Effect of ACL Reconstruction On Inter-limb Asymmetries and Limb Dominance

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Introduction:
Individuals with a prior anterior cruciate ligament (ACL) injury are at a greater risk of subsequent ACL re-injury. It has been theorized that biomechanical faults in conjunction with neuromuscular deficits exist between the affected and unaffected limb following an anterior cruciate ligament reconstruction (ACLR) which may predispose and predict the recurrence of an ACL injury in the athletes. Few studies have examined the relationship between limb dominance and ACL re-injury risk in athletes.[1-6] Investigating the significance of dominance on ACL injuries could guide further treatment to help prevent recurrence of an ACL tear and identify biomechanical deficits in uninjured limbs that could predispose one to an ACL injury.

Objectives:
The purpose of this study is to understand the inter-limb differences and asymmetries during the performance of functional tasks post ACL injury and reconstruction. It is hypothesized there are neuromuscular differences between the affected and unaffected limb in athletes that predispose them to an increased risk of re-injury compared to the unaffected limb.

Methods:
11 participants (age = 21.1 ± 3.8yrs, height =170.9 ± 5.2cm, weight = 70.9 ± 9.6kg, BMI = 24.2 ± 2.8 kg/m^2), at least 1 year post ACLR with return to sport clearance from physician and no other significant lower extremity injuries within the past 5 years, participated. Test tasks included treadmill running at a self selected pace, functional squat, Y-Excursion Balance Test, weight bearing lunge test, isokinetic strength testing using Biodex, and functional hop tests. Order of testing was randomized between participants. 2D kinematics of all hop tests in the sagittal plane were recorded for 4 of the participants and analyzed using Apple(R) iPads and Kinovea (R) software respectively. The participants' affected and unaffected limb were compared.

Results:
2D kinematics revealed significantly smaller peak knee flexion angle at initial contact during the 6-meter timed hop test for the affected limb (23.6° ± 9.4°; p=.04) compared to the unaffected limb (31.6° ± 5.8°). Results showed significantly smaller peak knee flexion at initial contact in the affected limb (19.7° ± 8.7°; p=0.03) compared to the unaffected limb (25.5° ± 6.6°) and

greater peak knee flexion angle in the unaffected limb (66.1° ± 8.5°; p=.05) compared to the affected limb (58.3° ± 9.7°) for the triple hop test.

Discussion:

We hypothesized there would be neuromuscular differences between the affected and unaffected limb in athletes that predispose the affected limb to increased risk of re-injury compared to the unaffected limb. Data shows decreased peak knee flexion at initial contact and smaller peak knee flexion angles in affected limbs during the triple hop test, demonstrating poor strategy in the absorption of ground reaction forces and lack of eccentric control of the affected limb.

Comparisons made to the unaffected limbs of our subjects exhibited underperformance compared to those of healthy literature controls. Our subjects' reach distance on the dominant limb was 37% less on the Y-excursion test in the posteromedial direction compared to literature controls. The nondominant unaffected limb underperformed in all hop tests and the Y-excursion test by an average of 18% compared to the nondominant limb of healthy controls, and the dominant limb underperformed by an average of 20.6%[7-10]. These percentages indicate that even with an injury occurring on one leg, the other leg's performance declines. This not only suggests potential re-injury of the ACL, but injury of the ACL to the unaffected limb.

Conclusion:

Results show potential neuromuscular deficits in the affected and the unaffected limb post-ACLR which could lead to re-injury of the affected limb or an ACL tear in the previously unaffected limb. Clinicians should approach post ACLR rehab with a focus on athletes returning to functional levels similar to that of their healthy counterparts rather than strictly achieving interlimb symmetries.

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