

Editorial Commentary: Back to the Past—Anterior Cruciate Ligament Repair Revisited



Wolf Petersen, M.D., and Andrea Achnich, M.D.

Abstract: There has been increasing scientific interest in primary anterior cruciate ligament (ACL) repair in recent years. The results of these procedures have improved significantly compared with the 1970s and 1980s. Nevertheless, the overall rerupture rates after ACL repair are worse than after ACL reconstruction, and patient-reported outcome measures do not improve after ACL repair, in contrast to those after ACL reconstruction. However, because primary ACL repair is performed in the acute phase, improvement in patient-reported outcome measures after surgery is not expected. We believe that in the future, primary ACL repair will be established next to ACL reconstruction and nonsurgical therapy. One possible indication is a proximal ACL rupture. Which surgical technique will prevail—and whether orthobiological treatments such as platelet-rich plasma or stem cells will improve postoperative outcomes after ACL repair—will need further clarification by clinical trials.

See related article on page 2233

We thank Nwachukwu, Patel, Lu, Allen, and Williams¹ for their interesting systematic review entitled “Anterior Cruciate Ligament Repair Outcomes: An Updated Systematic Review of Recent Literature.” Anterior cruciate ligament (ACL) repair is a surgical technique that was abandoned because of negative results in the 1970s and 1980s in favor of ACL reconstruction. At that time, ACL repairs were usually performed as open surgical procedures.

In their work, Nwachukwu et al.¹ have shown that in recent years, there has been an increasing interest in procedures for ACL repair. This is recognizable by the large number of studies published on this topic in recent years, most of which have come from Europe.

On the basis of their data analysis, Nwachukwu et al.¹ conclude that the results of ACL repairs have improved significantly compared with case series from the 1970s

and 1980s. Nevertheless, comparison with data from the literature on cruciate ligament reconstruction shows that cruciate ligament reconstruction is superior to ACL repair in terms of reruptures and reoperations, as well as regarding improvement in patient-reported outcome measures (PROMs).¹ For this reason, cruciate ligament reconstruction continues to be the gold standard for the surgical treatment of cruciate ligament rupture in most patients.¹

We fully agree with the last statement. ACL reconstruction with an autologous tendon graft is still the gold standard for protecting the knee joint from secondary meniscal injury and for improving knee function in patients with anterior instability.^{2,3}

Nevertheless, we see ACL repair somewhat more optimistically on the basis of our experience, and we believe that this surgical procedure will play an increasing role in the future.^{4,5} For this reason, we are grateful that we have been invited to author this editorial commentary, and we would like to take the opportunity to stimulate the very controversial discussion on this topic with our own thoughts.

In 2009, we started to apply surgical techniques from the shoulder to the knee (knotless anchor fixation) to develop an arthroscopic technique for refixation of proximal ACL ruptures.^{4,5} With strict indications, our experience with this technique so far has been positive for severe cases.⁴ We therefore agree with Nwachukwu

Berlin, Germany (W.P.) and Technische Universität München (A.A.)

The authors report the following potential conflicts of interest or sources of funding: W.P. receives consultant fees from Karl Storz and Otto Bock Health Care; receives money paid for lectures by Plasmaconcept, DIZG, and AAP Implants; receives money paid for manuscript preparation by Otto Bock; owns patents with Otto Bock; and receives royalties from Karl Storz and Otto Bock. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

© 2019 by the Arthroscopy Association of North America
0749-8063/19570/\$36.00

<https://doi.org/10.1016/j.arthro.2019.05.003>

et al.¹ that the renewed interest and improvement in primary ACL repairs compared with the 1970s and 1980s are a result of improved surgical techniques (arthroscopic vs open surgery). However, we believe that the results of the present systematic review regarding the outcomes of ACL repair require additional interpretation.

Systematic literature reviews are basically a meaningful scientific format because they summarize the current state of research according to clearly defined criteria. However, systematic reviews are always only as good and meaningful as the studies on which they are based. As Nwachukwu et al.¹ note, most ACL repair studies are retrospective and prospective case series (Level IV trials) with low case numbers. Basically, we welcome the inclusion of case series without control groups because randomized controlled trials are also not free of bias.⁶ Therefore, scientific considerations should not only focus on randomized controlled trials but rather exploit the broad spectrum of different study designs.⁶ Nevertheless, we consider it questionable that Nwachukwu et al. included case series with 5 patients and a survivorship rate of 60% in the literature review. Therefore, the rerupture and revision rates determined in this systematic review should be compared with caution with those of large registry studies or case series.^{7,8}

Regarding the interpretation of rerupture rates, it should also be taken into account that in some studies on ACL reconstruction, high rates of rerupture on the contralateral side are reported.^{9,10} In 1 study, the contralateral ACL rupture rates after ACL reconstruction were 23.7% for female patients and 10.5% for male patients.¹⁰ One reason for this observation is certainly that the prevalence of risk patterns (dynamic valgus) in a group of patients with ACL ruptures is higher than in the normal population. Therefore, some authors avoid the term “graft rupture,” instead using “reinjury.”¹¹ This fact should be considered when interpreting rerupture rates after surgical treatment of ACL ruptures. More attention should be paid to the prevention of secondary ACL ruptures (ipsilateral and contralateral).¹²

Regarding the frequency of reoperations, it should also be noted that the systematic review of Nwachukwu et al.¹ compares different ACL repair techniques: dynamic intraligamentary stabilization (DIS) and proximal refixation (usually via 1 or 2 suture anchors). In DIS, an augmentation cord for internal bracing of the injured ACL is connected to a spring anchored in a metal screw. This is to approximate the stiffness of the repair construct to the stiffness of the normal ACL, thus enabling better healing. One probable explanation for the high reoperation rates observed in DIS studies is planned implant removal and not a complication of the procedure.

Strictly speaking, a third surgical procedure, the bridge-enhanced ACL repair (BEAR),¹³ must be distinguished from proximal anchor fixation and the DIS procedure. The BEAR procedure combines proximal refixation with implantation of a collagen sponge, ligament bracing, and the additional application of autologous blood for healing stimulation.¹³ Recently, new positive data on this procedure have been published,¹³ which could not yet be considered in the systematic review of Nwachukwu et al.¹ In a controlled comparative study, the results of the BEAR procedure were similar to those after ACL reconstruction with hamstring tendon.¹³ A larger controlled, randomized, multicenter trial on this technique is currently being conducted in North America (NCT02664545).¹³

Nwachukwu et al.¹ criticize the fact that PROMs improved only minimally after ACL repair and, in some studies, were even lower than preoperatively. However, it can be seen in the data analysis that, for example, the mean preoperative Lysholm score was already 100 (maximum) in many studies. With a preoperative score of 100, further improvement is practically impossible. In view of these high preoperative scores, it should be kept in mind that ACL repairs are usually performed within the first 3 weeks after the trauma because the healing potential decreases after this time. Therefore, the patient's condition when determining the preoperative scores mostly reflects his or her condition before the trauma. The small improvement in clinical scores after ACL repair thus should be interpreted in a positive way. ACL reconstructions, however, are also performed in patients with chronic instability. These patients usually present with lower preoperative PROMs and therefore have the potential to improve postoperatively. With all these points taken into consideration, the assessment of the primary ACL repair procedure could certainly be a bit more positive than shown in the present work.

We believe that these methods are particularly useful in patients with proximally ruptured ACLs, as illustrated in the review of Nwachukwu et al.¹ Future studies are needed to clarify which of the various methods of primary ACL repair are appropriate for which patient and for which type of rupture. There is also a need for further research to investigate the role of additional healing stimulation (platelet-rich plasma, stem cells) and to evaluate the best rehabilitation and return-to-sports protocol after ACL repair. Moreover, the ideal indication for primary ACL repair is not clear. Because of the tight time window, delayed surgical treatment, as recommended by some authors,¹⁴ is practically impossible. A scientific comparison of ACL repair to nonsurgical therapy is still pending. In conclusion, we believe that—despite some still open

questions—primary ACL repair has a future for some indications and will be established next to the gold standard of ACL reconstruction and nonsurgical therapy.

References

1. Nwachukwu BU, Patel BH, Lu Y, Allen AA, William RJ III. Anterior cruciate ligament repair outcomes: An updated systematic review of recent literature. *Arthroscopy* 2019;35:2233-2247.
2. Mehl J, Otto A, Baldino JB, et al. The ACL-deficient knee and the prevalence of meniscus and cartilage lesions: A systematic review and meta-analysis (CRD42017076897). *Arch Orthop Trauma Surg* 2019;139:819-841.
3. Krause M, Freudenthaler F, Frosch KH, Achtnich A, Petersen W, Akoto R. Operative versus conservative treatment of anterior cruciate ligament rupture. *Dtsch Arztebl Int* 2018;115:855-862.
4. Achtnich A, Herbst E, Forkel P, et al. Acute proximal anterior cruciate ligament tears: outcomes after arthroscopic suture anchor repair versus anatomic single-bundle reconstruction. *Arthroscopy* 2016;32:2562-2569.
5. Achtnich A, Rosslbroich S, Beitzel K, Imhoff AB, Petersen W. Arthroscopic refixation of acute proximal anterior cruciate ligament rupture using suture anchors. *Oper Orthop Traumatol* 2017;29:173-179 [in German].
6. Petersen W, Achtnich A, Lattermann C, Kopf S. The treatment of non-traumatic meniscus lesions. *Dtsch Arztebl Int* 2015;112:705-713.
7. Andernord D, Desai N, Björnsson H, Ylander M, Karlsson J, Samuelsson K. Patient predictors of early revision surgery after anterior cruciate ligament reconstruction: A cohort study of 16,930 patients with 2-year follow-up. *Am J Sports Med* 2014;43:121-127.
8. Kaeding CC, Pedroza AD, Reinke EK, Huston LJ, Spindler KP. Risk factors and predictors of subsequent ACL injury in either knee after ACL reconstruction: Prospective analysis of 2488 primary ACL reconstructions from the MOON cohort. *Am J Sports Med* 2015;43:1583-1590.
9. Lai CCH, Ardern CL, Feller JA, Webster KE. Eighty-three per cent of elite athletes return to preinjury sport after anterior cruciate ligament reconstruction: A systematic review with meta-analysis of return to sport rates, graft rupture rates and performance outcomes. *Br J Sports Med* 2018;52:128-138.
10. Paterno MV, Rauh MJ, Schmitt LC, Ford KR, Hewett TE. Incidence of second ACL injuries 2 years after primary ACL reconstruction and return to sport. *Am J Sports Med* 2014;42:1567-1573.
11. Gupta R, Malhotra A, Sood M, Masih GD. Is anterior cruciate ligament graft rupture (after successful anterior cruciate ligament reconstruction and return to sports) actually a graft failure or a re-injury? *J Orthop Surg (Hong Kong)* 2019;27:2309499019829625.
12. Mehl J, Diermeier T, Herbst E, et al. Evidence-based concepts for prevention of knee and ACL injuries. 2017 guidelines of the ligament committee of the German Knee Society (DKG). *Arch Orthop Trauma Surg* 2018;138:51-61.
13. Murray MM, Kalish LA, Fleming BC, et al. Bridge-enhanced anterior cruciate ligament repair: Two-year results of a first-in-human study. *Orthop J Sports Med* 2019;7:2325967118824356.
14. Filbay SR, Roos EM, Frobell RB, Roemer F, Ranstam J, Lohmander LS. Delaying ACL reconstruction and treating with exercise therapy alone may alter prognostic factors for 5-year outcome: An exploratory analysis of the KANON trial. *Br J Sports Med* 2017;51:1622-1629.