LIMB ASYMMETRIES IN POST-ACL RECONSTRUCTION PATIENTS

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INTRODUCTION

Anterior Cruciate Ligament Reconstruction (ACLR) after a complete tear is intended to restore stability and functionality of the limb. At the conclusion of an athlete's rehabilitation, it is common practice to undergo return to sport (RTS) testing focused on assessing strength and function. Tests involving unilateral hops, isokinetic strength and postural stability are conducted to ensure a safe RTS. RTS testing has become common practice, as young athletes have a high secondary reinjury rate of 23%[1]. Reinjury often leads to removal from sport, diminished quality of life, and greater potential for long-term degeneration[1,2]. Limb asymmetries could potentially lead to re-tear of the affected limb (AL) or a new tear of the contralateral unaffected limb (UAL). Therefore, the objective of this study was to compare the performance of the AL and UAL >12months post-ACLR during RTS testing and to interlimb differences observed in healthy controls. Secondary objective was to correlate isokinetic movement tests and functional RTS testing procedures.

METHODS

11 ACLR subjects (9 females, 2 males, 22.4 ± 3.7 years old, 5.4 ± 4.2 years post-op) participated in this study. The RTS protocol for this study included the following: Y-excursion tests, single hop for distance (SLH), triple hop for distance (TH), triple cross-over hop for distance (TCH), and timed 6m hop. Y-excursion was performed anteriorly (Y-A), posteriolaterally (Y-PL) and posteriomedially (Y-PM). All RTS tests were performed and recorded over 3 acceptable trials per limb. Additionally, participants performed a Weight-Bearing Lunge (WBL) recorded over 6 acceptable trials per limb. Lastly, isokinetic testing of concentric peak torque of quadriceps and hamstrings at 60°/sec, 120°/sec, and 300°/sec using Biodex System 4 Dynamometer MVP™. The AL ACLR was compared to the dominant limb (DL) and the UAL was compared to the non-dominant limb (NDL) of controls. DL was determined by which leg subjects choose to kick a ball[3]. The LSI was calculated using the formula LSI = 100*(AL/UAL) or 100*(DL/NDL) to determine the percentage of ability between limbs. An LSI < 85% or LSI > 115% is considered a clinically important difference. Correlation statistics were collected to identify potential relationships between isokinetic and functional testing performed.

RESULTS

For all RTS measures, no clinically important differences were found when comparing LSIs for subjects post-ACLR. When comparing those subjects to healthy controls, no clinically important differences were found as well. Full LSI data can be seen in Table 1. Correlation statistics between RTS tests and isokinetic tests of subjects post-ACLR are shown in Table 2. For the affected limb, isokinetic testing for knee flexion at 300°/sec showed a moderate correlation to all Y excursion tests and isokinetic testing for knee extension at 300°/sec showed a moderate correlation to all hop tests. Small correlations were found between all isokinetic testing <300°/sec and functional tests.

DISCUSSION

For athletes >1 year post-ACLR, no clinically important differences in LSI were found between the affected and unaffected limbs for RTS testing. Additionally, no clinically important difference in LSI was found when compared to healthy controls. However, the high rate of a second ACL tear on the affected or unaffected side continues to be a common concern reported in the literature[1]. This is likely due to the complex anatomical and pathomechanical nature of the injury. Although the results show minimal differences in LSI, RTS testing may need to be qualitative as well as quantitative, including evaluations of proper landing mechanics and patient reported outcomes. Evaluating kinematics during RTS testing may improve the sensitivity of this assessment.

High speed knee extension isokinetic testing at 300º/sec moderately correlates to SLH (r =0.67), TH (r=0.66), and TCH (r=0.63). High speed knee flexion isokinetic testing at 300º/sec moderately correlates to Y-A (r=0.56), Y-PM (r=0.53), and Y-PL (r=0.55). It is important to note the small correlation between both isokinetic tests at <300º/sec and functional tests (r=0.01-0.44). Isokinetic testing can provide detailed objective data, such as quadriceps:hamstring ratio, peak torque, and peak torque/body weight. Functional testing can provide information regarding landing mechanics and gross power produced by the limb. Isokinetic and functional testing each provide specific information to fully assess an athlete's readiness for return to sport.

Variables	ACLR (%)	Controls[3-8] (%)
SLH (cm)	97.0 ± 12.5	99.5
TH (cm)	98.9 ± 7.6	99.5
TCH (cm)	98.6 ± 8.7	99.5
6m Hop (sec)	98.8 ± 8.0	101.3
Y-A (cm)	100.2 ± 5.3	100.0
Y-PM (cm)	97.0 ± 11.5	101.0
Y-PL (cm)	98.0 ± 4.9	101.1
WBL (cm)	110.3 ± 35.8	100.8
60°/sec Ext	101.5 ± 18.1	98.0
60°/sec Flex	105.7 ± 16.3	104.0
120°/sec Ext	106.2 ± 26.6	98.9
120°/sec Flex	107.2 ± 17.6	97.3
300°/sec Ext	104.9 ± 16.9	97.9
300°/sec Flex	97.6 ± 29.2	97.8

Table 1: LSI (%) between AL and UAL
during RTS tests compared to controls from literature.
LSI (limb symmetry index); ACLR (ACL reconstruction)
Control data extrapolated from sources: 4, 5, 6, 7, 8, 9, 10.

RTS Tests	Isokinetic Testing (º/ sec)											
	60				120				300			
	Flex		Ext		Flex		Ext		Flex		Ext	
	AL	UAL	AL	UAL	AL	UAL	AL	UAL	AL	UAL	AL	UAL
SLH	0.12	0.15	0.11	0.16	0.18	0.05	0.31	0.08	0.44	0.24	0.67†	0.01
TH	0.31	0.31	0.23	0.31	0.36	0.19	0.38	0.29	0.63†	0.40	0.66†	0.18
TCH	0.24	0.27	0.23	0.40	0.22	0.12	0.34	0.30	0.40	0.31	0.63†	0.33
Y-A	0.23	0.29	0.08	0.30	0.31	0.20	0.15	0.36	0.56†	0.45†	0.43	0.19
Y-PM	0.30	0.22	0.08	0.14	0.32	0.39	0.05	0.27	0.53†	0.29	0.49†	0.39
Y-PL	0.28	0.04	0.05	0.05	0.37	0.20	0.09	0.02	0.55†	0.06	0.31	0.24

Table 2: Correlation statistics between return to sport (RTS tests and peak isokinetic torques for ACLR.
AL (affected limb); UAL (unaffected limb); RTS (return to sport); SLH (single-leg hop); TH (triple hop); TCH (triple cross-over hop); Y-A (anterior Y-excursion); Y-PM (posteriomedial Y-excursion); Y-PL (Y-posteriolateral); † moderate correlation: $0.45 < r < 0.70$

CONCLUSION

RTS tests did not produce any clinical differences between the limbs or groups. This protocol, commonly used by clinicians, evaluates an individual's ability to safely return to high-level athletics post-ACLR. Given the high prevalence of reinjury, all objective data should be utilized from functional and isokinetic testing. Future study should include kinematic and kinetic assessment during functional testing along with their relationship to isokinetic testing to test for an athlete's readiness for return to sports.

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