



ACL Injuries: Four Factors Influencing Rehabilitation

February 4, 2022 | Article No. 81

Contributors | Aiden Scholey MSc, BKin
Mohit Bhandari MD, PhD

Guest Contributor



Darren de SA MD, MBA(c), FRCSC Assistant Professor, Division of Orthopaedic Surgery McMaster University

Dr. de SA is an Assistant Professor in the Department of Surgery and Orthopaedic Surgeon from Hamilton, Ontario whose clinical scope includes adult and paediatric sports medicine, arthroscopic surgery, and musculoskeletal trauma. He has a special clinical and research interest in complex knee reconstruction. Dr. de SA also serves as the Director of the Surgical Foundations Program within the Department of Surgery at McMaster University.

Insights

- Anterior cruciate ligament (ACL) injuries are among the most common ligament injuries, with approximately 100,000-200,000 reported incidents per year in the United States (1)
- Recovery following an ACL injury follows both a time-based and criterion-based process; under the influence of several factors
- Patients must be willing to commit to all elements (physical, mental, and emotional) of the rehabilitation process to optimize outcomes and return to activity or sport
- While full recovery from an ACL injury is certainly possible, it requires a coordinated and collaborative approach amongst patients, surgeons, physical therapists, and others in the circle of supportive care

ACL injuries should not be taken lightly. Their burden and sequelae can have detrimental effects on all elements of the patient experience. The goal – to establish a pain-free, stable joint with full range of motion seems simple. The journey however, warrants a committed, team-based approach focused entirely on motivating, supporting, and engaging the patient. In this OE Insight, four critical components of a complete rehabilitative approach post-injury are addressed. With continued attention to and efforts in these domains, the sports medicine community can continue the quest for optimizing outcomes.

ACL injuries can be devastating, career altering moments for athletes, potentially resulting in significant time loss from sport, long-term functional knee impairments, reduced quality of life and early-onset osteoarthritis (2). ACL tears can be treated with reconstructive surgery or nonoperative techniques, both of which are entail a significant rehabilitation process, often spanning 8-12 months (3) before athletes are “cleared to play”. Despite advances in surgical technique, the remains much room for improvement to optimize outcomes after ACL surgery (4). In fact, some studies report that just 55% of patients who undergo ACL reconstruction make a return to competitive, high-level, pre-injury sport, and between 15 and 23% may suffer a re-rupture or injury to their contralateral knee (2). Given the duration and cost implications of the injury and its rehabilitation, and considering the potential ramifications that an injured ACL may cause, a review of critical factors influencing ACL rehabilitation can help clinicians and patients with decision making in such clinical context.

“One of the most devastating consequences when returning to sport (RTS) after anterior cruciate ligament (ACL) reconstruction is a subsequent ACL injury. Adolescent patients (15–20 years) run a remarkably increased risk of a second ACL injury; up to 30% will require a new ACL reconstruction within the first two years after RTS” (5).

Beischer S, et al (2018)

Factor #1: Pre-habilitation

Like most injuries, rehabilitation for an ACL injury focuses on post-surgical time points. It is post-surgery, where patients spend time restoring their muscle strength, limb function and joint mobility to preoperative levels. Recent research has suggested that supplementing this post-operative recovery with preoperative approaches may have benefits in both the short- and long-term for those undergoing ACL reconstruction. This so-called “prehabilitation” aims to prepare the body for the effects of surgery. Patients who performed a prehabilitation program of supervised resistance training and balancing exercises for six weeks prior to surgery had improved functional performance and self-reported function up to 12 weeks after reconstruction when compared to controls who received no treatment (6). This has been supported in another study, where authors used both progressive strengthening and neuromuscular training in a prehabilitation program and demonstrated not only superior functional outcomes up to two years after surgery, but also higher percentages of return to pre-injury sport levels (7).

Despite these promising findings, recent systematic reviews have highlighted the need for more research in this area. Two studies (8, 9) concluded that not only is evidence limited, but there is also a wide range of both approaches and durations for pre-operative rehabilitation in the existing literature, making it difficult to determine the optimal approach for this sort of intervention. Further research seems worthwhile, as patients may find themselves waiting a substantial time from injury to surgery, depending on governmental and/or institutional factors. As such, prehabilitation during this preoperative time point is gaining traction as a useful adjunct that may potentially maximize post-surgical outcomes.

“Successful treatment of an ACL tear requires not only a technically demanding operation but also an extensive rehabilitation program.”
(10)

Cascio BM, et al (2004)

Factor #2: Surgical Techniques and Timing

When a patient sustains an ACL injury, they have both operative and non-operative treatment options. Operative treatment consists of surgically reconstructing the ligament, while non-surgical options consist of rehabilitation, bracing and/or activity modification (11). The optimal treatment will ultimately depend on the lifestyle of the patient and a shared decision-making approach between the surgeon and patient, considering risks and benefits of all alternatives. As an example, those who lead more sedentary lives may be appropriate for an initial non-operative trial (11). However, non-operative treatment does not mean no treatment. On the other hand, those with a desire to return to pre-injury activities, particularly those that entail jumping, cutting and pivoting, often are able to achieve this via surgical approaches (11). A recent OE Original ([Surgical Versus Non-surgical Treatment for ACL Injury: Powered by OE M.I.N.D.](https://myorthoedvidence.com/Blog/Show/156) (<https://myorthoedvidence.com/Blog/Show/156>)) examined surgical and non-surgical treatment for ACL injuries, comparing multiple outcomes after both interventions. Findings outlined that reconstructive surgery was associated with superior outcomes in Tegner activity score, knee stability, re-injury and revision surgery rates compared to non-operative treatment alone; while also observing no statistical benefit amongst composite clinical outcomes, pain and/or incidence of return to preinjury level (12).

When patients elect for ACL reconstruction surgery, they receive a tendon tissue graft to substitute their torn native ligament. The optimal graft remains highly studied yet still largely controversial (13). The most commonly used autografts, that is, tissue from the individual undergoing surgery, include that of bone-patellar tendon-bone, hamstring tendon, and the quadriceps tendon (13). A recent review comparing all three autografts reported similar rates of graft failure and comparable functional and clinical outcomes, although the quadriceps tendon had less donor site pain than bone-patellar tendon-bone and superior Lysholm scores than hamstring tendon (14) options. Only in very particular patient situations are allografts advocated, with options including allograft versions of the aforementioned autograft options, in addition to Achilles, peroneus longus, and anterior/posterior tibialis tendons (13). Interestingly, the success of allografts seems to depend on the age of the patient. Re-tear rates are reportedly as high as 25% in young and highly active patients (15), but this rate normalizes around ages of 35-40 years (16–18). The consensus for graft choice appears to be that graft select should be individualized to the patient, based on a host of factors including but not limited to age, activity level, presence of concomitant injuries, patient preference, and surgeon experience (13).

Another widely debated detail regarding ACL surgery is the timing of the operation. Initial research suggested that delaying ACL reconstruction anywhere from 3-6 weeks post-injury is ideal, to mitigate the risk of developing arthrofibrosis (19–22). Recently, studies have shown that with newer surgical techniques, surgery can be performed effectively within the acute phase with no difference in outcome measures (23–25). Furthermore, a recent ACE Report (<https://myorthoevidence.com/AceReport/Report/12301>) has shown that the number of sick days taken following ACL surgery is reduced when surgery is performed within eight days of injury. Thus, early surgery may be a viable option, specifically for such select highly active patients or competitive athletes (25). It also appears that delaying surgery beyond a certain point can have negative outcomes. One study (26) found the prevalence of new medial meniscus tears to be just 4.1% in individuals who underwent surgery within six months of the injury, while those who had surgery more than six months after their injury had a prevalence of 16.7% (26). This speaks to the potential protective effect of restoring a stable knee as early as possible. Thus, while there is no consensus for an optimal time for surgery, it appears that there is increasing advocacy for early time points.



“Targeting patient buy-in through quality individualized patient education, goal-setting and repeated functional testing to provide feedback and enhance motivation to complete adequate exercise and ‘sport-specific rehabilitation’ based on accepted resistance training principles should be a priority for all clinicians.” (4)

—Culvenor AG, et al (2018)—

Factor #3: Rehabilitation Duration and Adherence

Postoperative physical therapy is a critical component of recovery following ACL surgery, with the overall goal of restoring joint range of motion and strength, while protecting the integrity of the surgical graft (27). Studies examining rehabilitation compliance and postoperative outcomes have demonstrated positive correlations between the two. Patients who reported fewer knee symptoms six months postoperatively were found to have attended a higher percentage of therapy sessions, provided greater effort, complied with instructions better and were more receptive to change during their sessions (28). Furthermore, a recent scoping review (2) has shown that a longer duration of supervised rehabilitation, involving agility, landing and gym exercises, is associated with more favorable postoperative outcomes (2).

The duration of rehab is also highly relevant, because returning to sport too early and with deficits in knee function can significantly increase the risk of re-injury (5). A frequently reported criterion for assessing knee performance after ACL rehabilitation is the limb symmetry index (LSI), which is often used to assess whether strength or jumping performance is normal or abnormal. An LSI of >90% is used as a benchmark for return to play following ACL reconstruction. It is consistently reported that patients do not achieve this level (in both strength and specialised hop tests) 6-12 months after ACL reconstruction (29–33). This applies directly to younger patients, as they were found to return to knee-strenuous sport in eight months at a higher rate than adult patients (5). Specifically, this study found that fewer than 30% of all patients who had returned to knee-strenuous sport achieved an LSI >90% in all five components of their test battery, at both 8 months and 12 months postoperatively (5). In fact, a study of 150 young patients showed those who returned to sport before nine months post-operatively had a statistically significantly higher rate of second ACL injury.

Committing to a rehabilitation protocol of such duration does pose its own inherent challenges, particularly for eager, more active patients with high expectations (34). However, exercising appropriate caution and respecting the biology required of the rehabilitation process pays dividends for better long-term outcomes. Physical therapists can have an important role in the recovery process by offering motivation, support, guidance, and encouragement while also providing the informational support the patient may need. They also may be able to encourage rehab program adherence by setting realistic expectations and delivering a fun, progressive, and sport-specific program for the patient with regular goal setting and reassessment and ensure exercises are being performed correctly (2). A positive patient-therapist relationship is critical and cannot be understated.



“Do you consider the physical or the mental part to be the toughest?
And why?”

“Mental! Without any doubt. As I just said, especially the uncertainty

of reaching your old level is something that always stays in your head. Physically, it wasn't so bad, because I was just really happy to be able to train, even if it was often the same exercises I had to do.”

— Alan Shearer (35) —

Factor #4: Psychological Considerations

While optimizing the technical components of ACL reconstruction surgery and the physical rehabilitation protocol are important, the psychological impact (both mental and emotional) of an ACL injury and its sequelae deserves increased attention. Following surgery, it remains a possibility that despite adherence to the physical rehabilitation regimen and a technically sound surgery with uneventful postoperative course, some patients may not return to their pre-injury abilities, may change their sport from that done pre-injury, or may not return to sport. Research comparing athletes who did and did not return to their pre-injury level of sport after ACL reconstruction found that a low fear of re-injury, high motivation to return and psychological readiness to return to sport are all associated with returning to pre-injury levels (36–39). Additionally, a recent study found that 50% of the non-returners in one study (40) reported fear of re-injury to be the primary reason for not returning; whereas sport returners report significantly higher self-esteem levels comparatively. This is independent of knee stability or time since surgery (41). As alluded to earlier, ACL injuries and their rehabilitation are also associated with feelings of anxiety, depression, mood disturbances and feelings of decreased athletic identity (41,42).

Various psychological interventions and their effectiveness for athletes who are recovering from an ACL injury have been examined. One study (43) reported higher rates of exercise compliance and effort when goal setting and positive self-talk were used by patients (44). Interventions where athletes are encouraged to document their feelings and facilitate emotional disclosure during rehab were found to produce less stress and mood disturbance (45), and may be helpful when recovering from ACL injury. Additionally, counseling has been successful, offering potential benefits to help ACL patients accept and adjust to their injuries through the steady presence of emotional support (46,47). Modeling videos where other ACL patients share their thoughts and feelings associated with their injury and problems they faced during rehab also appear to be a useful tool. Patients who watched these videos reported less pain, more self-efficacy and better functional knee scores postoperatively compared to a group who did not watch the videos (48). Despite these findings, further research is needed, directly examining the effects of psychological interventions on return to sport/activity (49).

Based on the available literature, the psychological element of recovery is as important as the physical. While patients may have a common physical injury, their individual psychological experience and response may differ, and the degree to which certain interventions may offer benefit needs to be considered and individualized. Surgeons being more attuned to this aspect will further aid in helping patients achieve desired outcomes.

Conclusion

ACL injuries can be devastating, and the treatment approach requires a concerted and collaborative effort targeting all elements of recovery – including physical, mental, and emotional. There is considerable evidence to show that successful recovery is complex and affected by many factors – of which patient engagement is paramount. Future efforts should focus on better understanding and optimizing all these aspects of the injury and recovery experience.

Contributors



Aiden Scholey MSc, BKin

Aiden Scholey is a Data Quality Analyst at OrthoEvidence. He received a MSc in Applied Health Science from Brock University in 2021.



Mohit Bhandari MD, PhD

Dr. Mohit Bhandari is a Professor of Surgery and University Scholar at McMaster University, Canada. He holds a Canada Research Chair in Evidence-Based Orthopaedic Surgery and serves as the Editor-in-Chief of OrthoEvidence.

References

1. Sports Injuries | Anterior Cruciate Ligament (ACL) Tears | Beaumont Health [Internet]. [cited 2022 Jan 31]. Available from: <https://www.beaumont.org/conditions/acl-tears>
2. Walker A, Hing W, Lorimer A. The Influence, Barriers to and Facilitators of Anterior Cruciate Ligament Rehabilitation Adherence and Participation: a Scoping Review. *Sports Med - Open*. 2020 Dec;6(1):32.
3. ACL reconstruction - Mayo Clinic [Internet]. [cited 2022 Jan 27]. Available from: <https://www.mayoclinic.org/tests-procedures/acl-reconstruction/about/pac-20384598>
4. Culvenor AG, Barton CJ. ACL injuries: the secret probably lies in optimising rehabilitation. *Br J Sports Med*. 2018 Nov;52(22):1416–8.
5. Beischer S, Hamrin Senorski E, Thomeé C, Samuelsson K, Thomeé R. Young athletes return too early to knee-strenuous sport, without acceptable knee function after anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 2018 Jul;26(7):1966–74.
6. Shaarani SR, O'Hare C, Quinn A, Moyna N, Moran R, O'Byrne JM. Effect of Prehabilitation on the Outcome of Anterior Cruciate Ligament Reconstruction. *Am J Sports Med*. 2013 Sep 1;41(9):2117–27.
7. Failla MJ, Logerstedt DS, Grindem H, Axe MJ, Risberg MA, Engebretsen L, et al. Does Extended Preoperative Rehabilitation Influence Outcomes 2 Years After ACL Reconstruction? A Comparative Effectiveness Study Between the MOON and Delaware-Oslo ACL Cohorts. *Am J Sports Med*. 2016 Oct;44(10):2608–14.
8. Carter HM, Littlewood C, Webster KE, Smith BE. The effectiveness of preoperative rehabilitation programmes on postoperative outcomes following anterior cruciate ligament (ACL) reconstruction: a systematic review. *BMC Musculoskelet Disord*. 2020 Dec;21(1):647.
9. Alshewaiher S, Yeowell G, Fatoye F. The effectiveness of pre-operative exercise physiotherapy rehabilitation on the outcomes of treatment following anterior cruciate ligament injury: a systematic review. *Clin Rehabil*. 2017 Jan;31(1):34–44.
10. Cascio BM, Culp L, Cosgarea AJ. Return to play after anterior cruciate ligament reconstruction. *Clin Sports Med*. 2004 Jul;23(3):395–408, ix.

11. Bogunovic L, Matava MJ. Operative and Nonoperative Treatment Options for ACL Tears in the Adult Patient: A Conceptual Review. *The Physician and Sportsmedicine*. 2013 Nov 1;41(4):33–40.
12. Surgical Versus Non-surgical Treatment for ACL Injury: Powered by OE M.I.N.D. [Internet]. [cited 2022 Jan 28]. Available from: <https://myorthoevidence.com/Blog/Show/156>
13. Widner M, Dunleavy M, Lynch S. Outcomes Following ACL Reconstruction Based on Graft Type: Are all Grafts Equivalent? *Curr Rev Musculoskelet Med*. 2019 Dec 1;12(4):460–5.
14. Mouarbes D, Menetrey J, Marot V, Courtot L, Berard E, Cavaignac E. Anterior Cruciate Ligament Reconstruction: A Systematic Review and Meta-analysis of Outcomes for Quadriceps Tendon Autograft Versus Bone-Patellar Tendon-Bone and Hamstring-Tendon Autografts. *Am J Sports Med*. 2019 Dec;47(14):3531–40.
15. Wasserstein D, Sheth U, Cabrera A, Spindler KP. A Systematic Review of Failed Anterior Cruciate Ligament Reconstruction With Autograft Compared With Allograft in Young Patients. *Sports Health*. 2015 May;7(3):207–16.
16. Duchman KR, Lynch TS, Spindler KP. Graft Selection in Anterior Cruciate Ligament Surgery: Who gets What and Why? *Clin Sports Med*. 2017 Jan;36(1):25–33.
17. Maletis GB, Chen J, Inacio MCS, Love RM, Funahashi TT. Increased Risk of Revision After Anterior Cruciate Ligament Reconstruction With Soft Tissue Allografts Compared With Autografts: Graft Processing and Time Make a Difference. *Am J Sports Med*. 2017 Jul;45(8):1837–44.
18. Mardani-Kivi M, Karimi-Mobarakeh M, Keyhani S, Saheb-Ekhtari K, Hashemi-Motlagh K, Sarvi A. Hamstring tendon autograft versus fresh-frozen tibialis posterior allograft in primary arthroscopic anterior cruciate ligament reconstruction: a retrospective cohort study with three to six years follow-up. *Int Orthop*. 2016 Sep;40(9):1905–11.
19. Shelbourne KD, Patel DV. Timing of surgery in anterior cruciate ligament-injured knees. *Knee Surg, Sports traumatol, Arthroscopy*. 1995 Sep 1;3(3):148–56.
20. Shelbourne KD, Wilckens JH, Mollabashy A, DeCarlo M. Arthrofibrosis in acute anterior cruciate ligament reconstruction: The effect of timing of reconstruction and rehabilitation. *Am J Sports Med*. 1991 Jul 1;19(4):332–6.
21. Almekinders LC, Moore Th, Freedman D, Taft TN. Post-operative problems following anterior cruciate ligament reconstruction. *Knee Surg, Sports traumatol, Arthroscopy*. 1995 Jul 1;3(2):78–82.
22. Passler JM, Schippinger G, Schweighofer F, Fellinger M, Seibert FJ. [Complications in 283 cruciate ligament replacement operations with free patellar tendon transplantation. Modification by surgical technique and surgery timing]. *Unfallchirurgie*. 1995 Oct;21(5):240–6.
23. Eriksson K, von Essen C, Jönhagen S, Barenius B. No risk of arthrofibrosis after acute anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 2018 Oct 1;26(10):2875–82.
24. Smith TO, Davies L, Hing CB. Early versus delayed surgery for anterior cruciate ligament reconstruction: a systematic review and meta-analysis. *Knee Surg Sports Traumatol Arthrosc*. 2010 Mar 1;18(3):304–11.
25. Herbst E, Hoser C, Gföller P, Hepperger C, Abermann E, Neumayer K, et al. Impact of surgical timing on the outcome of anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 2017 Feb 1;25(2):569–77.
26. Anstey DE, Heyworth BE, Price MD, Gill TJ. Effect of timing of ACL reconstruction in surgery and development of meniscal and chondral lesions. *Phys Sportsmed*. 2012 Feb;40(1):36–40.
27. Klinge SA, Sawyer GA, Hulstyn MJ. Essentials of Anterior Cruciate Ligament Rupture Management. 2013;5.
28. Brewer B, Cornelius A, Van Raalte J, Brickner J, Sklar J, Corsetti J, et al. Rehabilitation adherence and anterior cruciate ligament reconstruction outcome. *Psychology, Health & Medicine*. 2004 May 1;9(2):163–75.
29. Grindem H, Granan LP, Risberg MA, Engebretsen L, Snyder-Mackler L, Eitzen I. How does a combined preoperative and postoperative rehabilitation programme influence the outcome of ACL reconstruction 2 years after surgery? A comparison between patients in the Delaware-Oslo ACL Cohort and the Norwegian National Knee Ligament Registry. *Br J Sports Med*. 2015 Mar;49(6):385–9.
30. Grindem H, Snyder-Mackler L, Moksnes H, Engebretsen L, Risberg MA. Simple decision rules can reduce reinjury risk by 84% after ACL reconstruction: the Delaware-Oslo ACL cohort study. *Br J Sports Med*. 2016 Jul 1;50(13):804–8.
31. Herbst E, Hoser C, Hildebrandt C, Raschner C, Hepperger C, Pointner H, et al. Functional assessments for decision-making regarding return to sports following ACL reconstruction. Part II: clinical application of a new test battery. *Knee Surg Sports Traumatol Arthrosc*. 2015 May;23(5):1283–91.
32. Thomeé R, Neeter C, Gustavsson A, Thomeé P, Augustsson J, Eriksson B, et al. Variability in leg muscle power and hop performance after anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 2012 Jun;20(6):1143–51.
33. Wellsandt E, Failla MJ, Snyder-Mackler L. Limb Symmetry Indexes Can Overestimate Knee Function After Anterior Cruciate Ligament Injury. *J Orthop Sports Phys Ther*. 2017 May;47(5):334–8.
34. Feucht MJ, Cotic M, Saier T, Minzloff P, Plath JE, Imhoff AB, et al. Patient expectations of primary and revision anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 2016 Jan 1;24(1):201–7.
35. ACL story - Alan Shearer [Internet]. Team ACL. [cited 2022 Jan 27]. Available from: <https://team-acl.com/acl-story-alan-shearer/>
36. Gobbi A, Francisco R. Factors affecting return to sports after anterior cruciate ligament reconstruction with patellar tendon and hamstring graft: a prospective clinical investigation. *Knee Surg Sports Traumatol Arthrosc*. 2006 Oct;14(10):1021–8.
37. Langford JL, Webster KE, Feller JA. A prospective longitudinal study to assess psychological changes following anterior cruciate ligament reconstruction surgery. *British Journal of Sports Medicine*. 2009 May 1;43(5):377–8.
38. Lentz TA, Zepieri G, Tillman SM, Indelicato PA, Moser MW, George SZ, et al. Return to preinjury sports participation following anterior cruciate ligament reconstruction: contributions of demographic, knee impairment, and self-report measures. *J Orthop Sports Phys Ther*. 2012 Nov;42(11):893–901.
39. Webster KE, Feller JA, Lambros C. Development and preliminary validation of a scale to measure the psychological impact of returning to sport following anterior cruciate ligament reconstruction surgery. *Phys Ther Sport*. 2008 Feb;9(1):9–15.
40. McCullough KA, Phelps KD, Spindler KP, Matava MJ, Dunn WR, Parker RD, et al. Return to high school- and college-level football after anterior cruciate ligament reconstruction: a Multicenter Orthopaedic Outcomes Network (MOON) cohort study. *Am J Sports Med*. 2012 Nov;40(11):2523–9.
41. Christino MA, Fleming BC, Machan JT, Shavloy RM. Psychological Factors Associated With Anterior Cruciate Ligament Reconstruction Recovery. *Orthopaedic journal of sports medicine* [Internet]. 2016 [cited 2022 Jan 26]; Available from: <https://journals.sagepub.com/doi/full/10.1177/2325967116638341>
42. Ardern CL, Taylor NF, Feller JA, Whitehead TS, Webster KE, Ardern CL, et al. Ligament Reconstruction Surgery Psychological Responses Matter in Returning to Preinjury Level of Sport After Anterior Cruciate On behalf of: American Orthopaedic Society for Sports Medicine Psychological Responses Matter in Returning to Preinjury Level o. 2013.
43. Scherzer CB, Brewer BW, Cornelius AE, Van Raalte JL, Petitpas AJ, Sklar JH, et al. Psychological Skills and Adherence to Rehabilitation after Reconstruction of the Anterior Cruciate Ligament. *Journal of Sport Rehabilitation*. 2001 Aug;10(3):165–72.
44. Christino MA, Fantry AJ, Vopat BG. Psychological Aspects of Recovery Following Anterior Cruciate Ligament Reconstruction. *JAAOS - Journal of the American Academy of Orthopaedic Surgeons*. 2015 Aug;23(8):501–9.
45. Mankad A, Gordon S, Wallman K. Psychoimmunological effects of emotional disclosure during long-term Injury rehabilitation. *Journal of clinical sport psychology*. 2009 Sep 1;3:205–17.
46. Cupal DD, Brewer BW. Effects of relaxation and guided imagery on knee strength, reinjury anxiety, and pain following anterior cruciate ligament reconstruction. *Rehabilitation Psychology*. 2001;46(1):28–43.
47. Rock JA, Jones MV. A Preliminary Investigation into the Use of Counseling Skills in Support of Rehabilitation from Sport Injury. *Journal of Sport Rehabilitation*. 2002 Nov 1;11(4):284–304.
48. Maddison R, Prapavessis H, Clatworthy M. Modeling and rehabilitation following anterior cruciate ligament reconstruction. *Annals of Behavioral Medicine*. 2006 Feb 1;31(1):89–98.
49. Do psychosocial interventions improve rehabilitation outcomes after anterior cruciate ligament reconstruction? A systematic review - Rogelio A Coronado, Mackenzie L Bird, Erin E Van Hoy, Laura J Huston, Kurt P Spindler, Kristin R Archer, 2018 [Internet]. [cited 2022 Jan 28]. Available from: <https://journals.sagepub.com/doi/abs/10.1177/0269215517728562>

ACE REPORTS

[Arthroplasty \(/Search/?SpecialtyIds=1\)](#)
[Foot & Ankle \(/Search/?SpecialtyIds=2\)](#)
[General Orthopaedics \(/Search/?SpecialtyIds=4\)](#)
[Hand & Wrist \(/Search/?SpecialtyIds=5\)](#)
[Metabolic Disorders \(/Search/?SpecialtyIds=3\)](#)
[Osteoarthritis \(/Search/?SpecialtyIds=12\)](#)
[Pediatric Orthopaedics \(/Search/?SpecialtyIds=6\)](#)

[Physical Therapy & Rehab \(/Search/?SpecialtyIds=13\)](#)
[Shoulder & Elbow \(/Search/?SpecialtyIds=11\)](#)
[Spine \(/Search/?SpecialtyIds=7\)](#)
[Sports Medicine \(/Search/?SpecialtyIds=8\)](#)
[Trauma \(/Search/?SpecialtyIds=9\)](#)
[Tumor \(/Search/?SpecialtyIds=10\)](#)

OE PLUS

[ACE Reviews \(/Search/?AceReportType=AceConferenceSeries \(/AceReports/ConferExclusiveInterviews \(/Search/?HasInterview=true\)EvidenceSeries \(/AceReports/EvidenceIdeas \(/Ideas\)OE Insights \(/OEInsights\)OE Originals \(/Blog\)Videos \(/Podcast\)](#)

SERVICES

[Pricing \(/Pricing\)](#)
[Help and Contact \(/About/Help\)](#)
[Reprints & Permissions \(https://www.parsintl.com/publication/orthoEvidence\)](#)
[CME \(https://www.parsintl.com/cme\)](#)

COMPANY

[About \(/About\)](#)
[Process \(/About/Process\)](#)
[Partners \(/about/partner\)](#)



3228 South Service Road, Suite 206
Burlington, Ontario L7N 3H8 Canada
(<https://goo.gl/maps/ojyKiEm8BEM2>)
1-289-337-5717 (tel:1-289-337-5717)
info@myorthoEvidence.com
(<mailto:info@myorthoEvidence.com>)



(<https://www.facebook.com/OrthoEvidence>)(<http://twitter.com/#!/orthoEvidence>)(<http://www.linkedin.com/company/orthoEvidence>)(<https://www.instagram.com/myorthoEvidence/>)



inc-)

[Terms of Service and Conditions \(/Terms\)](#) | [Privacy Policy \(/privacy\)](#) | [Cookies Policy \(/Cookies\)](#) | [Disclaimer \(/Disclaimer\)](#)