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Knee Laxities Correlates with in Vivo Tibio-Femoral Kinematics during Single-Leg Squat in ACL Deficient Patients: An Evaluation with Surgical Navigation and Dynamic RSA

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Summary:
For the first time it was possible to establish a relationship between Anterior Drawer and Pivot-Shift manual tests measured using navigation, with the in-vivo anterior translation and kinematics of lateral compartment measured with Dynamic RSA.

Abstract:

Summary

The injury of the ACL has important and measurable consequences on the knee laxities. Clinical tests are performed by clinicians, but it is unknown their correlation with the in-vivo kinematics. A cohort of 42 patients with complete isolated ACL injury were recruited and evaluated with dynamic RSA and clinical tests. Statistically significant differences were reported between the AP translation during a single leg squat evaluated with dynamic RSA and clinical tests.

Abstract

Introduction

The injury of the ACL has important and measurable consequences on the knee laxities, which could be evaluated through clinical stress test. However, clinical tests are maneuvers passively performed by clinicians and how these laxities affect the in-vivo kinematics during active motor tasks is unknown. The aim of this work is to correlate the results of the clinical test for knee laxity with the tibio-femoral kinematics during a single leg squat acquired with dynamic RSA.

Methods

A cohort of 42 young active patients with complete isolated ACL injury were recruited. Preoperative, patients were evaluated with dynamic Roentgen Stereophotogrammetry Analysis (RSA) during an active single leg-squat on the affected knee. The outputs of the RSA are the kinematical parameters of the motor task: IE rotation, VV rotation, AP translation, Contact areas of the femur with respect to the tibia. During the surgical procedure, the following parameters were acquired by as single expert surgeon before ACL reconstruction: Antero-posterior translation at 30° (AP30) and 90° (AP90), and the area included by the curves of internal/external rotation during the Pivot-Shift

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maneuver (PS). The 3D joint models were obtained from MRI.

The population was divided in 2 groups according to the average of every manual test result: those with a laxity value lower than the average (low laxity group) and those with a value higher than the average (high laxity group). For each population, the t-test between the two groups was performed for each values of RSA kinematic parameter. Significant values were with $p < 0.05$.

Results

Patients in the high laxity group of intra-operative AP90 showed a significant higher AP translation during the single-leg squat at 33 degrees of flexion ($p=0.041$); higher values were reported also for anterior translation of the lateral compartment between 8 and 20 degrees of flexion ($p<0.05$).

Patient in the high laxity group of PS showed a significantly higher anterior translation of the lateral compartment between 8 and 25 degrees of flexion ($p<0.05$). No significant differences were found with the AP30 values.

Discussion And Conclusion

For the first time it was possible to establish a relationship between Anterior Drawer and Pivot-Shift manual tests measured using navigation, with the in-vivo anterior translation and kinematics of lateral compartment measured with Dynamic RSA. This correlation was present at the early range of flexion during single-leg squat, between 5 and 35 degrees. In this range of flexion, the femoral quadriceps are not the main stabilizer and the influence of the ACL deficiency is evident. The Lachman test was not able to produce any correlation with the squat kinematics, thus resulting a suboptimal test to predict in-vivo knee behavior.