methods

Six adult male subjects with unilateral anterior cruciate ligament deficiency (ACLD) were scanned with magnetic resonance imaging while they pushed to extend a specially-constructed apparatus designed to result in strong isolated quadriceps contraction when maintaining the extended knee position. MRI scans were obtained for both left and right knees at maximum allowable extension with the restraint. Three-dimensional analyses, using a previous protocol (Wretenberg P et al 2002), were used to measure the tibiofemoral contact point in all knees, in all planes in both the medial and lateral compartments. All translation and rotation measurements were normalized on the basis of the location of the tibial tuberosity and the inter-condylar midpoint line of the femur. Measurements from the affected knee were compared to the intact contralateral knee.

Results

A typical set of images collected for each subject is shown in Figure 1. The results of the tibiofemoral contact point measured from the knees studied are summarized in Figure 2a and 2b. The data showed that ACLD caused the tibiofemoral contact point to shift on average 15 mm and 18mm more posterior on the medial and lateral tibia plateaus respectively when compared to the intact knee; the differences between knees and between compartments was significant (P<0.05).

![Figure 1](image1.png)

**FIGURE 1.** A), showing the medial condyle of the uninvolved control knee; B), showing the involved ACLD knee. Both knees above are imaged as the subject pushed against the restraint.

![Figure 2](image2.png)

**Figure 2a and 2b.** showing measurements of a), the medial compartment and b), the lateral compartment tibiofemoral contact point relative to the tibial tubercle. Anterior-Posterior (AP), Superior-Inferior (SI) and Medial-Lateral (ML) distances are shown for normal and ACLD knees.

In the superior-inferior axis, relative to the position of the tibial tuberosity, ACLD resulted in a significant reduction in the distance of the contact point in the medial compartment only. In the medial-lateral axis the ACLD produced a significant difference of about 7mm in the tibiofemoral contact point on the medial plateau, while in the lateral plateau the difference was smaller yet significant.

![Figure 3](image3.png)

**Figure 2.** Plot of tibiofemoral contact point for normal and ACLD knees

Discussion

The measurements from MRI show clearly the altered kinematics that result from ACLD with more effects on anterior tibial translation seen in the lateral side (Figure 2).

References


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