



Functional Strength Testing is Associated with Isometric Knee Strength in Adolescents Early After ACL Reconstruction

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INTRODUCTION

- Anterior cruciate ligament (ACL) injuries and reconstruction (ACLR) have become increasingly common in the adolescent athletic population¹.
- Knee extension strength symmetry prior to return to sport has been shown to decrease likelihood knee reinjury².
- Our institution tests isolated strength and function at 3 months post-operatively to guide rehabilitation progressions. Tests include:
 - Isometric knee extension and flexion peak torque at 60° knee flexion on HUMAC isokinetic dynamometer (CSMI USA, Stoughton, MA)
 - Y-balance test³
 - Timed Anterior Stepdown Test⁴
- While there is some data that report findings of isometric and isokinetic strength at three months postoperative, there is limited data in the use of functional strength tests in adolescents.
- The purpose of this study is to examine the relationship of isometric knee strength testing with functional strength tests in adolescent patients three months following ACLR.

METHODS

- A chart review was conducted on patients treated with ACLR between July 2017 and April 2019. Patients between 12 and 20 years of age that underwent ACLR and completed three month strength testing assessment were included in this study.
- Spearman correlation was used to determine if: 1) there was an association between isometric knee extension and flexion peak torque and Y-balance test distance and isometric knee extension and flexion peak torque deficit and Y balance test difference 2) there was an association between isometric knee extension and flexion peak torque and timed anterior step down test.

RESULTS

- The cohort consisted of 138 patients, (68 females; 16.16±1.88 years) tested at an average of 97.31±16.12 days post ACLR. Average strength test scores and measurements are shown in Table 1. Hamstring autografts were the most common reconstruction (n=80, 58%).
- Isometric knee extension strength showed a moderate correlation with anterior, posteromedial, and posterolateral reach distances. Isometric knee flexion strength showed a moderate correlation with posterior reaches and a weak correlation for anterior reach.
- Isometric involved knee extension strength and timed anterior stepdown test showed a weak positive correlation. There is no correlation between isometric knee flexion strength and anterior stepdown.
- Isometric knee extension strength deficit and Y-balance test difference showed a weak positive correlation. There was no correlation between isometric knee flexion strength deficit and Y balance test

Table 1

Average Isometric Strength Measures and Functional Test Scores			
Isometric Strength Testing	Involved	Uninvolved	Deficit
Peak Torque Knee Extension (ft-lbs)	71.30±28.98	103.12±32.62	30.83±24.02
Peak Torque Knee Flexion (ft-lbs)	41.67±13.82	57.70±15.18	28.18±18.06
Peak Torque Knee Extension/Body Weight (percentage)	47.47±18.63	66.70±20.78	
Peak Torque Knee Flexion/Body Weight (percentage)	28.67±12.70	38.70±11.75	
Y-balance test	Involved	Uninvolved	Difference
Anterior Reach (cm)	59.25±6.89	61.94±7.04	3.21± 5.91
Posteromedial Reach (cm)	96.78±11.29	98.58±10.75	2.6± 6.38
Posterolateral Reach (cm)	94.47±11.19	94.88±11.93	1.61± 6.57
Timed Anterior Stepdown Test***	Involved	Uninvolved	
Repetitions in 1 minute	21.09±11.34	25.51±8.95	

*** Only 101 were able to complete the anterior stepdown tests

Table 2

Spearman Correlation		
	Peak Torque Knee Extension	Peak Torque Knee Flexion
Y-Balance Anterior Reach	r= 0.405, p= <0.0001	r= 0.240, p= <0.005
Y-Balance Posteromedial Reach	r= 0.463, p= <0.0001	r= 0.391, p= <0.0001
Y-Balance Posterolateral Reach	r= 0.475, p= <0.0001	r= 0.340, p= <0.001
Timed Anterior Stepdown test	r= 0.250, p= .012 ***	r= 0.084, p= <0.405***
	Peak Torque Knee Extension Deficit	Peak Torque Knee Flexion Deficit
Y-Balance Anterior Reach Difference	r= 0.254, p= 0.002	r= -0.059, p= 0.494
Y- Balance Posteromedial Reach Difference	r= 0.0191, p= 0.026	r= 0.024, p= 0.782
Y- Balance Posterolateral Reach Difference	r= 0.049, p= 0.5716	r= -0.009, p= 0.924

DISCUSSION

- The results of this study provide isometric and functional strength reference data for adolescents 3 months status post ACLR.
- Isometric strength testing is associated with the Y-balance reach distances and timed anterior stepdown tests in adolescents at this post-operative time point. The Y-balance test reach distances had a greater relationship to knee extension peak torque than the anterior step down test.
- Isometric knee extension deficits were associated with Y-balance test asymmetries, anterior reach and posteromedial reaches only. Though there was an association, it was not as significant as peak torque and reach distances.

CONCLUSION

- Results of this study may suggest clinics without access to isometric strength testing devices can utilize functional strength testing as a way to assess knee extension strength at the 3 month time point status post ACLR.
- Based on the results of this study, the Y-balance test posterior reaches would best assess knee extension strength with a closed chain functional test.
- Further research is needed to better understand isometric and functional strength data at this stage and potential predictive value for improved outcomes during ACLR rehabilitation and return to play.

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