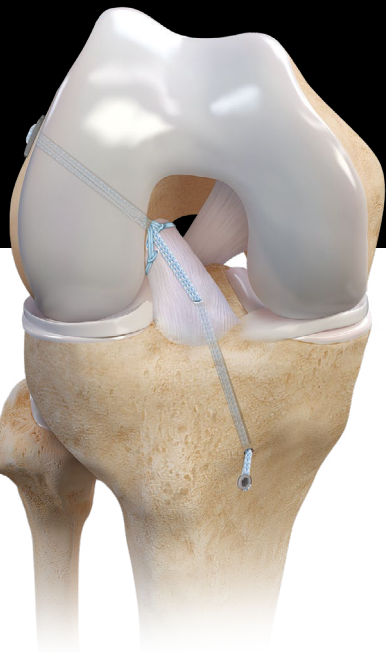


# Primary Cruciate Ligament Repair Scientific Update

A review of the design rationale, techniques, and outcomes



Simard SG,  
Greenfield CJ,  
Khoury AN

There has been a renewed interest in primary repair as the treatment for certain patterns of ACL rupture. Primary ACL repair was largely abandoned by the mid-1990s due to inconsistent clinical outcomes. However, careful analysis of the older data reveals that certain subgroups, especially proximal tears with good tissue quality, had better clinical outcomes than the group as a whole.<sup>1</sup>

In light of advances in diagnostic imaging, arthroscopic surgical technology, and rehabilitation approaches in recent decades, primary ACL repair is a concept that is ripe for reevaluation. Using modern MRI imaging and in-office diagnostic evaluation with the NanoScope™ camera, we have the ability to preoperatively identify tears that might be amenable to repair.

## In Vivo Studies: Clinical Outcomes

[Anterior cruciate ligament repair with suture tape augmentation of proximal tears and early anterior cruciate ligament reconstruction with suture tape augmentation result in comparable clinical outcomes with anterior cruciate ligament reconstruction at 2-year follow-up.](#)

*Arthroscopy*. Published online July 26, 2024. doi:10.1016/j.arthro.2024.07.021

- Level II prospective study comparing clinical outcomes following acute ACL repair to acute and nonacute ACL reconstruction all performed with suture tape augmentation.
- 100 patients with a minimum 2-year follow-up were categorized into 3 groups based on tissue quality, tear type, and duration of injury. All 3 groups received suture tape augmentation as part of their surgical intervention. The ACL repair group included 34 patients with a proximal avulsion (Sherman type I) sustained less than 8 weeks prior. The remaining 66 patients underwent ACL reconstruction using an all-inside technique with hamstring tendon autograft (33 treated before 8 weeks = ACLR<sup>acute</sup> and 33 treated after 8 weeks = ACLR).
- All 3 groups demonstrated improved PROs with no significant differences in side-to-side knee laxity, range of motion, or retear rates. MRI at 1-year post-op revealed proper graft incorporation among all 3 groups with no evidence of intra-articular complications.

## Takeaway

When performed acutely with suture tape augmentation, ACL repair was noninferior to both ACL reconstruction groups. Additionally, the differences between acute and nonacute ACL reconstruction were negligible.

Connolly PT,  
Zittel KW,  
Panish BJ,  
Rigor PD,  
Argintar EH

[A comparison of postoperative pain between anterior cruciate ligament reconstruction and repair.](#) *Eur J Orthop Surg Traumatol.* 2021;10.1007/s00590-020-02859-0. doi:10.1007/s00590-020-02859-0zz

- This comparison includes 36 ACL repair patients and 71 ACL reconstruction patients.
- The mean visual pain score was significantly lower for ACL repair patients compared to ACL reconstruction patients.

#### Takeaway

Patients who underwent ACL repair experienced less short-term postoperative pain and were prescribed fewer narcotics than patients who underwent ACL reconstruction.

Burton DA,  
Schaefer EJ,  
Shu HT,  
Bodendorfer BM,  
Argintar EH

[Primary anterior cruciate ligament repair using suture tape augmentation: a case series of 29 patients with minimum 2-year follow-up.](#) *Arthroscopy.* 2021;37(4):1235-1241. doi:10.1016/j.arthro.2020.11.034

- Evaluated clinical outcomes and patient-reported outcomes of patients who underwent primary ACL repair using suture tape augmentation.
- Level IV prospective case series that included patients with a proximal tear of the ACL who underwent primary ACL repair with a minimum 2-year follow-up.

#### Takeaway

Primary surgical repair of proximal ACL tears using suture tape augmentation results in a low rate of revision surgery (2 of 29 patients).

Vermeijden HD,  
Jonkergouw A,  
van der List JP,  
DiFelice GS

[The multiple ligament-injured knee: when is primary repair an option?](#) *Knee.* 2020;27(1):173-182. doi:10.1016/j.knee.2019.11.013

- Authors found that 55% of ACL, 73% of PCL, 88% of MCL/PMC, and 87% of LCL/PLC injuries were ultimately repaired within 6 weeks postinjury.
- Authors found that age above 35 years (OR 6.9, P = 0.010) and higher BMI (OR 3.5, P = 0.046) were associated with increased likelihood to undergo ACL repair.

#### Takeaway

This study showed high incidences of repairable ligaments when multiple ligament-injured knees are treated in the acute setting.

Ferretti A,  
Monaco E,  
Annibaldi A,  
Carrozzo A,  
Bruschi M,  
Argento G,  
DiFelice GS

[The healing potential of an acutely repaired ACL: a sequential MRI study.](#) *J Orthop Traumatol.* 2020;21(1):14. doi:10.1186/s10195-020-00553-9

- Retrospective study reviewed the short-term follow-up of the first 10 consecutive patients who underwent primary ACL repair.
- Sequential exams, both clinical and via MRI, were performed and showed predictable healing of the repaired ACL.

#### Takeaway

“Arthroscopic primary ACL repair performed acutely in a carefully selected group of patients with proximal ACL tears and good tissue quality showed good early clinical and radiological results.”



Vermeijden HD,  
van der List JP,  
O'Brien R,  
DiFelice GS

[Patients forget about their operated knee more following arthroscopic primary repair of the anterior cruciate ligament than following reconstruction.](#) *Arthroscopy.* 2020;36(3):797-804. doi:10.1016/j.arthro.2019.09.041

- Assesses the extent to which patients forget their operative knee joint on a daily basis following arthroscopic primary repair as compared with reconstruction of the ACL at short- to mid-term follow-up.
- Patients were treated with the algorithm of undergoing arthroscopic primary repair for proximal tears and reconstruction for nonrepairable tears.
- 83 patients completed the questionnaire (57%). Patients who underwent primary repair thought about their operated knee less when compared with those patients who underwent reconstruction.

#### Takeaway

Based on the data in this study, patients undergoing arthroscopic primary ACL repair can expect to have less daily awareness of their operated knee at short- to mid-term follow-up as compared with patients undergoing ACL reconstruction.

Douguilh WA,  
Zade RT,  
Bodendorfer BM,  
Siddiqui Y,  
Lincoln AE

[Anterior cruciate ligament repair with suture augmentation for proximal avulsion injuries.](#) *Arthrosc Sports Med Rehabil.* 2020;2(5):e475-e480. doi:10.1016/j.asmr.2020.05.003

- Retrospective review study of 27 patients who underwent ACL primary repair performed by a single surgeon. Patients were included if they were at least 24 months post-op from repair surgery.
- Authors found that 85.2% of patients had successful ACL repair with no clinical instability and no subjective complaints at final follow-up, and 14.8% required revision to reconstruction surgery.

#### Takeaway

Authors found that arthroscopic ACL primary repair with suture augmentation resulted in high functional outcomes and improved patient-reported outcomes at 2-year follow-up.

Vermeijden HD,  
van der List JP,  
O'Brien R,  
DiFelice GS

[Return to sports following arthroscopic primary repair of the anterior cruciate ligament in the adult population.](#) *Knee.* 2020;27(3):906-914. doi:10.1016/j.knee.2020.04.001

- A retrospective review study of 60 patients treated with ACL primary repair to assess return to sport rates and evaluate the timeline of rehabilitation milestones following arthroscopic primary repair of the ACL.
- Authors identified that time to return to work, time to return to running, and time to return to sport occurred quicker when compared to ACL reconstruction studies.

#### Takeaway

Authors found that 85% of patients returned to any sports participation, 70% of adult patients returned to knee-strenuous sports, and 60% to preinjury levels by 180 days after the primary repair.



van der List JP,  
Jonkergouw A,  
van Noort A,  
Kerkhoffs GMMJ,  
DiFelice GS

[Identifying candidates for arthroscopic primary repair of the anterior cruciate ligament: a case-control study.](#) *Knee.* 2019;26(3):619-627. doi:10.1016/j.knee.2019.02.004

- Retrospectively reviewed 261 patients who underwent ACL surgery to assess predictive factors for the possibility of undergoing arthroscopic primary ACL repair.

#### Takeaway

Of all patients, 44% had a repairable tear. Primary repair was associated with older age (>35 years old) lower BMI (<25), and surgery performed within four weeks of injury.

van der List JP,  
Vermeijden D,  
O'Brien R,  
DiFelice GS

[Anterior cruciate ligament reconstruction following failed primary repair: surgical technique and a report of three cases.](#) *Minerva Ortop Traumatol.* 2019;70(2):70-77. doi:10.23736/S0394-3410.19.03924-9

- Authors showed that ACL reconstruction after failed ACL repair in this small group of patients was an uncomplicated single-stage revision that is similar to primary reconstruction.

#### Takeaway

Authors described that no surgical bridges seem to be burned when performing primary ACL repair since it can be easily converted to a reconstruction if the repair happens to fail.

van der List JP,  
Jonkergouw A,  
DiFelice GS

[Failure and reoperation rates following arthroscopic primary repair versus reconstruction of the anterior cruciate ligament.](#) *Orthop J Sports Med.* 2019;7(7 suppl5):2325967119S00297. doi:10.1177/2325967119S00297

- Clinical significance: This is the first study to compare the failure and reoperation rates following arthroscopic primary repair versus reconstruction in a large cohort of patients.
- This study retrospectively reviewed patients with ACL injury operatively treated between April 2008 and May 2016 by one surgeon.
- Of the 154 patients included, 56 underwent primary repair. Patients with proximal tears were treated with primary repair using suture anchors or otherwise underwent standard reconstruction.
- Failure rates were lower following primary repair (10.7%) than ACL reconstruction (12.2%), but this was not statistically significant ( $P = 0.776$ ).

#### Takeaway

Arthroscopic primary repair is a safe and good treatment for ACL injuries with similar failure and reoperation rates when compared to the gold standard of ACL reconstruction.



Jonkergouw A,  
van der List JP,  
DiFelice GS

[Arthroscopic primary repair of proximal anterior cruciate ligament tears: outcomes of the first 56 consecutive patients and the role of additional internal bracing.](#) *Knee Surg Sports Traumatol Arthrosc.* 2019;27(1):21-28. doi:10.1007/s00167-018-5338-z

- This is a clinical study to assess outcomes of 56 patients who underwent arthroscopic ACL repair at a minimum 2-year follow-up. Twenty-seven of these patients also received additional internal bracing with the repair.
- Improvements were seen on subjective and objective IKDC, modified Cincinnati, SANE, and Tegner scores. There was a 13.8% failure rate without and a 7.4% failure rate with internal bracing.

#### **Takeaway**

Primary repair has resulted in good outcomes at 3-year follow-up in a carefully selected patient population. The role of internal bracing is possibly beneficial.

Heusdens CHW,  
Hopper GP,  
Dossche L,  
Roelant E,  
Mackay GM

[Anterior cruciate ligament repair with independent suture tape reinforcement: a case series with 2-year follow-up.](#) *Knee Surg Sports Traumatol Arthrosc.* 2019;27(1):60-67. doi:10.1007/s00167-018-5239-1

- This is the first case series that described the 2-year follow-up results of patients with an acute proximal ACL rupture who were treated with the independent suture tape reinforcement repair technique.
- “A meaningful KOOS sport and recreation change and significant improvements in the KOOS, VAS-pain and VR-12 physical scores as well as a significant decrease of the Marx activity scale in comparison to preoperative scores are demonstrated.”
- “Two of the 42 patients (4.8%) reported an ACL rerupture” and were treated with ACL reconstruction without complications.

#### **Takeaway**

Primary ACL repair with independent suture tape augmentation is a potentially advantageous treatment option for acute proximal ACL avulsions with good tissue quality.

DiFelice GS,  
van der List JP

[Clinical outcomes of arthroscopic primary repair of proximal anterior cruciate ligament tears are maintained at mid-term follow-up.](#) *Arthroscopy.* 2018;34(4):1085-1093. doi:10.1016/j.arthro.2017.10.028

- Level IV case series assessing clinical outcomes following primary arthroscopic repair of proximal ACL avulsions.

#### **Takeaway**

“The clinical outcomes of arthroscopic primary repair of proximal ACL tears with suture anchors are excellent and are maintained at mid-term follow-up in a carefully selected subset of patients with proximal tears and excellent tissue quality.”



van der List JP,  
DiFelice GS

[Range of motion and complications following primary repair versus reconstruction of the anterior cruciate ligament.](#) *Knee.* 2017;24(4):798-807. doi:10.1016/j.knee.2017.04.007

- Following primary ACL repair, patients had improved postoperative range of motion and trends toward fewer complications than those undergoing ACL reconstruction.
- This paper relates what surgeons who adopt ACL repair will experience with their patients. That is, their patients recover much quicker and have fewer problems than patients who undergo ACL reconstruction surgery.

#### **Takeaway**

“Primary repair is a safe, brief procedure with early range of motion and low complication rates.”

van der List JP,  
DiFelice GS

[Successful arthroscopic primary repair of a chronic anterior cruciate ligament tear 11 years following injury.](#) *HSS J.* 2017;13(1):90-95. doi:10.1007/s11420-016-9530-8

- This case reported on a successful arthroscopic primary repair of a proximal ACL tear 11 years following injury.

#### **Takeaway**

“The conditions, such as proximal tear location, sufficient tissue length, and excellent tissue quality, could potentially be more important for successful outcomes of arthroscopic primary ACL repair than acuity of the surgery.”

Achtnich A,  
Herbst E,  
Forkel P,  
Metzlauff S,  
Sprenger F,  
Imhoff AB,  
Petersen W.

[Acute proximal anterior cruciate ligament tears: outcomes after arthroscopic suture anchor repair versus anatomic single-bundle reconstruction.](#) *Arthroscopy.* 2016;32(12):2562-2569. doi:10.1016/j.arthro.2016.04.031

- The purpose of this study was “to compare clinical and radiologic results of primary ACL suture anchor repair and microfracturing with anatomic ACL single-bundle reconstruction in patients with acute proximal ACL avulsion tears.”
- “Proximal refixation of the ACL using knotless suture anchors and microfracturing restores knee stability and results in comparable functional outcomes to a control group treated with single-bundle ACL reconstruction. The results suggest that refixation of the ACL is a feasible treatment option in selected patients.”

#### **Takeaway**

“The independent suture tape reinforcement technique reinforces the ligament as a secondary stabilizer, encouraging natural healing of the ligament by protecting it during the healing phase and supporting early mobilization.”



DiFelice GS,  
Villegas C,  
Taylor S

[Anterior cruciate ligament preservation: early results of a novel arthroscopic technique for suture anchor primary anterior cruciate ligament repair.](#) *Arthroscopy*. 2015;31(11):2162-2171. doi:10.1016/j.arthro.2015.08.010

- “Preservation of the native ACL using the described arthroscopic primary repair technique can achieve short-term clinical success in a carefully selected subset of patients with proximal avulsion-type tears and excellent tissue quality.”
- The surgical technique is described using a Bunnell-type stitch to secure the ACL and anchor it to the femur wall using SwiveLock® anchors.

#### Takeaway

“Ten of eleven patients had good subjective and clinical outcomes after ACL preservation surgery at a minimum of 2 years’ and a mean of 3.5 years’ follow-up.”

MacKay G,  
Anthony IC,  
Jenkins PJ,  
Blyth M

[Anterior cruciate ligament repair revisited. preliminary results of primary repair with internal brace ligament augmentation: a case series.](#) *Orthop Muscul Syst*. 2015;4(2):1-5. doi:10.4172/2161-0533.1000188

- Sixty-eight consecutive patients who underwent ACL repair using the *InternalBrace*™ procedure were followed for a minimum of 1 year following surgery.
- “Improvement was seen over the study period in all KOOS and WOMAC domains with the majority of improvement seen in the first three months. The results were comparable to the literature on ACL reconstruction.”

#### Takeaway

“This audit provides early functional outcome and failure data that demonstrates the technique of ACL repair with IBLA is comparable with early results from ACL reconstruction, with the greatest improvements seen in return to sporting activity.”

### In Vitro Studies: Biomechanical Validation

Bachmaier S,  
DiFelice GS,  
Sonnery-Cottet B,  
Douguih WA,  
Smith PA, Pace LJ,  
Ritter D,  
Wijdicks CA

[Treatment of acute proximal anterior cruciate ligament tears-part 1: gap formation and stabilization potential of repair techniques.](#) *Orthop J Sports Med*. 2020;8(1):2325967119897421. doi:10.1177/2325967119897421

- This study compares gap formation and residual load-bearing capability in different ACL repair techniques, including single- and double-cinch loop (CL) cortical button fixation as well as knotless single-suture anchor fixation.

#### Takeaway

Significantly improved stabilization and reduced gap formation was noted following a single-cinch loop cortical button adjustable fixation compared to all other constructs. It should be noted that due to the limitations of the testing model, only the single-suture anchor configuration was evaluated in this study.

The *InternalBrace* surgical technique is intended only to augment the primary repair/reconstruction by expanding the area of tissue approximation during the healing period and is not intended as a replacement for the native ligament. The *InternalBrace* technique is for use during soft tissue-to-bone fixation procedures and is not cleared for bone-to-bone fixation.



Chahla J,  
Nelson T,  
Dallo I,  
Yalamanchili D,  
Eberlein S,  
Limpisvasti O,  
Mandelbaum B,  
Metzger MF

[Anterior cruciate ligament repair versus reconstruction: a kinematic analysis.](#) *Knee.* 2020;27(2):334-340. doi:10.1016/j.knee.2019.10.020

- The purpose of this study was to compare the biomechanical properties of an ACL anatomic repair of a true femoral avulsion to an anatomic ACL reconstruction.
- Ten paired fresh frozen cadaveric specimens (n = 20) were used to investigate knee kinematics when an anterior drawer force, varus, valgus, internal, and external rotation moment were applied at 0°, 14°, 30°, 45°, 60°, and 90° of flexion.
- Repair and reconstruction procedures both restored anterior tibial translation in matched-pair specimens.

#### Takeaway

ACL repair and ACL reconstruction procedures restored knee anterior tibial translation in matched pair specimens. There was no difference in varus, valgus, internal, or external rotation forces.

Massey P,  
Parker D,  
McClary K,  
Robinson J,  
Barton RS,  
Solitro GF

[Biomechanical comparison of anterior cruciate ligament repair with internal brace augmentation versus anterior cruciate ligament repair without augmentation.](#) *Clin Biomech.* 2020;77:105065. doi:10.1016/j.clinbiomech.2020.105065

- Proximal femoral avulsion-type anterior cruciate ligament injuries were created in 20 cadaver knees. Anterior cruciate ligament repair only or repair with the *InternalBrace*™ procedure was performed using arthroscopic tools. Load-to-failure and failure modes were collected with calculations of stiffness and energy-to-failure performed.
- The average load-to-failure for the *InternalBrace* procedure group was higher than the repair-only group: 693 N (SD 248) vs 279 N (SD 91).
- There was higher load-to-failure, stiffness, and energy-to-failure for the *InternalBrace* procedure group compared to the repair-only group and a high positive correlation between bone density and load-to-failure for the *InternalBrace* procedure group.

#### Takeaway

ACL repair with the *InternalBrace* procedure showed significantly higher load-to-failure, demonstrating that the *InternalBrace* procedure may be a useful adjunct to ACL repair during the early healing phase.

van der List JP,  
DiFelice GS

[Gap formation following primary repair of the anterior cruciate ligament: a biomechanical evaluation.](#) *Knee.* 2017;24(2):243-249. doi:10.1016/j.knee.2016.10.009

- Following proximal ACL repair, gap formation of approximately 1 mm was measured after repetitious knee cycling with mean maximum failure load of 243 N.

#### Takeaway

These findings are likely to be sufficient for careful early active range of motion (ROM) when extrapolating from other available studies.





Wilson WT,  
Hopper GP,  
Banger MS,  
Blyth MJG,  
Riches PE,  
MacKay GM

## Systematic Reviews and Meta-analysis

[Anterior cruciate ligament repair with internal brace augmentation: a systematic review.](#) *Knee.* 2022;35:192-200. doi:10.1016/j.knee.2022.03.009

- This systematic review and meta-analysis was the first to examine ACL primary repair using the *InternalBrace*™ technique exclusive of other techniques and included 9 studies consisting of 346 patients with a mean age of 32.5 years and a mean minimum 2-year follow-up.
- Meta-analysis of PROMs—including KOOS, Lysholm, and IKDC—revealed mean scores greater than 87% of max for all and mean side-to-side difference in AP laxity of 1.2 mm.

### Takeaway

The authors concluded that ACL repair using the *InternalBrace* technique is a safe technique for treatment of proximal ruptures, which have the most potential for healing, with a failure rate of 10.4% at a mean follow-up of 2.7 years.

Kandhari V,  
Vieira TD,  
Ouanezar H,  
Praz C,  
Rosenstiel N,  
Pioger C,  
Franck F,  
Saithna A,  
Sonnery-Cottet B

[Clinical outcomes of arthroscopic primary anterior cruciate ligament repair: a systematic review from the scientific anterior cruciate ligament network international study group.](#) *Arthroscopy.* 2020;36(2):594-612. doi:10.1016/j.arthro.2019.09.021

- Nineteen eligible studies were identified (including five comparative studies).

### Takeaway

Comparative studies identified no significant differences between ACL repair and reconstruction with respect to Lysholm, IKDC, side-to-side laxity difference, pivot shift grade, or graft rupture rates.

van der List JP,  
Vermeijden HD,  
Sierevelt IN,  
DiFelice GS,  
van Noort A,  
Kerkhoffs GMMJ

[Arthroscopic primary repair of proximal anterior cruciate ligament tears seems safe but higher level of evidence is needed: a systematic review and meta-analysis of recent literature.](#) *Knee Surg Sports Traumatol Arthrosc.* 2020;28(6):1946-1957. doi:10.1007/s00167-019-05697-8

- Studies reporting outcomes of arthroscopic primary repair of proximal ACL tears using primary repair with static (suture) augmentation and dynamic augmentation between January 2014 and July 2019 in PubMed, Embase, and Cochrane were identified.
- A total of 13 studies and 1101 patients (mean age 31 years, mean follow-up 2.1 years, 60% male) were included.

### Takeaway

This systematic review found that the different techniques of primary repair (primary repair without augmentation, with static, and with dynamic augmentation) were safe with failure rates between 7% and 11% and good functional outcome scores in 1101 patients.



van der List JP,  
DiFelice GS

[Role of tear location on outcomes of open primary repair of the anterior cruciate ligament: a systematic review of historical studies.](#) *Knee.* 2017;24(5):898-908. doi:10.1016/j.knee.2017.05.009

- “All studies reporting outcomes of open primary ACL repair published between the inception of PubMed, Embase, and Cochrane and 2000 were identified.”

#### **Takeaway**

“Good outcomes were noted in the total cohort, and excellent outcomes were noted following repair of proximal tears. Positive correlation was found between the percentage proximal tears in the studies and percentage satisfied patients (p=0.010).”

van der List JP,  
DiFelice GS

[Preservation of the anterior cruciate ligament: surgical techniques.](#) *Am J Orthop.* 2016;45(7):E406-E414.

- Discusses the history of ACL preservation and how modern advances have altered its risk-benefit ratio.

#### **Takeaway**

Authors propose a specific ACL injury treatment algorithm based on tear location and tissue quality.

Taylor SA,  
Khair MM,  
Roberts TR,  
DiFelice GS

[Primary repair of the anterior cruciate ligament: a systematic review.](#) *Arthroscopy.* 2015;31(11):2233-2247. doi:10.1016/j.arthro.2015.05.007

- All studies reporting primary ACL repair outcomes in the PubMed, Embase, and Cochrane databases were identified between 2003 and 2014.
- This review suggests that primary ACL repair may be an effective treatment for the ACL-injured knee in appropriately selected patients.

#### **Takeaway**

Authors concluded that although long-term outcomes of open primary ACL repair were felt to be unacceptable, a good-sized subset of patients did achieve good long-term results.

### **Magnetic Resonance Imaging Based Studies**

Vermeijden HD,  
Cerniglia B,  
Mintz DN,  
Rademakers MV,  
Kerkhoffs GMMJ,  
van der List JP,  
DiFelice GS

[Distal remnant length can be measured reliably and predicts primary repair of proximal anterior cruciate ligament tears.](#) *Knee Surg Sports Traumatol Arthrosc.* 2020;10.1007/s00167-020-06312-x. doi:10.1007/s00167-020-06312-x

- Authors showed that ACL tear location could reliably be measured on MRI by assessing distal and proximal remnant lengths.

#### **Takeaway**

“Tear location in the proximal quarter of the ACL was found to have a positive predictive value for reparability of 94%.”



van der List JP,  
Mintz DN,  
DiFelice GS

[Postoperative magnetic resonance imaging following arthroscopic primary anterior cruciate ligament repair.](#) *Adv Orthop.* 2019;2019:5940195. doi:10.1155/2019/5940195

- A retrospective review of all postoperative MRIs of patients who underwent arthroscopic primary ACL repair was conducted.
- Authors showed that the repaired ACL is hyperintense within the first postoperative year, while the signal becomes similar to the intact PCL after 2 years.

#### **Takeaway**

Postoperative MRIs can accurately predict rerupture of the repaired ACL.

van der List JP,  
Mintz DN,  
DiFelice GS

[The locations of anterior cruciate ligament tears in pediatric and adolescent patients: a magnetic resonance study.](#) *J Pediatr Orthop.* 2019;39(9):441-448. doi:10.1097/BPO.0000000000001041

- Among 274 patients (range 6.9 to 18.0 years), type I tears were seen in 15%, type II in 23%, type III in 52%, type IV in 1%, and type V in 8% (of which 7% had bony avulsion).
- In patients aged 6 to 10 years, 93% had type V (bony avulsion tear), while this accounted for only 2% of patients aged 14 to 17 years.

#### **Takeaway**

This study demonstrated that ACL tear location is somewhat dependent on patient age.

van der List JP,  
DiFelice GS

[Preoperative magnetic resonance imaging predicts eligibility for arthroscopic primary anterior cruciate ligament repair.](#) *Knee Surg Sports Traumatol Arthrosc.* 2018;26(2):660-671. doi:10.1007/s00167-017-4646-z

- Assessed the role of MRI on eligibility for arthroscopic primary ACL repair.

#### **Takeaway**

Tear location and tissue quality, as shown on preoperative MRI, can predict eligibility for arthroscopic primary ACL repair.

van der List JP,  
Mintz DN,  
DiFelice GS

[The location of anterior cruciate ligament tears: a prevalence study using magnetic resonance imaging.](#) *Orthop J Sports Med.* 2017;5(6):2325967117709966. doi:10.1177/2325967117709966

- Proposes an MRI classification system for different ACL tear types and showed that type I tears were seen in 16%, type II in 27%, and type III in 52% of patients.

#### **Takeaway**

The classification system was noted to be reliable in assessing tear location in acute ACL injuries.



Youssefzadeh KA,  
Stein SM,  
Limpisvasti O

## Technique Publications

[Anterior cruciate ligament repair using a knotless suture implant.](#) *Arthrosc Tech.* 2020;9(5):e623-e626. doi:10.1016/j.eats.2020.01.013

- Discusses the pitfalls of ACL reconstruction, such as graft-site morbidity, invasive drilling, loss of vascularity, and destruction of proprioceptive fibers.

### Takeaway

The authors discuss a surgical technique using a knotless suture anchor in the lateral femoral condylar ACL footprint.

Vermeijden HD,  
van der List JP,  
DiFelice GS

[Arthroscopic primary repair of the anterior cruciate ligament with single-bundle graft augmentation.](#) *Arthrosc Tech.* 2020;9(3):e367-e373. doi:10.1016/j.eats.2019.11.006

- The technique shows the augmented repair of the anteromedial bundle with reconstruction of the posteromedial bundle using a TightRope® RT implant.

### Takeaway

The goal of this technique for primary ACL repair with graft augmentation is to preserve and tension native tissue to restore anatomy while avoiding cyclops lesions. The graft provides additional strength to the repaired ligament.

Moura JL,  
Kandhari V,  
Rosenstiel N,  
Helfer L,  
Queirós CM,  
Abreu FG,  
Praz C,  
Sonnerly-Cottet B

[Figure-of-4 cruciate remnant objective assesment test reducibility of anterior cruciate ligament stump for feasibility of arthroscopic primary anterior cruciate ligament repair.](#) *Arthrosc Tech.* 2019;8(6):e637-e640. doi:10.1016/j.eats.2019.02.008

- 2 different testing positions were used to evaluate reducibility of anterior medial and posterior lateral bundles.

### Takeaway

An arthroscopic technique is described to determine the reducibility of the ACL remnant to help select appropriate patients for arthroscopic primary ACL repair.

Heusdens CHW,  
Hopper GP,  
Dossche L,  
Mackay GM

[Anterior cruciate ligament repair using independent suture tape reinforcement.](#) *Arthrosc Tech.* 2018;7(7):e747-e753. doi:10.1016/j.eats.2018.03.007

- “Repair of the acute proximal ruptured ACL can be achieved with the independent suture tape reinforcement ACL repair technique.”

### Takeaway

“The independent suture tape reinforcement technique reinforces the ligament as a secondary stabilizer, encouraging natural healing of the ligament by protecting it during the healing phase and supporting early mobilization.”



van der List JP,  
DiFelice GS

[Arthroscopic primary anterior cruciate ligament repair with suture augmentation.](#) *Arthrosc Tech.* 2017;6(5):e1529-e1534. doi:10.1016/j.eats.2017.06.009

- This article describes the surgical technique of arthroscopic primary ACL repair with dual suture anchor fixation with added suture augmentation for patients with acute proximal ACL tears and excellent tissue quality.

#### Takeaway

Suture augmentation is thought to be beneficial for protecting the healing repaired ligament during early phases of rehabilitation.

DiFelice GS,  
van der List JP

[Arthroscopic primary repair of proximal anterior cruciate ligament tears.](#) *Arthrosc Tech.* 2016;5(5):e1057-e1061. doi:10.1016/j.eats.2016.05.009

- Describes the surgical technique of arthroscopic primary ACL repair with dual suture anchor fixation in patients with acute proximal tears and excellent tissue quality.

#### Takeaway

This newly described arthroscopic technique is considerably less invasive and a more conservative surgical approach to restoring knee joint stability as compared to ACL reconstruction.

van der List JP,  
DiFelice GS

[Preservation of the anterior cruciate ligament: a treatment algorithm based on tear location and tissue quality.](#) *Am J Orthop.* 2016;45(7):E393-E405.

- This study used a proposed modification of the Sherman classification of the different tear types.

#### Takeaway

The surgical techniques and variations that can be used to treat these different tear types are discussed.

### Reference

1. van der List JP, DiFelice GS. Role of tear location on outcomes of open primary repair of the anterior cruciate ligament: a systematic review of historical studies. *Knee.* 2017;24(5):898-908. doi:10.1016/j.knee.2017.05.009