Epidemiology of Existing Extensor Mechanism Pathology in Primary Anterior Cruciate Ligament Ruptures in an Active-Duty Population

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Authors: 
MAJ Todd P. Balog, MD MAJ Benjamin P. Blanks, PA MAJ Aaron D. Dykstra, MD MAJ Stephen A. Parada, MD COL (ret) Edward D. Arrington, MD
Author Affiliation | Disclosures

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Dr. Balog is a Staff Orthopedic Surgeon, Tripler Army Medical Center, Honolulu, Hawaii. Mr. Blanks is a Staff Physician Assistant, OrthoGeorgia, Macon, Georgia. Dr. Dykstra is a Staff Orthopedic Surgeon, Black Hills Orthopedic and Spine Center, Rapid City, South Dakota. Dr. Parada is Staff Orthopedic Surgeon, Eisenhower Army Medical Center, Fort Gordon, Georgia. Dr. Arrington is a Staff Orthopedic Surgeon and Director, Orthopedic Surgery Residency Program, Madigan Army Medical Center, Tacoma, Washington.

Address correspondence to: LTC Todd P. Balog, MD, 1 Jarrett White Rd, Honolulu, HI 96859 (tel, 832-326-5583; email, tbalog99@gmail.com).

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Take-Home Points

- Extensor mechanism pathology is a common finding in patients with ACL injuries.
- Extensor mechanism pathology such as a multipartite patella, unresolved Osgood-Schlatter’s disease, and patella tendinopathy are easily identifiable on standard imaging.
- It is unknown what type of effect, if any, these pathologies may have on graft strength.
- The bone-patella tendon-bone and quadriceps autograft are the most likely to be affected.
- Surgeons should take into account existing extensor mechanism pathology when considering individual patient graft selection for ACL reconstruction.

Anterior cruciate ligament (ACL) reconstruction is an extremely common procedure; in fact, an estimated 60,000 to 175,000 ACL reconstructions are performed annually in the United States. One of the most widely debated aspects of ACL reconstruction is the choice of graft. Grafts are broadly categorized into allografts and autografts. The autograft selections for ACL reconstruction include patellar bone-tendon-bone (pBTB), combined semitendinosus and gracilis hamstrings (HS), free quadriceps tendon (QT) without accompanying bone block, and quadriceps tendon-bone (qTB). Allograft choices predominantly include pBTB and HS, as well as the tibialis anterior and Achilles tendons. The pBTB autograft is traditionally considered the reference standard for ACL reconstruction.
reconstruction. Recent advances in allograft processing, along with improved fixation techniques and devices, have improved results following the use of soft-tissue autografts and both bony and soft tissue allografts. Thus, the optimal graft choice for ACL reconstruction has become controversial in light of several studies demonstrating no significant, long-term difference in clinical and/or functional outcomes based on graft selection.

Given the lack of a clear gold standard in graft selection, multiple patient factors, such as age, activity demands, and patient preference, should be taken into account when considering the choice of graft. In addition, intrinsic factors that could potentially weaken an autograft should be considered. Several extensor mechanism pathological findings that are easily visualized on either plain radiographs or magnetic resonance imaging (MRI) could potentially affect graft selection. Findings such as a multipartite patella, free ossicles about the tibial tuberosity consistent with Osgood-Schlatter’s disease, and proximal patella tendon thickening suggestive of patellar tendinopathy are easily identifiable on preoperative imaging and could exert adverse effects on pBTB, QT, and qTB autografts. The purpose of this study is to identify the prevalence of these pre-existing conditions in active-duty military patients presenting with acute ACL tears.

**Methods**

A retrospective review was conducted on all active-duty patients who underwent primary ACL reconstruction at our institution from July 2006 to February 2009. A systematic review of all plain radiographs and MRIs was performed on a calibrated picture archiving and communication system workstation. Imaging review was conducted by 2 of the authors. Pertinent findings included a multipartite patella, free ossicles within the patella tendon, and hypertrophy of the proximal aspect of the patella tendon. Assessment for multipartite patella and unresolved Osgood-Schlatter’s disease was made using plain radiographs with MRI for confirmation. Measurements of the patella tendon were performed on the short tau inversion recovery and T2-weighted sagittal MRI images at the point of maximal tendon width. A width of ≥7 mm was considered suggestive of patella tendinopathy based on prior studies. The prevalence of each finding was then determined based on the total number of patients.

**Results**

A total of 197 active-duty patients, including 27 females (13.7%) and 170 males (86.3%), underwent primary ACL reconstruction during the study time period. A total of 93 right knees and 104 left knees were evaluated. The average age at presentation was 29 years (range, 19-45 years).

Of the 197 patients, only 1 was found to have a multipartite patella (prevalence, 0.5%). This 37-year-old male patient showed a right bipartite patella located in the superior-lateral aspect (Figure 1).

Four patients had free ossicles within the inferior patellar tendon consistent with unresolved Osgood-Schlatter’s disease (prevalence, 2.0%) (Figure 2). All 4 patients were male, which is consistent with the higher incidence of Osgood-Schlatter’s disease in males than in females. The average age of these patients was 27.5 years (range, 22-33 years).

The most common extensor mechanism pathology present on preoperative imaging was proximal patella tendon thickening suggestive of patella tendinopathy. Thickening of the proximal portion of the patellar tendon was present in 15 of the 197 MRIs (prevalence, 7.6%) (Figure 3). The average width of this thickening was 8.49 mm (7.17-10.17 mm), and the average age of patients with radiographic evidence of patellar tendinopathy was 29.9
years (range, 20-43 years). Gender distribution was predominantly male (14 males, 1 female). Details of all extensor mechanism pathologies found are provided in the Table.

**Discussion**

When considering ACL reconstruction, determination of the graft type is one of the most important decisions to be made, perhaps second only to the decision to perform the surgery itself. Recent multiple, well-designed studies comparing differences among grafts have shown equivalent long-term results, leading to the lack of a universally accepted gold standard.\(^5\)\(^-\)\(^7\) Thus, both autograft and allograft ACL surgeries are routinely performed in the United States. Surgeons typically take into account factors such as patient age and physical demands, along with their own preferences and/or experience, when considering graft selection. A paucity of research concerning existing pathological conditions that could also influence preoperative decision-making has been observed; most reports consist only of expert opinion.\(^11\)\(^-\)\(^13\) Our goal is to determine the prevalence of several conditions that could potentially affect an autograft harvested from the extensor mechanism.

This study revealed an overall prevalence of 10.1% of existing extensor mechanism pathology in patients sustaining an acute ACL tear and presenting for ACL reconstruction. Only 1 (0.5%) showed evidence of a multipartite patella, which is below the reported prevalence of 0.2% to 6%.\(^14\) The presence of a multipartite patella could potentially have the most deleterious effect on a qTB autograft. Although not as commonly used as HS, QT, or pBTF autografts, some surgeons prefer a qTB autograft because of its increased surface area, bony fixation, and reported decreased donor site pain.\(^15\) A multipartite patella could complicate harvesting, disrupt the bone block, or lead to an unstable segment of the patella. These effects are of great concern since the most common location of a bipartite patella is superior-lateral and the quadriceps tendon has been shown to asymmetrically insert laterally.\(^16\) While these potential adverse effects have not been specifically studied, the availability of comparable options makes the use of a qTB autograft in the setting of a bipartite patella questionable.

Four patients (2%) revealed evidence of ossicles within the inferior patellar tendon consistent with unresolved Osgood-Schlatter’s disease. Osgood-Schlatter’s disease has been reported to occur in up to 21% of active adolescents and is historically considered a self-resolving process.\(^17\) Recent papers have reported persistent symptoms in up to 10% of patients, with a small percentage experiencing persistent free ossicles within their patella tendon on MRI.\(^18\)\(^,\)\(^19\) The presence of such ossicles raises concern about the integrity of the patellar tendon and questions its use as an autograft when present. This concern was published in a report with the surgeon opting to utilize an alternate graft due to the presence of unresolved Osgood-Schlatter’s disease.\(^13\)

Fifteen patients (7.6%) demonstrated radiographic evidence suggestive of patella tendinopathy based on the thickness of the proximal patellar tendon. Patella tendinopathy is the most common tendinopathy in skeletally mature athletes and one of the most common athletic injuries of the knee, with a reported career prevalence of 22%.\(^20\) It is described as an overuse injury due to the cumulative effect of micro trauma without an adequate healing interval. While it remains a clinical diagnosis, patellar tendinopathy often shows radiographic findings best assessed on sagittal MRIs. In general, the normal patella tendon appears as a homogenous low-intensity structure and is of uniform thickness. A tendon affected with tendinopathy typically demonstrates a focal increase in signal on T2-weighted sequences just distal to the tendon origin on the inferior pole of the patella. In addition, the patella tendon will usually demonstrate thickening, primarily in the proximal medial and posterior fibers. Patella marrow changes and indistinct tendon margins can also be present. The sensitivity and specificity of diagnosing patellar tendinopathy on MRI are 78% and 86%, respectively.\(^20\) We derived our criteria for MRI evidence suggestive of patella tendinopathy from studies by El-Khoury and colleagues,\(^8\) Johnson and colleagues,\(^9\) and Popp and colleagues.\(^10\) In a 1992 study, El-Khoury and colleagues\(^8\) compared MRI findings between a group of
patients with a clinical diagnosis of patella tendonitis and a control group without knee complaints. The authors found that the average proximal patella tendon diameter in the control group was 3.7 mm while the average proximal patella tendon diameter in the patella tendinopathy group was 10.9 mm; no patella tendons in the control group were >7 mm. In a 1996 study, Johnson and colleagues determined that the most reliable MRI finding for patients with patellar tendonitis is significant thickening of the proximal patella tendon seen on the sagittal view. The average thickness in symptomatic patients was 8.5 mm (range, 5-15 mm). The average thickness in the control group was 5.5 mm. None of the control patients had a proximal tendon thickness >7 mm. Finally, Popp and colleagues reviewed the MRI of 11 knees of patients who underwent surgical débridement of chronic patellar tendonitis and reported an average proximal patella tendon thickness of 12 mm (range, 9-16 mm). We therefore used a proximal patella tendon thickness of >7 mm on the sagittal view as a radiographic finding suggestive of patella tendinopathy. No data regarding symptoms of anterior knee pain were available among our patients. Histological studies of patients with patella tendonitis have shown evidence of chronic inflammation, fibrinoid necrosis, mucoid degeneration, and synovial proliferation within the patella tendon insertion. Although no controlled data showing that patella tendons with a history of tendonitis are more prone to failure than those without such history when used as an autograft for ACL reconstruction, the idea of utilizing a diseased tendon for a graft is not ideal. Some surgeons question their patients regarding a history of anterior knee pain and will not use a pBTB autograft in a patient with a positive history.

The goal of this study is to obtain epidemiological evidence of the prevalence of existing extensor mechanism pathologies in patients with acute ACL ruptures and determine how these pathologies may relate to the choice of graft. Out of 197 patients studied, over 10% presented with radiographic evidence of pathologies that could influence the choice of graft. This prevalence is certainly significant enough for surgeons to consider including a radiographic evaluation of the extensor mechanism in their standard ACL rupture work-up.

This study presents obvious limitations. While we report the prevalence of some extensor mechanism pathologies, no definitive evidence that recommends against the use of these autografts from these affected individuals has yet been published. In addition, our diagnosis of patella tendinopathy is based solely on MRI findings with no information regarding clinical symptoms. This limitation is a weakness as several additional studies have questioned the validity of a 7 mm proximal patella tendon thickness. Furthermore, no studies demonstrating the inferior strength of autografts with the co-existing findings described in our work have yet been performed.

**Conclusion**

We found that 10% of active-duty patients presenting for ACL reconstruction demonstrated radiographic evidence of an extensor mechanism pathology that could affect the harvesting of or integrity of select autografts. Given the recent trend of functionally equivocal results in ACL reconstructions utilizing a variety of grafts, this information could and should influence surgical recommendations for graft utilization to obtain optimal surgical results.

**Key Info**
Figures/Tables

Figures / Tables:

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Figure 1. Radiograph of a superolateral bipartite patella.
Figure 2. Radiograph of free ossicles within the patella tendon indicative of unresolved Osgood-Schlatter’s disease.
Table. Identified Extensor Mechanism Pathology

<table>
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20/97 (10.10%)
References


Multimedia
Product Guide

Product Guide

- Med4 Elite
- GRPro 2.1
- Shoulder Wrap
- Knee Wrap

Citation

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MAJ Todd P. Balog, MD