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Evaluating Readiness to Return to Sport after Anterior Cruciate Ligament Reconstruction in Soccer Players: A Scoping Review of the Validity, Reliability, and Predictive Value of Hop Test Batteries and Psychological Assessments

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ABSTRACT

Soccer players recovering from anterior cruciate ligament reconstruction (ACLR) must achieve both physical and psychological readiness to safely return to sport (RTS) and reduce the risk of re-injury. However, uncertainty remains regarding the validity, reliability, and predictive value of commonly used hop test batteries, particularly when combined with psychological assessments. This scoping review aimed to examine the evidence on the use of functional hop tests and psychological measures in evaluating RTS preparedness among soccer players following ACLR. A comprehensive search of databases including Medline, PubMed, Embase, CINAHL, and SPORTDiscus identified studies meeting the eligibility criteria. Nineteen studies were included, several of which specifically focused on soccer players. Commonly assessed measures included the 6-meter timed hop, the Tampa Scale of Kinesiophobia, and the ACL-Return to Sport after Injury scale. Findings indicated that hop tests are reliable tools for assessing lower-limb function, though their predictive accuracy for RTS and reinjury risk varied across studies. Psychological readiness, particularly self-confidence and fear of reinjury, showed a strong association with RTS outcomes. Overall, the evidence supports that combining psychological evaluations with hop test batteries provides a more comprehensive assessment of RTS readiness than functional testing alone. These findings highlight the need to integrate both functional and psychological domains when developing clinically relevant, evidence-based RTS criteria for soccer players following ACLR.

Keywords: *Anterior cruciate Ligament, Soccer, Return to sport, Hop test, Psychological Readiness, Rehabilitation, Reinjury Risk*

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1. INTRODUCTION

Soccer places substantial physical demands on athletes, particularly through rapid cutting, pivoting, and sudden directional changes, making anterior cruciate ligament (ACL) injuries among the most frequent and severe musculoskeletal injuries encountered in the sport [1,2]. In young athletes, the risk of reinjury following anterior cruciate ligament reconstruction (ACLR) remains high, with recurrence rates reported between 20–30%, often preventing players from returning to their pre-injury level of performance [3]. Consequently, the development and use of accurate, reliable tools to evaluate readiness to return to sport (RTS) is a critical component of both injury prevention and rehabilitation.

Batteries of functional hop tests—such as the single-leg hop, triple hop, crossover hop, and 6-meter timed hop are widely used to assess lower-limb performance after ACLR [4,5]. These tests aim to provide objective measures of neuromuscular control, functional strength, and limb symmetry. However, their validity, reliability, and predictive value in determining safe RTS and reinjury risk remain debated, with studies showing inconsistent conclusions [6].

Beyond physical recovery, psychological readiness is increasingly recognized as a key determinant of successful RTS. Many athletes continue to face barriers such as fear of reinjury, diminished confidence, and reduced motivation, even when physical performance tests suggest adequate recovery [7]. Tools like the Anterior Cruciate Ligament—Return to Sport after Injury (ACL-RSI) scale have been introduced to quantify psychological preparedness and address these concerns [8]. Incorporating psychological assessments alongside functional test batteries may therefore enhance decision-making and provide a more holistic evaluation of RTS readiness.

Soccer players are particularly vulnerable to reinjury because of the sport's intense physical demands, competitive pressures, and high recurrence rates. This population requires RTS assessment frameworks that integrate both functional and psychological domains, ensuring that evaluations are comprehensive, evidence-based, and tailored specifically to the unique challenges of soccer [9].

Despite the increasing use of functional and psychological measures in isolation, there remains a lack of comprehensive evidence integrating both domains specifically within professional soccer players. This gap underscores the need for a formal synthesis to inform evidence-based, sport-specific RTS criteria in this high-risk group. Given these considerations, the objectives of this review were two-fold: firstly, to evaluate the validity, reliability, and predictive utility of hop test batteries in determining soccer players' readiness to RTS following ACLR, and further, to examine the influence of psychological assessments on RTS preparedness and reinjury risk in this population.

2. METHODOLOGY

This scoping review was undertaken to map the existing evidence on the preparedness of soccer players to RTS following ACLR, with emphasis on psychological assessments and functional test batteries such as hop tests. The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines, thereby ensuring methodological transparency and reproducibility of findings [10].

Literature Search Strategy

A comprehensive literature search was carried out across multiple electronic databases, including PubMed, Web of Science, Cochrane Library, and Google Scholar, up to July 2023. The following combination of keywords and Boolean operators was applied:

- ("anterior cruciate ligament" OR "ACL" OR "ACL reconstruction")
- AND ("soccer" OR "soccer players")
- AND ("return to sport" OR "RTS" OR "re-injury risk")
- AND ("hop test" OR "hop test battery" OR "functional test")
- AND ("psychological assessment" OR "psychological readiness" OR "ACL-RSI" OR "Tampa scale" OR "fear of re-injury").

Additionally, the reference lists of included studies and relevant reviews were screened manually to capture further eligible records [11–14].

Eligibility Criteria

Studies were eligible for inclusion if they evaluated psychological readiness assessments and/or hop test batteries in soccer players following ACLR, involved participants aged 18 years or older, and were published in peer-reviewed journals in the English language. Excluded were expert opinions, case reports, editorials, letters, and procedural papers; studies that did not provide measurable RTS assessment outcomes; research focused solely on non-soccer athletes without subgroup analyses for soccer players; studies involving participants younger than 18 years; and duplicate or overlapping publications.

Data Extraction

Data were systematically charted to generate a descriptive overview of the evidence. Extracted information included:

- Study characteristics (design, sample size, competition level, and time since ACLR).
- Functional test batteries (e.g., single-leg hop, triple hop, crossover hop, timed hop).

- Psychological assessment tools (e.g., ACL-RSI, Tampa Scale of Kinesiophobia, IKDC psychological items).
- Reported cut-off values, reliability, and predictive features where available.

The primary aim was to summarize the scope, range, and characteristics of RTS assessments in the literature rather than to critically appraise methodological quality.

Quality Assessment

Consistent with the principles of scoping review methodology, no formal risk of bias or quality appraisal was undertaken, as the objective was to map the breadth of existing evidence rather than evaluate the methodological rigor of individual studies.

Data Synthesis

Extracted data were charted in structured tables capturing study characteristics, participant details, graft types, and reported return-to-sport (RTS) assessments. Findings were narratively synthesized and organized into three primary domains: functional hop and performance tests, strength-based measures, and psychological self-report tools. Patterns in validity, reliability, cutoff thresholds, and clinical applicability were described, while heterogeneity across studies was highlighted. Descriptive statistics (e.g., ranges of participant age, sample size, intraclass correlation coefficients) were applied to illustrate variability, and evidence gaps along with soccer-specific adaptations were mapped to identify opportunities for future research. To complement the narrative synthesis, schematic frameworks were integrated to visually represent test selection under varying resource constraints and to illustrate the multidimensional structure of RTS assessments, thereby strengthening the clarity and interpretability of the analysis.

3. RESULTS

Study Selection and Participant Characteristics

The initial search identified 27 studies encompassing 8,689 participants. Following the application of inclusion and exclusion criteria, 19 studies were included in this scoping review, representing a total of 7,513 soccer and mixed-athlete participants. The included studies demonstrated considerable variability in participant characteristics, with sample sizes ranging from 28 to 224 athletes (Table 1). The majority of cohorts comprised young to middle-aged individuals (mean ages 20–27 years), although some studies specifically examined adolescents (mean age 16–17 years). Sex distribution varied, with several studies including balanced samples, while others focused exclusively on males, reflecting the sporting populations recruited.

Hamstring tendon autografts were the most commonly reported graft type, followed by bone–patellar tendon–bone autografts, with fewer studies including quadriceps tendon or allograft reconstructions (Table 1). Several studies also included revision cases. The predominant sporting backgrounds were high-demand, pivoting activities such as soccer, handball, and basketball, with some investigations recruiting exclusively soccer players. Reported outcomes included validated patient-reported measures such as the International Knee Documentation Committee, Knee injury and Osteoarthritis Outcome Score, as well as Tegner activity scores and return to strenuous sport participation, underscoring the focus on functional recovery and return to high-level athletic activity after ACL.

Table 1. Study and Participant Characteristics

Study	Sample Size, n (M/F)	Age (Mean/Range)	Surgical Details	Sports / Outcomes
Ahmed (2017)	29 (16/13)	26.4 (14–54)	Primary ACLR: HS autograft; Revision ACLR: contralateral HS autograft	IKDC subjective score 84; strenuous/very strenuous sports (15; 52%)
Beischer (2020)	159 (79/80)	21.5 ± 4.4	BPTB (21), HS (133), QT (1), allograft (1)	Preinjury Tegner 6
Di Stasi (2013)	42 (30/12)	29.3 ± 10.8	Soft tissue allograft or ST-G autograft	—
Ebert (2018)	111 (73/38)	27.3 ± 9.1	HS autograft (all)	IKDC level 1 or 2 sports
Gokeler (2017)	28 (22/6)	25.4 ± 8.2	BPTB (8), HS (19), allograft (1)	—
Granan	83 (40/43)	25.5 ± 11.2	—	KOOS Sport/Rec: no revision

(2015)				65.0; revision 45.2
Grindem (2016)	100 (46/54)	24.3 ± 7.3	HS (67%), BPTB (33%); Secondary injuries: meniscus/cartilage/MCL	Preinjury level 1 sports: handball (30%), soccer (53%), basketball (6%), floorball (11%)
Herbst (2015)	69 (42/27)	20.9 ± 7.8	BPTB (10; 14.5%), HS (47; 68.1%), QT (12; 17.4%); 12 revisions	—
Krych (2015)	224 (93/131)	22 (12–59)	BPTB (34; 27%), HS (28; 22%), BPTB allograft (62; 50%)	Tegner 6 (2–10)
Kyritsis (2016)	132 (132/0)	21 ± 4	HS (89; 67.4%), BPTB (43; 32.6%); secondary injuries yes (60)	Soccer (65.2%), handball (14.4%), other (20.5%)
Logerstedt (2014)	158 (92/66)	26.9 ± 9.7 (13–56)	BPTB (30; 16%), HS (81; 42%), allograft (63; 33%), NR (20; 10%)	IKDC level 1 or 2 sports
Nawasreh (2018)	95 (63/32)	27.1 ± 10.6	Allograft (59; 60%), ST-G (37; 38%), BPTB (2; 2%)	IKDC level 1 or 2 sports
Paterno (2018)	40 (NR)	16.2 ± 3.4	—	—
Paterno (2017)	163 (58/105)	16.7 ± 3.0	BPTB (53; 33%), HS (95; 58%), allograft (15; 9%)	IKDC level 1 or 2 sports
Sousa (2017)	223 (92/131)	22 (12–59)	BPTB (132; 60%), HS (28; 13%), allograft (63; 28%)	—
Thomeé (2012)	82 (56/26)	28 ± 8.2	BPTB (36; 44%), HS (46; 56%)	—
Toole (2017)	115 (27/88)	17.1 ± 2.5	BPTB (50; 43.5%), HS (57; 49.6%), allograft (8; 7%)	Tegner at RTS: 8.3 ± 1.5; 1 year post-RTS: 8.4 ± 1.6
Welling (2018)	62 (45/17)	24.2 ± 6.2	BPTB (25; 31%), HS (36), allograft (1)	Soccer (45), basketball (6), handball (4), tennis (3), korfball (2), rugby (1), volleyball (1)
Wellsandt (2017)	70 (47/23)	26.6 ± 10.0	HS (28), allograft (26)	Cutting & pivoting athletes
ACLR – Anterior Cruciate Ligament Reconstruction; BPTB – Bone–Patellar Tendon–Bone (autograft); F – Female; HS – Hamstring (autograft); IKDC – International Knee Documentation Committee; KOOS – Knee injury and Osteoarthritis Outcome Score; M – Male; MCL – Medial Collateral Ligament; NR – Not Reported; QT – Quadriceps Tendon; RTS – Return to Sport; ST-G – Semitendinosus–Gracilis (autograft)				

The included studies evaluated a wide range of RTS assessments, with hop test batteries and psychological self-report measures being the most frequently reported tools. A summary of the included studies and their reported RTS assessments is presented in Table 2. The studies involved soccer players across multiple competitive levels, including undergraduate, amateur, and professional athletes. While some investigations were designed specifically for soccer subgroups, others assessed mixed cohorts where soccer players comprised a significant component. This diversity provided a broad overview of RTS assessments across different competitive contexts and populations. Across the included studies, thirteen of twenty-one RTS tests were commonly reported, with emphasis on hop test batteries and psychological readiness assessments. Strength-based evaluations, such as isokinetic and isometric testing, were occasionally described; however, their implementation in soccer-specific rehabilitation was limited due to resource demands and practicality constraints [15–21].

Table 2. Studies included in the final report and the RTS tests conducted on it

Study (Lead Author, Year)	Isokinetic Knee Ext	Isokinetic Knee Ext/Flex	Isometric Knee Ext	Distance Hop	Triple Hop	Triple Crossover Hop	6-m Timed Hop	Vertical Jump	Drop Jump	Side Hop	Running T-Test	Speedy Jump	SEBT/Y-Balance	Sport-Specific Rehab	Jump Landing (LESS)	Quick Feet Test	KOOS-Sport/Rec	IKDC Subjective	GRS-PF	ACL-RSI	TSK
Ahmed (2017)				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Beischer (2020)	X	X	X	X																	
Di Stasi (2013)	X		X																		
Ebert (2018)																	X				
Gokeler (2017)	X			X	X	X	X	X	X												
Granan (2015)	X	X																			
Grindem (2016)	X	X	X																		
Herbst (2015)	X			X	X	X	X														
Krych (2015)	X			X	X																
Kyritsis (2016	X			X																	

)																					
Logerstedt (2014)	X			X																	
Nawasreh (2018)	X			X																	
Paterno (2018)	X			X	X																
Paterno (2017)	X			X	X	X	X														
Sousa (2017)	X			X	X																
Thomeé (2012)	X	X		X	X																
Toole (2017)	X																				
Welling (2018)	X	X	X	X	X	X	X	X													

Strength and Balance Assessments

Strength testing was primarily conducted using isokinetic and isometric dynamometers, though alternative field-based approaches were also reported (Table 3). The dynamic isokinetic knee extension test (quadriceps) and the dynamic quadriceps-to-hamstring ratio test required specialized isokinetic equipment, which is costly and time-intensive, but demonstrated strong reliability (intraclass correlation coefficient (ICC) values up to 0.89) and validation for use in combination with hop or jump tests. Static maximal voluntary isometric contraction of the quadriceps showed comparable reliability (ICC 0.88) and is similarly validated, though it also relies on expensive equipment.

Alternative options included the 8-repetition maximum test using weight training equipment and elastic band-based testing. Both methods were low-cost and quick to administer, with moderate to high concurrent validity when compared to dynamometer-based testing (correlation values ranging from 0.5 to 0.85). However, their application to RTS decision-making remains limited due to the lack of standardized cutoff criteria. Overall, laboratory-based dynamometer assessments were consistently rated as recommended, while field-based alternatives were considered intermediate or restricted due to limited validation.

Table 3. Summary of Strength Tests: Clinical Practicability, Validity, Reliability, and Recommendations for Return-to-Sport Assessment

Test	Clinical Practicability	Equipment Costs	Time Needed	Standard Outcome	Validity (Reinjury Prediction)	Reliability (ICC / r values)	Alternative Tests	Cutoff Values	Orientation Values	Overall Recommendation
Dynamic Isokinetic Knee Extension (Quadriceps)	Isokinetic dynamometer needed	Very expensive (>10,000 EUR)	>10 min (red)	Isokinetic torque at 60°, 180°, 300°/s	Validated as discharge criteria in combination with hop/jump tests	ICC = 0.89 (0.77–0.95)	8-RM knee extension; handheld dynamometer	LSI >90% for noncontact sports; >100% for pivoting/contact sports	Reference values: age, sex, body size explain 84% variability	**Green (approved)**
Dynamic Isokinetic Extension/Flexion (Quadriceps/Hamstring Ratio)	Isokinetic dynamometer needed	Very expensive (>10,000 EUR)	>10 min (red)	Functional ratio (quad/ham)	Associated with hamstring injury risk	ICC not consistently reported	8-RM ext/flex ratio	Ratio <0.6 = ↑ risk; 0.7–1 = accepted	Sex-specific ratios: M = 62.5%, F = 55%	**Yellow (restrictions)**
Static Maximal Voluntary Isometric Contraction (Quadriceps)	Isometric dynamometer needed	Very expensive (>10,000 EUR)	6–10 min (yellow)	Isometric torque at 90° hip & knee flexion	Validated in combination with hop/jump tests	ICC = 0.88 (0.73–0.94)	Handheld dynamometer	LSI >90% noncontact; >100% pivoting/contact	Orientation values: McKay et al, age- and sex-stratified	**Green (approved)**
Alternative Test 1: 8-RM Test (Knee Extension/Flexion)	Weight training equipment	Low–moderate costs	<10 min (yellow)	Reproducible, easy to apply	Concurrent validity with standard test	r = 0.71–0.85	Fixed position dynamometer (r = 0.5–0.8)	Same LSI thresholds as above	Healthy ref values available	**Yellow (intermediate)**
Alternative Test 2: Elastic Band Test	Portable, easy to use	Low cost (green)	<5 min (green)	Reproducible, field-friendly	Concurrent validity with standard test	ICC >0.96–0.97	1-RM prediction possible	Not yet validated for RTS cutoff	Ref: 1-RM ≈ 44.4–52.0 kg (sex-specific)	**Yellow (restrictions**
8-RM – Eight-Repetition Maximum; 1-RM – One-Repetition Maximum; EUR – Euro (currency); F – Female; ICC – Intraclass Correlation Coefficient; LSI – Limb Symmetry Index; M – Male; RTS – Return to Sport										

Hop and Functional Performance Tests

Hop-based performance tests were widely used due to their simplicity, low cost, and strong reliability [22-25]. The single-leg distance hop, triple hop, triple crossover hop, and 6-meter timed hop required only a small area and a tape measure, with administration times of about 5 minutes. These tests demonstrated high reliability values between 0.82 and 0.96) and were validated in combination with other hop measures (Table 4). A limb symmetry index above 90% was consistently used as a cutoff, with approved recommendations for clinical practice.

More advanced assessments included the single-leg vertical countermovement hop, drop jump, speedy hop, and running T-test. While these provided additional insight into movement quality, reinjury risk, or agility, they required higher-cost equipment, longer administration times, and demonstrated variable reliability. For example, drop jump valgus moments greater than 2.8 Nm/kg increased reinjury risk (odds ratio = 3.3), but interrater and intrarater reliability varied. Overall, the simple hop tests were recommended for routine use, while the more complex measures were considered useful with restrictions due to feasibility and cost. The primary aim of these assessments was to detect lower limb asymmetries, evaluate functional strength, and monitor readiness for athletic activities [26–30]. Horizontal hop tests (single-leg, triple, crossover, timed hop) were the most consistently reported across rehabilitation contexts, while vertical and drop jumps were less frequently included and were typically reserved for advanced performance analysis [31–39].

Table 4: Summary of Hop and Functional Performance Tests: Clinical Practicability, Validity, Reliability, and Recommendations for Return-to-Sport Assessment

Test	Clinical Practicability	Equipment Costs	Time Needed	Standard Outcome	Validity (Reinjury Prediction)	Reliability (ICC / r values)	Cutoff Values	Orientation Values	Overall Recommendation
Distance Hop	10-m² empty area, tape measure	Low (tape)	~5 min (green)	Distance length, LSI	Validated in combination with other hop tests	ICC = 0.94 (0.92–0.87)	LSI >90% (EPIC >90%)	ACLR: 444 cm vs healthy: 468 cm; LSI ~87.8	**Green (approved)**
Triple Hop	10-m² empty area, tape measure	Low (tape)	~5 min (green)	Distance length, LSI	Validated in combination with other hop tests	ICC = 0.96 (0.88–0.80, 0.94–0.955)	LSI >90% (better EPIC >90%)	ACLR: 538–549 cm vs healthy: 499–565 cm; LSI ~87.8	**Green (approved)**
Triple Crossover Hop	10-m² empty area, tape measure	Low (tape)	~5 min (green)	Distance length, LSI	Validated in combination with other hop tests	ICC = 0.90–0.963	LSI >90%	ACLR: 400 cm vs healthy: 414 cm	**Green (approved)**
6-m Timed Hop	110-m² empty area, tape measure	Low (tape)	~5 min (green)	Time to completion (sec), LSI	Validated with hop tests	ICC = 0.82–0.90, 0.94–0.955	LSI >90%	ACLR: 2.3 sec vs uninvolved: 2.2 sec	**Green (approved)**
Single-Leg Vertical (Countermovement) Hop	Contact mat (100–500 EUR) or smartphone app/inertial sensor	Medium cost	~30 min (red)	Jumping height, LSI	Validated, used with isokinetic tests	ICC = 0.89–0.97; with sensors ICC = 0.98	LSI >90%	Healthy: 187–192 cm vs ACLR: 178–199 cm; high reinjury risk at LSI	**Yellow (restrictions)**

								<98.5	
Drop Jump	30–32 cm box + 1–2 cameras	Medium–high cost	15 min (yellow)	Knee valgus moment (Nm/kg), knee separation distance	Valid predictor of reinjury (valgus >2.8 Nm/kg, OR = 3.3)	ICC = 0.93; interrater = 0.92; intrarater = 0.55	Separation distance >60% safe	Normative: <60% separation = ↑ risk	**Yellow (restrictions)**
Speedy Hop	Course setup 2x4 m	~89 EUR (or tape)	~10 min (yellow)	Time to completion (sec)	Unknown validity	ICC = 0.79–0.82	Suggested LSI >90%	ACLR: 5.0 cm vs healthy: 13.3–18.1 cm	**Yellow (restrictions)**
Running T-Test	12x12 m empty area, stopwatch	Low cost	~10 min (yellow)	Time to completion (sec)	Validated only in combination with strength + hop tests	ICC = 0.82–0.98	<11 sec (M <10 sec; F <11 sec)	ACLR: 10 ±1 sec; college athletes faster (M ~9.9 s; F ~10.9 s)	**Yellow (restrictions)**
ACLR – Anterior Cruciate Ligament Reconstruction; cm – Centimeter; EUR – Euro (currency); F – Female; ICC – Intraclass Correlation Coefficient; LSI – Limb Symmetry Index; M – Male; Nm/kg – Newton meter per kilogram; OR – Odds Ratio; sec – Seconds									

Patient-Reported Outcome Measures (PROMs) in Return-to-Sport Assessment

PROMs provide valuable insight into subjective aspects of recovery, such as functional ability, psychological readiness, and fear of reinjury. Tools such as the Knee injury and Osteoarthritis Outcome Score for Sport and Recreation and the Anterior Cruciate Ligament–Return to Sport after Injury scale are quick, inexpensive, and easy to administer (Table 5). While they lack direct biomechanical assessment, their strong psychometric properties make them reliable adjuncts when combined with objective functional tests. Both questionnaires demonstrate high internal consistency and test–retest reliability, supporting their clinical use in determining readiness for sport.

Table 5: Clinical Applicability of Patient-Reported Outcome Measures Following ACL Reconstruction

Test	**Clinical Practicability**	**Equipment Costs**	**Time Needed**	**Standard Outcome**	**Validity (Reinjury Prediction)**	**Reliability**	**Cutoff Values**	**Orientation Values**	**Overall Recommendation**
KOOS-Sport/Rec	Only questionnaire + pen; very easy to administer	None (green)	~5 min (green)	Self-reported knee function in sport/recreation (%)	Validated as discharge criteria when combined with hop/jump tests or alone	ICC = 0.91 ± 2.9; Cronbach α = 0.96	No strict cutoff; higher scores = better readiness	Commonly used in combination with strength & hop tests (e.g., isometric quadriceps, drop jump,	**Green (approved)**

								single-leg hop)	
ACL-RSI (Anterior Cruciate Ligament – Return to Sport after Injury scale)	Only questionnaire + pen; very easy to administer	None (green)	~3 min (green)	Psychological readiness, confidence, fear of reinjury	Validated as discharge criteria; strong predictor when combined with functional tests	Cronbach α = 0.96; inter-item correlation mean = 0.69	>65 = higher readiness; <45.2 (38.3–52.0) = ↑ risk of re-rupture	Post-ACLR 2-year mean = 71.8 (64.9–78.7); return to same activity: 6.1 ±1.9; return to same level: 7.0 ±1.8	**Green (approved**

ACL: Anterior Cruciate Ligament; ACL-RSI: Anterior Cruciate Ligament – Return to Sport after Injury scale; ICC: Intraclass Correlation Coefficient; KOOS-Sport/Rec: Knee injury and Osteoarthritis Outcome Score – Sport and Recreation; PROMs: Patient-Reported Outcome Measures

Psychological Readiness

Psychological self-report measures were consistently reported as complementary assessments to functional testing. The most widely used tools included the ACL–Return to Sport after Injury scale, which assesses confidence, emotions, and risk appraisal associated with return to competition, with higher scores (>65 at two years and >60 at six months) linked to successful return to sport in soccer [40–43]. The Knee Injury and Osteoarthritis Outcome Score for Sport and Recreation evaluates knee function during sports activities, where lower scores were associated with an increased risk of reinjury or revision surgery [44–47]. The Tampa Scale of Kinesiophobia (TSK-11) was occasionally applied to assess fear of movement and reinjury. Together, these psychological measures complemented functional performance testing by providing valuable insight into mental preparedness and perceived reinjury risk [48–50].

Evidence Mapping and Patterns

The scoping review identified several trends in RTS assessments. Hop test batteries and psychological questionnaires such as the ACL–Return to Sport after Injury scale and the Knee Injury and Osteoarthritis Outcome Score for Sport and Recreation were the most frequently reported tools. However, there was considerable heterogeneity in the choice, combination, and administration of these assessments. Standardized protocols, cut-off values, and soccer-specific adaptations were inconsistently reported, while strength-based measures, including isokinetic and isometric testing, were applied mainly in research contexts rather than routine rehabilitation practice [51].

Resource-Based Considerations

Several studies emphasized practical factors influencing RTS assessments, including time, equipment, and clinical setting [52]. Hop test batteries and psychological self-report tools were highlighted as feasible, cost-effective, and applicable across competitive levels. Advanced assessments, such as vertical hops, drop jumps, or strength testing, were occasionally used for detailed profiling but required specialized equipment.

Functional and Psychological Integration

Hop test batteries such as the single-leg hop, triple hop, and 6-meter timed hop were identified as cost-efficient (less than 5 minutes, minimal equipment and space required) and suitable for team-based rehabilitation contexts [53]. Advanced tests like the drop jump and vertical hop, though less commonly employed, provided deeper insights into explosive power and dynamic knee control when specialized tools (force platforms, motion analysis systems, or wearable sensors) were available. Self-report tools such as the ACL–Return to Sport after Injury scale and the Knee Injury and Osteoarthritis Outcome Score for Sport and Recreation were considered practical and efficient (completion time <10 minutes), making them particularly useful in low-resource settings [54]. The 11-item Tampa Scale of Kinesiophobia was suggested as an optional addition for assessing fear of reinjury. Although hop test batteries remain the cornerstone of soccer-specific RTS evaluation, optional quadriceps strength testing (isokinetic or isometric) may provide additional objectivity. However, given their resource-intensive nature, these are not recommended as routine clinical measures.

Framework for Resource-Based Test Selection

Figure 1 illustrates the selection process of RTS tests according to time, space, and cost efficiency. It highlights practical alternatives such as handheld dynamometry or elastic band testing for strength, smartphone or contact mat–based hop assessments for functional ability, and self-report questionnaires like the ACL–Return to Sport after Injury scale or the Knee injury and Osteoarthritis Outcome Score for psychological readiness. The schematic emphasizes how clinicians can transition from resource-efficient options to standardized testing protocols depending on clinical feasibility.

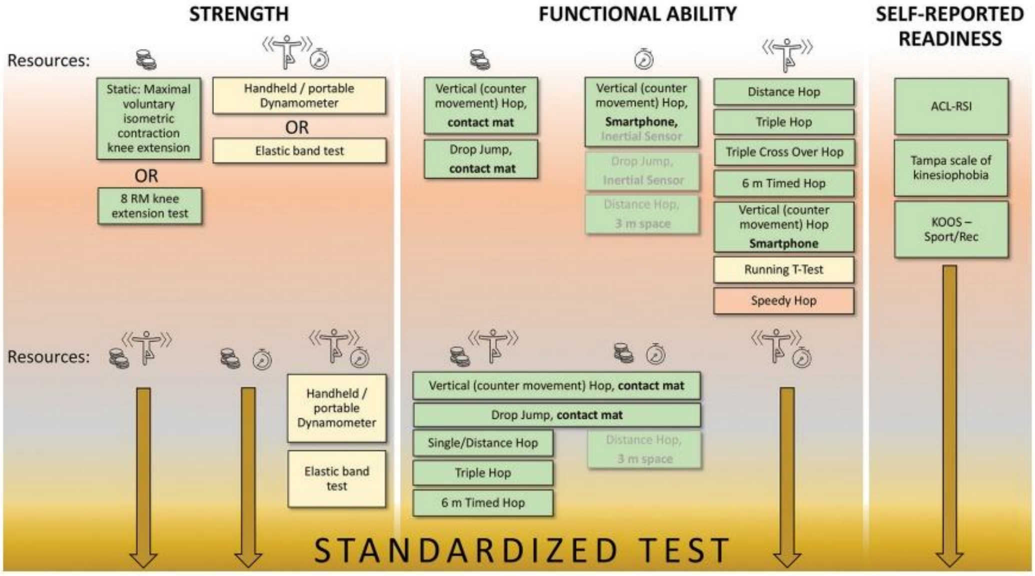

Figure 1: Test selection schematic based on time, money, and space restrictions. Arrows depict the transition from resource-efficient alternatives to standardized RTS assessments. Colored boxes indicate tests meeting quality requirements.

Integrated RTS Test Compilation

Figure 2 presents a conceptual framework for compiling RTS assessments in soccer players following anterior ACLR. Strength tests (e.g., isokinetic knee extension), functional hop-based assessments (e.g., single-leg hop, triple hop, drop jump), and psychological self-report tools (e.g., International Knee Documentation Committee subjective form, ACL–Return to Sport after Injury scale, Tampa Scale of Kinesiophobia) are depicted as complementary elements. This schematic underlines the multidimensional nature of RTS testing, where integrating physical and psychological measures offers a more comprehensive evaluation of readiness for competition.

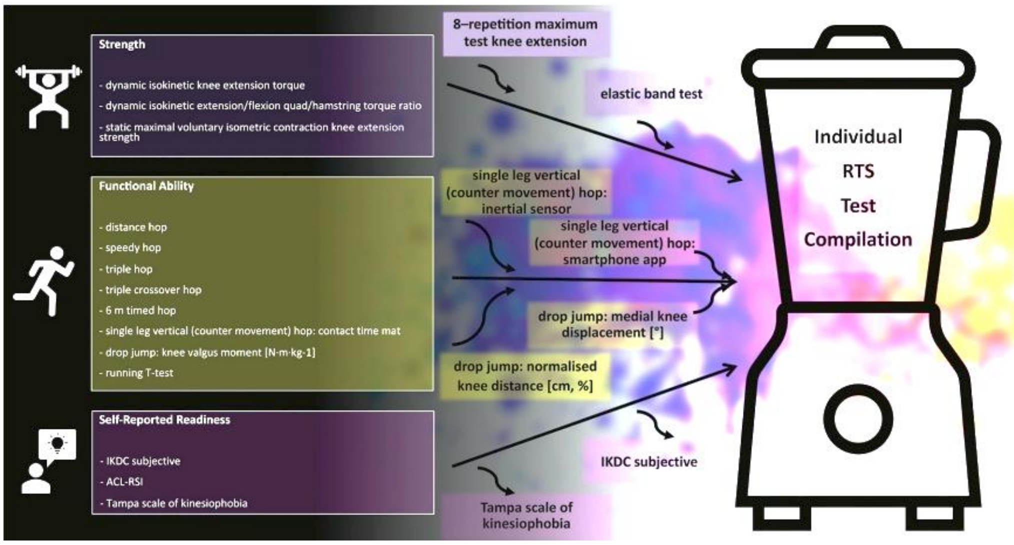

Figure 2: Conceptual compilation of RTS assessments in soccer players following ACL reconstruction. The framework integrates strength, functional ability, and psychological readiness measures into an individualized RTS profile.

Summary of Findings

Hop test batteries (single-leg, triple, crossover, and 6-meter timed hop) were consistently highlighted as reliable, low-cost, and clinically feasible tools. These tests demonstrated strong reliability (ICC up to 0.96) and were typically recommended with a limb symmetry index cutoff above 90%. More advanced measures, including vertical hops, drop jumps, and running agility tests, offered additional insights into reinjury risk and dynamic control but required specialized equipment and were applied less consistently. Strength-based measures (isokinetic and isometric quadriceps assessments) were validated and reliable but resource-intensive, limiting their use to research settings or advanced rehabilitation contexts. Field-based alternatives, such as the 8-repetition maximum test and elastic band resistance, were easier to administer but lacked standardized cutoffs for clinical application.

Psychological self-report measures, particularly the Anterior Cruciate Ligament–Return to Sport after Injury scale and the Knee injury and Osteoarthritis Outcome Score for Sport and Recreation, were widely reported as complementary tools, providing insights into confidence, functional perception, and fear of reinjury. These questionnaires demonstrated strong psychometric properties and were time-efficient, making them highly applicable in both clinical and team settings. Collectively, the findings underscore the value of integrating functional hop testing with psychological readiness measures for a multidimensional approach to RTS decision-making. However, the review also identified heterogeneity in test selection, cut-off criteria, and soccer-specific adaptations, highlighting the need for greater standardization and further validation to optimize return-to-play pathways in this population.

4. DISCUSSION

Extensive research demonstrates that there is currently no universally accepted timescale or standardized set of physiological parameters for determining safe RTS after ACLR [45–51]. This lack of consensus contributes to considerable variability in RTS protocols across rehabilitation centers. Although isokinetic strength testing is often regarded as the gold standard due to its objective reliability, it is rarely implemented in routine soccer rehabilitation owing to high costs, time requirements, and the need for specialized equipment.

Among the available assessments, hop test batteries and psychological readiness evaluations emerged as the most frequently reported and clinically feasible tools. Hop tests such as the single-leg hop, triple hop, crossover hop, and 6-meter timed hop are particularly valued for assessing limb symmetry and explosive power [52–56]. These tests are cost-effective, time-efficient, and require minimal space, making them suitable for team-based rehabilitation. More complex assessments, such as vertical hops and drop jumps, demand specialized equipment but provide valuable insights into neuromuscular control and dynamic valgus, which are critical for cutting, pivoting, and jumping in soccer. Evidence suggests that using test batteries offers a more comprehensive picture of functional readiness and reinjury risk than relying on single-hop measures alone.

Psychological readiness represents another key determinant of RTS success. Soccer players frequently report barriers such as fear of reinjury, low self-efficacy, and reduced confidence [57]. Validated tools including the ACL-Return to Sport after Injury scale, Tampa Scale of Kinesiophobia, and Knee injury and Osteoarthritis Outcome Score for Sport and Recreation subscale are widely used, cost-effective, and simple to administer. Incorporating these instruments into rehabilitation enhances decision-making by capturing the psychological dimensions of recovery alongside physical performance. A combined psychological–functional assessment framework therefore holds promise for tailoring more targeted interventions.

Another challenge lies in establishing meaningful cutoff values. While limb symmetry indices ≥90% are often cited as thresholds for safe RTS, subtle deficits in movement quality (e.g., medial knee displacement) may still persist despite meeting quantitative criteria [58,59]. Supplementary technologies such as video motion analysis and wearable inertial sensors can provide more nuanced insights into biomechanical deficits.

Taken together, the findings of this review support the need for multidimensional RTS assessments in soccer players post-ACLR. Integrating hop test batteries, psychological readiness measures, and where resources permit, strength testing provides a holistic evaluation of recovery status [61]. This multivariate approach aligns with the complex physical and psychological demands of soccer and facilitates safer, individualized, and sustainable RTS decisions.

5. CONCLUSION

This scoping review demonstrates that hop test batteries and psychological self-report measures, particularly the ACL–Return to Sport after Injury scale and the Knee injury and Osteoarthritis Outcome Score for Sport and Recreation, represent the most reliable, practical, and cost-effective assessments for evaluating readiness to RTS after ACLR in soccer players. While isokinetic and isometric strength testing remain valuable for objective quantification, their resource demands limit widespread clinical use, with field-based alternatives requiring further validation.

A combined framework that integrates functional hop testing with psychological readiness measures offers a comprehensive and soccer-specific approach to RTS decision-making. Such testing should be applied as a decision-support strategy rather than a definitive safeguard, with outcomes interpreted alongside clinical expertise, athlete context, and individualized rehabilitation goals. Greater standardization of protocols and soccer-specific adaptations is needed to refine best practices, reduce reinjury risk, and facilitate safe and effective return to competitive play.

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REFERENCES

[1] 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; 50(13): 804–8.

[2] Waldén M, Hägglund M, Magnusson H, Ekstrand J. ACL injuries in men's professional football: a 15-year prospective study on time trends and return-to-play rates reveals only 65% of players still play at the top level 3 years after ACL rupture. Br J Sports Med. 2016; 50(12):744-50.

[3] Webster KE, Feller JA. Exploring the High Reinjury Rate in Younger Patients Undergoing Anterior Cruciate Ligament Reconstruction. Am J Sports Med. 2016;44(11):2827-32.

[4] Noyes FR, Barber SD, Mangine RE. Abnormal lower limb symmetry determined by function hop tests after anterior cruciate ligament rupture. Am J Sports Med. 1991;19(5):513-8.

[5] Dingenen B, Gokeler A. Optimization of the Return-to-Sport Paradigm After Anterior Cruciate Ligament Reconstruction: A Critical Step Back to Move Forward. Sports Med. 2017;47(8):1487-1500.

[6] Losciale JM, Zdeb RM, Ledbetter L, Reiman MP, Sell TC. The Association Between Passing Return-to-Sport Criteria and Second Anterior Cruciate Ligament Injury Risk: A Systematic Review With Meta-analysis. J Orthop Sports Phys Ther. 2019;49(2):43-54.

[7] 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(21):1543-52.

[8] 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;9(1):9-15.

[9] Kyritsis P, Bahr R, Landreau P, Miladi R, Witvrouw E. Likelihood of ACL graft rupture: not meeting six clinical discharge criteria before return to sport is associated with a four times greater risk of rupture. Br J Sports Med. 2016;50(15):946-51.

[10] Choi GJ, Kang H. The umbrella review: a useful strategy in the rain of evidence. Korean J Pain. 2022;35(2):127-8.

[11] Ashigbi EYK, Banzer W, Niederer D. Return to Sport Tests' Prognostic Value for Reinjury Risk after Anterior Cruciate Ligament Reconstruction: A Systematic Review. Med Sci Sports Exerc. 2020;52(6):1263-71.

[12] Capin JJ, Snyder-Mackler L, Risberg MA, Grindem H. Keep calm and carry on testing: a substantive reanalysis and critique of 'what is the evidence for and validity of return-to-sport testing after anterior cruciate ligament reconstruction surgery? A systematic review and meta-analysis'. Br J Sports Med. 2019;53(23):1444-6.

[13] Zhou W, Liu X, Hong Q, Wang J, Luo X. Association between passing return-to-sport testing and re-injury risk in patients after anterior cruciate ligament reconstruction surgery: a systematic review and meta-analysis. PeerJ. 2024;12:e17279.

[14] Webster KE, Hewett TE. What is the Evidence for and Validity of Return-to-Sport Testing after Anterior Cruciate Ligament Reconstruction Surgery? A Systematic Review and Meta-Analysis. Sports Med. 2019;49(6):917-29.

[15] van Melick N, Pronk Y, Nijhuis-van der Sanden M, Rutten S, van Tienen T, Hoogeboom T. Meeting movement quantity or quality return to sport criteria is associated with reduced second ACL injury rate. J Orthop Res. 2022;40(1):117-28.

[16] Krych AJ, Woodcock JA, Morgan JA, Levy BA, Stuart MJ, Dahm DL. Factors associated with excellent 6-month functional and isokinetic test results following ACL reconstruction. Knee Surg Sports Traumatol Arthrosc. 2015;23(4):1053-9.

[17] Hewett TE, Myer GD, Zazulak BT. Hamstrings to quadriceps peak torque ratios diverge between sexes with increasing isokinetic angular velocity. J Sci Med Sport. 2008;11(5):452-9.

[18] Gokeler A, Dingenen B, Hewett TE. Rehabilitation and Return to Sport Testing After Anterior Cruciate Ligament Reconstruction: Where Are We in 2022? Arthrosc Sports Med Rehabil. 2022;4(1):e77-e82.

[19] Nawasreh Z, Logerstedt D, Cummer K, Axe M, Risberg MA, Snyder-Mackler L. Functional performance 6 months after ACL reconstruction can predict return to participation in the same preinjury activity level 12 and 24 months after surgery. Br J Sports Med. 2018 Mar;52(6):375.Sueyoshi T, Nakahata A, Emoto G, Yuasa T. Single-Leg Hop Test Performance and Isokinetic Knee Strength After Anterior Cruciate Ligament Reconstruction in Athletes. Orthop J Sports Med. 2017; 5(11): 2325967117739811.

[20] King E, Richter C, Daniels KAJ, Franklyn-Miller A, Falvey E, Myer GD, Jackson M, Moran R, Strike S. Can Biomechanical Testing After Anterior Cruciate Ligament Reconstruction Identify Athletes at Risk for Subsequent ACL Injury to the Contralateral Uninjured Limb? Am J Sports Med. 2021;49(3):609-19.

[21] Ford KR, Myer GD, Hewett TE. Reliability of landing 3D motion analysis: implications for longitudinal analyses. Med Sci Sports Exerc. 2007;39(11):2021-8.

[22] Paterno MV, Schmitt LC, Ford KR, Rauh MJ, Myer GD, Huang B, Hewett TE. Biomechanical measures during landing and postural stability predict second anterior cruciate ligament injury after anterior cruciate ligament reconstruction and return to sport. Am J Sports Med. 2010;38(10):1968-78.

[23] Finkbiner MJ, Gaina KM, McRandall MC, Wolf MM, Pardo VM, Reid K, Adams B, Galen SS. Video Movement Analysis Using Smartphones (ViMAS): A Pilot Study. J Vis Exp. 2017;(121):54659.

[24] Redler LH, Watling JP, Dennis ER, Swart E, Ahmad CS. Reliability of a field-based drop vertical jump screening test for ACL injury risk assessment. Phys Sportsmed. 2016;44(1):46-52.

[25] Gallardo-Fuentes F, Gallardo-Fuentes J, Ramírez-Campillo R, Balsalobre-Fernández C, Martínez C, Caniuqueo A, Cañas R, Banzer W, Loturco I, Nakamura FY, Izquierdo M. Intersession and Intrasession Reliability and Validity of the My Jump App for Measuring Different Jump Actions in Trained Male and Female Athletes. J Strength Cond Res. 2016;30(7):2049-56.

[26] Barber-Westin SD, Noyes FR. Objective criteria for return to athletics after anterior cruciate ligament reconstruction and subsequent reinjury rates: a systematic review. Phys Sportsmed. 2011;39(3):100-10.

[27] Di Stasi SL, Logerstedt D, Gardinier ES, Snyder-Mackler L. Gait patterns differ between ACL-reconstructed athletes who pass return-to-sport criteria and those who fail. Am J Sports Med. 2013;41(6):1310-8.

[28] Ebert JR, Edwards P, Yi L, Joss B, Ackland T, Carey-Smith R, Buelow JU, Hewitt B. Strength and functional symmetry is associated with post-operative rehabilitation in patients following anterior cruciate ligament reconstruction. Knee Surg Sports Traumatol Arthrosc. 2018;26(8):2353-61.

[29] Grindem H, Wellsandt E, Failla M, Snyder-Mackler L, Risberg MA. Anterior Cruciate Ligament Injury—Who Succeeds Without Reconstructive Surgery? The Delaware-Oslo ACL Cohort Study. Orthopaedic Journal of Sports Medicine. 2018;6(5).

[30] Logerstedt D, Di Stasi S, Grindem H, Lynch A, Eitzen I, Engebretsen L, et al. Self-reported knee function can identify athletes who fail return-to-activity criteria up to 1 year after anterior cruciate ligament reconstruction: a delaware-oslo ACL cohort study. J Orthop Sports Phys Ther. 2014;44(12):914-23.

[31] Cristiani R, Engström B, Edman G, Forssblad M, Stålman A. Psychological factors are strong predictors of short-term return to sport after anterior cruciate ligament reconstruction: a prospective cohort study. Knee Surg Sports Traumatol Arthrosc. 2020;28(2):477–84.

[32] Paterno MV, Huang B, Thomas S, Hewett TE, Schmitt LC. Clinical Factors That Predict a Second ACL Injury After ACL Reconstruction and Return to Sport: Preliminary Development of a Clinical Decision Algorithm. Orthop J Sports Med. 2017;5(12):2325967117745279.

[33] Toole AR, Ithurburn MP, Rauh MJ, Hewett TE, Paterno MV, Schmitt LC. Young Athletes Cleared for Sports Participation After Anterior Cruciate Ligament Reconstruction: How Many Actually Meet Recommended Return-to-Sport Criterion Cutoffs? J Orthop Sports Phys Ther. 2017;47(11):825-33.

[34] Sousa PL, Krych AJ, Cates RA, Levy BA, Stuart MJ, Dahm DL. Return to Sport: Does Excellent 6-Month Strength and Function Following ACL Reconstruction Predict Midterm Outcomes. Sports Traumatol Arthrosc. 2017; 25(5): 1356-63.

[35] Wang, J., Xu, J., and Shull, P. B., 2018, "Vertical Jump Height Estimation Algorithm Based on Takeoff and Landing Identification via Foot-Worn Inertial Sensing," J. Biomech. Eng., 140(3), p. 034502. doi:10.1115/1.4038740.

[36] Losciale JM, Bullock G, Cromwell C, Ledbetter L, Pietrosimone L, Sell TC. Hop Testing Lacks Strong Association With Key Outcome Variables After Primary Anterior Cruciate Ligament Reconstruction: A Systematic Review. Am J Sports Med. 2020; 48(2): 511-22.

[37] Kotsifaki A, Korakakis V, Whiteley R, Van Rossom S, Jonkers I. Measuring Only Hop Distance During Single Leg Hop Testing is Insufficient to Detect Deficits in Knee Function After ACL Reconstruction: A Systematic Review and Meta-Analysis. Br J Sports Med. 2020; 54(3): 139-53.

[38] Kotsifaki A, Van Rossom S, Whiteley R, Korakakis V, Bahr R, et al. Single Leg Vertical Jump Performance Identifies Knee Function Deficits at Return to Sport After ACL Reconstruction in Male Athletes. Br J Sports Med. 2022; 56(9): 490-498.

[39] Ardern CL, Kvist J. Rehabilitation, return to play and the psychological aspects of anterior cruciate ligament reconstruction: a narrative review. Br J Sports Med. 2016;50(24):1545–52.

[40] Ardern CL. Anterior Cruciate Ligament Reconstruction-Not Exactly a One-Way Ticket Back to the Preinjury Level: A Review of Contextual Factors Affecting Return to Sport After Surgery. Sports Health. 2015;7(3):224-30.

[41] 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(22): 1613-9.

[42] Ahmed I, Salmon L, Roe J, Pinczewski L. The long-term clinical and radiological outcomes in patients who suffer recurrent injuries to the anterior cruciate ligament after reconstruction. Bone Joint J. 2017;99-B(3):337-43.

[43] Roe C, Jacobs C, Hoch J, Johnson DL, Noehren B. Test Batteries After Primary Anterior Cruciate Ligament Reconstruction: A Systematic Review. Sports Health. 2022;14(2):205-215.

[44] Welling W, Benjaminse A, Seil R, Lemmink K, Zaffagnini S, Gokeler A. Low rates of patients meeting return to sport criteria 9 months after anterior cruciate ligament reconstruction: a prospective longitudinal study. Knee Surg Sports Traumatol Arthrosc. 2018;26(12):3636-44.

[45] Sadeqi M, Klouche S, Bohu Y, Herman S, Lefevre N, Gerometta A. Progression of the Psychological ACL-RSI Score and Return to Sport After Anterior Cruciate Ligament Reconstruction: A Prospective 2-Year Follow-up Study From the French Prospective Anterior Cruciate Ligament Reconstruction Cohort Study (FAST). Orthop J Sports Med. 2018;6(12):2325967118812819.

[46] Diermeier T, Rothrauff BB, Engebretsen L, Lynch AD, Ayeni OR, Paterno MV, et al. Treatment After Anterior Cruciate Ligament Injury: Panther Symposium ACL Treatment Consensus Group. Orthop J Sports Med. 2020;8(6):2325967120931097.

[47] Granan LP, Baste V, Engebretsen L, Inacio MCS. Associations Between Inadequate Knee Function Detected by KOOS and Prospective Graft Failure in an Anterior Cruciate Ligament-Reconstructed Knee. Knee Surg Sports Traumatol Arthrosc. 2015; 23(4): 1135-40.

[48] Kvist J, Ek A, Sporrstedt K, Good L. Fear of re-injury: a hindrance for returning to sports after anterior cruciate ligament reconstruction. Knee Surg Sports Traumatol Arthrosc. 2005;13(5):393-7.

[49] Paterno MV, Flynn K, Thomas S, Schmit L. Self-Reported Fear Predicts Functional Performance and Second ACL Injury After ACL Reconstruction and Return to Sport: A Pilot Study. Sports Health. 2018; 10(3): 228-33.

[50] Buckthorpe M, Tamisari A, Villa FD. A ten task-based progression in rehabilitation after acl reconstruction: from post-surgery to return to play - a clinical commentary. Int J Sports Phys Ther. 2020;15(4):611-23.

[51] Beischer S, Gustavsson L, Senorsk EH, Karlsson J, Thomee C, Samuelsson K, et al. Young Athletes Who Return to Sport Before 9 Months After Anterior Cruciate Ligament Reconstruction Have a Rate of New Injury 7 Times That of Those Who Delay Return. J Orthop Sports Phys Ther. 2020; 50(2): 83-90.

[52] Albano TR, Rodrigues CAS, Melo AKP, de Paula PO, Almeida GPL. Clinical Decision Algorithm Associated With Return to Sport After Anterior Cruciate Ligament Reconstruction. J Athl Train. 2020;55(7):691-8.

[53] 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;20(6):1143-51.

[54] Barber-Westin SD, Noyes FR. Factors used to determine return to unrestricted sports activities after anterior cruciate ligament reconstruction. Arthroscopy. 2011;27(12):1697-705.

[55] Czuppon S, Racette BA, Klein SE, Harris-Hayes M. Variables associated with return to sport following anterior cruciate ligament reconstruction: a systematic review. Br J Sports Med. 2014;48(5):356-64.

[56] Nielsen TG, Dalgas U, Lind M. Limited correlation between physical performance and patient-reported outcomes at 1-year follow-up after anterior cruciate ligament reconstruction. J Exp Orthop. 2024 July;11(3):e12071.

[57] Ptasinski AM, Dunleavy M, Adebayo T, Gallo RA. Returning Athletes to Sports Following Anterior Cruciate Ligament Tears. Curr Rev Musculoskelet Med. 2022;15(6):616-28.

[58] Narducci E, Waltz A, Gorski K, Leppla L, Donaldson M. The clinical utility of functional performance tests within one-year post-acl reconstruction: a systematic review. Int J Sports Phys Ther. 2011;6(4):333-42.

[59] Filbay SR, Grindem H. Evidence-based recommendations for the management of anterior cruciate ligament (ACL) rupture. Best Pract Res Clin Rheumatol. 2019 Feb;33(1):33-47.

[60] Hong IS, Pierpoint LA, Hellwinkel JE, Berk AN, Salandra JM, Meade JD, et al. Clinical Outcomes After ACL Reconstruction in Soccer (Football, Futbol) Players: A Systematic Review and Meta-Analysis. Sports Health. 2023;15(6):788-804.

[61] deMille P, Lewis CL, Nguyen JT, Brown AM, Hannafin JA, Chiaia T. Quality of Movement for Athletes 6 Months After ACL Reconstruction. Orthop J Sports Med. 2025 May 5;13(5):23259671251324525.