**Lateral Ankle Sprain Return-to-Sport Guidelines for the Jumping Athlete**

* **Time**
	+ Mild (Grade I): ≥ 3 weeks following acute injury
	+ Moderate to Severe (Grade II-III): ≥ 6 weeks following acute injury
* **Symptoms**
	+ Pain and swelling: Absence of Pain and minimal swelling during and following sport-specific activity
	+ Pain Self-Efficacy Questionnaire (PSEQ): ≥ 48 on PSEQ-10
* **Body** **Impairments**
	+ Range of Motion (ROM)
		- Total Ankle ROM (DF, PF, Ev, Inv): ≥ 95% LSI
			* Weight-bearing Dorsiflexion Lunge Test: ≥ 95% LSI and ≥ 8 cm
	+ Strength
		- Ankle DF, PF, Eversion and Inversion at 0° and 20° DF: ≥ 95% LSI via dynamometry
		- Hip Extension, Abduction and Adduction: ≥ 95% LSI via dynamometry
* **Athlete** **Perception**
	+ Foot and Ankle Ability Measure (FAAM) Sports subscale: ≥ 87.7%
	+ Patient-Reported Outcomes Measurement Information System (PROMIS) Physical Function (PF): ≥ 85%
	+ Fear-Avoidance Beliefs Questionnaire (FABQ) OR Athlete Fear-Avoidance Questionnaire (AFAQ)
* **Sensorimotor** **Control**
	+ Star Excursion Balance Test (SEBT): ≥ 90% LSI and >77.5% of leg length in posteromedial direction
	+ Single-leg balance on a firm surface with eyes closed (Timed): ≥ 90% LSI
	+ Demi-Pointe Test (Time): ≥ 90% LSI
* **Functional Performance**
	+ Single-leg Hop test battery: ≥ 90% LSI
		- Single-leg Hop Test (Time)
		- Side-Hop Test (Time)
		- Multiple-Hop Test (Error scoring)
	+ Single-leg Drop-Vertical Jump: ≥ 90% LSI
	+ Single-leg Drop Landing: Appropriate biomechanics and no observed or perceived instability
* **Sport-Specific Movements**
	+ Varies depending on the Sport
		- Jumping athlete considerations: Propulsion and landing mechanics
	+ Live Practice session without symptoms, observed or reported episodes of instability.
* **Additional Factors to consider**
	+ Sport-specific demands, position-specific demands, competition level and clinical judgement

**Explanation for Guidelines**

These return-to-sport, RTS, guidelines were created by modification of he PAASS framework, a group of assessment items developed by Smith et al. through a survey of over 150 health professionals working with elite field and court sports to inform RTS decisions for individuals with acute lateral ankle sprains.1 The PAASS frameworks consists of assessment categories: Pain severity, Ankle impairments, Athlete perception, Sensorimotor control, and Sport/functional performance, but does not include specific tests or measures. This RTS guideline aims to expand on the PAASS framework and develop criteria-based guidelines for RTS decisions in this patient population. There is a currently a lack of formal criteria-based guidelines for return-to-sport following lateral ankle sprains, therefore, the criteria presented is based on the individual evidence for each test and measure, along with evidence on how the injury typically presents. These guidelines are not meant to serve as the sole factor for RTS decisions, but rather as a guideline to assist in the decision-making process along with clinical judgement and reasoning.

**Time**

* The time for return-to-sport is often an emphasis for the athlete and other individuals involved such as coaches, parents and team staff. The recommendations in this guideline of ≥ 3 weeks for mild injury, and ≥ 6 weeks for moderate to severe injuries is a conservative recommendation that will vary based on the patient’s presentation. Clinical practice guidelines recommend 3 to 4 weeks from the initial injury for return to sport following a distortion inversion injury without ligament tearing and 6 to 8 weeks for partial or total rupture of ligaments, however, this is depending on the task requirements and the result of physical therapy.2-4 When looking at the clinical phases of recovery following a ligament injury, the remodeling phase, in which the healing ligament increases in strength and continuously adapts to loads with tissue synthesis and degradation, can begin in the weeks following the injury but can last for many months to years and original strength may not be regained.5,6 Return-to-sport should not be based on time alone, but also the other criteria presented in the guidelines.

**Symptoms**

* The acute phase of injury is characterized by pain and signs of inflammation at the site of injury. The recommendation is for an absence of pain and minimal swelling during and following sport-specific activity, along with ≥ 48 on the PSEQ-10. Pain typically resolves in the first few weeks following the injury, however, a significant portion of individuals following LAS continue to report pain in the years following the initial injury.4 Recovery of range of motion and function can depend on decreasing pain and inflammation. Rehabilitation protocols for conservative management of lateral ankle sprains from Mass General Brigham include decreased pain and minimal swelling as goals for the acute phase of injury and criteria to progress to the next phase.7 Rehabilitation protocols for recovery following operative management of lateral ankle sprains from Mass General Brigham, Ohio State and Sanford sports medicine also include decreased pain and inflammation as criteria along with the absence of pain with movement.8,9 Low self-efficacy has been shown to be able to account for variation in ankle specific symptoms, limitations and pain intensity after ankle sprain injury as opposed to the degree of pathophysiology or grade of sprain, which had no influence.10 Self-efficacy, as determined by the PSEQ, can help better determine the patient’s symptoms and the psychological factors associated with the injury. The PSEQ-10 has good content and structural validity along with excellent test-retest reliability.11 The minimal detectable change, MDC, which was higher than the minimal clinically important difference, MCID, was determined to be just under 12, placing the cutoff score for the guidelines just outside of the MDC.

**Body Impairments**

* Following an acute lateral ankle sprain, there are often range of motion and strength deficits observed at the ankle joint. The recommendations include total ankle range of motion with an emphasis on dorsiflexion, along with ankle and hip strength. Dorsiflexion is typically impaired following an acute lateral ankle injury. During jump landings, individuals with CAI have been shown to have increased inversion just prior to initial contact and move into less eversion, a component of dorsiflexion, after contact compared with healthy controls which will also come into play during the functional performance tests.12 This can be a result of impaired dorsiflexion range or reduced eversion strength which is also associated with recurrent injury and CAI but likely a combination of the factors. The weight-bearing lunge test is strongly recommended for use in the clinical practice guidelines. Asymmetries in this measure have been associated with lateral ankle sprains and this is included in criteria for return-to-sport following lateral ankle surgery.9 The value was determined using return-to-sport guidelines following a Brostrom procedure and ankle joint dorsiflexion reference values determined using non-injured youth basketball players.13 Normal dorsiflexion as determined by the lunge test was determined to be just over 8 cm in this population while the criteria presented in the Ohio State guidelines was > 7.5 cm. Low hip strength has also been associated with increased risk of lateral ankle sprain, as these measures were found to be decreased in individuals with CAI when compared to both healthy controls and copers.14,15 Specifically, decreased hip extensor, abductor and adductor torque are correlated with balance ability and the posterolateral direction of the Y-Balance Test.15 Hip strength criteria was absent in each of the rehabilitation guidelines reviewed for conservative and operative management of lateral ankle sprains.

**Athlete Perception**

* Patient-reported outcome measures have become essential for rehabilitation following any injury. There has also been recent studies assessing the psychological aspect associated with return-to-sport following injury and the association with re-injury. The recommendations in this guideline include use of the FAAM Sports subscale, PROMIS-PF and either the FABQ or the AFAQ. The FAAM and the PROMIS-PF have been validated and strongly recommended for use in the treatment of lateral ankle sprains based on the clinical practice guidelines, while the fear-avoidance questionnaires have less evidence. For individuals with foot and ankle musculoskeletal conditions, the FAAM Sports subscale and the PROMIS-PF were found to be highly responsive to changes in patient-reported health.16 While no cut-off scores exist, for this population scores should be maximized before returning to sport to reduce the risk of re-injury. A wide range of MCID values for the PROMIS-PF has been found specifically for foot and ankle orthopedic populations, ranging from 3 to 30 points.17 These guidelines took a conservative approach using 90% confidence intervals for MCID, 15 points, which led to the selection of a higher score criteria which is associated with higher patient-reported function. The FAAM Sports subscale has established MDC and MCID values for the foot and ankle musculoskeletal population, in which the MDC is larger at 12.3.18 Therefore these guidelines used this value to set the criteria for the FAAM Sports subscale score. College athletes with a history of recurrent ankle sprains reported higher levels of fear-avoidance, as determined by the FABQ, when compared with both athletes with a history of a single sprain and controls without ankle sprain injuries.19,20 The AFAQ was developed from the FABQ specifically to assess athletes, and though limited research has been done, significant correlations between the AFAQ and the FABQ-Physical activity have been found.21 This may be a more appropriate option when return to sport is a goal. Cut-off scores were not established for these measures; however, they should be utilized and patient rear-avoidance should be minimized prior to return.

**Sensorimotor Control**

* It has been suggested in literature that the high re-injury rate after ankle sprains is, in part, caused by proprioceptive impairment from the injury.22 With this, balance and sensorimotor exercises have been found to effectively reduce re-injury rates. The recommendation in this area are for limb symmetry for the Star Excursion Balance test, single-leg balance with eyes closed, and demi-point tests. Each are stationary balance tests with different requirements to challenge stability. The SEBT is very commonly used for the ankle injury patient population, and used as criteria for return-to-sport in each of the rehabilitation guidelines for conservative and operative management of ankle sprains. While limb symmetry is one of the criteria and common among each of the tests in the guidelines, the SEBT also has specific criteria for performance on the test. In a study involving netball players, which is similar to basketball and involves a high volume of jumping and leaping, it was found that a posterior-medial reach distance of less than or equal to 77.5% of leg length was associated with increased risk for ankle sprains.23 This direction has also been found to be most representative of overall SEBT performance and one of just three directions able to identify dynamic balance deficits in individuals with CAI.22,23 This value was supported by another study involving soccer players which identified cutoff scores for each direction, including 76% for the posterior-medial direction. 24 The National Athletic Trainers’ Association recommends performance on the SEBT to be at least 80% of the uninjured limb while other guidelines recommend 90%.7,9,22 Also included in these guidelines is single-leg balance at least 90% which was modified to include eyes closed. The clinical practice guidelines also strongly recommend this examination of balance and given the proprioceptive deficits associated with the injury, taking away vision will further challenge the athlete giving a more accurate evaluation of proprioception and reducing the ability for compensatory mechanisms. Lastly, the demi-pointe test is not commonly seen in the practice guidelines nor the rehabilitation guidelines, but was selected as a modification to normal single-leg balance. With the mechanism of injury for lateral ankle sprains being excess inversion and typically in a plantarflexed position, this test challenges the athlete in that specific position. A significantly lower failure rate on this test was found among a healthy control group when compared with individuals with both unilateral and bilateral ankle instability.25

**Functional Performance**

* Performance tests are considered an essential part of return-to-sport criteria. These tests are used to objectively measure the athlete’s functional ability to perform a variety of movements and skills. The recommendations in these guidelines include a variety of single-leg hop tests, single-leg jumping and landing tasks. There have been various hop tests that have been evaluated for use in the ankle sprain population, with a few that stand out in their ability to evaluate instability. A systematic review and meta-analysis performed by athletic trainers identified studies that included over a dozen different hop tests in order to determine which were the most effective in differentiating between individuals with CAI and healthy controls.26 Among these tests, the most effective at determining instability were the side-hop test, the multiple-hop test, and timed-hop tests, which included the single-leg hop test for time. It has been suggested that a criteria for readiness to return-to-sport on functional hopping tests is 80% or better when compared to the uninjured limb.22 These guidelines follow many return-to-sport ACLR guidelines with 90% LSI and also are consistent return-to-sport criteria in ankle sprain rehabilitation protocols from Mass General and Ohio State.7,9 It is also recommended that a visual analog scale be administered following completion of functional tests to determine the individual’s perceived instability, as it was found that individuals with CAI reported significantly higher levels of instability on their involved limb even when demonstrating similar performance to their uninvolved limb.27 Even in individuals with functional ankle instability, there were performance deficits found when completing single-leg hop tests along with reports of instability, therefore, the battery of hop tests was included in order to evaluate ankle stability.28 The single-leg drop vertical jump and drop landing were chosen to evaluate the athlete’s mechanics when jumping and landing on the affected limb. It was found that in individuals with CAI, when performing a single-leg drop landing the ankle had increased inversion from 200 to 95 milliseconds prior to initial contact.29 Along with this, both healthy and CAI groups displayed movement into eversion after contact during single-leg drop vertical jump landings, however the CAI group moved into less eversion, staying in a more inverted position while stabilizing. This is significant as the typical mechanism of injury is excess inversion and could be attributed to the range of motion or strength deficits described earlier, but either way should be evaluated and addressed to reduce the risk of re-injury. Along with this impairment, individuals with CAI had significantly greater preparatory hip joint flexion, a reduced flexor moment following initial contact and an associated increase in hip joint stiffness during the single-leg drop landing task.30 This difference was found between individuals with CAI and both healthy controls and lateral ankle sprain copers.

**Sport-Specific Movements**

* Sport-specific movements will vary depending on the specific sport. For individuals participating in repetitive jumping sports, such as basketball, volleyball and gymnastics, this will involve looking into jump propulsion and landing techniques. As mentioned before with the single-leg drop tasks, individuals with ankle instability will alter their mechanics, potentially further increasing their risk for recurrent injury. In CAI populations, there have been improper mediation of landing forces and inappropriate coordination, seen with the hip joint stiffness described above, and this has contributed to vulnerability during landing.31 Reactive and coordination jumping and landing exercises should be implemented along with evaluation of mechanics while completing the tasks. Another consideration for jumping that will depend on the specific sport is the different joint contributions for vertical and horizontal jumping. For horizontal propulsion the work contribution is significantly greater in the hip and ankle joints compared with the knee joint and vertical jumping.32 These demands should be considered based on the athlete’s sport and position. Restoration of sport-specific skills was identified as criteria of the American College of Sports Medicine’s return-to-play consensus statement.22

**Abbreviations:**

* ACR – American College of Radiology
* AFAQ – Athlete Fear Avoidance Questionnaire
* CAI – Chronic Ankle Instability
* DF – Dorsiflexion
* Ev – Eversion
* FAAM – Foot and Ankle Ability Measure
* FABQ – Fear Avoidance Beliefs Questionnaire
* Inv – Inversion
* LAS – Lateral Ankle Sprain
* MCID – Minimal Clinically Important Difference
* MDC – Minimal Detectable Change
* PF – Plantarflexion
* PROMIS – Patient-Reported Outcomes Measurement Information System
* PSEQ – Pain Self-Efficacy Questionnaire
* ROM – Range of Motion
* RTS – Return-to-Sport
* SEBT – Star Excursion Balance Test

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**Description of Sensorimotor Control and Functional Performance Tests**

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| **Tests** | **Description** | **Scoring** |
| Star Excursion Balance Test | The athlete stands on a single limb, maintaining balance while reaching with the opposite limb into 8 different directions, returning upright in between each.26 | Distance reached and % of leg length |
| Single-leg, firm surface, eyes closed  | The athlete stands on a single limb over a firm surface, maintaining balance with their eyes closed. | Time in balance |
| Demi-pointe Test | The athlete stands on a single limb over a firm surface while positioned as high as possible on the ball of their foot, in a plantarflexed position.25 | Time in balance |
| Single-leg Hop Test | Timed single limb hop tests may be performed a variety of ways. The athlete hops on a single limb through a course or over a distance as quickly as possible.26 | Time to completion |
| Side-Hop Test | The athlete hops on a single limb medially and laterally over a 3 cm distance, as quickly as possible for 10 repetitions.26 | Time to completion |
| Multiple-Hop Test | The athlete hops on a single limb through a zig-zag pattern of 2x2 cm floor markers, maintaining balance on a single limb and avoiding balance errors.26 | Time and error scoring |
| Single-leg Drop-Vertical Jump | The athlete begins standing on a box, height may vary depending on the athlete but 30 cm was used in the study. The athlete drops off the box landing on a single limb and jumps as high as possible before landing on the same limb.29 | Observation, error scoring and jump height |
| Single-leg Drop Landing | The athlete begins standing on a box, height may vary depending on the athlete but 40 cm was used in the study. The athlete drops off the box, landing and maintaining balance on a single limb.30 | Observation and error scoring |