Landing Adaptations Following Isolated Lateral Meniscus Tears in Athletes

+ 1 Minning S J; 2 Ford K F; 2 Myer G D; 1 Mangine R E; 3 Colosimo A J; 2 Hewett T E
+ 1 NovaCare Rehabilitation/University of Cincinnati, Cincinnati, OH, 2 Cincinnati Children’s Hospital Medical Center, Cincinnati, OH, 3 University of Cincinnati College of Medicine, Cincinnati, OH

Senior author tim.hewett@cchmc.org

Introduction:
The lateral meniscus is an important load-bearing structure that aids shock absorption during weight bearing closed chain activities. Subjective and clinical outcome results of the medial versus lateral partial meniscectomy demonstrate similar results, however radiological outcomes are much worse for the lateral partial meniscectomy (1). In addition, peak contact stresses and maximum shear stress are up to 200% greater following a lateral meniscectomy relative to a medial meniscectomy (2). Partial or complete meniscectomy have a direct impact on contact stresses and any deficits in these structures from injury or their removal likely have detrimental effects on knee joint function. The literature is sparse with few if any published studies on objective functional outcomes following isolated radial lateral meniscus tears in the athletic populations. The objective of this study was to determine if biomechanical differences would be observed during athletic maneuvers within subject (involved vs uninvolved limb) and between subject (lateral meniscectomized subjects vs uninjured controls) during bilateral drop landings three months after lateral meniscectomy surgery. We hypothesized that following a lateral meniscectomy, athletes aged 14-25 years old would demonstrate altered landing biomechanics during a functional task without concomitant strength differences relative to uninvolved limb and match control limb.

Methods:
Nine subjects (7 male and 2 female) who had undergone primary isolated radial lateral meniscus tears were tested three months following partial lateral meniscectomies and compared to nine sex, age, height, weight, and sport matched controls. This research was approved by two separate IRB boards at Cincinnati Children’s Hospital Medical Center and The University of Cincinnati and all subjects signed informed consents prior to participation in this study. Inclusion criteria was confirmed arthroscopically at the time of surgery. Subjects were excluded if there was a history of previous knee surgery or prior lower extremity complaints that were not resolved one year prior to surgery. Subjective knee function was determined with the use of the International Knee Documentation Criteria (IKDC) assessment tool. Subjects and controls were instrumented with 37 retroreflective markers. A ten camera motion analysis system and two force platforms were used to measure kinematics and kinetics during three trials of a bilateral drop landing. Internal joint movements were calculated using standard inverse dynamics within visual3Deach movement condition (bilateral drop-landings and medially and laterally directed single leg landings on each leg). A 2X2 ANOVA was used to test the effects of side (involved vs uninvolved) and group (patient, control) with alpha established a priori at p < 0.05.

Results:
The patient group demonstrated decreased internal knee extensor moment during the drop landing task compared to the uninvolved side and controls (interaction p<0.05)(Figure 1). However, the involved limb quadriceps strength did not demonstrate a similar reduction compared to the contralateral or control limbs during open chain isokinetic strength measurement (p>0.05). Decreased internal knee extensor moment was related to decreased subjective rating of knee function (r = 0.69, p<0.05). Interestingly, the decreased perception of function showed no similar relationship to quadriceps strength of the involved limb for the investigational subjects.

Discussion:
Three months following lateral meniscectomy surgery and physician release to play, the current investigational subjects employed compensation strategies during landing. The decreased internal knee extensor moment of the knee joint may be related to reduced knee force absorption potential from the removed lateral meniscus. These altered force absorption strategies do not appear to be related to quadriceps strength deficits. Lateral meniscectomy athletic populations may not provide optimal treatment results. Future work to determine the most effective salvage procedures for the lateral meniscus is warranted in competitive athletes.

Figure 1. Maximum knee extensor moment of patient and control subjects during bilateral drop landings. * p <0.05

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