

Paper #90

The Effect of Physeal Closure on Quadriceps Strength and Symmetry after Anterior Cruciate Ligament Reconstruction in Adolescent Patients

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Summary:

An evaluation of the effect of an open or closed physis on objective functional strength measures 6 months after ACL reconstruction

Abstract:

Background

Anterior cruciate ligament (ACL) injury has continued to increase in recent years, especially in patients under the age of 18. This has been attributed to the rise in youth sports and increased intensity of athletic competition at younger ages. As a result, many of these young patients present with injury and undergo surgery with incompletely closed physes. Persistent muscle weakness, impaired function and poor patient reported outcomes are a concern for patients early after reconstruction and impact a timely and successful return to unrestricted physical activity without re-injury. To date, little has been studied regarding skeletal immaturity as it relates to strength and functional outcomes after ACL reconstruction (ACLR). The purpose of this study was to compare muscle strength and patient reported outcomes in adolescent patients stratified by physis closure and sex.

Methods

Patients under the age of 18 were recruited 5-7-months following primary, isolated ACLR. All patients completed patient reported outcomes (IKDC, KOOS, Tegner Activity Scale) and bilateral isokinetic (90°/sec) and isometric (90°) strength tests of the knee extensor and flexor groups. Outcomes were recorded in a single session as part of a return-to-sport test battery. Strength was expressed as torque normalized to mass (Nm/kg) and limb-symmetry was expressed as a ratio of involved:uninvolved torque. Pre-surgical X-rays obtained clinically were evaluated by a single trained examiner to determine femoral and tibial physeal status at the time of ACLR (open/closed). We used 2 x 2 ANCOVA (Sex*Physeal Status) while controlling for the current activity level to compare knee extensor and flexor strength between males and females. Post-hoc tests were used to identify specific group differences. Statistical significance was defined as $p < 0.05$.

Results

A total of 69 patients meeting inclusion criteria were extracted from a larger database for analysis (16.13±1.38 years old, 40 females, 5.95±.52 months post ACLR). Of those, 47 patients (68%) had closed physes at the time of ACLR. On

ISAKOS

International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine

12th Biennial ISAKOS Congress • May 12-16, 2019 • Cancun, Mexico

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average, male patients were stronger and more symmetric than females ($P < 0.5$) at 6 months following reconstruction. A significant Sex*Physes Status interaction was observed for mass-normalized isokinetic peak knee extensor torque ($P = .024$) and knee extensor MVIC limb symmetry ($P = .047$). Males with open physes were stronger (Open = 2.1 ± 0.59 Nm/kg vs Closed = 1.55 ± 0.34 Nm/kg, $P = 0.004$) and more symmetric (Open = 0.85 ± 0.19 vs. Closed = 0.59 ± 0.17 , $P = 0.001$) than males with closed physes. These differences were not observed in females (Strength: Open = 1.55 ± 0.37 vs Closed = 1.35 ± 0.39 , $P = 0.14$; Symmetry: Open = 0.69 ± 0.27 vs Closed = 0.63 ± 0.23 , $P = 0.53$).

Conclusion

When controlling for activity level, adolescent patients with open physes had greater quadriceps strength and higher symmetry compared to those with closed physes. Female quadriceps strength and symmetry was not affected by physis status. Skeletally younger male patients who would theoretically have lower amounts of testosterone actually fared better on the strength tests, suggesting that functional recovery is not hindered by the presence of an open physis.