

# Anterolateral Ligament Reconstruction Practice Patterns Across the United States

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**Background:** A proposed mechanism for recurrent instability following anterior cruciate ligament (ACL) reconstruction is failure of the anterolateral ligament (ALL). Presently, there are a number of approaches to treating ALL pathology.

**Purpose:** To determine practice patterns among orthopaedic surgeons regarding ALL during ACL reconstruction.

**Study Design:** Cross-sectional study.

**Methods:** An online 7-question survey was sent to all physicians registered with the American Orthopaedic Society for Sports Medicine between June and July 2017. Results were analyzed with the survey website.

**Results:** Overall, 225 of 3467 surgeons responded to the survey, 86 of whom performed ALL reconstruction and completed each question in the survey. Eighty-six (38.2%) surgeons who responded to the questionnaire stated that they perform ALL reconstruction/lateral extra-articular tenodesis in conjunction with ACL reconstruction. The most common indications for ALL reconstruction were grade III pivot-shift test (46.0%) on physical examination and revision ACL reconstruction (46.0%). The most common technique used to perform ALL reconstruction was hamstring autograft (48.2%). The majority of participating surgeons (87.5%) stated that they do not make any alterations to their postoperative rehabilitation protocol after they perform ALL reconstruction. In addition, most surgeons responding to the survey (91.3%) anticipated either an increase in or the same number of ALL procedures performed in the coming year.

**Conclusion:** The majority of surgeons who responded to the survey did not routinely reconstruct the ALL. Revision procedures and grade III pivot shift were the most cited indications for performing lateral augmentation. Anatomic reconstruction with hamstring was the most commonly used procedure, although there was no consensus among surgeons responding to the survey. Understanding the ALL and its contribution to knee stability is essential. For a community of physicians, it is useful to discover how fellow sports orthopaedic surgeons address ALL pathology to integrate effective and efficient treatment strategies into practice.

**Keywords:** anterolateral ligament; ALL reconstruction; ACL reconstruction; knee instability

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Anterior cruciate ligament (ACL) reconstruction is one of the most common procedures performed by sports orthopaedic surgeons, with about 130,000 cases annually in the United States alone.<sup>2,22</sup> Although the results of ACL reconstruction with current techniques is generally good, there remains a subset of patients who do not return to optimal levels following surgery, owing to complications such as graft failure and persistent knee instability.<sup>21,27,28,46</sup> Isolated ACL reconstructions were reported to have failure rates from 1.8% to 14%.<sup>18,30,43</sup> In addition, up to 25% of ACL reconstructions were reported to have some level of residual rotational instability, despite technically appropriate procedures.<sup>3</sup> While graft failure following ACL reconstruction has been well studied,<sup>13,29,45</sup> a proposed mechanism of instability that has recently gained increased interest in the orthopaedic community is failure of the anterolateral ligament (ALL).<sup>10,12,14,23</sup>

The ALL is a fibrous bundle running from the lateral distal femur to the anterolateral proximal tibia.<sup>5,44</sup>

Disruption of the ALL is a common concurrent injury during an ACL tear.<sup>11</sup> A study evaluating the ALL with magnetic resonance imaging of individuals who underwent ACL reconstruction found that 78.8% of knees demonstrated concomitant radiological ALL abnormalities.<sup>4</sup> There have been numerous biomechanical studies investigating the contribution of the ALL to maintaining knee stability as a secondary restraint to anterior tibial translation and internal rotation.<sup>7,37,42</sup> These studies highlight the importance of the ALL in maintaining rotational stability of the knee. Rotary knee laxity, demonstrated by a high-grade pivot-shift test on physical examination, is a cause of patient dissatisfaction following ACL repair.<sup>12,26,40</sup>

Controversy exists whether ALL repair/reconstruction or lateral extra-articular tenodesis during ACL repair is indicated and beneficial in improving knee stability following reconstruction.<sup>15,33-35,38,41</sup> Based on currently available information, it remains challenging for the practicing orthopaedic sports surgeon to be aware of the current practice trends regarding ALL reconstruction.

The purpose of our study was to conduct an online survey to gain an understanding of how sports orthopaedic surgeons address the ALL during ACL reconstruction. Additionally, we set out to determine the indications used for performing ALL repair/reconstruction or lateral extra-articular tenodesis, the surgical techniques utilized, and the changes to postoperative rehabilitation protocols. We hypothesized that the majority of surgeons currently do not perform routine reconstruction of the ALL in primary reconstruction but consider it in the setting of revision surgery.

## METHODS

We created a 7-question survey as presented in Figure 1. The survey was created online (www.surveymonkey.com) and sent to all physicians registered with the American Orthopaedic Society for Sports Medicine (AOSSM). The directory was obtained from the membership office of the AOSSM. The survey was sent on June 1, 2017, and again on July 1, 2017. All responses were organized through the results analyzer on the SurveyMonkey website. All personal information of the respondents (name, email address, and IP address) was kept confidential and unknown to us. Physicians were instructed to respond to all relevant questions and were not able to complete the survey unless all questions were answered.

## RESULTS

Overall, 6.5% of physicians listed on the AOSSM directory (225 of 3467 surgeons) responded to the survey; 86 of them performed ALL reconstructions and responded to every question. The majority of surgeons surveyed (86%) performed less than 100 ACL reconstructions per year, with the largest percentage performing 26 to 50 per year (Table 1).

Eighty-six surgeons stated that they perform ALL reconstruction/lateral extra-articular tenodesis in conjunction with ACL reconstruction. Grade III pivot shift (46.0%)

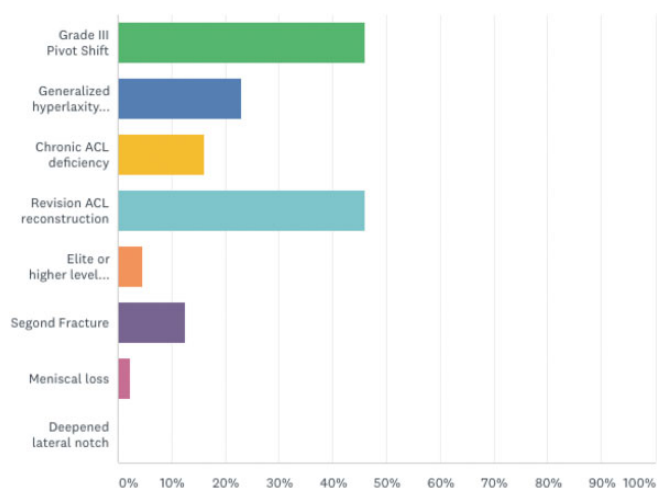
1. How many ACL reconstructions do you perform per year?
  - a. 1-25
  - b. 26-50
  - c. 51-75
  - d. 76-100
  - e. Over 100
2. Do you perform ALL reconstruction or LET in conjunction with ACL reconstruction?
  - a. Yes
  - b. No
3. What are your indications for ALL reconstruction? (Check all that apply)
  - a. Grade III pivot shift
  - b. Generalized hyperlaxity
  - c. Chronic ACL deficiency
  - d. Revision ACL reconstruction
  - e. Elite or high-level athlete
  - f. Segond fracture
  - g. Meniscal loss
  - h. Deepened lateral notch
4. What technique do you perform for ALL reconstruction?
  - a. ITB tenodesis, LeMaire technique or modified
  - b. ITB tenodesis, MacIntosh technique or modified
  - c. Anatomic ALL reconstruction with hamstring
  - d. Other
5. In what percentage of your ACL reconstruction cases do you perform ALL reconstruction?
  - a. <10%
  - b. 10-25%
  - c. 26-50%
  - d. 51-75%
  - e. >75%
6. Is your post operative rehabilitation altered if an ALL reconstruction or LET is performed with ACL reconstruction?
  - a. No, rehab is the same
  - b. Yes, more aggressive
  - c. Yes, less aggressive
7. In the coming year would you anticipate an increase, decrease or about the same number of ALL procedures performed with your ACL surgery?
  - a. Increase
  - b. Decrease
  - c. The same

**Figure 1.** Seven-question survey. ACL, anterior cruciate ligament; ALL, anterolateral ligament; ITB, iliotibial band; LET, lateral extra-articular tenodesis.

**TABLE 1**  
Number of ACLRs Performed per Year  
With Percentage of Total Responses<sup>a</sup>

No. of ACLRs Performed	Responses	
	n	%
1-25	23	26.44
26-50	26	29.89
51-75	13	14.94
76-100	12	13.79
>100	12	13.79

<sup>a</sup>ACLR, anterior cruciate ligament reconstruction.



**Figure 2.** Indications for performing anterolateral ligament reconstruction or lateral extra-articular tenodesis; percentage of total responses. ACL, anterior cruciate ligament.

and revision ACL reconstruction (46.0%) were the most common indications for ALL reconstruction. Other indications mentioned were generalized hyperlaxity (23.0%), chronic ACL deficiency (16.0%), Segond fracture (12.6%), elite- or high-level athlete (4.5%), and meniscal loss (2.3%). No surgeons stated that a deepened lateral notch was used as an indication for ALL reconstruction (Figure 2).

The most common technique used to perform ALL reconstruction was anatomic ALL reconstruction with hamstring autograft or allograft (48.2%). The second most commonly used technique was “iliotibial band tenodesis, the LeMaire technique, or modified” (20.4%). Other techniques mentioned included MacIntosh or modified (13.0%), anatomic with semitendinosus allograft (1 surgeon), anatomic with Achilles allograft (1 surgeon), Werner Müller lateral reconstruction (1 surgeon), and Andrews extra-articular tenodesis (1 surgeon) (Figure 3).

The majority of surgeons who responded to the survey (59.6%) did not routinely preform ALL reconstruction in conjunction with ACL reconstruction. Most surgeons responding to the questionnaire (89.8%) who performed ALL augmentation undertook the procedure on less than 10% of patients undergoing ACL reconstruction. The remainder performed ALL reconstruction on 10% to 25% of patients undergoing ACL reconstruction.

When asked about postoperative rehabilitation, 87.5% of surgeons stated that they did not make any alterations to the protocol, while 13% responded that they were less aggressive with postoperative rehabilitation. No surgeon stated that he or she was more aggressive with rehabilitation after ALL reconstruction.

Roughly a quarter of surgeons (23.2%) believed that the number of ALL procedures that they perform will increase in the coming year. The majority of surgeons surveyed (68.1%) did not anticipate an increase in the coming year. A small number of surgeons (8.7%) anticipated a decrease in their volume of ALL procedures (Figure 4).

## DISCUSSION

Our primary study hypotheses were confirmed: the majority of surgeons who responded to the survey did not routinely preform ALL reconstruction in conjunction with ACL reconstruction, and the most commonly cited indications for ALL reconstruction were revision ACL reconstruction and grade III pivot shift.

To our knowledge, this is the first study to survey orthopaedic surgeons on ALL reconstruction practices. Since early anatomic investigations, there has been a surge in literature examining the ALL.<sup>5</sup> While the biomechanics and treatment of ALL pathology have become well documented in the literature, there is little known about how these have become integrated into modern surgical practice. Given the increasing incidence of ACL injury and reconstruction, determining the ideal treatment is important. This study gives us insight into current surgical trends among the orthopaedic community.

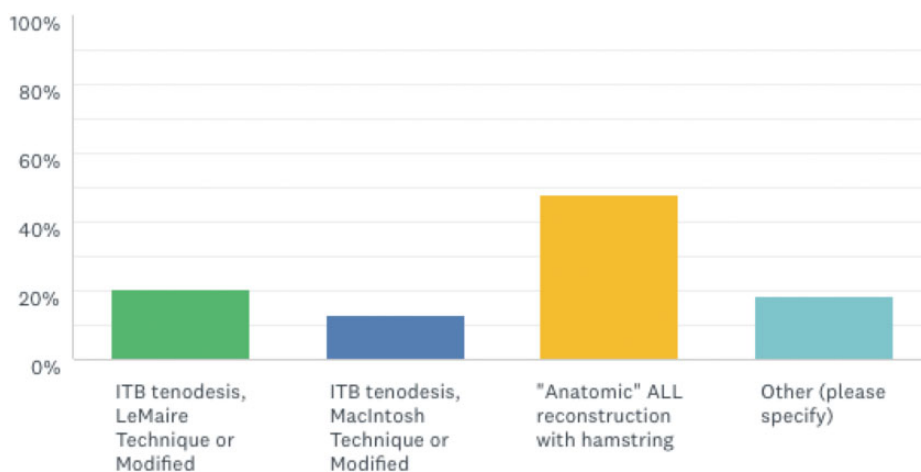
### Surgical Indications

The most commonly cited indications for ALL reconstruction among those surveyed were revision ACL reconstruction and a grade III pivot-shift test (46.0% each). This is consistent with the currently available literature, which frequently references revision cases and high-grade pivot shift as primary indications for proceeding with ALL reconstruction.<sup>20,31,35</sup> Biomechanical studies have shown that grade III pivot shift occurs with sectioning of the ALL and ACL versus the ACL alone.<sup>31</sup> Residual rotational instability may be a cause of clinical ACL reconstruction failure, and ALL reconstruction potentially increases rotary stability following revision surgery.<sup>34,36,41</sup>

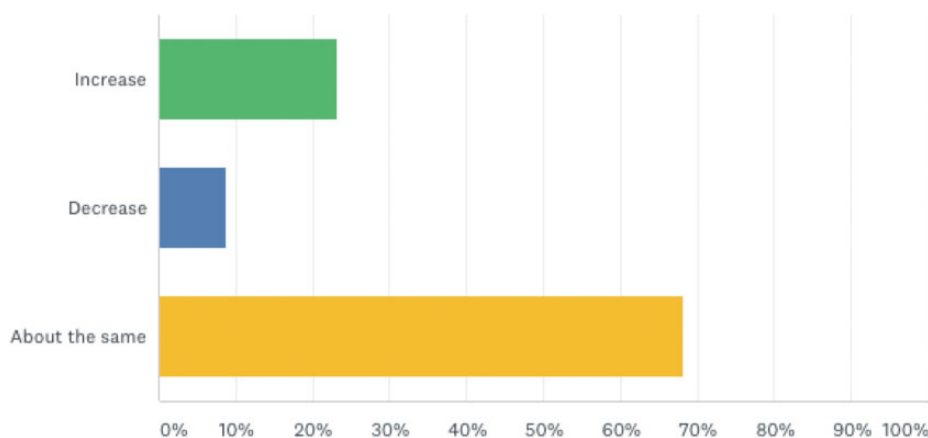
The decision to proceed with ALL reconstruction can also be based on the patient’s level of activity. Previous authors have advocated for additional procedures among very high-level athletes or individuals participating in tasks that require absolute stability of the lower extremity.<sup>32</sup> While ALL reconstruction during primary ACL has been identified as a risk factor for overconstraint in biomechanical studies,<sup>25</sup> the treating orthopaedic surgeon must consider patient factors and goals when approaching the ALL-deficient knee.

### Surgical Technique

The most common surgical technique used by physicians in our study was ALL reconstruction via hamstring autograft or allograft. Given the previous variability in anatomic descriptions, a number of surgical techniques have been developed to address ALL deficiency.<sup>6</sup> These procedures involve either lateral extracapsular tenodesis (LET) or graft reconstruction of the ligament. In 1967, Lemaire described a technique involving utilization of a central slip of the iliotibial band.<sup>37</sup> In this procedure, the graft is left attached distally to the Gerdy tubercle, while the proximal portion is lifted off and passed deep to the lateral collateral ligament (LCL) through a femoral tunnel to the presumed insertion point of the ALL posterior and proximal to the



**Figure 3.** Technique used for lateral augmentation; percentage of total responses. ALL, anterolateral ligament; ITB, iliotibial band.



**Figure 4.** Percentage of total responses to the question "Will the number of ALL procedures you perform increase, decrease, or remain the same in the coming year?" ALL, anterolateral ligament.

lateral epicondyle. The graft is then passed back under the LCL and sutured in place at its insertion on the Gerdy tubercle. The modified Lemaire technique involves a similar approach; however, the slip of iliotibial band is passed superficial, rather than deep, to the LCL. This allows the LCL to sit in its anatomic position, without the graft interposed between the ligament and the femur. Proponents of the modified technique cite the passage of graft deep to the LCL as a potential interference to normal ligament biomechanics, whereas passing superficial helps bolster the LCL and provides additional rotational stability.<sup>39</sup>

The Macintosh procedure involves a similar lateral approach to the knee, with a 15-cm strip of iliotibial band lifted off its proximal insertion and left attached distally. The slip of iliotibial band is then passed through a soft tissue tunnel formed underneath the proximal portion of the LCL. A small osteoperiosteal flap is created, and the strip of iliotibial band is laid deep to it. The iliotibial band is then wrapped several times around the insertion of the intramuscular septum, pulled as tight as possible, and

sutured in place. Finally, the graft is passed back underneath the LCL and sutured in place at its attachment to the Gerdy tubercle.<sup>17</sup> The modified Macintosh procedure, popularized by Arnold et al,<sup>1</sup> involves a similar approach except that the graft is passed deep to the popliteus tendon as well as the LCL.

Additionally, reconstruction of the ALL can be performed with hamstring graft fixation via bone tunnels at the previously described anatomic landmarks of the ALL.<sup>9</sup> Specifically, the ALL has been found to originate on the femur 2.7 mm proximal and 2.8 mm posterior to the LCL, while the insertion on the tibia is 24.7 mm posterior to the center of the Gerdy tubercle and 26.1 mm proximal to the anterior margin of the fibular head.<sup>19</sup> Published techniques involve use of either gracilis or semitendinosus autograft or allograft. The majority of techniques involve reaming bone tunnels and providing graft fixation via biointerference screws to restore the anatomic footprint of the ALL.

Multiple studies have been conducted to assess knee stability following combined ACL and ALL reconstruction or

LET.<sup>6,16,24</sup> These biomechanical studies comparing various reconstruction techniques in cadavers found that ALL reconstruction and LET resulted in significantly decreased residual instability as compared with ACL reconstruction alone. Additionally, there were no significant biomechanical differences between the ALL reconstruction or LET techniques.

### Limitations

There were several limitations to our study. Online surveys are known to have inherent limitations.<sup>8</sup> Additionally, there was no way to confirm the validity of provided responses, and the amount of detail is limited in our survey format. We were only able to draw conclusions regarding expert consensus on management of ALL injury. There was a low response rate based on the number of surveys sent; thus, true practice patterns may differ from those of the respondents. This was a cross-sectional survey, and it is possible that individuals have modified their approach to ALL pathology since they responded to the survey. Additionally, the survey provided general answers to surgical approach and did not specify variables such as graft choice. Finally, our sample size of surgeons completing the entire survey represents a small percentage of the overall sports medicine physician population.

### CONCLUSION

The survey presented in this study found that the majority of responding surgeons do not perform routine ALL reconstruction. Although there has been a recent surge in literature investigating ALL anatomy and contribution to knee biomechanics, there remains disagreement among surgeons regarding indications and surgical techniques for reconstruction. Despite these new investigations, the majority of surgeons surveyed anticipate a similar volume of ALL reconstructions performed in the coming years.

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