



Anterior cruciate ligament reconstruction in the modern era: A patient-centered approach

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Abstract

Anterior cruciate ligament (ACL) injuries are among the most frequent knee pathologies, with athletes—particularly females and those in pivot-heavy sports such as soccer, basketball, volleyball, and skiing—at increased risk. The success of ACL reconstruction is multifactorial, relying on individualized graft selection, surgical precision, patient-specific characteristics, and optimized rehabilitation. Despite the availability of various graft options—hamstring tendon, bone-patellar tendon-bone, and quadriceps tendon—no single type has demonstrated clear superiority, reinforcing the need for patient-tailored approaches based on anatomical, functional, and age-related factors. Surgical techniques continue to evolve, with adaptations such as physeal-sparing methods for skeletally immature patients and minimally invasive procedures aimed at reducing morbidity and improving recovery. Rehabilitation is a critical determinant of functional outcomes. Current evidence supports immediate mobilization, early weight-bearing, and initiation of neuromuscular and strength training, while routine use of continuous passive motion and bracing is discouraged, except in multi-ligament injuries. Prehabilitation is recommended, though accelerated rehabilitation remains controversial. Implant choice and fixation strategy are also essential to long-term success. The use of materials that reduce the risk of chronic complications and support biological integration is increasingly favored. Nevertheless, rare mechanical failures emphasize the need for accurate tunnel placement, appropriate implant selection, and vigilant postoperative monitoring. Outcomes are further influenced by patient-specific variables, including bone quality, metabolic status, and physical activity levels. Optimal ACL reconstruction results

from a comprehensive, patient-centered strategy that integrates surgical accuracy, individualized rehabilitation, and continuous follow-up to minimize complications and enhance recovery.

Key Words: Anterior cruciate ligament reconstruction; Athletic injuries; Graft survival; Rehabilitation; Patient-centered care; Surgical procedures; Minimally invasive; Treatment outcome

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Core Tip: Optimal outcomes in anterior cruciate ligament reconstruction depend on more than technical precision, they require a personalized approach accounting for patient-specific anatomy, sport demands, comorbidities, and psychological readiness. This review offers a comprehensive synthesis of current best practices across graft choice, surgical technique, rehabilitation, and postoperative monitoring to guide individualized clinical decision-making.

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INTRODUCTION

Anterior cruciate ligament (ACL) reconstruction (ACLR) has undergone a paradigm shift in recent years, evolving from a technically focused procedure to a multifaceted, patient-centered intervention. While surgical innovation remains central, modern ACLR increasingly emphasizes shared decision-making (SDM), individualized rehabilitation strategies, and outcome alignment with patient-defined goals[1].

ACL injuries affect an estimated 200000 to 250000 individuals annually in the United States alone, with rising incidence globally due to increased participation in high-impact sports[2,3].

Historically, ACLR progressed from open surgical techniques in the 1970s and 1980s to arthroscopically assisted methods, enabling more precise graft placement and reduced morbidity. The introduction of anatomic single- and double-bundle reconstructions in the early 2000s marked a turning point, ushering in a new focus on biomechanical restoration. Over 100000 ACL reconstructions are performed annually in the United States, with return-to-sport (RTS) and long-term joint preservation as primary goals[4].

Graft selection and fixation methods remain central to the surgical debate. Meta-analyses suggest subtle differences in graft failure rates, anterior laxity, donor site morbidity, and time to return to sport, highlighting the importance of tailoring graft choice to patient-specific factors including age, sport, skeletal maturity, and prior knee pathology[5-7].

Contemporary approaches now integrate patient factors—such as age, sport level, comorbidities, and psychosocial drivers—into every aspect of care. This evolution compels a redefinition of what constitutes surgical success in ACL injuries.

This editorial proposes a reorganized and integrative view of ACLR through the lens of patient specificity, encompassing graft selection, prehabilitation, comorbid risk factors, and functional expectations.

PREHABILITATION AND PATIENT OPTIMIZATION

Modern ACLR begins well before the incision. Prehabilitation—a preparatory phase focusing on range of motion, quadriceps strength, and psychological readiness—has demonstrated significant benefits in enhancing postoperative recovery, including improved neuromuscular control and pain reduction[1,8]. Achieving key preoperative benchmarks, such as minimal effusion, full knee extension, and quadriceps strength index $\geq 80\%$, correlates with improved outcomes post-surgery[9]. Patient education during this phase is equally important. Empowering patients with realistic timelines, rehabilitation goals, and complication risk profiles fosters adherence and reduces psychological barriers to recovery[10-13].

Despite promising evidence, the implementation of structured prehabilitation remains variable across clinical settings, often limited by time, cost, and patient adherence. Nonetheless, it serves as a proactive strategy during surgical waiting periods and should be considered integral to comprehensive care.

GRAFT AND IMPLANT SELECTION: BALANCING EVIDENCE AND INDIVIDUALIZATION

The debate surrounding the optimal graft type for ACLR remains unresolved. Bone-patellar tendon-bone (BPTB) grafts are associated with strong fixation and low graft laxity but carry increased risks of anterior knee pain and patellofemoral

complications[14,15]. Hamstring autografts offer lower donor site morbidity but may result in increased laxity in young, high-demand athletes[16]. Quadriceps tendon (QT) autografts have emerged as a promising alternative, providing a favorable balance between strength and morbidity, though long-term data remain limited[3,17].

Implant technology has evolved alongside graft strategies. Metallic interference screws provide superior mechanical strength, but bioabsorbable materials—such as polylactic acid derivatives—support biological integration and eliminate the need for removal. However, these materials can produce acidic degradation byproducts, potentially provoking local inflammation[9,14]. Incorporation of buffering agents and composite materials like hydroxyapatite has shown promise in mitigating these effects while enhancing osteointegration[15,16]. The choice between metallic and bioabsorbable implants should be guided by patient age, bone quality, and functional demands. The development of bioabsorbable implants represented a significant advancement in orthopedic surgery. These materials, designed to degrade over time, aim to provide temporary support during the healing process and eliminate the potential need for implant removal[18]. To date, the most commonly utilized bioabsorbable polymers in orthopedic applications, including ACL reconstruction, are polyglycolic acid (PGA), poly-L-lactic acid, poly-D, L-lactic acid, and their copolymers[19]. Despite the use of bioabsorbable implants in ACL reconstruction offers significant biological advantages, these benefits come with inherent mechanical limitations. Compared to metallic implants, bioabsorbable materials showed inferior mechanical properties that must be carefully considered in the context of biomechanical demands during the healing process[20,21]. The mechanical reliability of bioabsorbable implants is also significantly influenced by their degradation kinetics. PGA, for example, begins to lose mechanical strength within the first 7 days, with substantial degradation observed by the fourth week[22]. The evolution of bioabsorbable implants in orthopedics offers promising advantages in terms of tissue integration and the potential to reduce long-term complications associated with permanent hardware. However, challenges related to mechanical strength, degradation profiles, and inflammatory responses must be addressed through continued research and innovation. A nuanced understanding of these factors, coupled with personalized patient care should guide the optimal selection and application of implant materials tailored to individual patient needs.

TAILORED TECHNIQUES

Graft selection in ACLR remains a pivotal decision point, significantly influencing biomechanical outcomes, donor-site morbidity, and revision risk. BPTB grafts are favored for their strong fixation and bone-to-bone healing, especially in elite athletes, but carry a risk of anterior knee pain and patellofemoral dysfunction[8,9]. Hamstring tendon (HT) grafts are popular due to lower donor-site morbidity, yet may be associated with increased laxity and slower incorporation[14].

QT grafts have emerged as a promising compromise, offering customizable thickness and robust strength with lower harvest morbidity[15-17]. Mechanistically, BPTB autografts achieve superior initial fixation due to cortical bone healing on both ends, while HT and QT grafts rely on tendon-to-bone integration—a biologically slower process influenced by tunnel vascularity and collagen remodeling[23]. The QT's centrally located collagen alignment and flat morphology have shown favorable resistance to multidirectional shear and torsion, aligning biomechanically with the native ACL's role in rotational control[24].

Long-term comparative data suggest equivalent or superior outcomes for QT grafts in revision cases and in patients with anterior knee sensitivity or failed prior autografts[3]. As a result, many surgeons now consider QT autografts a viable first-line choice across diverse patient profiles (Table 1).

COMORBIDITIES, SEX-SPECIFIC FACTORS, AND RISK STRATIFICATION

ACL injury risk and postoperative recovery trajectories are modulated by systemic and demographic factors such as obesity, diabetes, and hormonal influences. Obese adolescents have been shown to experience higher complication rates, including graft failure and impaired proprioception, likely due to altered joint mechanics and inflammation-mediated healing delays[25]. Beyond simple body mass index (BMI), higher body fat percentage and lower muscle mass predict worse function after ACLR. Patients with greater whole-body lean mass had stronger quadriceps and better hop performance, whereas higher fat mass was associated with poorer patient-reported knee function and strength metrics[26]. Obesity in particular has been studied: Overweight/obese patients often achieve similar overall outcome scores and RTS rates as normal-weight individuals, although obese patients tend to report slightly lower International Knee Documentation Committee (IKDC) scores and have a higher risk of post-traumatic osteoarthritis[27,28]. Notably, overweight patients paradoxically had lower revision and contralateral ACL rupture rates[29], perhaps reflecting different activity levels. However, obesity is associated with perioperative challenges: A recent large database analysis found that obesity independently predicted longer hospital stays and a higher likelihood of non-routine discharge after ACLR[30].

Similarly, patients with diabetes mellitus face a significantly increased risk of postoperative infection, delayed wound healing, and inferior functional outcomes[28]. In a multicenter cohort, diabetes increased odds of post-ACLR infection nearly 19-fold compared to non-diabetics[31]. Therefore, in diabetic patients surgeons should strive for optimal glycemic control pre- and post-operatively and consider using BTB autograft when appropriate, as this graft type is associated with lower infection odds than hamstrings[32]. Beyond infection, however, diabetes does not seem to worsen long-term ACLR outcomes: In a multicenter study Herzberg *et al*[32] showed that diabetic patients reached slightly lower self-reported scores than non-diabetics but maintained higher activity levels and did not undergo more additional surgeries[33]. Other comorbid conditions (smoking, rheumatoid disease, *etc.*) should similarly be optimized preoperatively since they can

Table 1 Comparison of anterior cruciate ligament graft options: Patient profiles, benefits, and limitations

Graft type	Ideal patient profile	Advantages	Limitations
Bone-patellar tendon-bone	High-demand athletes; patients needing strong fixation	Bone-to-bone healing; lower graft failure rates; time-tested	Anterior knee pain; risk of patellar fracture; extensor mechanism dysfunction
Hamstring tendon	Patients prioritizing lower donor-site morbidity	Less anterior knee pain; easy harvest; good cosmesis	Possible increased laxity; slower graft integration; hamstring weakness
Quadriceps tendon	Revision cases; patients with previous graft issues	Customizable size; reduced harvest site pain; strong biomechanical properties	Less studied long-term; potential for quadriceps weakness
Allograft	Low-demand, older patients; revision or multiple ligament injuries	Shorter operative time; no donor-site morbidity	Higher failure rates in young athletes; delayed incorporation

impair graft incorporation and wound healing.

Sex-specific considerations are increasingly recognized as clinically relevant in ACL injury and reconstruction. Female athletes exhibit higher baseline ligament laxity and biomechanical risk profiles, partly due to hormonal fluctuations affecting collagen elasticity and neuromuscular control[32,34]. The menstrual cycle, particularly the ovulatory phase, has been associated with an elevated ACL injury risk, although results remain heterogeneous across cohorts[34]. These findings warrant consideration of hormonal phase in both timing of surgery and rehabilitation pacing. Furthermore, estrogen-mediated inhibition of collagen crosslinking may contribute to differential remodeling rates between male and female patients[35].

Bone quality is emerging as a critical determinant in ACLR success. Following ACL rupture, localized osteopenia develops rapidly, particularly in the subchondral bone of the injured knee, where reductions in bone mineral density have been consistently documented[36]. Prolonged delays in surgical intervention exacerbate this loss, with chronic ACL deficiency further accelerating bone demineralization. These changes compromise the biomechanical integrity of the femoral and tibial tunnels, increasing the risk of intraoperative complications such as screw pull-out, tunnel widening, or fracture[37]. To mitigate these risks, preoperative assessment of bone quality—*via* dual-energy X-ray absorptiometry or computed tomography (CT)—should be considered in selected patients. Early surgical timing, ideally within three months of injury, may also help preserve bone health and facilitate more secure graft fixation[38]. In patients with known osteopenia or osteoporosis, proactive bone optimization strategies—including supplementation with calcium and vitamin D, or pharmacologic therapy when indicated—should be initiated before surgery.

Regarding younger patients, graft choice in pediatric ACLR tends toward soft-tissue tendons (hamstring or iliotibial band) rather than bone plugs to avoid physeal insult. In contrast, middle-aged and older adults (≥ 40 –50 years) have historically been managed nonoperatively due to osteoarthritis concerns, but current evidence supports offering ACLR to those who are active. A recent meta-analysis from Herzberg *et al*[32] found that patients ≥ 50 years achieve comparable IKDC and Lysholm score improvements and knee laxity reduction as younger patients, with no increase in complication rate. Thus age alone should not be a contraindication to ACLR; however, clinicians should counsel older patients about concomitant degenerative changes and may favor less aggressive rehab to accommodate slower healing.

Incorporating these variables into risk stratification tools is a growing priority. Machine learning-assisted predictive models, although still in early stages, have shown promise in forecasting graft failure, rerupture risk, and RTS outcomes based on integrated clinical and demographic data[29]. Algorithms leveraging BMI, glycemic status, joint laxity indices, graft choice, and neuromuscular assessments could enable preoperative tailoring of surgical and rehabilitation strategies. Beyond AI, clinical scoring systems such as the KOOS and IKDC, when paired with frailty or endocrine markers, may enhance long-term planning for older or systemically compromised patients.

POSTOPERATIVE REHABILITATION AND PSYCHOSOCIAL RECOVERY

The success of ACLR relies as much on rehabilitation as on surgical execution. Criterion-based progression models have supplanted time-based milestones, emphasizing quadriceps symmetry, neuromuscular control, and dynamic stability[10, 11]. Historically, prolonged bracing and continuous passive motion (CPM) devices were standard in ACLR rehabilitation. However, randomized trials have demonstrated that routine bracing does not improve long-term outcomes and may delay neuromuscular control and psychological readiness. Similarly, CPM has not shown superior benefits in pain control, range of motion recovery, or patient satisfaction compared to active rehabilitation and is now largely discouraged except in specific cases such as complex multi-ligament injuries or patients with meniscal repairs[39,40].

A critical goal of contemporary rehabilitation is protecting the healing graft while avoiding the deleterious effects of disuse. Early weight-bearing, guided by pain tolerance and joint effusion, promotes mechanotransduction, reduces muscle atrophy, and enhances proprioceptive feedback. Quadriceps strength restoration is particularly important, as persistent deficits have been linked to poor function, altered gait mechanics, and elevated risk of re-injury[41]. Neuromuscular electrical stimulation (NMES), especially in the first 6–8 postoperative weeks, has demonstrated efficacy in preserving quadriceps activation and mitigating arthrogenous muscle inhibition[42].

Psychological readiness is another critical factor in recovery. Fear of reinjury, low self-efficacy, and poor motivation are independently associated with delayed return to sport and suboptimal functional outcomes[35]. Addressing these variables through guided counseling, structured goal-setting, and continuous education can positively influence recovery

trajectories.

RETURN TO SPORT, PATIENT SATISFACTION AND LONG-TERM CONSIDERATIONS

True patient-centered ACL reconstruction begins with SDM, where surgeon and patient collaboratively weigh surgical options, graft types, risks, and recovery timelines based on scientific evidence and individual goals[43]. Current literature shows that SDM improves treatment satisfaction, enhances adherence, and may even lead to better surgical outcomes[44]. Yet, clinical inertia and structural inefficiencies often prevent SDM from being systematically adopted[29]. Patient-centered care also involves longitudinal support. A study by Cronström *et al*[45] noted that only 55% of young athletes return to their pre-injury level of sport within two years of surgery, and mental readiness often lags behind physical rehabilitation[46]. This underscores the importance of embedding mental health support into the continuum of care, rather than treating it as ancillary or optional.

RTS decisions remain a focal point of debate. Traditionally, time-based protocols (*e.g.*, 6 months post-op) were used as surrogates for readiness. However, this approach has proven inadequate, as nearly one-third of ACLR patients experience a second injury within two years of RTS, with the highest risk observed in athletes under 20 years of age[47]. Instead, functional milestones—such as > 90% limb symmetry index for hop tests and strength, psychological readiness [ACL-Return to Sport after Injury (RSI) score > 65], and movement quality during sport-specific tasks—have gained prominence in contemporary RTS criteria[48].

The RTS process now incorporates a multidimensional framework encompassing physical capacity, movement quality, and psychological readiness. Validated tools such as the ACL-RSI scale support identification of psychological barriers, allowing clinicians to intervene before physical readiness is compromised[48]. Additionally, limb symmetry indices (> 90% for strength and hop performance), sport-specific movement assessments, and fatigue resilience are increasingly employed to guide RTS clearance. However, the precise volume and intensity thresholds required to drive neuromuscular adaptation and minimize reinjury remain inadequately defined.

Adjunct modalities—including NMES, cryotherapy, and aquatic therapy—have demonstrated variable efficacy. While some support their role in early-phase recovery and patient satisfaction, their long-term contribution to functional outcomes is less clear[49,50].

Returning to sport is often fraught with ambiguity. High-level athletes may face external pressures that compromise biological healing and psychological readiness[44]. Conversely, recreational athletes may prioritize function over performance, altering graft demands and rehabilitation goals[51,52].

Outcome disparities between patient populations emphasize the importance of tailored endpoints. Patient-reported outcome measures such as the IKDC and KOOS scores provide nuanced insights into subjective recovery, enabling clinicians to calibrate return-to-play decisions[53]. Female athletes, in particular, benefit from sex-specific training modifications that address underlying neuromuscular deficits and hormonal variability[20].

CONCLUSION

ACLR must evolve to reflect a dynamic integration of surgical technique, individualized rehabilitation, and patient-reported goals. By tailoring decisions—ranging from graft selection to surgical timing and postoperative progression—to the specific demands, physiology, and psychology of the individual, orthopedic surgeons can improve both biomechanical outcomes and patient satisfaction.

The era of one-size-fits-all ACL reconstruction is rapidly coming to a close. A contemporary ACLR paradigm must prioritize precision over convention. While technical excellence remains essential, success is increasingly defined by return-to-function timelines, sport-specific readiness, and patient-perceived recovery. This evolution invites the orthopedic community to embrace individualization as a scientific imperative, not just a philosophical ideal.

Future clinical pathways should integrate demographic data, hormonal profiles, comorbidity indexes, and machine learning-enhanced risk models to inform every phase of treatment—from prehabilitation through RTS clearance. This requires a shift from reactive to predictive care, where treatment plans are proactive, data-driven, and aligned with what recovery means to each patient.

Ultimately, the ACLR landscape must reflect a new standard: Restoration of the person, not just reconstruction of the ligament. The integration of evidence-based customization, patient education, and interdisciplinary follow-up holds the key to maximizing long-term success, minimizing complications, and redefining what it means to “recover” from an ACL injury in the modern orthopedic era.

FOOTNOTES

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REFERENCES

- 1 Glattke KE, Tummala SV, Chhabra A. Anterior Cruciate Ligament Reconstruction Recovery and Rehabilitation: A Systematic Review. *J Bone Joint Surg Am* 2022; **104**: 739-754 [RCA] [PMID: 34932514 DOI: 10.2106/JBJS.21.00688] [FullText]
- 2 Ardern CL, Taylor NF, Feller JA, Webster KE. Fifty-five per cent return to competitive sport following anterior cruciate ligament reconstruction surgery: an updated systematic review and meta-analysis including aspects of physical functioning and contextual factors. *Br J Sports Med* 2014; **48**: 1543-1552 [RCA] [PMID: 25157180 DOI: 10.1136/bjsports-2013-093398] [FullText]
- 3 Ardern CL, Österberg A, Tagesson S, Gauffin H, Webster KE, Kvist J. The impact of psychological readiness to return to sport and recreational activities after anterior cruciate ligament reconstruction. *Br J Sports Med* 2014; **48**: 1613-1619 [RCA] [PMID: 25293342 DOI: 10.1136/bjsports-2014-093842] [FullText]
- 4 Sanders TL, Kremers HM, Bryan AJ, Fruth KM, Larson DR, Pareek A, Levy BA, Stuart MJ, Dahm DL, Krych AJ. Is Anterior Cruciate Ligament Reconstruction Effective in Preventing Secondary Meniscal Tears and Osteoarthritis? *Am J Sports Med* 2016; **44**: 1699-1707 [RCA] [PMID: 26957217 DOI: 10.1177/0363546516634325] [FullText]
- 5 Chu CR, Williams AA, Coyle CH, Bowers ME. Early diagnosis to enable early treatment of pre-osteoarthritis. *Arthritis Res Ther* 2012; **14**: 212 [RCA] [PMID: 22682469 DOI: 10.1186/ar3845] [FullText] [Full Text(PDF)]
- 6 Kotsifaki R, Korakakis V, King E, Barbosa O, Maree D, Pantouveris M, Bjerregaard A, Luomajoki J, Wilhelmsen J, Whiteley R. Aspetar clinical practice guideline on rehabilitation after anterior cruciate ligament reconstruction. *Br J Sports Med* 2023; **57**: 500-514 [RCA] [PMID: 36731908 DOI: 10.1136/bjsports-2022-106158] [FullText] [Full Text(PDF)]
- 7 Coppola SM, Collins SM. Is physical therapy more beneficial than unsupervised home exercise in treatment of post surgical knee disorders? A systematic review. *Knee* 2009; **16**: 171-175 [RCA] [PMID: 18851916 DOI: 10.1016/j.knee.2008.09.001] [FullText]
- 8 Lin KM, Boyle C, Marom N, Marx RG. Graft Selection in Anterior Cruciate Ligament Reconstruction. *Sports Med Arthrosc Rev* 2020; **28**: 41-48 [RCA] [PMID: 32345925 DOI: 10.1097/JSA.0000000000000265] [FullText]
- 9 DeFazio MW, Curry EJ, Gustin MJ, Sing DC, Abdul-Rassoul H, Ma R, Fu F, Li X. Return to Sport After ACL Reconstruction With a BTB Versus Hamstring Tendon Autograft: A Systematic Review and Meta-analysis. *Orthop J Sports Med* 2020; **8**: 2325967120964919 [RCA] [PMID: 33403206 DOI: 10.1177/2325967120964919] [FullText] [Full Text(PDF)]
- 10 Adams D, Løgerstedt DS, Hunter-Giordano A, Axe MJ, Snyder-Mackler L. Current concepts for anterior cruciate ligament reconstruction: a criterion-based rehabilitation progression. *J Orthop Sports Phys Ther* 2012; **42**: 601-614 [RCA] [PMID: 22402434 DOI: 10.2519/jospt.2012.3871] [FullText]
- 11 Brinlee AW, Dickenson SB, Hunter-Giordano A, Snyder-Mackler L. ACL Reconstruction Rehabilitation: Clinical Data, Biologic Healing, and Criterion-Based Milestones to Inform a Return-to-Sport Guideline. *Sports Health* 2022; **14**: 770-779 [RCA] [PMID: 34903114 DOI: 10.1177/19417381211056873] [FullText]
- 12 Greenberg EM, Greenberg ET, Albaugh J, Storey E, Ganley TJ. Rehabilitation Practice Patterns Following Anterior Cruciate Ligament Reconstruction: A Survey of Physical Therapists. *J Orthop Sports Phys Ther* 2018; **48**: 801-811 [RCA] [PMID: 29787697 DOI: 10.2519/jospt.2018.8264] [FullText]
- 13 Andrade R, Pereira R, van Cingel R, Staal JB, Espregueira-Mendes J. How should clinicians rehabilitate patients after ACL reconstruction? A systematic review of clinical practice guidelines (CPGs) with a focus on quality appraisal (AGREE II). *Br J Sports Med* 2020; **54**: 512-519 [RCA] [PMID: 31175108 DOI: 10.1136/bjsports-2018-100310] [FullText]
- 14 Samuelsen BT, Webster KE, Johnson NR, Hewett TE, Krych AJ. Hamstring Autograft versus Patellar Tendon Autograft for ACL Reconstruction: Is There a Difference in Graft Failure Rate? A Meta-analysis of 47,613 Patients. *Clin Orthop Relat Res* 2017; **475**: 2459-2468 [RCA] [PMID: 28205075 DOI: 10.1007/s11999-017-5278-9] [FullText]
- 15 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; **47**: 3531-3540 [RCA] [PMID: 30790526 DOI: 10.1177/0363546518825340] [FullText]
- 16 Kurkowski SC, Thimmesch MJ, Murphy M, Kuechly HA, Emmert AS, Grawe B. Uncovering the State of Current Data on Quadriceps Tendon Autograft Use Versus Bone-Patellar Tendon-Bone and Hamstring Tendon Autografts in Anterior Cruciate Ligament Reconstruction at ≥5 Years After Surgery: A Systematic Review and Meta-analysis. *Am J Sports Med* 2025; **53**: 1739-1749 [RCA] [PMID: 39763441 DOI: 10.1177/03635465241266628] [FullText]
- 17 Malige A, Baghdadi S, Hast MW, Schmidt EC, Shea KG, Ganley TJ. Biomechanical properties of common graft choices for anterior cruciate ligament reconstruction: A systematic review. *Clin Biomech (Bristol)* 2022; **95**: 105636 [RCA] [PMID: 35428007 DOI: 10.1016/j.clinbiomech.2022.105636] [FullText]
- 18 Narayanan G, Vernekar VN, Kuyinu EL, Laurencin CT. Poly (lactic acid)-based biomaterials for orthopaedic regenerative engineering. *Adv Drug Deliv Rev* 2016; **107**: 247-276 [RCA] [PMID: 27125191 DOI: 10.1016/j.addr.2016.04.015] [FullText]

- 19 **Kawai H**, Sukegawa S, Nakano K, Takabatake K, Ono S, Nagatsuka H, Furuki Y. Biological Effects of Bioresorbable Materials in Alveolar Ridge Augmentation: Comparison of Early and Slow Resorbing Osteosynthesis Materials. *Materials (Basel)* 2021; **14**: 3286 [RCA] [PMID: 34198634 DOI: 10.3390/ma14123286] [FullText] [Full Text(PDF)]
- 20 **Kacsó AB**, Peter I. A Review of Past Research and Some Future Perspectives Regarding Titanium Alloys in Biomedical Applications. *J Funct Biomater* 2025; **16**: 144 [RCA] [PMID: 40278252 DOI: 10.3390/jfb16040144] [FullText]
- 21 **Roy M**, Bhikshavarthi Math SA, Das D, Dwidmuthe S. Broken bioabsorbable tibial interference screw post-arthroscopic anterior cruciate ligament reconstruction: A case report. *World J Clin Cases* 2025; **13**: 105003 [RCA] [PMID: 40821412 DOI: 10.12998/wjcc.v13.i23.105003] [FullText] [Full Text(PDF)]
- 22 **Liu H**, Slamovich EB, Webster TJ. Less harmful acidic degradation of poly(lactico-glycolic acid) bone tissue engineering scaffolds through titania nanoparticle addition. *Int J Nanomedicine* 2006; **1**: 541-545 [RCA] [PMID: 17722285 DOI: 10.2147/nano.2006.1.4.541] [FullText] [Full Text(PDF)]
- 23 **Claes S**, Verdonk P, Forsyth R, Bellemans J. The "ligamentization" process in anterior cruciate ligament reconstruction: what happens to the human graft? A systematic review of the literature. *Am J Sports Med* 2011; **39**: 2476-2483 [RCA] [PMID: 21515806 DOI: 10.1177/0363546511402662] [FullText]
- 24 **Marieswaran M**, Jain I, Garg B, Sharma V, Kalyanasundaram D. A Review on Biomechanics of Anterior Cruciate Ligament and Materials for Reconstruction. *Appl Bionics Biomech* 2018; **2018**: 4657824 [RCA] [PMID: 29861784 DOI: 10.1155/2018/4657824] [FullText] [Full Text (PDF)]
- 25 **Werner BC**, Yang S, Looney AM, Gwathmey FW Jr. Trends in Pediatric and Adolescent Anterior Cruciate Ligament Injury and Reconstruction. *J Pediatr Orthop* 2016; **36**: 447-452 [RCA] [PMID: 25985368 DOI: 10.1097/BPO.0000000000000482] [FullText]
- 26 **Fang Z**, Liu W. Obesity-associated outcomes after ACL reconstruction: a propensity-score-matched analysis of the US Nationwide Inpatient Sample 2005-2018. *J Orthop Traumatol* 2024; **25**: 36 [RCA] [PMID: 39048813 DOI: 10.1186/s10195-024-00779-x] [FullText]
- 27 **Mardani-Kivi M**, Leili EK, Shirangi A, Azari Z. Return to sports activity in the revision of anterior cruciate ligament reconstruction: A 2-6 Year follow-up study. *J Clin Orthop Trauma* 2021; **16**: 80-85 [RCA] [PMID: 33717943 DOI: 10.1016/j.jcot.2020.12.022] [FullText]
- 28 **Brophy RH**, Wright RW, Huston LJ, Nwosu SK, MOON Knee Group, Spindler KP. Factors associated with infection following anterior cruciate ligament reconstruction. *J Bone Joint Surg Am* 2015; **97**: 450-454 [RCA] [PMID: 25788300 DOI: 10.2106/JBJS.N.00694] [FullText]
- 29 **van Haren IEPM**, van der Worp MP, van Rijn R, Stubbe JH, van Cingel REH, Verbeek ALM, van der Wees PJ, Staal JB. Return to sport after anterior cruciate ligament reconstruction - prognostic factors and prognostic models: A systematic review. *Ann Phys Rehabil Med* 2025; **68**: 101921 [RCA] [PMID: 39892026 DOI: 10.1016/j.rehab.2024.101921] [FullText]
- 30 **Zhao D**, Liang GH, Pan JK, Zeng LF, Luo MH, Huang HT, Han YH, Lin FZ, Xu NJ, Yang WY, Liu J. Risk factors for postoperative surgical site infections after anterior cruciate ligament reconstruction: a systematic review and meta-analysis. *Br J Sports Med* 2023; **57**: 118-128 [RCA] [PMID: 36517215 DOI: 10.1136/bjsports-2022-105448] [FullText] [Full Text(PDF)]
- 31 **Brophy RH**, Huston LJ, Wright RW, Nwosu SK, Kaeding CC, Parker RD, Andrich JT, Marx RG, McCarty EC, Amendola A, Wolf BR, Dunn WR, Wolcott ML, Spindler KP. Outcomes of ACL Reconstruction in Patients with Diabetes. *Med Sci Sports Exerc* 2016; **48**: 969-973 [RCA] [PMID: 26765634 DOI: 10.1249/MSS.0000000000000876] [FullText]
- 32 **Herzberg SD**, Motu'apuaka ML, Lambert W, Fu R, Brady J, Guise JM. The Effect of Menstrual Cycle and Contraceptives on ACL Injuries and Laxity: A Systematic Review and Meta-analysis. *Orthop J Sports Med* 2017; **5**: 2325967117718781 [RCA] [PMID: 28795075 DOI: 10.1177/2325967117718781] [FullText] [Full Text(PDF)]
- 33 **Chidi-Ogbolu N**, Baar K. Effect of Estrogen on Musculoskeletal Performance and Injury Risk. *Front Physiol* 2018; **9**: 1834 [RCA] [PMID: 30697162 DOI: 10.3389/fphys.2018.01834] [FullText] [Full Text(PDF)]
- 34 **Hansen M**. Female hormones: do they influence muscle and tendon protein metabolism? *Proc Nutr Soc* 2018; **77**: 32-41 [RCA] [PMID: 28847313 DOI: 10.1017/S0029665117001951] [FullText]
- 35 **Ardern CL**, Taylor NF, Feller JA, Webster KE. A systematic review of the psychological factors associated with returning to sport following injury. *Br J Sports Med* 2013; **47**: 1120-1126 [RCA] [PMID: 23064083 DOI: 10.1136/bjsports-2012-091203] [FullText]
- 36 **Webster KE**, Feller JA, Leigh WB, Richmond AK. Younger patients are at increased risk for graft rupture and contralateral injury after anterior cruciate ligament reconstruction. *Am J Sports Med* 2014; **42**: 641-647 [RCA] [PMID: 24451111 DOI: 10.1177/0363546513517540] [FullText]
- 37 **Fay CM**. Complications associated with use of anterior cruciate ligament fixation devices. *Am J Orthop (Belle Mead NJ)* 2011; **40**: 305-310 [RCA] [PMID: 21869942] [FullText]
- 38 **Niinomi M**, Liu Y, Nakai M, Liu H, Li H. Biomedical titanium alloys with Young's moduli close to that of cortical bone. *Regen Biomater* 2016; **3**: 173-185 [RCA] [PMID: 27252887 DOI: 10.1093/rb/rbw016] [FullText] [Full Text(PDF)]
- 39 **Grant JA**, Mohtadi NG, Maitland ME, Zernicke RF. Comparison of home versus physical therapy-supervised rehabilitation programs after anterior cruciate ligament reconstruction: a randomized clinical trial. *Am J Sports Med* 2005; **33**: 1288-1297 [RCA] [PMID: 16002493 DOI: 10.1177/0363546504273051] [FullText]
- 40 **Palmieri-Smith RM**, Thomas AC, Wojtys EM. Maximizing quadriceps strength after ACL reconstruction. *Clin Sports Med* 2008; **27**: 405-424, vii [RCA] [PMID: 18503875 DOI: 10.1016/j.csm.2008.02.001] [FullText]
- 41 **Hauger AV**, Reiman MP, Bjordal JM, Sheets C, Ledbetter L, Goode AP. Neuromuscular electrical stimulation is effective in strengthening the quadriceps muscle after anterior cruciate ligament surgery. *Knee Surg Sports Traumatol Arthrosc* 2018; **26**: 399-410 [RCA] [PMID: 28819679 DOI: 10.1007/s00167-017-4669-5] [FullText]
- 42 **Hughes L**, Paton B, Rosenblatt B, Gissane C, Patterson SD. Blood flow restriction training in clinical musculoskeletal rehabilitation: a systematic review and meta-analysis. *Br J Sports Med* 2017; **51**: 1003-1011 [RCA] [PMID: 28259850 DOI: 10.1136/bjsports-2016-097071] [FullText]
- 43 **Gokeler A**, Grassi A, Hoogeslag R, van Houten A, Lehman T, Bolling C, Buckthorpe M, Norte G, Benjaminse A, Heuvelmans P, Di Paolo S, Tak I, Villa FD. Return to sports after ACL injury 5 years from now: 10 things we must do. *J Exp Orthop* 2022; **9**: 73 [RCA] [PMID: 35907095 DOI: 10.1186/s40634-022-00514-7] [FullText] [Full Text(PDF)]
- 44 **Buerba RA**, Zaffagnini S, Kuroda R, Musahl V. ACL reconstruction in the professional or elite athlete: state of the art. *J ISAKOS* 2021; **6**: 226-236 [RCA] [PMID: 34272299 DOI: 10.1136/jisakos-2020-000456] [FullText]
- 45 **Cronström A**, Tengman E, Häger CK. Return to Sports: A Risky Business? A Systematic Review with Meta-Analysis of Risk Factors for Graft Rupture Following ACL Reconstruction. *Sports Med* 2023; **53**: 91-110 [RCA] [PMID: 36001289 DOI: 10.1007/s40279-022-01747-3]

- [FullText] [Full Text(PDF)]
- 46 **Hambly K**, Griva K. IKDC or KOOS: which one captures symptoms and disabilities most important to patients who have undergone initial anterior cruciate ligament reconstruction? *Am J Sports Med* 2010; **38**: 1395-1404 [RCA] [PMID: 20351201 DOI: 10.1177/0363546509359678] [FullText]
 - 47 **Piussi R**, Beischer S, Thomeé R, Hamrin Senorski E. Hop tests and psychological PROs provide a demanding and clinician-friendly RTS assessment of patients after ACL reconstruction, a registry study. *BMC Sports Sci Med Rehabil* 2020; **12**: 32 [RCA] [PMID: 32426142 DOI: 10.1186/s13102-020-00182-z] [FullText] [Full Text(PDF)]
 - 48 **Shelbourne KD**, Benner R, Gray T, Bauman S. Range of Motion, Strength, and Function After ACL Reconstruction Using a Contralateral Patellar Tendon Graft. *Orthop J Sports Med* 2022; **10**: 23259671221138103 [RCA] [PMID: 36479460 DOI: 10.1177/23259671221138103] [FullText]
 - 49 **Cunha J**, Solomon DJ. ACL Prehabilitation Improves Postoperative Strength and Motion and Return to Sport in Athletes. *Arthrosc Sports Med Rehabil* 2022; **4**: e65-e69 [RCA] [PMID: 35141537 DOI: 10.1016/j.asmr.2021.11.001] [FullText] [Full Text(PDF)]
 - 50 **Speziali A**, Delcogliano M, Tei M, Placella G, Bartoli M, Menghi A, Cerulli G. Fixation techniques for the anterior cruciate ligament reconstruction: early follow-up. A systematic review of level I and II therapeutic studies. *Musculoskelet Surg* 2014; **98**: 179-187 [RCA] [PMID: 25269758 DOI: 10.1007/s12306-014-0338-8] [FullText]
 - 51 **Joseph C**, Pathak SS, Aravinda M, Rajan D. Is ACL reconstruction only for athletes? A study of the incidence of meniscal and cartilage injuries in an ACL-deficient athlete and non-athlete population: an Indian experience. *Int Orthop* 2008; **32**: 57-61 [RCA] [PMID: 17033759 DOI: 10.1007/s00264-006-0273-x] [FullText]
 - 52 **Piussi R**, Simonson R, Kjellander M, Jacobsson A, Ivarsson A, Karlsson J, Samuelsson K, Hamrin Senorski E. When context creates uncertainty: experiences of patients who choose rehabilitation as a treatment after an ACL injury. *BMJ Open Sport Exerc Med* 2023; **9**: e001501 [RCA] [PMID: 36987514 DOI: 10.1136/bmjsem-2022-001501] [FullText] [Full Text(PDF)]
 - 53 **Mancino F**, Gabr A, Plastow R, Haddad FS. Anterior cruciate ligament injuries in female athletes. *Bone Joint J* 2023; **105-B**: 1033-1037 [RCA] [PMID: 37777208 DOI: 10.1302/0301-620X.105B10.BJJ-2023-0881.R1] [FullText]



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