PRE-OPERATIVE SELF-REPORTED FUNCTION PREDICTS KNEE EXCURSION ASYMMETRIES IN ACL-INJURED ATHLETES

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INTRODUCTION

Restricted knee motion during activities of daily living is a common impairment following acute rupture of the anterior cruciate ligament (ACL) and may represent impaired joint mobility or an abnormal neuromuscular control strategy [1]. Importantly, the pre-operative condition of the injured knee is known to affect both mid-term and long-term functional outcomes in ACL-injured athletes [2,3]. Specifically, post-injury stiffness is significantly associated with stiffness six months after ACL reconstruction [3]. A knee stiffening strategy during dynamic tasks may be indiscernible without the use of highly sensitive motion analysis systems. Therefore, determinants of neuromuscular dysfunction, which can be easily captured in the clinical environment, may facilitate the development of targeted and effective pre-operative rehabilitation strategies.

Self-report outcome measures provide important data on a patient’s perceived level of function in the wake of ACL injury. The Knee Injury and Osteoarthritis Outcome Score (KOOS) is a reliable, valid and responsive outcome measure in individuals with ACL injury, where lower scores represent greater disability [4]. Its relationship to dynamic measures of neuromuscular dysfunction early after ACL injury, however, is unknown. The purpose of this study is to determine whether poorer functional outcome scores of acutely ACL-injured athletes are predictive of pre-operative knee excursion asymmetries during gait.

METHODS

Fifteen athletes who sustained an acute ACL rupture (age: 24.5 ± 11.5 years, mass: 78.4 ± 13.9 kg) underwent three-dimensional motion analysis of walking gait. The Institutional Review Board approved all study methods, and all subjects provided informed consent prior to participation.

Kinematic data during three gait trials were sampled at 240Hz and then low-pass filtered at 6Hz using a bi-directional Butterworth filter. Joint motion was calculated using rigid body analysis and Euler angles with custom Visual 3D (C-motion Inc., Germantown MD) and Matlab (Mathworks Inc. Natick, MA) coding. Ensemble averages were generated for the involved and uninvolved limbs of each athlete. Sagittal plane knee joint excursions were calculated during the stance phase of gait and normalized to 100% for comparison between athletes.

Linear regression analyses were used to examine whether subscales of the KOOS (Symptoms/Stiffness; Pain; Function, Daily Living; and Quality of Life) could independently predict sagittal plane knee excursion asymmetries acutely after ACL injury. A priori statistical significance was set at \( P < 0.05 \), and adjusted R square values are reported.

RESULTS AND DISCUSSION

Pre-operative knee excursion asymmetry during the stance phase of gait significantly predicted self-reported outcomes on two of the four KOOS subscales. Lower scores on the Symptoms/Stiffness and Pain subscales of the KOOS were significant predictors of larger knee excursion asymmetries (Symptoms/Stiffness: \( P = 0.048 \), adjusted \( R^2 = 0.211 \); Pain, \( P = 0.001 \), adjusted \( R^2 = 0.531 \)) early after ACL rupture. Scores on the Function, Daily Living (ADL) and Quality of Life (QOL) subscales
were not significantly predictive of knee excursion asymmetries (ADL: $P = 0.08$, adjusted $R^2 = 0.157$; QOL: $P = 0.057$, adjusted $R^2 = 0.193$)

Our data support the findings of previous studies which highlight aberrant gait mechanics as a characteristic of the most poorly performing athletes following ACL injury [1]. Self-report measures, as part of a battery of clinical tests, have successfully identified ACL-deficient athletes capable of returning to sport in the short-term following a bout of neuromuscular training [5]. While these tests are easy to implement, they are time-intensive and require expensive equipment; thus, a single self-report outcome measure that can effectively predict ACL-deficient athletes who may and may not benefit from pre-operative care is of significant value to sports medicine clinicians. Based on these preliminary data, use of the KOOS may help identify those athletes in particular need of targeted rehabilitation prior to ACL reconstruction.

CONCLUSIONS

Delaying ACL reconstruction in order to restore normal joint motion has been advocated as a means to reduce the development of post-operative knee stiffness. Subscales of the KOOS appear to capture important functional and neuromuscular asymmetries in athletes prior to ACL reconstruction; its utility as a clinical surrogate for determining the need for pre-operative rehabilitation is unknown. Whether these early measures of abnormal function predict post-operative outcome is currently under investigation.

REFERENCES


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