CLINICAL GUIDELINES

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Ankle Stability and Movement Coordination Impairments: Lateral Ankle Ligament Sprains Revision 2021

Clinical Practice Guidelines
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Reviewers

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Ankle Ligament Sprain: Clinical Practice Guidelines

Recommendations*

ADD AFTER ALL APPROVED

List of Abbreviations

ACR	American College of Radiology
ADLs	activities of daily living
ADT	anterior drawer test
AII	Ankle Instability Instrument
ALDT	anterolateral drawer test
AOFAS	American Academy of Orthopedic Surgeons Foot and Ankle Questionnaire
APTA	American Physical Therapy Association
ATFL	anterior talofibular ligament
BAR	Bernese Ankle Rule
BESS	Balance Error Scoring System
BMI	body mass index
CAI	chronic ankle instability
CAIT	Cumberland Ankle Instability Tool
CAT	computer adaptive test
CFL	calcaneofibular ligament
CI	confidence interval
CPG	clinical practice guideline
CT	computerized tomography
FAAM	Foot and Ankle Ability Measure
FABQ	Fear-Avoidance Beliefs Questionnaire
FADI	Foot and Ankle Disability Index
FAOS	Foot and Ankle Outcome Score
FFI	Foot Function Index
FPI	Foot Posture Index
HR	hazard ratio
ICD	International Statistical Classification of Diseases and Related Health Problems
ICF	International Classification of Functioning, Disability, and Health
IdFAI	Identification of Functional Ankle Instability
JOSPT	Journal of Orthopaedic & Sports Physical Therapy
LAS	lateral ankle sprain
LE-FMS	Lower Extremity Functional Movement Screen
LEFS	Lower Extremity Functional Scale
LRAR	Low Risk Ankle Rules
MCID	minimal clinically important difference
MRI	magnetic resonance imaging
NSAIDs	non-steroidal anti-inflammatory drugs
OAR	Ottawa Ankle Rules
OR	odds ratio
PROMIS	Patient-Reported Outcomes Measurement Information System
PROMIS PF	Patient-Reported Outcomes Measurement Information System Physical Function
PROMIS PI	Patient-Reported Outcomes Measurement Information System Pain Interference
PSEQ	Pain Self-Efficacy Questionnaire
PTFL	posterior talofibular ligament
RALDT	reverse anterolateral drawer test
RCT	randomized clinical trial

ROM	range of motion
SAFAS	Sports Athlete Foot and Ankle Score
SEBT	Star Excursion Balance Test
TSK	Tampa Scale of Kinesiophobia
USI	ultrasound imaging

INTRODUCTION

AIM OF THE GUIDELINES

The Academy of Orthopaedic Physical Therapy of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based clinical practice guidelines (CPGs) for orthopaedic physical therapy management of patients with musculoskeletal impairments described in the World Health Organization's International Classification of Functioning, Disability, and Health (ICF).[473] The purposes of these clinical guidelines are to:

• Describe evidence-based physical therapy practice including diagnosis, prognosis, intervention, and assessment of outcome for musculoskeletal disorders commonly managed by orthopaedic physical therapists
• Classify and define common musculoskeletal conditions using the World Health Organization's terminology related to impairments of body function and body structure, activity limitations, and participation restrictions
• Identify interventions supported by current best evidence to address impairments of body function and structure, activity limitations, and participation restrictions associated with common musculoskeletal conditions
• Identify appropriate outcome measures to assess changes resulting from physical therapy interventions in body function and structure as well as in activity and participation of these individuals
• Provide a description to policy makers, using internationally accepted terminology, of the practice of orthopaedic physical therapists
• Provide information for payers and claims reviewers regarding the practice of orthopaedic physical therapy for common musculoskeletal conditions
• Create a reference publication for orthopaedic physical therapy clinicians, academic instructors, clinical instructors, students, interns, residents, and fellows regarding the best current practice of orthopaedic physical therapy

STATEMENT OF INTENT

These guidelines are not intended to be construed or to serve as a standard of medical care. Standards of care are determined on the basis of all clinical data available for an individual patient and are subject to change as scientific knowledge and technology advance and patterns of care evolve. These parameters of practice should be considered guidelines only. Adherence to them will not ensure a successful outcome in every patient, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgment regarding a particular clinical procedure or treatment plan must be made based on clinician experience and expertise in light of the clinical presentation of the patient, the available evidence, available diagnostic and treatment options, and the patient's values, expectations, and preferences. However, we suggest that significant departures from accepted guidelines should be documented in the patient's medical records at the time the relevant clinical decision is made.

SCOPE AND RATIONALE OF THE GUIDELINE

This guideline addresses the distinct, but related lower extremity impairments for those with a first-time lateral ankle sprain (LAS) and those with chronic ankle instability (CAI). Studies generally categorize LAS based on chronicity, with the acute period occurring during the first 10 days following injury.[342] In the 2013 CPG, the term "subacute" was used to characterize the time after the acute period and for up to 12-months post injury. In the current 2021 CPG, the term "subacute" was replaced with "post-acute" to better characterize the time after the acute period to the 12-month point. Depending on many factors, impairments may continue following injury. It has been reported that while around 60% of individuals achieve resolution of activity limitations and participation restrictions by the 12-month point, 40% progress to develop CAI.[106] Those with CAI are characterized by perceived instability or episodic "giving way" of the ankle that persists greater than 12 months following the initial injury and results in activity limitation and participation restriction.[174] Individuals with CAI may have varying degrees of mechanical instability due to connective tissue impairment, functional instability resulting from sensorimotor impairment, or elements of both.[174] These impairments, which are mediated by intrinsic and extrinsic factors, contribute to activity limitation and restriction of participation. While the International Ankle Consortium has published criteria to identify patients with CAI,[154] these criteria were not consistently used in the literature. When summarizing the literature in this 2021 CPG, conditions described as "recurrent sprains," "ankle instability," "functional ankle instability," and "mechanical ankle instability" greater than 12-months following the first-time injury are categorized as CAI. Therefore, the term LAS when used in this CPG is meant to describe those with first time ankle sprains less than 12 months after injury and CAI is used to describe those with persistent symptoms for 12 months or more. Additionally, the term "ankle sprain" is used in this CPG when specific studies applied that term to their subjects. It was assumed that a vast majority of those with "ankle sprains" had LAS unless, otherwise indicated in those studies. These criteria described above were applied as consistently as possible given the information provided by the studies summarized in this CPG.

METHODS

Content experts were appointed by the Academy of Orthopaedic Physical Therapy, APTA, Inc to conduct a review of the literature and develop an updated ankle stability and movement coordination impairments: lateral ankle ligament sprains: Clinical Practice Guideline. The aims of the revision were to provide a concise summary of the contemporary evidence since publication of the original guideline and to develop new recommendations or revise previously published recommendations to support evidence-based practice. The authors of this guideline revision worked with the CPG editors and medical librarians for methodological guidance. The research librarians were chosen for their expertise in systematic review and rehabilitation literature search and to perform systematic searches for concepts associated with classification, examination, and intervention strategies for ankle stability and movement coordination impairments: lateral ankle ligament sprains. Briefly, the following databases were searched from April 2012 to June 2020: MEDLINE; CINAHL; Cochrane Library; and PEDro [See **APPENDIX A** for full search strategies and **APPENDIX B** for search dates and results, available at www.orthopt.org.].

The authors declared relationships and developed a conflict management plan, which included submitting a Conflict-of-Interest form to the Academy of Orthopaedic Physical Therapy, APTA, Inc. Articles that were authored by a reviewer were assigned to an alternate reviewer. Funding was provided to the CPG development team for travel and expenses for CPG development training by the Academy of Orthopaedic Physical Therapy, APTA, Inc. The CPG development team maintained editorial independence.

Articles contributing to recommendations were reviewed based on specified inclusion and exclusion criteria with the goal of identifying evidence relevant to physical therapist clinical decision-making for adults with ankle stability and movement coordination impairments: lateral ankle ligament sprains. The title and abstract of each article were reviewed independently by 2 members of the CPG development team for inclusion. [See **APPENDIX C** for Inclusion and Exclusion criteria, available at www.orthopt.org]. Full text review was then similarly conducted to obtain the final set of articles for contribution to recommendations. The team leader (RLM) provided the final decision for discrepancies that were not resolved by the review team. [See **APPENDIX D** for flow chart of articles and **APPENDIX E** for articles included in recommendations by topic, available at www.orthopt.org]. For selected relevant topics that were not appropriate for the development of recommendations, such as incidence and imaging, articles were not subject to systematic review process and were not included in the flow chart. Evidence tables for this CPG are available on the Clinical Practice Guidelines page of the Academy of Orthopaedic Physical Therapy of the APTA website: www.orthopt.org.

This guideline was issued in 2021 based on the published literature up through June 2020, and will be considered for review in 2025, or sooner if new evidence becomes available. Any updates to the guideline in the interim period will be noted on the Academy of Orthopaedic Physical Therapy of the APTA website: www.orthopt.org

LEVELS OF EVIDENCE

Individual clinical research articles were graded according to criteria adapted from the Centre for Evidence-Based Medicine, Oxford, United Kingdom for diagnostic, prospective, and therapeutic studies. In teams of 2, each reviewer independently assigned a level of evidence and evaluated the quality of each article using a critical appraisal tool. [See **APPENDIX F** and **G** for Levels of Evidence table and details on procedures used for assigning levels of evidence, available at www.orthopt.org]. The evidence update was organized from highest level of evidence to lowest level. An abbreviated version of the grading system is provided below.

I	Evidence obtained from high quality diagnostic studies, prospective studies, systematic reviews, or randomized controlled trials
II	Evidence obtained from lesser-quality diagnostic studies, systematic reviews, prospective studies, or, randomized controlled trials (eg, weaker diagnostic criteria and reference standards, improper randomization, no blinding, less than 80% follow-up)
III	Case controlled studies or retrospective studies
IV	Case series
V	Expert opinion

GRADES OF EVIDENCE

The strength of the evidence supporting the recommendations was graded according to the previously established methods for the original guideline and those provided below. Each team developed recommendations based on the strength of evidence, including how directly the studies addressed the question of ankle stability and movement coordination impairments: lateral ankle ligament sprains. In developing their recommendations, the authors considered the strengths and limitations of the body of evidence and the health benefits, side effects, and risks of tests and interventions.

GRADES OF RECOMMENDATION		STRENGTH OF EVIDENCE	LEVEL OF OBLIGATION
A	Strong evidence	A preponderance of level I and/or level II studies support the recommendation. This must include at least 1 level I study	Must or should
B	Moderate evidence	A single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation	Should
C	Weak evidence	A single level II study or a preponderance of level III and IV studies, including statements of consensus by content experts, support the recommendation	May
D	Conflicting evidence	Higher-quality studies conducted on this topic disagree with respect to their conclusions. The recommendation is based on these conflicting studies	
E	Theoretical/ foundational evidence	A preponderance of evidence from animal or cadaver studies, from conceptual models/principles, or from basic sciences/bench research support this conclusion	May
F	Expert opinion	Best practice based on the clinical experience of the guidelines development team	May

GUIDELINE REVIEW PROCESS AND VALIDATION

Identified reviewers who are experts in ankle stability and movement coordination impairments: lateral ankle ligament sprains management and rehabilitation reviewed the CPG draft for integrity, accuracy, and to ensure that it fully represented the current evidence for the condition. The guideline draft was also posted for public comment and review on www.orthopt.org and a notification of this posting was sent to the members of the Academy of Orthopaedic Physical Therapy, APTA, Inc. In addition, a panel of consumer/patient representatives and external stakeholders, such as claims reviewers, medical coding experts, academic educators, clinical educators, physician specialists, and researchers also reviewed the guideline. All comments, suggestions, and feedback from the expert reviewers, public, and consumer/patient representatives were provided to the authors and editors for consideration and revisions. Guideline development methods policies, and implementation processes are reviewed at least yearly by the Academy of Orthopaedic Physical Therapy, APTA's Clinical Practice Guideline Advisory Panel, including consumer/patient representatives, external stakeholders, and experts in physical therapy practice guideline methodology.

DISSEMINATION AND IMPLEMENTATION TOOLS

In addition to publishing these guidelines in the Journal of Orthopaedic & Sports Physical Therapy (JOSPT), these guidelines will be posted on CPG areas of both the JOSPT and the Academy of Orthopaedic Physical Therapy, APTA, Inc websites, which are free access website areas, and submitted to be made available free access on the ECRI Guidelines Trust® (guidelines.ecri.org) and the Physiotherapy Evidence Database (PEDRo.org). The implementation tools planned to be made available for patients, clinicians, educators, payors, policy makers, and researchers, and the associated implementation strategies are listed in **TABLE 1**.

TABLE 1. Planned strategies and tools to support the dissemination and implementation of this Clinical Practice Guideline

Tool	Strategy
"Perspectives for Patients"	Patient-oriented guideline summary available on jospt.org and orthopt.org
Mobile application of guideline-based exercises for patient/clients and healthcare practitioners	Marketing and distribution of app using orthopt.org
Clinician's Quick-Reference Guide	Summary or guideline recommendations available on orthopt.org
Read-for-credit continuing education units	Continuing education units available for physical therapists and athletic trainers from JOSPT
Webinars educational offering for healthcare practitioners	Guideline-based instruction available for practitioners on orthopt.org
Mobile and web-based app of guideline for training of healthcare practitioners	Marketing and distribution of app using orthopt.org
Physical Therapy National Outcomes Data Registry	Support the ongoing usage of data registry for common musculoskeletal conditions of the foot and ankle
Logical Observation Identifiers Names and Codes (LOINC) mapping	Publication of minimal data sets and their corresponding LOINC codes for the foot and ankle region on orthopt.org
Non-English versions of the guidelines and guideline implementation tools	Development and distribution of translated guidelines and tools to JOSPT's international partners and global audience via jospt.org

CLASSIFICATION

The primary International Statistical Classification of Diseases and Related Health Problems (ICD)-10 codes associated with ankle stability and movement coordination impairment are **S93.4 sprain and strain of ankle** and **M24.27 Disorder of ligament, ankle and foot.**

The corresponding ICD-9CM codes include 845.00 sprain of ankle, unspecified site, 845.02 sprain of calcaneofibular (ligament) of ankle, 845.03 sprain of tibiofibular (ligament), distal of ankle, and 718.87 other joint derangement, not elsewhere classified, ankle and foot.

The primary ICF body function codes associated with ankle ligament sprain are **b7150 stability of a single joint** and **b7601 control of complex voluntary movements**.

The primary ICF body structures codes associated with ankle stability and movement coordination impairments are **s75023 ligaments and fasciae of ankle and foot**, **s75012 muscles of lower leg**, **s75002 muscles of thigh**, and **s7402 muscles of pelvic region**.

The primary ICF activities and participation codes associated with ankle stability and movement coordination impairments are **d450 walking**, **d4552 running**, **d4553 jumping**, **d4558 Exercise tolerance functions, other specified**, and **d9201 sports**.

ORGANIZATION OF THE GUIDELINE

A summary of the updated literature is provided for incidence/prevalence, pathoanatomical features, and differential diagnosis. As described in the Scope and Rationale of the Guideline, the term LAS is used to describe those with first time ankle sprains less than 12 months after injury and CAI to describe those with persistent symptoms for 12 months or more. For risk factors, clinical course, diagnosis, examination, and intervention the summary recommendation and grade of evidence from the 2013 guideline are presented followed by a synthesis of the recent literature with the corresponding evidence levels. Each of those five topics concludes with the 2021 summary recommendation and its updated grade of evidence.

Impairment/Function-Based Diagnosis

INCIDENCE/PREVALENCE UPDATE 2021

Acute Lateral Ankle Sprain

It is estimated that approximately 50% of individuals that sustain a LAS seek medical attention, so reports of incidence and prevalence of LAS are suspected to be lower than actual rates of occurrence.[446] Despite this, ankle sprains are still the most common foot-ankle and sports related injury for which individuals seek medical care,[116, 323] including emergency room visits.[208] Level I evidence from a 2014 systematic review with meta-analysis shows a pooled prevalence period of 11.88% of LAS in the general population.[116] Of the patients that do seek care, only 6.8% to 11.0% are referred to a rehabilitation specialist within 30 days of the injury.[129, 130]

The same meta-analysis found that the incidence and prevalence of ankle sprains were greatest in children ≤ 12 years of age (incidence = 2.85 per 1000 exposures; 95% confidence interval (CI): 2.51, 3.19), prevalence = 12.62% of injuries).[116] Adolescents (age 13 to 17 years) sustained sprains at a rate of 1.94 per 1000 exposures (95% CI: 1.73, 2.14) while adults (≥ 18 years of age) had a lower rate of ankle sprains, with an incidence of 0.72 per 1000 exposures (95% CI: 0.67, 0.77).[116] The prevalence of ankle sprains in adolescents was reported to be 10.55% of all injuries, which was lower than the prevalence of LAS in adults (11.41% of all injuries).[116] A 2016 level III study of more than 225 000 individuals who presented to an emergency room with an ankle sprain showed a slightly different distribution of injuries across age levels.[382] This study found 27% of sprains occurred in individuals under 18 years of age, 40% occurred in individuals who were between 18 and 35 years of age, 19% occurred in individuals aged 36-49 years old, and 15% occurred in individuals who were > 49 years old.[382] One level III study reported the median age of individuals sustaining ankle sprains at 27 years old, with the highest rate of injury occurring in males between the ages of 14 and 37 years.[9]

Females had an estimated incidence rate of 13.6 sprains per 1000 exposures (95% CI: 13.25, 13.94), which is nearly double that of males (incidence = 6.94 per 1000 exposures [95% CI: 6.8, 7.09]).[116] Prevalence rates between the sexes were similar: prevalence in females was 10.99% and in males 10.55%.[116] A 2016 level III study supported the evidence that sprains occur more often in females, reporting that 57% of recorded sprains were sustained by females.[382] A second level III study with a much smaller sample size reported the prevalence of LAS was similar between the sexes.[9]

Forty percent of LAS occur during sports.[446] A 2016 study by Halabchi et al[165] reported 58.5% of professional basketball and football athletes had experienced an ankle sprain. In high school athletes in the United States, ankle sprains occur at a rate of 3.13 sprains per 10 000 exposures.[411]

Ankle sprains are the most common injury in amateur student athletes in Brazil, making up 18.2% of all reported injuries during the 2013 sports seasons.[17] In the United States, ankle sprains accounted for 7.3% of all reported injuries in collegiate athletics between 2009 and 2015, occurring at a rate of 4.95 sprains per 10 000 athlete exposures.[367] Although more than half (57.3%) of these injuries occurred during practice, there was a higher rate of sprains per athletic exposure during competition.[367] Ankle sprains are most common in indoor/court sports such as volleyball and basketball, occurring at a rate of 7 sprains per 1000 athlete exposures.[116] Field sports, such as soccer, football, and rugby have a much lower pooled incidence at only 1 sprain per 1000 athlete exposures.[116] Sport-specific prevalence and incidence of LAS have been described for American football,[29, 319, 331] Australian rules football,[463] baseball,[284, 376] baskeball,[152, 175, 282, 299, 340, 363, 367, 434] dancing,[355, 440] fencing,[167] figure skating,[248] floorball,[339, 340] futsal,[281] Gaelic football,[365] handball,[4, 15, 314, 315] ice hockey,[71] in-line hockey,[317] lacrosse,[453] netball,[395] rugby,[139, 140, 356] soccer,[9, 17, 51, 126, 132, 159, 254, 403, 448, 463] surfing,[186] ultimate frisbee,[177]and volleyball,[17, 75, 211, 315, 358] as well as for those in military service.[39, 116, 338, 384, 477]

Recurrent injury and CAI

It is estimated that 18.7% to 20.4% of lateral and medial ankle sprains are recurrent injuries, in comparison to just 11 to 14.9% of high ankle sprains.[434] Reports of the prevalence of CAI vary, ranging from 0.7% to 1.1%[173] in young adults, to 20% in adolescent athletes,[120] 23.4% in high school and collegiate athletes,[415] and 29% in high school students.[187] Recurrent sprains and instability are common among athletes. Female high school and collegiate athletes had significantly higher prevalence of CAI than their male counterparts.[415] A 2014 level IV study found that the prevalence of instability was significantly higher in high school athletes than in collegiate athletes.[415] In collegiate athletes, nearly 12% of reported sprains were recurrent.[367] These recurrent sprains were most often sustained in athletes participating in women's basketball, outdoor track, and field hockey, and men's basketball.[367] At the elite and professional levels of competition, recurrent sprains occur at a similar rate, with 14.2% of professional football and basketball players reporting a history of a recurrent sprain[165] and 13.7% of elite soccer players sustaining recurrent LAS.[126] In the only prospective study performed to date on the topic, Doherty et al[106] reported that the prevalence of CAI was 40% in individuals who sought care for a first time LAS. The much higher estimate of CAI from this prospective study[106] compared to results from retrospective studies is likely related to care-seeking behaviors, with the true burden likely underrepresented in the studies that employed retrospective designs.

PATHOANATOMICAL FEATURES UPDATE 2021

Concomitant injuries commonly occur with an acute LAS,[88, 303] with bone bruising being one of the most common findings.[53, 212] The extent of ankle effusion present after injury may be associated with more severe associated injuries,[69] but does not necessarily indicate the presence or absence of a fracture.[10] Ankle impingement, which can cause pain and limited motion, was found in 25% of individuals after LAS[209] and potentially results from soft-tissue injury and/or post-traumatic tibiotalar osteophytes.[255, 306, 406] There is also evidence that alterations in the mechanical properties around the ankle can lead to abnormal kinematics and symptoms after a LAS,[231, 247] including increased talar inversion and rotation,[264, 336] that may result from a lengthened anterior talofibular ligament (ATFL)[2, 73, 213, 321] and/or increased ATFL–posterior talofibular ligament (PTFL) angle.[263] The abnormal kinematics that occur after a LAS may contribute to altered joint loading and explain findings of increase in cartilage stress and degeneration in talocrural,[192, 233, 438, 469], subtalar,[218] and talonavicular joints.[286, 438] Signs of early arthritis have been related to painful end range of motion (ROM) in individuals with symptoms lasting 6-12 months after the initial injury.[438] Symptoms of pain and instability may continue after a LAS and result from coexisting pathologies including os trigonum, osteochondral injury, syndesmotic, deltoid, subtalar ligament injuries, talonavicular, calcaneonavicular, and calcaneocuboid joint injuries, fibularis muscle group injuries, and/or fibular nerve pathologies.[13, 55, 77, 195, 206, 275, 278, 334, 406, 480] In individuals with CAI, intraarticular pathologies may be associated with continued symptoms.[275, 406] It should be noted that these coexisting pathologies are seen on diagnostic testing in those who sustain a LAS but do not have symptoms.[144, 439] There may also be anatomical factors, such as distal tibiofibular joint variations,[18, 232] flatter subtalar joint,[433] and hindfoot varus alignment[274] associated with chronic complaints of instability.

Sensorimotor and ROM deficits can occur after a LAS and may lead to movement system abnormalities. While findings may be dependent on measurement technique and subject selection, investigators have found altered movement strategies with balance activities, [28, 100, 105, 109, 110, 115, 149, 221, 224] gait,[104, 133, 353] and jumping.[11, 107, 112, 114] These changes may not be limited to the ankle but can occur proximally at the knee and hip[11, 104, 105, 107, 109, 110, 112, 114, 115] as well as in the uninvolved lower extremity.[105, 115] Changes in movement strategies on the involved lower extremity may be protective in nature to prevent re-injury and include a reliance on the hip and knee to reduce forces at the ankle.[11, 107, 109, 112, 114] Specific sensorimotor and ROM deficits at the foot-ankle complex include decreased strength of leg/ankle muscles,[135, 341] decreased fibularis muscle reaction time,[184] decreased ankle dorsiflexion and plantar flexion ROM,[1, 135, 427] increased ankle frontal plane ROM,[135] and increased forefoot and midfoot mobility.[135] Due to the heterogeneity of pathomechanics and tissues injured during an inversion sprain, the role of these sensorimotor ROM deficits and movement system abnormalities are debated as they are not always present or are present to varying degrees, with symptoms frequently lasting from a few weeks to 12 months or longer.[11, 24, 76, 78, 86, 89, 96, 200, 220, 249, 313, 328, 348, 408, 422, 429]

Individuals that recover from a LAS, as defined by returning to at least moderate level of activity and having a near normal self-reported functional level of activity within 12 months, are identified as 'copers' while those that continue to have complaints of instability are identified as having CAI.[465] Attempts to identify the sensorimotor ROM deficits in those with CAI have received considerable attention. While findings may be dependent on measurement technique and subject selection, investigators have generally identified the following sensorimotor ROM deficits at the foot, ankle, knee, and hip: 1) abnormal timing of muscle activation at the ankle, knee and hip,[6, 90, 92, 119, 128, 184, 201, 207, 217, 236, 237, 250, 257, 262, 268, 312, 324, 325, 378, 394, 396, 398, 401, 402, 425, 437, 455, 456] 2) decreased force output/strength at the ankle[3, 58, 59, 135, 244, 327, 337, 346, 470, 478] and hip,[91, 244, 294, 298, 327] 3) impaired force and proprioception at the ankle,[22, 58, 164, 215, 289, 374, 399] 4) decreased ankle dorsiflexion ROM,[135, 234, 346] and 5) increased subtalar and midfoot motion.[135] Research has also found impaired central mediated processes, including spinal-level sensorimotor control/reflex inhibition[36, 63, 118, 142, 166, 222, 223, 285, 301, 332, 398, 401, 402, 418, 428] and supraspinal corticomotor abnormalities.[166, 301, 324, 326, 370, 372, 419, 421, 423, 454] These impaired sensorimotor and central mediated processes may be evident in both the injured and the uninjured limb and impact the movement system as seen with static and dynamic balance, walking, stepping, running, jumping, cutting, and kicking.[92, 102, 105, 257, 391, 399 398, 400-402]

RISK FACTORS

Condensed summary from 2013

The 2013 CPG examined intrinsic and extrinsic factors of acute LAS and ankle instability. Evidence showed that there was an increased risk of acute LAS in individuals who have a history of LAS and loss of ankle dorsiflexion ROM, who do not warm up properly, do not use an external support (bracing and taping), and do not participate in neuromuscular re-training. The risk factors for CAI were less clear than those for LAS in 2013. Authors suggested that, in addition to not using an external support and not participating in a balance program, anatomical factors, such as increased talar curvature, may increase risk for ankle instability.

Evidence Update

Acute Lateral Ankle Sprain: Non-modifiable Intrinsic Risk Factors

Previous Injury

II

There is conflicting evidence that a previous LAS elevates risk for a subsequent LAS. A meta-analysis by Vuurberg et al[446] of studies between 2009 and 2016 found that previous injury was not a significant risk factor for LAS (relative risk 1.44; 95% CI: 0.96, 2.16). Results from two studies not included in this review were consistent with this finding.[20, 169] However, two other studies reported that individuals with a history of LAS are at increased risk for a subsequent sprain with a hazard ratio (HR) of 2.21 (95% CI: 1.07, 4.57) when the index sprain occurred within the previous 6 months.[84, 349]

III

A study of professional basketball players found that players with a history of LAS were 1.41 (95% CI: 1.13, 1.74) times more likely to sustain a subsequent sprain than players that did not have a history of sprain within the previous year.[176] A similar study of professional soccer players also showed that history of LAS increased the risk of future sprain.[56]

Sex

I

A 2014 meta-analysis found that female sex was a risk factor for LAS with a cumulative incidence rate of 13.6 per 1000 exposures (95% CI: 13.25, 13.94) versus a cumulative incidence rate for males of 6.94 per 1000 exposures (95% CI: 6.8, 7.09).[116]

II

A study of high school lacrosse players showed that females were more likely to sustain a LAS at a rate of 2.4 per 1000 exposures versus 1.6 per 1000 exposures for males.[452]

III

Female sex as a risk factor for LAS was also identified in a meta-analysis by Vuurberg et al.[446] Female athletes with a history of concussion had 1.88 to 2.54 higher odds of also reporting a LAS or knee injury.[189] Conflicting results regarding sex as a risk factor for LAS was found in a case control study of professional soccer players.[56]

Body Mass Index
II
A meta-analysis identified lower body mass index (BMI) as a potential intrinsic risk factor for a LAS.[446] When data from studies published between 2009 and 2016 were pooled, individuals with a lower BMI had a slightly higher rate of sprain (mean difference -0.08; 95% CI: -0.14, 0.02).[446] Articles not included in this analysis both agreed[360, 361] and disagreed with this finding.[84, 169]

III
A case control study found BMI was not a risk factor for LAS in those presenting to emergency departments.[481]

Age
II
In elite football and basketball players, it was noted that each 5-year increase of age was found to increase the odds of sustaining a LAS by 1.51 times (odds ratio [OR] = 1.51; 95% CI: 1.02, 2.25).[347] In contrast, younger age was associated with increased risk of LAS in military recruits undergoing training.[360, 361]

III
In professional soccer players it was found that age was not related to LAS injury risk.[56]

Other Non-Modifiable Intrinsic Risk Factors
II
Among collegiate athletes those with a navicular-medial malleolar distance > 4.65 cm were 4.14 times more likely to sustain a LAS than athletes with a smaller navicular-medial malleolar distance.[235] Leg-heel angle and foot internal rotation angle in plantar flexion were not found to be associated with risk of a LAS.[235]

III
Among soldiers, a Beighton's score ≥ 4[21] and narrower bimalleolar width were associated with increased risk for LAS.[361] Foot posture index (FPI) score and all six component scores[56] and Q-angle[481] were not found to be associated with risk of a LAS. Two studies have potentially identified a genetic predisposition to LAS.[354, 383]

Acute Lateral Ankle Sprain: Modifiable Intrinsic Risk Factors
Range of Motion
II
Asymmetrical ankle dorsiflexion ROM > 2.5 cm between sides, as measured with the weight-bearing lunge test, was predictive of LAS in firefighters.[441] Conflicting findings were found in collegiate male athletes.[169] Non-weight bearing measures of ankle dorsiflexion ROM and inversion-eversion motion were not found to be risk factors for a LAS.[20, 84]

Strength

I

Decreased hip abductor strength was found to increase the risk of LAS in male soccer players with a reported OR of 1.10 (95% CI: 1.02, 1.18).[351] When hip abductor strength was < 33.8% of bodyweight, the probability of LAS increased from 11.9% to 26.7%.[351]

II

Decreased hip extensor strength was associated with a significant (*P* = .28) increased risk of LAS in youth soccer players.[87]

Functional Performance

II

Risk of LAS is generally increased with worse performance on unilateral standing reach tests like the Star Excursion Balance Test (SEBT) and the Y-Balance test. Better performance on the SEBT- posterolateral direction decreased the risk of LAS (HR 0.96; 95% CI: 0.92, 0.99).[84] When netball players reached ≤ 77.5% of their leg length on the posteromedial direction of the SEBT, risk of LAS was increased by more than 4 times (OR = 4.04; 95% CI: 1.00, 16.35).[20] Worse performance on the anterior reach component of the Y-balance test was associated with increased incidence of LAS in males (but not in females).[169] In adolescent soccer players, the inability to reach at least 76% and 70% of limb length in the posteromedial and posterolateral directions, respectively, during the SEBT were significant cutoff points indicating increased risk of LAS in the subsequent 10 months.[229] Asymmetrical performance (> 2 cm in the anterior direction, > 3 cm in the posteromedial and posterolateral directions, right versus left lower extremity) on the Y-balance test was predictive of LAS in firefighters.[441]

II

Athletes that performed the multiple hop test with more than 12 “change-in-support errors” had a four times increased risk for index LAS.[125] These “change-in-support errors” include shuffling or jumping on the support foot, removing the hands from the iliac crests, and putting the non-support foot down.[125]

II

LAS was not associated with performance on the foot lift test in active university students[84] or in netball players.[20] Single leg stance quality graded using the Balance Error Scoring System (BESS)[169] and performance on the side recognition test[84] were also not found to be associated with increased risk of LAS. In netball players, vertical jump height and performance on the demi-pointe balance test were not associated with incidence of LAS.[20]

II

Adolescent athletes that took greater than 15.4 seconds to complete the single-leg hop test, with 10 repetitions over a 30cm distance, were at higher risk of sustaining a LAS in the following 10 months.[229]

II

In elite soccer players, poor performance (mediolateral force more than 0 – 0.4 seconds and/or resultant horizontal ground-reaction forces more than 3-5 seconds) on a single leg drop jump landing was predictive of a LAS within 3 years.[131] Gait abnormalities with earlier peak pressure on the lateral forefoot, higher peak pressure under the first metatarsal, higher peak metatarsal impulse, and more medial pressure at heel-off were associated with higher risk of a LAS in military recruits.[360, 361]

II

There is a slight increase in the odds of LAS for semiprofessional soccer players with worse performance on the single leg hop for distance (OR = 1.10; 95% CI: 1.00, 1.23).[300] Composite score on the soccer injury movement screen (components include: anterior reach, single leg deadlift, in-line lunge, single leg hop for distance, tuck jump) does not predict LAS in semiprofessional soccer players.[300]

Acute Lateral Ankle Sprain- Extrinsic Risk Factors

Activity

I

A meta-analysis found that risk of LAS was associated with type of sport played: the highest risk was in individuals playing court sports (cumulative incidence of 7 per 1000 exposures; 95% CI: 6.8, 7.2).[116] Another meta-analysis showed that a LAS is more likely to occur in the second half of games during soccer, rugby, futsal, American football, and Gaelic football games.[85]

II

Elite Gaelic football players are more likely to sustain a LAS during match play versus during training, with the likelihood during match play of 62.2% and during training of 32.4%.[365] In high school lacrosse players, competition, compared to practice, was more likely to elicit a LAS in both males (3.0 per 1000 competition exposures versus 1.0 per 1000 practice exposures) and females (3.8 per 1000 competition exposures versus 1.8 per 1000 practice exposures).[452]

Playing Surface

II

There was no difference in LAS risk among major league soccer players playing on artificial turf versus natural grass.[46] There was no difference in rate of ankle sprain for rugby players playing on artificial turf versus grass.[357]

Chronic Ankle Instability: Risk Factors

Physical Characteristics

II

In a retrospective study of more than 800 000 young adults serving in the military, increased BMI was found associated with CAI in males (overweight, OR 1.249, $P<.001$; obese, OR 1.418, $P<.001$) and females (overweight, OR 1.989, $P<.001$; obese, OR 2.754, $P<.001$).[173]

II

Among athletes returning to sport following a LAS, those whose height was more than 191 cm had 16-times greater odds of sustaining a recurrent sprain that same season. Athletes whose mass was more than 100 kg had 8 times greater odds of sustaining a recurrent sprain in the same season.[297]

III

In a large study of 900 healthy individuals aged 8 – 101 years, Baldwin et al[23] found that, for every degree of ankle dorsiflexion tightness, the odds of bilateral ankle instability (defined by a score on the Cumberland Ankle Instability Tool [CAIT] of ≤ 25) increased by 3% (95% CI: 0%, 6%). Healthy females with a CAIT score of ≤ 25 were 2.6 times more likely to have bilateral ankle instability (95% CI: 1.7, 3.8) and the odds of having bilateral ankle instability (defined as CAIT ≤ 25) decreased by 2% (95% CI: 1%, 3%) for each year of increasing age. Additionally, the odds of having ankle instability (defined by CAIT ≤ 25) were increased by 4% for every centimeter of increased waist size (95% CI: 2%, 6%).[23]

Functional Performance
II
Inability to complete jumping and landing tasks within 2 weeks of the initial injury, poorer dynamic postural control, and lower self-reported function at 6 months after the initial injury were predictors of CAI at 6 months.[106]

Other Risk Factors
I
Not using prophylactic bracing and not participating in an exercise program that includes balance training are risk factors for a subsequent LAS following a first-time LAS.[33, 42, 99, 330, 350, 446]
II
Participating in sports increases the risk of recurrent ankle sprains as the odds of sustaining a recurrent ankle sprain were 6.83 times higher (95% CI: 1.35, 34.56) in individuals that participated in sports than those that did not participate in sports.[286]

2021 Risk Factor Evidence Summary
Female sex, hip abductor and extensor weakness, poor performance on balance and hopping tests, and participating in court sports are risk factors for an acute LAS. Not using prophylactic bracing, not participating in an exercise-balance program, poor functional performance after a LAS, participating in sports, and higher BMI are risk factors for CAI.

CLINICAL COURSE

2013 Condensed Summary without Recommendation
Following a LAS there is a rapid decrease in pain and improvement in function the first 2 weeks after injury. However, 5% to 33% of patients continue to experience pain 1-year or more after the LAS, with 5% to 25% still experiencing pain after 3 years. Fifty to 85% of individuals with a LAS report full recovery at approximately 3 years after the injury, independent of sprain severity. When symptoms of instability continue beyond one year after a LAS, patients are commonly diagnosed as having CAI. In high-quality studies, continued reports of instability were noted in 0% to 33% of patients in follow-up periods of 3 years or less. Prognosis may also be related to not receiving appropriate treatment after injury, including bracing and rehabilitation. There is higher risk of ankle instability and reinjury in high- compared to low-activity groups.

Evidence Update
Acute and Post-Acute Lateral Ankle Sprain
The acute phase is operationally defined as 10 days or less after injury while the post-acute period may last up to 12-months following injury.

I
For a faster return to sports, an evidence-based clinical guideline by Vuurberg et al[446] recommended a supervised exercise program to address the strength, coordination, proprioception, and functional deficits that occur after a LAS. This is consistent with a systematic review that found a shorter time to return to sports after an acute ankle sprain following functional treatment, compression stockings, and anteroposterior talocrural joint mobilization.[8]

I
An assessment of recovery time in high school athletes after a first-time ankle sprain found that there was a 75% chance of returning to sport within 3 days after the injury and a 95% chance of returning within 10 days, with no difference between new and recurrent ankle sprains.[302] Another study of high school athletes found more severe injuries involving multiple ligaments resulted in a greater than 3 week loss of participation.[412] In college athletics, 44.4% of individuals returned to play in less than 24 hours after injury.[367] In soccer players, the average time lost after ankle sprain was 12-15 days,[126, 462] while rugby players returned to participation on average 24 days after injury.[417]

I
The SPRAINED (Synthesizing a clinical Prognostic Rule for Ankle Injuries in the Emergency Department) study, with 682 individuals evaluated within 7 days after an ankle sprain, found older age, higher BMI, higher pain level when resting, higher pain level when bearing weight, longer time (days) from injury to assessment, inability to bear weight, and prior recurrent sprain to be predictors of a poor outcome.[379]

II
A systematic review and meta-analysis found that the addition of rehabilitation exercises to standard care significantly reduced re-injury in the 7-12 months following injury.[33] Another systematic review and meta-analysis found that bracing and neuromuscular training were not associated with reduced recurrence of ankle sprains.[42]

II
Despite significant improvements in self-reported function over a 6 week period after a LAS, ankle laxity did not significantly change as assessed with anterior drawer testing ($P > .05$).[73]

II
Those with a medial bone marrow contusion identified on magnetic resonance imaging (MRI) within 2 weeks after a LAS had a significantly longer recovery time to return to normal walking (25 versus 16 days; $P = .0002$) and sports (92 versus 56 days; $P = .0001$).[53] Those with simple or complex LAS, as determined by radiological imaging, did not have different outcomes at 6 months ($P > .05$).[40]

II
At baseline, older age, more severe injury, and less than full weight bearing status were correlated (adjusted $r^2 = 0.341$; $P < .01$) with worse functional status at week 4, while baseline older age, less than full weight bearing status, and injury mechanism were correlated (adjusted $r^2 = 0.20$; $P < .01$) with worse functional status at 4 months.[329] Pain with weight bearing

dorsiflexion and medial joint line tenderness at 4-week assessment were associated (adjusted r^2 = 0.49; $P < .01$) with lower function at 4 months.[329]

II

Adaptiveness in response to pain and lower age ($P < .017$) but not severity of injury ($P > .68$) were associated with fewer symptoms and limitations at 3-weeks follow-up from LAS.[37] A recent LAS (OR = 8.23) and younger age (OR = 8.41) were independent predictors of a recurrent ankle sprain in a convenience sample (n=100).[349]

II

In a prospective cohort of 70 individuals who sustained a LAS, 60% (n=42) were categorized as "copers" and recovered, while 40% (n=28) went on to CAI.[101, 106] Inability to complete jumping and landing tasks within 2 weeks after a first-time LAS was predictive of CAI at 6 months (sensitivity, 83%; specificity, 55%; $P = .004$).[106] Clinical tests of ROM, swelling, ligament laxity, and posterior glide within 2 weeks after injury had limited predictive value (accuracy = 68.8%) in determining those who went on to develop CAI versus becoming a 'coper' at 1-year.[101]

III

A cohort study in the National Basketball Association found 56% of those that sustained an ankle sprain did not miss any games. The incidence of ankle sprain among players with a history of prior ankle sprain in the past year was 1.41 times higher than those without a history of ankle sprain in the past year ($P = .002$).[176]

III

Among 44 patients recruited from general practitioners and physical therapy clinics at 4-year follow-up from a LAS, 18% (n = 8) experienced a subsequent injury, 29.5% (n = 13) reported pain, 45.5% (n = 20) had tenderness on clinical examination, and 25% (n = 11) had limited ankle dorsiflexion ROM.[209] Almost 20% (n = 24) of individuals continued to have ankle complaints of some kind at 5-year follow-up.[287]

III

Obesity may influence outcome as full recovery at 6 months was 65%, 59%, and 52% for those with a BMI of < 25 kg/m^2, 25-30 kg/m^2, and > 30 kg/m^2, respectively.[32] In a study of anthropometric and clinical assessments, the highest correlation with a new ankle sprain was the history of a previous sprain ($r = 0.265$; $P < .001$).[481]

III

A significant decrease in dorsiflexion, plantar flexion, and eversion ROM (26-27%; $P < .002$) was found 4 weeks after LAS among 20 patients.[427] Fraser et al[135] found decreased ankle dorsiflexion ROM ($P < .001$), increased ankle frontal plane ROM ($P < .001$), and increased forefoot and midfoot mobility ($P < .001$) in individuals with a history of LAS.

III

An assessment of the movement system using static and dynamic balance activities,[28, 100, 105, 109, 110, 115, 149, 221, 224] gait,[104, 133, 353] and jumping[11, 107, 111, 112, 114] can identify abnormal movement strategies at the ankle, knee, and hip caused by sensorimotor ROM deficits.

IV

At a 1-year telephone follow-up of those seen in the emergency department after an ankle sprain, those with more severe injuries had more persistent complications ($\chi^2 = 3.636$; $P < .05$).[158]

IV

A case series found that greater severity of injury diagnosed using ultrasound imaging (USI) was predictive of 1-year self-reported outcome following LAS ($P < .05$).[62]

IV

Another case series found that after a LAS, increasing height and weight were associated with a recurrent sprain within the same season.[293]

IV

Fair to moderate correlations (r = -0.40 to -0.57; P < .05) were identified between pain levels and reported confidence with weight bearing lunge and hopping tests.[67]

Evidence Synthesis and Rationale

A full return to participation can be expected from 1 day to a little more than 3 weeks after LAS, depending on the demands of the desired activity or sport. However, full recovery with no symptoms or limitations may take months or years to obtain, and cannot be expected in all patients. There is conflicting evidence for the role of injury severity on the clinical course after a LAS. The updates evidence from 2013 continues to support that a supervised impairment driven exercise program can allow for a faster recovery and help prevent reinjury with patient factors being able to help predict the clinical course after LAS.

2021 RECOMMENDATION

B

Clinicians should include patient age, BMI, adaptiveness to pain, report of instability, history of previous sprain, ability to bear weight, pain with weight bearing, ankle dorsiflexion ROM, medial joint line tenderness, balance, and ability to jump and land in their initial assessment because of their role in influencing the clinical course and estimation of time to accomplish goals of an individual with an acute LAS.

Chronic Ankle Instability

II

Baseline self-reported functional limitations, decreased single limb balance, and number of previous ankle sprains was predictive of treatment success in individuals with CAI, with single-limb balance test being the single best predictor.[466, 467] A single-limb balance test greater than or equal to 5 errors being predictive of success with ankle joint mobilizations (positive likelihood ratio 33.3, 95% CI: 4.1, 274.4) and greater than or equal to 2 errors being predictive of success with plantar massage (positive likelihood ratio 62.5, 95% CI: 8.3, 472.4).[467]

II

A functional treatment program aimed to improve jumping and landing biomechanics increased self-reported functional status in the treatment (n =14) compared to control group (n =14). The estimate of effect size using the Foot and Ankle Ability Measure (FAAM) was 1.95, 95% CI: 1.03, 2.86)].[14]

III
A systematic review by Al Adal et al[7] reported the presence of pain in 50% to 79% of those with CAI. Pain was usually intermittent, mild, and occurred during vigorous activity.[7] A study not included in that review had similar findings, and also noted that those with more severe perceived ankle instability were more likely to have pain (OR = 5.38; *P* <.001).[5]
III
Individuals with CAI have movement system abnormalities that have been identified during activity such as static and dynamic balance activities, walking, stepping,[48, 391] running, jumping, cutting,[136, 226, 241, 242, 393] and kicking.[121, 362] A systematic review by Rosen et al[371] found deficits in static and dynamic postural control in those with CAI. Similar findings were noted by other studies not included in the review by Rosen et al.[22, 93, 102, 113, 135, 162, 201, 234, 245, 253, 346, 482]
III
A systematic review that evaluated the literature on walking and running biomechanics reported that those with CAI had increased ankle and rearfoot inversion, ankle plantar flexion, vertical forces on the lateral part of the foot, and fibularis longus muscle activity.[310] Similar findings were noted by others whose studies were not included in this review.[68, 95, 97, 133, 146, 216, 328, 396, 416] There have also been abnormalities noted at the knee and hip with less knee adduction, decreased gluteus medius muscle activity, and altered hip-ankle coordination.[269, 311, 396, 478] These abnormalities may alter the timing of movements and cause the center of mass to laterally deviate and fall outside of the base of support to potentially cause instability.[310]
III
In the systematic review by Rosen et al[371] it was identified that those with CAI had deficits with hopping and jumping activity. Another systematic review that evaluated the literature on landing biomechanics in those with CAI noted the following: 1) dynamic postural stability deficits with longer time to stabilization after landing; 2) altered ankle and knee kinematics landing with greater knee extension and ankle dorsiflexion, 3) greater vertical and lateral loading rates, and 4) reduction in fibularis longus and brevis muscles activation prior to contact.[392] Similar findings were noted by studies not included in these reviews.[38, 124, 171, 172, 188, 203, 272, 312, 394, 424, 425, 456] Studies investigating jumping have also found less hip flexion and hip adduction at initial contact with decreased gluteus medius activity in addition to a reduced jump height and flight distance.[188, 250, 312] A study by Lui et al[276] found that dynamic postural stability during multi-directional hopping could not accurately differentiate among healthy, coper, and unstable groups. In aggregate, these findings suggest those with CAI may use a landing strategy that relies on proximal joints to protect the ankle from re-injury.[392]
III
Those that go onto developing CAI may be differentiated from copers based on their movement patterns including dynamic balance,[102, 113, 201, 245, 346] walking,[103 49, 133, 451] stepping down,[48, 122] running,[252] and landing from a jump,[108] with copers having biomechanics more similar to healthy individuals.[48, 49, 102, 113, 122, 133, 201, 252, 346] The neuromuscular ankle strategies adopted by copers may allow them to prevent recurrent symptoms.
III
A decrease in activity and participation and overall health related quality of life was found in those with CAI[120, 135, 179, 243, 290, 468] compared to those without CAI and may result from the

sensorimotor ROM deficits and altered movement control strategies.[194, 390] However, this might not be true for younger individuals (age 15 - 16 years) as their reported physical activity level did not seem to be affected by a history of ankle instability.[187]

III

In individuals with CAI, significant ($P < .001$) predictors of a successful improvement with a balance training program were impaired dynamic balance with a SEBT-posteromedial reach distance ≤ 85.18% and FAAM activities of daily living (ADL) score or Foot and Ankle Disability Index (FADI) score of ≤ 92.55%) at baseline. For patients who met both criteria there was a 70% probability of a successful outcome.[41]

III

A systematic review-based consensus recommended non-surgical treatment for 3 to 6 months prior to considering surgery for CAI.[397] A cross sectional study found that those with CAI who did not seek medical treatment for their LAS had worse subjective function.[193]

III

Radiographic measures of a cavus foot type did not discriminate between those with CAI and controls ($P > .05$).[256]

Evidence Synthesis and Rationale

Those who do not become 'copers' after LAS and go on to develop CAI may have sensorimotor and ROM impairments at the trunk, hip, knee, ankle, and foot as well as impaired central mediated processes, as noted in the pathoanatomical section, that may put them at risk for further injury. Patient factors can help predict the clinical course in those with CAI.

2021 RECOMMENDATION

C

Clinicians may include previous treatment, number of sprains, pain level, and self-report of function in their evaluation as well as an assessment of the sensorimotor movement systems of the foot, ankle, knee, and hip during dynamic postural control and functional movements because of their role in influencing the clinical course and estimation of time to accomplish goals of an individual with CAI.

DIAGNOSIS/CLASSIFICATION

2013 Recommendation

Lateral Ankle Sprain

B

Clinicians should use the clinical findings of level of function, ligamentous laxity, hemorrhaging, point tenderness, total ankle motion, swelling, and pain to classify a patient with acute ALS into the ICD category of sprain and strain of ankle (S93.4), and the associated ICF impairment-based category of ankle stability (b7150 stability of a single joint) and movement coordination impairments (b7601 control of complex voluntary movements).

Evidence Update

Lateral Ankle Sprain

II

In a prospective, double blind trial, Li and colleagues[265] compared the diagnostic properties of the anterior drawer test (ADT), anterolateral drawer test (ALDT), and the reverse anterolateral drawer test (RALDT) between two raters in a mixed group of healthy individuals (n = 34) and those with confirmed ATFL injury (n = 38). The results indicated that the RALDT was superior to both the ADT and ALDT in nearly all categories for both raters. Mean sensitivity (averages of rater 1 & 2) was 0.224 for the ADT, 0.473 for the ALDT, and 0.894 for the RALDT. Specificity was at or near 1 for the ADT and ALDT though only slightly less for the RALDT (0.897). Mean accuracy was 0.590 for the ADT, 0.715 for the ALDT, and 0.896 for the RALDT. Kappa values were also higher for the RALDT (0.639) compared to the ADT (0.196) and ALDT (0.528). The authors concluded the RALDT was more sensitive and accurate when compared to the ADT and ALDT for diagnosis of[101] ATFL injuries.[265]

II

Croy et al[72] prospectively evaluated the diagnostic accuracy of the ADT in 66 individuals with a history of a LAS and 20 control individuals against digital USI during mechanical testing. The ADT uses a 5-point ordinal scale to classify degree of laxity (0 = hypomobile; 1 = normal; 2 = mild increased laxity; 3 = moderate increased laxity; 4 = severe increased laxity). The diagnostic accuracy of ADT was assessed for two thresholds: ≥2 and ≥3. Two thresholds were used for the imaging reference standard, based on the literature (2.3 mm) and twice the standard deviation of the control group (3.7 mm). Sensitivity of the ADT was 0.74 for the 2.3 mm cut-off and 0.83 for the 3.7 mm cut-off. Specificity of the ADT was 0.38 and 0.40 for the 2.3 mm and 3.7 mm cut-offs, respectively. The authors concluded the ADT provides a limited ability to detect excessive anterior talocrural laxity. The authors however conceded that because a side-to-side comparison was not performed as is typical in clinical practice, the ADT might provide useful information when used in this manner.[72]

III

Wiebking et al[464] compared the diagnostic accuracy of the ADT, arthrometer assessment, and stress-ultrasonography in 30 patients with lateral ankle trauma under anesthesia. The investigators were blinded from the diagnosis and both ankles of all participants were examined. The ADT exhibited a sensitivity of 0.93 with a specificity of 0.67. The arthrometer displayed a sensitivity of 0.8 and a specificity of 0.4 while the stress-ultrasonography demonstrated a sensitivity of 0.27 and specificity of 0.87. The authors concluded clinical examination with adequate analgesia was superior to both arthrometry and stress-ultrasonography for diagnosing acute LAS.[464]

III

Ellera Gomes et al[148] in a cross-sectional study, assessed the efficacy of anterolateral talar palpation for diagnosing ankle instability. Two blinded investigators examined 24 participants (14 patients with confirmed anterior/lateral ligamentous injury and 10 controls). The first examiner performed the ADT while the second examiner performed anterolateral talar palpation on all participants. Tests were categorized as positive or negative. The ADT had a sensitivity of 0.50, specificity of 1.0, a positive predictive value of 100%, negative predictive value of 56.3%

with an overall accuracy of 69.6%. The anterolateral talar palpation had a sensitivity of 1.0, specificity of 0.77, a positive predictive value of 87.5%, negative predictive value of 100% with an overall accuracy of 91.3%. The authors concluded that while the results for the anterolateral talar palpation test were encouraging, it should be used as a complement to the ADT to improve diagnostic accuracy in this patient population.[148]

Evidence Synthesis and Rationale
While the ADT continues to be one of the most common tests used clinically, the RADT and anterolateral talar palpation have stronger evidence to support their use in diagnosing ATFL injuries after LAS.

2021 Recommendation
B
Clinicians should use special tests including the RALDT and anterolateral talar palpation to aid in the diagnosis of a LAS, in addition to the ADT and a thorough history and physical examination.

Chronic Ankle Instability
2013 Recommendation
B
Clinicians may incorporate a discriminative instrument, such as the CAIT, to assist in identifying the presence and severity of ankle instability associated with the ICD category of instability secondary to old ligament injury, ankle and foot (M24.27), and the associated ICF impairment-based category of ankle stability (b7150 stability of a single joint) and movement coordination impairments (b7601 control of complex voluntary movements).

Evidence Update
I
Rosen and colleagues[371] completed a systematic review with meta-analysis of 29 studies to determine if functional performance tests could identify individuals with CAI. The authors found level B (moderate to strong) evidence for several functional performance tests. Specifically, the side-hop ($P = .009$, n = 7), timed-hop ($P = .002$, n = 9), multiple-hop test ($P < .001$, n = 13), and the foot-lift test ($P = .020$, n = 3) were able to discriminate between individuals with CAI and healthy controls. Additionally, components of the SEBT (medial [$P = .006$, n = 7], anteromedial [$P = .022$, n = 7], posteromedial [$P < .001$, n = 13]) were also capable of discriminating between the two groups.[371]
I
In an attempt to diagnose mechanical ankle instability and provide objective measures of laxity, arthrometers have been employed to quantify either anterior talocrural displacement and/or inversion ROM. A recent systematic review by Wenning and colleagues[461] identified that while most devices have good to excellent reliability (0.65 – 0.99), there were only two studies reporting the sensitivity and specificity of testing in individuals with CAI.

III
In 2013, Donahue and colleagues[117] introduced a new discriminative instrument, the Identification of Functional Ankle Instability (IdFAI). The IdFAI which consists of 10 questions, combined elements of both the CAIT and the Ankle Instability Instrument (AII). Scores can range from 0 – 37. A score ≥ 11 suggests that the individual is likely to have CAI. Unique to the IdFAI, the instrument has an operational definition of 'giving way' at the top of the form. The IdFAI demonstrated an overall test-retest reliability of 0.92 and was significantly related to responses on the Lower Extremity Functional Scale (LEFS) (Spearman's rho= -0.38, $P < .01$).[117] Subsequent investigation of 1127 college aged individuals found that the IdFAI was able to predict 87.8% of cases in which a person met the minimum criteria for CAI including a history of at least one ankle sprain and episode of giving way.[389] This prediction percentage was greater than the combined use of the CAIT and AII.[389]
III
In 2014, Wright and colleagues[475] revisited the cut-off score for the CAIT. This work was prompted by some investigators noting that individuals who indicated their ankle was relatively asymptomatic, were classified as having CAI. Using two independent data sets, the authors identified a new cut off score of ≤ 25, down 2 points from what was previously established.[475] The recalibrated cut-off score exhibited a sensitivity of 96.6%, specificity of 86.8%, positive likelihood ratio of 7.31, and negative likelihood ratio of 0.39. Additional work on the CAIT identified the minimal detectable change was 3.08 and minimally clinically important difference (MCID) was ≥ 3 points.[476]
III
Given the usefulness of these questionnaires, several have been cross-culturally adapted and translated into other languages and formats. Evidence is available to support Arabic,[240] Dutch,[447] French,[145] Greek,[430] Persian,[163] Spanish,[364]and digital[369] versions of the CAIT. Similarly, evidence exists to support Chinese,[449] Korean,[228] Japanese,[304] Persian,[305, 309] and Portuguese[291] versions of the IdFAI. Additionally, reliability of the IdFAI has been established across several adult age groups.[161] Likewise, the AII has been translated into Chinese,[266] French,[279] and Persian[308] with evidence to support their use. One systematic review questioned the use of validated instruments translated and cross-culturally adapted for Brazilian-Portuguese after critical analysis of their psychometric properties.[352]

V
The International Ankle Consortium suggest the following criteria to identify individuals with CAI: history of at least one significant ankle sprain; subjective reports of previously injured ankle 'giving way', episodes of a subsequent sprain and/or perceptions of ankle instability, and diminished function as measured with the FAAM. Additionally, the consortium recommended confirmation of ankle instability by using a validated ankle specific questionnaire with appropriate cut-off score.[154]

Evidence Synthesis and Rationale
While discriminative self-report instruments continue to have the most evidence to support their use in diagnosing CAI, functional performance test, that include hopping and dynamic balance,

also have evidence to support their usefulness. The criteria outlined by the International Ankle Consortium will hopefully unify how individuals with CAI are identified. However further evidence is needed to support these criteria. The ability of arthrometers to diagnose mechanical ankle instability and provide objective measures of laxity is unclear and their utility is limited by their practicality in the majority of clinical settings.

2021 Recommendation
B
When determining whether an individual has CAI, clinicians should use a reliable and valid discriminate instrument, such as the CAIT and IdFAI, as well as a battery of functional performance tests that have established validity to differentiate between healthy controls and individuals with CAI.

DIFFERENTIAL DIAGNOSIS

2013 Acute Lateral Ankle Sprain Recommendation

Clinicians should use diagnostic classifications other than an acute LAS when the patient's reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline. Particularly, the Ottawa and Bernese Ankle Rules should be used to determine whether a radiograph is required to rule out a fracture of the ankle and/or foot.

Evidence Update

The ankle has been cited as the most frequently mis-diagnosed region for patients reporting to the emergency department.[316] An inadequate history and/or physical examination and failure to order or interpret radiographs have been identified as the most common reasons for misdiagnosis.[316] To decrease the likelihood of missing a fracture, application of the Ottawa Ankle Rules (OAR) has been deemed an integral part of the diagnostic process.[409, 446]

A recent systematic review and meta-analysis concluded the OAR is the gold standard of decision rules for excluding fractures after an acute ankle injury.[25] This includes fractures of the distal tibia, distal fibula, base of the 5th metatarsal, and navicular. Utilization of the OAR has been validated in different populations[450] across the lifespan.[127, 322] Although some investigators are proponents of the Low Risk Ankle Rules (LRAR) in the pediatric population,[34, 35] others have shown that the sensitivity of the LRAR (85.7%) is inferior to the OAR (100%) in this demographic.[127] There is evidence that implementation of the OAR in the emergency department decreases costs,[271] patient wait time,[178] length of stay (median 20 minutes),[178] and radiograph imaging[178, 426] without sacrificing outcomes.[79] Likewise, there is evidence the OAR can be used during athletic events.[81, 153] To improve dissemination and adherence, the use of technology including apps[333] and electronic clinical decision support tools have been recommended.[388, 414] Collectively, investigators routinely report the OAR to have a high sensitivity (92-100%) though low to moderate specificity (7.8 - 68%).[30, 79, 205, 345, 426] Specificity may be improved with other tests such as the Bernese Ankle Rule (BAR).[205] However, the BAR alone has not been advocated for clinical use because of the lower than desirable sensitivity.[94] To maintain the level of OAR sensitivity, the OAR should be applied in its entirety. Amiri and colleagues[12] reported that utilization of solely the ability of a patient to bear weight and complete four steps in the emergency department while omitting tenderness at the malleoli resulted in a lower sensitivity (88%) compared to sensitivity values associated with full application of the OAR. Despite the amount of evidence that supports clinical use of the OAR, not all studies are in agreement,[70] possibly because clinical biases and concern of litigation remain.[16]

In addition to a fracture of the distal tibia, distal fibula, base of the 5th metatarsal, and navicular, soft tissue pathology must be considered when differentially diagnosing a patient who has sustained an acute ankle sprain. To optimize the differential diagnosis of soft tissue injury, the physical exam is most accurate if performed four to five days after injury.[446] Using MRI, co-pathologies have been confirmed in 92% of cases following an acute sprain.[88] Differential diagnosis and assessment for co-pathologies may include:

- Syndesmotic injury[44, 157, 366]
- Osteochondral lesions[88, 366]
- Talar bone contusion[366]
- Deltoid ligament sprain[366]
- Tendinous injuries,[88] including Achilles tendon rupture and fibularis longus/brevis tendon injury
- Os Trigonum[206]
- Mid-foot sprains (eg, talonavicular, calcaneocuboid and calcaneonavicular ligaments)[10]
- Epiphyseal plate injuries[34, 443]

2021 Summary
Lateral Ankle Sprain
Clinicians should conduct a thorough patient history and examine the multiple segments of the ankle-foot complex to rule in or out the pathologies that may be present when differentially diagnosing an acute sprain, and utilize the OAR when determining whether a radiograph is necessary after an acute LAS.

2013 Chronic Ankle Instability Recommendation
Clinicians should use diagnostic classifications other than ankle instability when the patient's reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline.

Evidence Update

Chronic Ankle Instability
While the majority of patients recover after an acute ankle sprain, around 40% of may continue to exhibit symptoms consistent with CAI. Concurrent pathologies may explain why symptoms remain problematic months or later in some cases. Frequently, these co-pathologies are documented at the time of surgery following unsuccessful non-surgical management.[13, 275] Co-existing pathology accompanying CAI may include:

- Fibularis muscles pathology[13, 195]
- Ankle impingement[13, 255]
- Osteochondral lesions[13]
- Synovitis[275]
- Chondral lesions – superficial or deep[192, 258, 275]
- Bony or avulsion fragments[275, 359]
- Loose bodies[275]
- Syndesmotic injury[64, 320]
- Arthritis[286]
- Bifurcate ligament injury[410]
- Os Trigonum[77]
- Accessory ossicles[359]

2021 Chronic Ankle Instability Recommendation
Clinicians should consider the presence of pathologies that may co-exist or exist in isolation and refer to other appropriate professional when symptoms and/or function do not fully recover after a LAS.

IMAGING

2013 Condensed Summary
Radiographs may be useful in acute cases when indicated by the OAR and BAR. Generally, patients with suspected ankle sprains are treated non-surgically for 4-6 weeks. For patients with persistent symptoms, including symptoms consistent with ankle instability, radiographs, stress radiographs, MRI, arthrography, computerized tomography (CT), USI, and/or bone scan/scintigraphy can be used to assess the integrity of the soft tissue and/or osseous anatomy.

2021 Evidence Update and Summary
The American College of Radiology (ACR) has produced the "ACR Appropriateness Criteria®" an evidence-based guideline to assist providers in making the most appropriate imaging choices for specific clinical conditions, including those with acute and chronic ankle injuries. (https://www.acr.org/) These ACR Appropriateness Criteria® state that if the AOR are positive, ankle radiograph is the first appropriate imaging study. If radiographs demonstrate potential osteochondral injury or there are persistent symptoms, an MRI or CT scan without contrast are usually appropriate. Leg radiographs, ankle stress radiographs, MRI scan without contrast, or CT scan without contrast are usually appropriate for those who have an alignment abnormality suggesting syndesmotic/ligamentous injury or dislocation. Ultrasound imaging is usually not the first imaging study after an acute trauma to the ankle, but may be an appropriate secondary

evaluation modality to assess for underlying soft-tissue injuries, chondral avulsion fractures in children, or abnormalities with dynamic imaging stress testing. Exclusion criteria from these recommendations would include children < 5 years of age or those with altered leg sensation (ie, diabetic), altered mental capacity, and/or inability to communicate. (https://www.acr.org/)

In those with symptoms that are present for more than 6 weeks, the Appropriateness Criteria® note ankle radiographs are usually appropriate. If ankle radiographs are negative but ankle instability, ankle impingement, osteochondral lesions, and/or tendon injuries are suspected, an MRI without contrast is usually appropriate. Ultrasound imaging may also be appropriate if a tendon injury is suspected and contrast can be added to MRI if ankle instability is suspected (https://www.acr.org/)

Ultrasound imaging is a growing area of interest in physical therapy. Systematic reviews have found USI to be reliable and accurate in the diagnosis of ATFL and calcaneofibular (CFL) injuries.[47, 259, 380, 381] Specific studies have supported USI with stress testing[307] as well as being useful to further assess the ATFL to identify the type of injury,[43] grade severity of injury,[62] and assess its thickness.[277] Another systematic review found USI to be accurate in identifying foot fractures[52] and specifically fifth metatarsal, lateral malleolus, and medial malleolus fractures in those with a foot and/or ankle sprain.[19] Ultrasound imaging was also found to be accurate and sensitive in detecting tendinous injuries[375] as well as useful for visual biofeedback to target activation of specific muscles during rehabilitation.[238]

EXAMINATION

OUTCOME MEASURES
2013 RECOMMENDATION

A

Clinicians should incorporate validated functional outcome measures, such as the FAAM and the LEFS, as part of a standard clinical examination. These should be utilized before and after interventions intended to alleviate the impairments of body function and structure, activity limitations, and participation restrictions associated with ankle sprain and instability.

Evidence Update

I

The Patient-Reported Outcomes Measurement Information System Physical Function (PROMIS PF) computer adaptive test (CAT) performed as well as the FAAM-ADL subscale and Foot Function Index (FFI)-5 point, in an assessment of content validity, convergent validity, and item reliability, with less response burden, in 60 (19.4%) individuals scheduled for CAI surgery.[196] In a general orthopedic population (n=3069) the minimal clinically important difference (MCID) values varied depending on methods and were calculated for the PROMIS PF (range 3 to 30; median = 11.3), PROMIS Pain Interference (PROMIS PI) (range 3 to 25; median = 8.9), and FAAM Sports (range 9 to 77; median = 32.5).[199]

II

In a general orthopaedic foot population, the PROMIS PF, PROMIS PI, and FAAM Sports were sensitive and responsive to changes in patient-reported health with effect sizes ranging from 0.95-1.31 across 4 time points (3, >3, 6, and > 6 months).[198] In analyses that included Rasch Modeling, the PROMIS PF, mobility, and PI scales were more normally distributed with fewer floor and ceiling effects than the Foot and Ankle Outcome Score (FAOS).[239] Additionally, the PROMIS CATs were more precise and had better test-retest reliability than both the FAOS and Short Form 12 general health status survey in 19 (6.2%) individuals scheduled for ankle instability surgery.[239]

II

There was evidence of validity, reliability, and responsiveness for the Korean version of American Academy of Orthopedic Surgeons Foot and Ankle Questionnaire (AOFAS) in a study that included 11 (5.3%) individuals with ankle instability.[219]

II

The score 5-7 days after a LAS on the Pain Self Efficacy Questionnaire (PSEQ), which assesses a patient's confidence to accomplish activities despite pain, was significantly correlated with function (r = 0.26; P =.017) and pain level (r = 0.32; P < .01) 3 weeks after injury.[37]

III

The PROMIS PF CAT was found to be efficient, reliable, valid, and precise, while adequately assessing function in 48 (15%) patients scheduled for ankle instability surgery.[197]

III

A difference in FAAM Sport subscale (95 versus 84.8) but not ADL subscale (99 versus 97.2) was noted between ‘copers’ and those with chronic complaints of instability.[147] Slightly different results were noted by Wright et al[474] as FAAM scores were different in those with chronic complaints of instability compared to ‘copers’ and uninjured with ADL subscale scores of 96.36, 99.54, and 99.79 and sports subscales scores of 89.76, 98.70, and 97.83, respectively.

III

The Fear-Avoidance Beliefs Questionnaire (FABQ) correlated (r^2 = 0.18-35, P < .028) with measure of balance and joint laxity.[190]

III

Evidence to support the use of the Tampa Scale of Kinesiophobia (TSK)-11 to asses fear of movement and reinjury and the FABQ to assess fear-avoidance beliefs is available as scores on these instruments differentiated those with CAI and healthy controls (P < .001).[191] Other studies have found the TSK-11 scores of controls and ‘copers’ to be different from those with CAI (P < .001).[135] TSK-11 scores were also correlated with ankle joint laxity in female athletes (r = 0.285, P = .013) but not males (r = -0.094; P = .46).[138]

III

There is evidence to support the use of a 12 item Quick FAAM, with combined ADL and Sports subscale,[180, 181] as well as evidence to support the use of Turkish,[50, 436] German,[280] Japanese,[435] Chinese,[150] and Dutch[457] versions of the FAAM for those with a history of an ankle sprain and/or chronic complaints of instability. Evidence is also available to support the use of Chinese,[151] Brazilian-Portuguese,[292] Thai,[405] Italian,[442] versions of the FFI in individuals that include those with a history of an ankle sprain.

IV
Preliminary research on 26 participants found evidence of validity of the Sports Athlete Foot and Ankle Score (SAFAS) for assessing sports-related ankle injuries in high-performing athletes.[318]
IV
There is evidence to support a Persian version of the AOFAS-ankle-hindfoot scale, a reliable and valid instrument for those with ankle ligament injuries.[445]
IV
Greater kinesiophobia with TSK-11 scores was associated with less confidence on the SEBT (r = -0.46) and vertical jump (r = -0.45).[67]

Evidence Synthesis and Rationale
There continues to be strong evidence to support the use of patient reported outcome measures over the course of treatment to asses for changes in impairments of body function and structure, activity limitations, and participation restrictions for those with an acute LAS or CAI. The PROMIS, which can be delivered in a contemporary CAT format, has been supported since the 2013 recommendation. Additionally, there is recent evidence to support instruments to capture various aspects of the patient's psychological status, such as fear of reinjury, kinesiophobia, fear-avoidance beliefs, and reinjury anxiety.

2021 RECOMMENDATION
A
Clinicians should use validated patient reported outcome measures, such as the PROMIS PF and PI scales, FAAM, and LEFS as part of a standard clinical examination. Clinicians should utilize these before and one or more times after the application of interventions intended to alleviate the impairments of body function and structure, activity limitations, and participation restrictions associated with an acute LAS or CAI.

C
Clinicians may use the PSEQ in acute and post-acute periods after a LAS to assess self-efficacy with adaptiveness to pain and the TSK-11 and FABQ to asses fear of movement and reinjury and fear-avoidance beliefs in those with CAI.

EXAMINATION – PHYSICAL IMPAIRMENT MEASURES
2013 RECOMMENDATION
A

When evaluating a patient with an acute or subacute LAS over an episode of care, assessment of impairment of body function should include objective and reproducible measures of ankle swelling, ankle ROM, talar translation and inversion, and single-leg balance.

Evidence Update
Lateral Ankle Sprain
II
After an acute LAS, pain with dorsiflexion measured at 4 weeks using the weight bearing lunge test was associated with a lower functional status at 4 months (unstandardized $\beta = 6.8$, $P < .005$).[329]

III
In individuals with LAS symptoms lasting 6-12 months, multivariate analysis showed a significant ($P < .05$) positive association with swelling (OR = 3.58) and a difference in passive plantar flexion ROM (OR = 1.09) to bone edema in the talocrural joint. A difference in passive plantar flexion ROM (OR = 1.07) and pain at the end range of dorsiflexion and/or plantar flexion (OR = 5.23) were associated with osteophytes in the talonavicular joint.[438]
III
Bilateral reduction in SEBT reach distances were identified in individuals assessed within 2 weeks after a LAS, with large effect sizes (0.27 – 0.29) for the involved and uninvolved lower extremity in posterolateral and posteromedial reach directions, medium effect size (0.18) for the involved lower extremity in the anterior direction, and a small effect size (0.06) for the uninvolved limbs in the anterior direction.[115] In those after LAS, the SEBT was found to be reliable in all eight directions (ICC range 0.72 – 0.93) with minimal clinical difference values of 8.56%, 13.36%, and 13.33% for the anterior, posteromedial, and posterolateral directions, respectively.[343]
III
A combination of balance, proprioception, and motor control assessment could differentiate individuals 3.5 months after a LAS from healthy controls.[348] This assessment included clinical measures of dorsiflexion ROM measured with weight bearing lunge test, SEBT, number of touches or foot lifts in 30 seconds during single leg balance with eye closed (foot-lift test), and time down stairs. The association between sprain status was best between the SEBT in the anterior direction and single leg balance with eyes closed ($\chi^2 = 15.2$, $P < .001$).[348]
III
Non-weight bearing ROM (dorsiflexion $P = .452$, plantar flexion $P = .436$, inversion $P = .383$, and eversion $P = .657$), pain level ($P = .822$), and foot volume measures ($P = .654$) were not different between those with a first time LAS and those with recurrent injuries when measured within 5 days after injury.[460]

Chronic Ankle Instability
II

Univariate comparison found impairment measures of dorsiflexion ROM with the weight bearing lunge test and number of errors with 20 second single-limb balance test on a firm surface with eyes closed could be used to predict treatment success for patients with CAI ($P < .10$).[466, 467]

III
Dorsiflexion ROM measured in non-weight bearing with the knee flexed was associated with severity of CAI as assessed with the CAIT ($r = 0.22$; $P = .04$).[368]

III
Those with CAI have decreased weight bearing dorsiflexion ROM compared to healthy controls (inclinometer 48.3° versus 43.3°; $P < .05$;[234] wall-toe distance 8.3 versus 10.0 cm; $P = .013$.)[245] Weight bearing dorsiflexion ROM with the lunge test (measured with digital inclinometer) was correlated (r = -0.39; $P = .002$) with lateral step-down performance, as those with poor movement quality had less ankle dorsiflexion ROM than those with good movement quality (36° versus 42°; $P = .01$).[156] Weight bearing dorsiflexion ROM was also correlated with movement at the knee during single leg landing (r = 0.53; $P = .04$).[182] Different findings were noted by Vomacka et al[444] as no difference was found in dorsiflexion ROM between those with CAI, copers, and healthy controls ($P > .05$).

III
Rosen et al[371] performed a systematic review with meta-analysis to evaluate balance tests to differentiate healthy individuals from those with CAI and found the foot lift test to be a useful static balance test (mean effect size = -0.76; $P = .020$) and the SEBT to be a useful dynamic balance test in posteromedial (mean effect size = 0.37; $P < .001$), medial (mean effect size = 0.37; $P = .006$), and anteromedial (mean effect size = 0.33; $P = .022$) reach directions. Included in the Rosen review, Ko et al[227] found high intrarater reliability for the foot lift test (SEM = 1.3 errors) and SEBT (SEM = 4.6 cm), while Linens et al[273] found cutoff scores to identify those with CAI from healthy individuals to be 5 errors/touches for the foot-lift test and 91% reach distance on the SEBT in the posteromedial direction.

III
Studies after the review by Rosen et al found all eight directions of the SEBT were different between healthy and those with CAI, with the posterior medial and lateral direction best predictors of CAIT score ($P \leq .001$ and $P < .05$, respectively).[234, 387] Poor performance with the SEBT- posteromedial direction (< 85.2% reach distance) was found to be the best single predictor of a successful treatment (OR = 11.32).[41] Other studies support the anterior reach direction[93, 204, 230, 245] as well as the posteromedial direction as being able to differentiate CAI from healthy controls.[230, 245]

III
The SEBT was found to be an accurate and valid measure of dynamic balance in those with CAI as there was a large and significant correlation ($r^2 = 0.98$ $P < .001$) between visual estimation and motion analysis measures of maximum reach distance.[27] While variations in how the SEBT is administered can affect results, one method does not seem superior to another.[74]

III
Associations have been identified between dorsiflexion ROM with the weight bearing lunge test and the anterior reach direction ($r = 0.55$, $P < .001$), posterolateral reach direction ($r = .29$, $P =$

.03), and the composite SEBT scores (r = 0.30, P = .02) while there was no association to the posteromedial reach direction (r = 0.01, r^2 = 0.001, P = .47).[26] Terada et al[420] also found a significant correlation between dorsiflexion ROM and SEBT anterior reach (r = 0.410; P = .014). Similar findings were found by Gabriner et al[143] as dorsiflexion ROM with weight bearing lunge test and plantar cutaneous sensation explained a significant amount of the variance associated with SEBT anterior reach distance (r^2 = 0.16; P = .041) while eversion strength and time to medial-lateral boundary explained a significant amount of the variance associated with SEBT posteromedial (r^2 = 0.28; P =.002).[143] Weight bearing dorsiflexion ROM was also correlated with sagittal knee (r = -0.53; P = .04) and frontal trunk (r = 0.62; P = .01) movements as well as SEBT anterior reach distance (r = 0.51; P = .05).[183]

III

Some studies have found the SEBT was able to differentiate 'copers' from CAI[135, 201, 245] while other have not.[147]

III

A systematic review and meta-analysis found those with CAI had decreased hip abduction, extension, and external rotation strength (P < .001, effect size range: 0.52 – 0.93) but no difference in knee kinematics with dynamic balance activities (P = .26).[91] Studies included in this review also found hip abduction and external rotation strength each explained a significant (r^2 = 0.25; P = .01) amount of the SEBT posteromedial and posterolateral reach directions.[295]

III

The BESS with the eyes closed was significantly different (P = .01) and could distinguish copers (mean ± standard deviation BESS score = 1.12 ± 0.85) from CAI (2.7 ± 1.87).[251]

III

The FPI score may affect static and dynamic postural control in individuals with CAI, as a neutral group had better dynamic postural control while the pronator group had better static postural control ($P \leq$ .05).[185] However, no significant differences in foot posture, Arch Height Index, or Foot Mobility Magnitude have been found in individual with or without LAS or CAI.[135]

III

In those with CAI, measures of static and dynamic postural control (eg, SEBT), dorsiflexion ROM, plantar cutaneous sensation, strength, and ankle-subtalar joint motion contributed significantly (r^2 = 0.18 – 0.35; P < .05) to multiple patient reported outcome measures score variances.[190]

IV

A significant correlation between the isokinetic inversion muscle strength and the single-leg balance test, single-heel raise test, and sidestep test (r = 0.23 – 0.51; P < .009) was identified in those with CAI.[337] Postural control evaluation using the modified Romberg test could substitute for dynamometer testing of joint-position sense as these measures were correlated (r = -0.81; P < .001) in those with chronic complaints of instability.[58]

Evidence Synthesis and Rationale

A growing body of evidence supports that assessing for impairments of body function before beginning treatment and then two or more time over an episode of care can be used to identify limitations, predict treatment success, and define progress over the course of treatment for those with acute LAS or CAI.

2021 RECOMMENDATION EXAMINATION – PHYSICAL IMPAIRMENT MEASURES

A

Clinicians should assess and document ankle swelling in patients with an acute or post-acute LAS, and ankle ROM, talar translation, talar inversion, and single-leg balance in patients with an acute LAS, post-acute LAS, or CAI when evaluating a patient two or more times over an episode of care. Clinicians should specifically include measures of dorsiflexion as measured with the weight-bearing lung test, static balance with a single-limb balance on a firm surface with eyes closed, and dynamic balance with the SEBT anterior, anteromedial, posteromedial, and posterolateral reach directions.

C

In those with CAI, clinicians may also assess and document hip abduction, extension, and external rotation strength two or more times over an episode of care.

ACTIVITY LIMITATION - PHYSICAL PERFORMANCE MEASURES

2013 RECOMMENDATION EXAMINATION ACTIVITY/PHYSICAL PERFORMANCE MEASURES

B

When evaluating a patient in the post-acute period following a recent or recurring LAS, physical therapists/clinicians should assess and document activity limitation, participation restriction, and symptom reproduction using objective and reproducible measures that assess performance with lateral movements, diagonal movements, and directional changes such as single-limb hop tests.

Evidence Update

III

The systematic review and meta-analysis by Rosen et al[371] assessed functional performance tests and found the timed hop (mean effect size = -1.056; P = .009), side-hop (mean effect size = -2.314; P =.001), and multiple-hop tests (mean effect size = 1.399; P < .001) were able to differentiate healthy individuals from those with CAI. Included in the review by Rosen et al, Ko et al[227] found the single leg hop test (standard error of measurement 0.6 sec) to have high intrarater reliability with Linens et al[273] identifying a cutoff score of 12.88 seconds as being able to differentiate those with CAI from healthy individuals.

III

The lower extremity functional movement screen (LE-FMS) scores were different between healthy individuals compared to those with CAI (8.2 versus 6.9; $P < .05$) with both inline lunge (affected side and non-affected side) and hurdle step (affected side and non-affected side) being different ($P < .05$) while there was no difference between the two groups in the deep squat (P > 0.05). Also in those with CAI, the total LE-FMS score and inline lunge test correlated to FADI ADL and Sports scores (r = 0.807-0.896, P < .01).[61]

III

The timed Dynamic Leap and Balance Test was able to differentiate those with CAI from controls (51.85 seconds versus 41.12 seconds; $P < .001$).[202]

IV

Those with ankle laxity, as assessed with anterior drawer, had lower hopping for distance (% body height: 95.03 versus 105.26; $P < .05$) and performed poorer on a hexagon hopping course (count 13.21 versus 14.52; $P < .05$) when compared to those with stable ankles.[471]

IV

One-leg hopping for distance demonstrated significant side-to-side differences compared with the unaffected ankle ($P = .035$) and was correlated with joint position sense (r = -.38-.66; P < .05) in those with chronic complaints of instability.[58]

Evidence Synthesis and Rationale

There continues to be the best evidence to support the use of single-limb hopping under timed conditions to assess activity limitation and participation restrictions. Further studies are needed to define the usefulness of more comprehensive movement screens.

2021 UPDATE RECOMMENDATION EXAMINATION – ACTIVITY – PHYSICAL PERFORMANCE MEASURES

B

Clinicians should assess and document objective and reliable measures of activity limitation, participation restriction, and symptom reproduction two or more time when evaluating a patient with a LAS or CAI, and specifically include measures of single-limb hopping under timed conditions.

TECHNOLOGY AND INTRUMENTATION

2021 Evidence Summary

The use of technology (eg, computerized measurement devices) to assess physical impairment as well as activity and functional performance in those with a history of LAS and chronic complaints of ankle instability has been supported.[1, 6, 57, 60, 141, 246, 253, 270, 387, 408, 472, 479] Research studies have also used motion analysis and force plate to assess static and dynamic balance, gait, and jumping[48, 49, 54, 68, 82, 89, 98, 100, 104, 105, 107, 109, 110, 112-115, 123, 133, 136, 137, 162, 168, 170, 171, 188, 201, 214, 221, 224, 250, 252, 267, 269, 272, 311, 344, 374, 391, 393, 394, 396, 404, 416, 424, 425, 478] as well as isokinetic dynamometer for an assessment of strength, joint reposition, and movement detection.[58, 59, 76, 80, 257, 327, 337, 341, 374, 387, 399, 470]

INTERVENTIONS

Interventions for acute and subacute LAS and CAI were presented in the 2013 CPG using the context of acute and progressive loading/sensorimotor training phases of treatment. Since that time, study samples have become more consistent using language that is different than the initial CPG. The major distinction between the two phases of treatment as described in the 2013 CPG was a time threshold of 72 hours post-injury.[1] For the 2021 CPG update, intervention guidelines are presented using a consensus framework that reflects how research evidence has developed since the initial CPG (**Table 2**). It uses the terms acute LAS and CAI.[154, 155] This evidence update identified specific neuromusculoskeletal impairments, activity limitations, participation restrictions, treatment response, and the mediating intrinsic factors, which exist along a spectrum of acute LAS, post-acute LAS, and CAI.

Table 2. Treatment-based classification of lateral ankle sprains. Operational definitions to guide intervention for lateral ankle sprain based on history and physical examination findings, comparing the initial 2013 CPG and 2021 CPG update.

	Treatment-based Classification for Lateral Ankle Sprains	
	Acute/Protected Motion	**Sensorimotor Training**
2013	Within 72 hours following inversion mechanism injury Individuals who demonstrated significant swelling, pain, limited weight bearing, and overt gait deviations (ie, limited stance time, abbreviated/omitted terminal stance phase)	Post-acute period Primary concerns of instability, weakness, limited balance responses, and intermittent swelling
	Acute Lateral Ankle Sprain	**Chronic Ankle Instability**
2021	Within 72 hours following inversion mechanism injury Individuals who demonstrated significant swelling, pain, limited weight bearing, and overt gait deviations (ie, limited stance time, abbreviated/omitted terminal stance phase)	History of at least 1 significant ankle sprain within the past 12 months A history of the previously injured ankle joint ‘‘giving way’’ and/or recurrent sprain and/or ‘‘feelings of instability’’

Clinicians should consider the updated evidence-based recommendations provided in this guideline in the appropriate context of clinical experience and patient-preference when determining the nature and timing of interventions during the course of rehabilitation for an individual with LAS. Due to heterogeneity of impairment and activity limitation experienced by individuals with LAS and CAI, interventions should be tailored to the specific needs of the patient. Furthermore, intrinsic and environmental factors that mediate outcomes should also be addressed when prescribing interventions for individuals with LAS and CAI. Physical therapists and other rehabilitation specialists are members of larger, multidisciplinary teams while treating patients with LAS and CAI. Engaging other physical therapists, athletic trainers, physicians, surgeons, mental and behavioral health care providers, nurses, strength and conditioning specialists, vocational specialists, and other health disciplines may be warranted for optimal transition to work or sport. Patient-reported and objective clinical and instrumented measures that can capture resolution of ankle-foot impairment, return to activity, and resumption of social participation are paramount to managing intensity and dose of interventions.

PREVENTION OF LATERAL ANKLE SPRAINS

Primary Prevention of a First-Time Lateral Ankle Sprain

2013 Recommendation: None

Evidence Update
I
Leppänen and colleagues[261] conducted a systematic review and meta-analysis to examine the effects of any primary prevention interventions in sports injuries. Ten trials addressing prevention of ankle injuries with external ankle joint supports were included. Pooled results showed a significant reduction in the frequency of ankle injuries compared to no ankle supports (pooled OR: 0.40; 95% CI: 0.30, 0.53). Subjects in these trials (N = 6662) were young male and female athletes in basketball, male athletes in soccer and American football, and military paratroopers. The external ankle supports used were different kinds of stabilizing devices, such as orthoses and braces. Ankle taping was not studied in these randomized clinical trials (RCTs).
I
Vuurberg and colleagues[446] reported that the use of ankle brace or tape reduces the risk of first-time LAS (relative risk: 0.69; 95% CI: 0.49, 0.96), especially in those who participate in sports. When compared to bracing, taping has been suggested to be less advantageous from a cost-benefit perspective.[330] The choice between brace and tape should depend on patient/client preference, the clinician's judgement, and the cost effectiveness of the interventions. The review of 3 RCTs (N = 3410) assessing the prophylactic effects of low-fitted or high-fitted footwear found this intervention yielded no significant reduction in ankle sprain risk.
I

Bellows and Wong[31] found 3 trials (N = 3581) in a systematic review and meta-analysis that demonstrated a statistically significant 4.2% absolute risk reduction of ankle sprains for the use of a brace compared to no treatment, corresponding to a 64% reduction of relative risk.

I

The Bellows and Wong[31] review also identified 6 trials (N = 3577) that demonstrated a statistically significant 6.5% absolute risk reduction of ankle sprains for a balance training program compared to no treatment, corresponding to a 46% relative risk reduction. The specific nature and level of supervision for balance training exercises demonstrated high variability among the included studies. This review and meta-analysis included studies of individuals with and without a history of prior LAS.

I

Vuurberg and colleagues[446] reported that while there is evidence to support the use of exercise for prevention of recurrent sprains, there is a lack of evidence to support the use of prophylactic exercises for the prevention of first-time ankle sprains.

Evidence Synthesis and Rationale

There is strong evidence to support the use of prophylactic bracing and taping for the prevention of first-time ankle sprains. While bracing appears to be more cost-effective than taping, clinician experience and patient preference should be considered when deciding which intervention to employ. There is strong evidence for the use of balance exercise for the prevention of recurrent ankle sprains, yet there is a lack of evidence for the use of these interventions for the primary prevention of first-time ankle sprains at present. However, clinicians may recommend exercise as part of a comprehensive fitness program due to the potential prophylactic benefits and relatively low associated risks. More research is needed to clarify the specific mode and volume of exercise necessary to produce preventive effects. Based on the frequency of injury and morbidity associated with LAS and CAI, prophylactic bracing and taping should be routinely employed in individuals with intrinsic risk factors or those who engage in high-risk activities such as court sports.

2021 Recommendation:

A

Clinicians should recommend the use of prophylactic bracing to reduce the risk of a first-time LAS, particularly for those with risk factors for LAS.

C

Clinicians may recommend the use of prophylactic balance training exercises to individuals who have not experienced a first-time LAS.

Secondary Prevention of Recurrent Lateral Ankle Sprains Following an Initial Sprain

2013 Recommendation

C

Clinicians can implement balance and sport-related activity training to reduce the risk for recurring ankle sprains in athletes.

Evidence Update

I

In a meta-analysis of three systematic reviews investigating the effectiveness of exercise interventions for secondary prevention of LAS, Doherty and colleagues[99] found a significantly decreased risk of sustaining a recurrent ankle sprain in the intervention group compared to controls (OR = 0.59; 95% CI: 0.51, 0.68).

I

Doherty and colleagues[99] also found unanimous consensus among the five included systematic reviews that bracing was effective at preventing a recurrence of an ankle sprain (OR = 0.40, 95% CI: 0.29, 0.56), especially if the individual engaged in high risk activity such as indoor court or field-based athletics.

I

Doherty and colleagues[99] concluded from data in two systematic reviews that bracing was superior to taping and 3 systematic reviews advocated for the value of taping. There is limited evidence on mechanisms that lead to these beneficial effects. When compared to bracing, taping has been suggested to be less advantageous from a cost-benefit perspective.[330]

I

There is inconclusive evidence from systematic reviews for footwear modification or foot orthoses in preventing a recurrent ankle sprain after an initial LAS or its recurrence among evaluated systematic reviews.[99, 350] Furthermore, there is a lack of evidence pertaining to orthotic use in the treatment of CAI or the prevention of ankle sprain recurrence.[99, 350]

I

Therapeutic exercise involving proprioceptive and balance retraining is associated with reduced frequency of recurrent LAS based on data from 10 trials (N = 1284) and reduced prevalence of functional ankle instability based on data from 3 trials (N = 174).[446]

I

Based on data from 7 trials (N = 1417), Bleakley and colleagues[33] found a significant reduction in recurrent injury following exercise-based intervention in people with an existing LAS compared to usual care at 7-12 months post-injury (OR = 0.53; 95% CI: 0.38, 0.73). Usual care consisted of one or more of protection, rest, ice, and elevation. Although most programs in the included studies emphasized strength and balance training, the specific nature and volume of exercises demonstrated substantial variability.

I

Burger and colleagues[42] found a statistically similar rate of recurrence in people with a prior LAS who received neuromuscular exercise compared to bracing, based on a systematic review and meta-analysis (3 trials, N = 144).

Evidence Synthesis and Rationale

There is strong evidence to support the use of prophylactic bracing, taping, and balance training exercises for the prevention of subsequent ankle sprains. While bracing appears to be more cost-effective than taping, clinician experience and patient preference should be considered when deciding which intervention to employ. Shoe wear modification and orthotic prescription has been shown to be ineffective for general prophylaxis of subsequent ankle sprain, however the utility of these interventions for addressing specific ankle-foot impairments that contribute to activity limitation following LAS and CAI has yet to be elucidated.

2021 Recommendation
A
Clinicians should prescribe prophylactic bracing and use proprioceptive and balance-focused therapeutic exercise training programs used to address impairments identified on physical examination to reduce the risk of a subsequent injury in patients with a first-time LAS.

INTERVENTIONS FOR ACUTE AND POST-ACUTE LATERAL ANKLE SPRAINS

Protection and Optimal Loading

2013 Recommendation
A
Clinicians should advise patients with an acute LAS to use external supports (taping and bracing) and to progressively bear weight on the affected limb. The type of external support and gait assistive device recommended should be based on the severity of the injury, phase of tissue healing, level of protection indicated, extent of pain, and patient preference. In more severe injuries, immobilization ranging from semi-rigid bracing to below knee casting may be indicated.

Evidence Update
I
Petersen and colleagues[342] performed a systematic review and meta-analysis of treatment of acute ankle ligament injuries. The authors included a review by Kerkhoffs and colleagues,[210] who compared studies (21 trials; N = 2184 participants) regarding functional treatment and immobilization. Functional treatment promoted significant improvements in return to sports rate, time to return to sports, return to work rate, time to return to work, swelling, and satisfaction with treatment compared to immobilization. Vuurberg and colleagues[446] also found that a functional approach involving early weight bearing with the ankle braced or taped and inclusion of neuromuscular and proprioceptive exercises led to the fastest resumption of work and daily life activities compared to immobilization.
I
In the review conducted by Vuurberg and colleagues,[446] the authors concluded based on 3 RCTs (N = 694) that a short period of immobilization of 10 days or less with a plaster cast or rigid support can be of added value in the treatment of Grade III sprains, resulting in decreased pain and edema and improved functional outcomes.
I
A period of 4 weeks in a lower leg cast following an acute LAS results in a longer time required and a lower proportion of patient able to return to work and sport 4-6 weeks after injury compared to individuals treated with functional support and exercise strategies (22 RCTs, N = 2304).[210]

Evidence Synthesis and Rationale
Based on strong evidence, optimized loading should begin in the acute phase and continue into the post-acute phase following a LAS. The duration and extent of loading should be dictated by the physical examination and should consider comorbidities, clinician experience, and patient preference when planning care. Treatment with early neuromuscular and proprioceptive exercises in the post-acute period appears to be superior to immobilization in optimizing

functional outcomes. A period of immobilization may be considered for severe sprains. If immobilization is employed post injury, a period of no more than 10 days is suggested.

2021 Recommendation

A

Clinicians should advise patients with an acute LAS to use external supports, such as braces or taping, and to progressively bear weight on the affected limb. The type of external support and gait assistive device recommended should be based on the severity of the injury, phase of tissue healing, level of protection indicated, extent of pain, and patient preference.

A

In more severe injuries, immobilization ranging from semi-rigid bracing to below-knee casting may be indicated for up to 10 days post-injury.

Therapeutic Exercise

Therapeutic exercise as described in the literature generally consists of a structured program with varying components that can include protected active ROM, stretching exercises, neuromuscular training, postural re-education, and balance training.

2013 Recommendation

A

Clinicians should implement rehabilitation programs that include therapeutic exercises for patients with severe LAS.

Evidence Update

I

In a systematic review and meta-analysis, Vuurberg and colleagues[446] found that exercise therapy programs, initiated early following an acute LAS injury, promoted faster time to recovery with improved objective instability (relative risk: 0.68; 95% CI: 0.49, 0.95) and subjective instability (relative risk: 0.80; 95% CI: 0.64, 1.00). Exercise programs generally consisted of balance re-training, postural re-education, and neuromuscular training with varying and diverse modes and volumes of exercises.

I

Feger and colleagues[130] included 4 trials in a systematic review and meta-analysis. Compared to independent exercise, supervised exercise was associated with less pain and subjective instability at intermediate follow-up (8 weeks after injury), but no differences in self-reported outcomes at longer follow-up periods (3 and 12 months after injury); greater gains in ankle strength and joint position sense but worse postural control at 4-month follow-up; and inconclusive results regarding prevention of recurrent ankle sprains at 12 months after injury. The authors concluded that supervised exercise may promote additional clinical benefit in patients with severe LAS compared to mild LAS, compared to a home exercise program.

I

There is conflicting evidence for improved balance responses after virtual reality training in individuals with LAS. Gumaa and Youseff[160] identified 4 trials through a systematic review that assessed the clinical effectiveness of virtual reality for individuals with LAS (N = 273), which involved a variety of different virtual environments and video games. In two of the included RCTs, significant improvements were noted in measures of dynamic balance and postural sway, and no significant differences were noted in the other two trials.

Evidence Synthesis and Rationale

Therapeutic exercise consisting of neuromuscular training, postural re-education, and balance training appears to improve subjective and objective talocrural stability, as well as reduce time to return to pre-injury activity. Compositions of exercise programs in the literature are diverse, so specific recommendations regarding mode and volume are unfeasible. Clinicians should customize exercise programs to findings from the physical examination and analysis of the task to which the individual will return. There appears to be clinical benefit for exercise to specifically be supervised in individuals with more severe LAS compared to mild LAS. Virtual environments and computerized game applications have mixed effects on measurements of body structures and functions in people with LAS, but may be useful in an adjunctive role for skilled exercise prescription.

2021 Recommendation

A

Clinicians should implement rehabilitation programs with a structured therapeutic exercise program, that can include protected active ROM, stretching exercises, neuromuscular training, postural re-education, and balance training both in clinic and at home, as determined by injury severity, identified impairments, preferences, learning needs, and social barriers in those with a LAS.

D

There is conflicting evidence as to the best way to augment the unsupervised components of a home program in those with a LAS, either by written instructions, exercise-based video games, and app-based instruction, and therefore can be determined by the individual's specific learning needs and access to relevant technology.

Occupational and Sport-related Activity Training

2013 Recommendation

C

Clinicians may implement balance and sport-related activity training to reduce the risk for recurring LAS in athletes.

Evidence Update

I

In the systematic review and evidence-based multidisciplinary guidelines developed by Vuurberg and colleagues,[446] the authors recommended return to sedentary work should occur 2-6 weeks following injury and at 6-8 weeks for more physical occupations and sports activities. These specific guidelines should be considered with the contextual factors of injury severity, access and response to rehabilitation care, and task requirements (**Figure 2**).

Evidence Synthesis and Rationale
While the previous literature focused on injury prevent, the bulk of the current literature focuses on prevention of recurrent injuries. While further research is needed for specific occupations and sports, return to work and sports can be facilitated with functional treatment earlier in the rehabilitation course, use of a brace, and employing a return to work/sports schedule.

2021 Recommendation:
B
Clinicians should implement a return to work schedule and use a brace early in the rehabilitation, occupational or sport-related training, and/or work hardening program to mitigate activity limitation and participation restriction following LAS.

Manual Therapy

2013 Recommendation
B
Clinicians should use manual therapy procedures, such as lymphatic drainage, active and passive soft tissue and joint mobilization, and anterior-to-posterior talar mobilization procedures, within pain-free movement to reduce swelling, improve pain-free ankle and foot mobility, and normalize gait parameters in individuals with an acute LAS.

Evidence Update
I
Vuurberg and colleagues[446] concluded that manual joint mobilization can provide a short-term increase in ankle joint dorsiflexion ROM following acute LAS based on data from 12 trials (N = 427). Ankle joint mobilization has been reported to decrease pain,[283] and when combined with exercise has resulted in better outcomes compared to exercise therapy alone in one well designed RCT.[66]
I
Clar and colleagues[65] reviewed one high, 10 moderate, and two low quality trials concerning manual therapy after LAS. The authors concluded there was moderate evidence in favor of manual therapy (mobilization/manipulation) of the knee and/or full kinetic chain and of the ankle and/or foot, combined with multimodal or exercise therapy for LAS. Data from 12 trials (N = 687) in the review by Doherty and colleagues[99] indicated manual therapy resulted in equivocal outcomes for self-reported function and injury recurrence.

Evidence Synthesis and Rationale
Additional evidence in favor of manual therapy has emerged that highlights the importance of hands-on treatments to reduce pain and increase short-term ankle dorsiflexion ROM in those with a LAS. Hands-on treatments combined with exercise appear to stimulate optimal effects on short-term treatment outcomes. Although the effects of manual therapy after LAS are most prominent in the short-term, use of manual therapy appears to add value for pain control and movement in the acute period compared to exercise alone or no treatment. Selection of manual therapy techniques should be based on the clinical examination and analysis of the movement requirements of the function to which the individual will return. The clinician should favor slow velocity techniques that do not provoke symptoms in the acute phase.

2021 Recommendation
A
Clinicians should use manual therapy procedures, such as lymphatic drainage, active and passive soft tissue and joint mobilization, and anterior-to-posterior talar mobilization procedures within pain-free movement, alongside therapeutic exercise to reduce swelling, improve pain-free ankle and foot mobility and normalize gait parameters in individuals with a LAS.

Acupuncture

2013 Recommendation: None

Evidence Update
I
Doherty and colleagues[99] evaluated three systematic reviews involving acupuncture for the treatment of acute LAS. Two of the reviews reported insufficient data to determine the relative effectiveness of complementary medicine in the treatment of acute LAS for self-reported function or injury recurrence. The third review concluded that acupuncture was likely to have a therapeutic effect on improving acute symptoms, yet it acknowledged that the magnitude of the effect was likely to be overestimated due to the low quality of the included studies. Included in the review by Doherty and colleagues,[99] a systematic review and meta-analysis by Park and colleagues[335] included 17 trials (N = 1820). Trial quality was generally poor with high heterogeneity and risk of bias. Three trials reported adequate methods of randomization and only one a method of allocation concealment. The benefit of acupuncture remained significant when the analysis was limited to studies with the lowest risk of bias. Specifically, acupuncture was more effective than conventional treatment in relieving pain, facilitating return to normal activity, and promoting quality of life.

Evidence Synthesis and Rationale
There is a paucity of high-quality studies that report complete data on the clinical application of acupuncture in individuals with acute LAS. On this basis, the evidence for the efficacy of acupuncture in the treatment of acute LAS for the primary outcomes of injury recurrence/self-reported function is inconclusive. Observations of clinical benefit were based on only a small number of well-designed studies and require additional replication before a recommendation can be made for this intervention.

2021 Recommendation
D
There is conflicting evidence regarding the use of acupuncture to reduce symptoms associated with acute LAS.

Physical Agents: Cryotherapy

2013 Recommendation
A

Clinicians should use repeated intermittent applications of ice to reduce pain, decrease the need for pain medication, and improve weight bearing following an acute ankle sprain.

Evidence Update

I

Doherty and colleagues[99] concluded that ice, compression, and elevation alone are not effective for improving the primary outcomes of self-reported function or recurrence following acute ankle sprain compared with no treatment. Three systematic reviews included by Doherty and colleagues[99] concluded that treatment success was achieved with exercise therapy combined with rest, ice, compression, and elevation.

I

Vuurberg and colleagues[446] reviewed 27 trials (N = 1670) and concluded there was no evidence to support the isolated use of ice to increase function and decrease swelling and pain at rest in individuals with LAS. The combination of ice and exercise results in significant improvements in ankle function in the short term, allowing patients to increase loading during weight bearing compared with standard functional treatment (1 RCT, n = 101). In combination with exercise therapy, ice has a greater effect on reducing swelling compared with heat application in individuals with LAS (1 trial, n = 30).

Evidence Synthesis and Rationale

Since the initial CPG, strong evidence has emerged that rest, ice, compression, and elevation is insufficient to improve self-reported function and injury recurrence in people with an acute LAS. Use of ice in a combined approach to intervention that involves exercise may improve load tolerance during weight bearing, which can improve the ability of individuals to bear weight on the affected limb. Clinicians should consider individual effects of ice on weight bearing and patient preference to decide whether the application of ice may be warranted.

2021 Recommendation

C

Clinicians may use repeated intermittent applications of ice in association with a therapeutic exercise program to address symptoms and functioning following an acute LAS.

Physical Agents: Diathermy

2013 Recommendation

C

Clinicians can utilize pulsating shortwave diathermy for reducing edema and gait deviations associated with acute ankle sprains

Evidence Update

None.

2021 Recommendation

No change.

Physical Agents: Electrotherapy

2013 Recommendation
D
There is moderate evidence both for and against the use of electrotherapy for the management of acute ankle sprains.

Evidence Update
None.

2021 Recommendation
No change.

Physical Agents: Low-Level Laser Therapy

2013 Recommendation
D
There is moderate evidence both for and against the use of low-level laser therapy for the management of acute ankle sprains.

Evidence Update
I
In one RCT (N = 40), de Moraes Prianti and colleagues[83] observed significant reductions in pain and swelling in the first 6 days following acute LAS in response to treatment with light-emitting diodes ($\lambda 627 \pm 10$ nm) with an energy density of 10 J/cm^2 combined with a standardized cryotherapy protocol.

III
In another RCT (N = 19), Calin and colleagues[45] measured significant improvements in ankle pain and function at 10 days following the initiation of a fractionated irradiation photobiomodulation therapy protocol (635 nm, 15 mW) consisting of two sessions (4.5 and 9 J/cm^2) separated by a 30-minute time interval. No significant differences in ankle pain and function were observed at 6-week follow-up.

Evidence Synthesis and Rationale
There remains a paucity of high-quality trials to support the use of low-level laser therapy, including the range of intervention parameters available.

2021 Recommendation
C
Clinicians may use low-level laser therapy to reduce pain in the initial phase of an acute LAS.

Physical Agents: Ultrasound

2013 Recommendation
A
Clinicians should not use ultrasound for the management of acute ankle sprains.

Evidence Update
I
Doherty and colleagues[99] concluded from their systematic review and meta-analysis that none of the included studies demonstrated any beneficial effect of ultrasound therapy in the treatment of acute LAS.

Evidence Synthesis and Rationale
There are very few trials evaluating the effectiveness of ultrasound therapy for acute LAS, and even fewer have considered the range of parameters available.

2021 Recommendation:
A
Clinicians should not use ultrasound for the management of acute ankle sprains.

Non-steroidal Anti-inflammatory Medication

2013 Recommendation

None

Evidence Update
I
Vuurberg and colleagues[446] concluded that the use of oral or topical non-steroidal anti-inflammatory drugs (NSAIDs) results in less pain < 14 days after LAS without significantly increasing the risk of adverse events compared with placebo (26 trials, N = 4225). Doherty and colleagues[99] established equivocal effect of pharmacological agents, typically NSAIDs, on function and recurrent injury in individuals with LAS based on data from 13 trials (N = 2423).
I
Selective NSAIDs (celecoxib 200 mg two times daily) are non-inferior to non-selective NSAIDs (eg, ibuprofen, naproxen. or diclofenac) to reduce pain after an acute LAS (4 trials, N = 1490).[446] Diclofenac showed superior results at days 1 and 2 compared with piroxicam (2 trials, N = 201) and ibuprofen (1 trial, N = 60) for reducing pain during motion in patients with mild to severe acute ankle sprains and demonstrated equal adverse event rates.[446] Despite dose differences, the clinical benefit of acetaminophen (paracetamol) is equivalent to NSAIDs for pain, swelling, and ROM after LAS.[446]

Evidence Synthesis and Rationale
Based on available evidence, NSAIDs may be expected to reduce pain in individuals with acute LAS, but not expected to improve ankle ROM and reduce the likelihood of recurrent injury. Non-steroidal anti-inflammatory medications may confer benefit over risk within the first 14 days following injury. The observed short-term pain reduction may be important for early weight

bearing. Selective NSAIDs, non-selective NSAIDs, and acetaminophen/paracetamol may be considered based on individual needs, given their similar clinical effects.

2021 Recommendation:
C
Clinicians may prescribe non-steroidal anti-inflammatory medications (as physical therapy practice acts allow) to reduce pain and swelling in those with an acute LAS.

INTERVENTIONS FOR CHRONIC ANKLE INSTABILITY

External Support

2013 Recommendation: None

Evidence
I
In a systematic review and network meta-analysis (21 trials; N = 469), Tsikopoulos and colleagues[432] identified moderate-level evidence that insoles plus bracing, bracing, insoles, taping, and placebo provide superior clinical benefit for postural stability and balance performance compared to a wait-and-see approach. Yet, there were no significant relative differences in postural stability and balance performance in individuals with CAI who received a placebo treatment compared to insoles plus bracing, bracing, insoles, and taping.

Evidence Synthesis and Rationale
Although various forms of external support are more effective than a wait-and-see approach, placebo supports appear similar in effect to active supports. Thus, the use of external support is insufficient to promote sustained improvements in balance and postural stability in people with CAI. The clinician may consider whether the use of external supports, such as taping and bracing, would assist the individual with CAI to achieve short-term goals of rehabilitation through improved ability to engage in interventions that can promote long-term clinical benefit.

2021 Recommendation
B
Clinicians should not use external support, including braces or taping, as a standalone intervention to improve balance and postural stability in individuals with CAI.

Therapeutic Exercise and Activities

2013 Recommendation
C
Clinicians may include therapeutic exercises and activities, such as weight bearing functional exercises and single limb balance activities using unstable surfaces, to improve mobility, strength, coordination, and postural control in the post-acute period of rehabilitation for ankle sprains.

Evidence Update

I

Doherty and colleagues[99] assessed 22 systematic reviews that evaluated exercise therapy for treatment of CAI or recurrent ankle sprain. The authors concluded that exercise therapy is generally considered effective in the treatment of CAI for the outcomes of self-reported function and reinjury incidence.[99]

I

In the meta-analysis of 8 RCTs conducted by Powden and colleagues,[350] rehabilitation protocols that were balance training focused effectively improved health-related quality of life, as measured by patient-oriented outcomes, in individuals with CAI.

Evidence Synthesis and Rationale

The general consensus across the literature is that therapeutic exercises demonstrate a strong positive clinical benefit CAI. Therapeutic exercises that have been studied include balance re-training, postural re-education, neuromuscular training, and strengthening of ankle and lower quarter kinetic chain muscles using isolated exercises and movement patterns. Exercise protocols across studies are substantially heterogenous and comparisons across studies are infeasible, so specific recommendations currently are not possible for the best mode and volume of exercise to promote clinical benefit.

2021 Recommendation

A

Clinicians should prescribe proprioceptive and neuromuscular therapeutic exercise to improve dynamic postural stability and patient perceived stability during function in individuals CAI.

Manual Therapy

2013 Recommendation

A

Clinicians should include manual therapy procedures, such as graded joint mobilizations, manipulations, and non-weight bearing and weight bearing mobilization with movement, to improve ankle dorsiflexion, proprioception, and weight bearing tolerance in patients recovering from chronic LAS symptoms.

Evidence Update

I

In the systematic review and multidisciplinary guideline conducted by Vuurberg and colleagues,[446] a combination of manual therapy interventions with other treatment modalities, such as exercise therapy, enhanced the effectiveness of manual joint mobilization and was recommended in the treatment of CAI.

I

Five systematic reviews that investigated manual therapy for the treatment of CAI were included in the study conducted by Doherty and colleagues.[99] Each of these reviews identified that manual mobilization likely has short-term positive effect on ankle dorsiflexion ROM.

I

In the meta-analysis of studies that encompassed manual therapy focused treatment programs, Powden and collegues[350] found that interventions such as anterior-to-posterior Maitland grade III joint mobilizations, Mulligan talocrural mobilizations with movement, tibiofibular manipulations, and plantar massage had large, significant pre-to-post treatment effects in improving patient-oriented outcomes in individuals with CAI.

I

In the systematic review and meta-analysis conducted by Weerasekara and colleagues,[459] joint mobilization demonstrated clinical benefit in individuals with CAI through immediate improvements in dynamic balance and weight bearing dorsiflexion ROM in the short-term. Joint mobilization did not have an immediate effect on static balance or pain intensity, nor did it affect weight bearing ankle dorsiflexion ROM in the long term.

I

Based on a systematic review and meta-analysis including 4 trials of people with CAI (N = 208), Shi and colleagues[385] found that six sessions of manual therapy promoted significant improvements in ankle strength, balance, and functional tests, while a single session of manual therapy did not promote significant improvements in these measurements.

I

Stathopoulous and colleagues[407] identified 2 trials (N = 93) involving individuals with CAI who received Mulligan-based mobilization with movement. The trials were characterized by high statistical heterogeneity and meta-analysis was not undertaken. Qualitative synthesis suggested significant improvement of ankle dorsiflexion ROM after intervention in the included trials. Weerasakara and colleagues[458] identified evidence from 4 trials (N = 201) suggesting significant improvement of weight bearing ankle dorsiflexion ROM after mobilization with movement compared to sham and no intervention in people with CAI. However, there was insufficient evidence to draw conclusions about long term effects (6 months or greater) and other outcome measures.

Evidence Synthesis and Rationale

Manual therapy procedures appear to have added value in the clinical management of people with CAI to increase short-term ankle dorsiflexion ROM, ankle strength, balance, and functional test performance. Although these effects are not observed in the long term, observed short-term effects of intervention may be important to help people with CAI to meet short-term goals for rehabilitation.

2021 Recommendation

A

Clinicians should use manual therapy procedures, such as graded joint mobilizations, manipulations, and non-weight bearing and weight bearing mobilization with movement, to improve weight bearing ankle dorsiflexion and dynamic balance in the short-term for individuals with CAI.

Dry Needling

2013 Recommendation

No recommendations provided

Evidence Update

I

The results of a single-blinded RCT (n = 20) assessing trigger point dry needling of the fibularis muscles in individuals with a history of ankle sprain suggest that the intervention may provide some short-term improvements in strength and unilateral balance.[373]

II
In a RCT assessing the inclusion of fibularis muscle trigger point dry needling as part of a proprioceptive and strengthening exercise program for individuals with CAI, the treatment group demonstrated better outcomes in pain and function at 1-month following treatment.[377]

III
Data from a small cohort study by Rossi and colleagues (n = 20),[373] included in the systematic review and meta-analysis by Mansfield et al,[288] indicates that the addition of Lumbar multifidus dry needling in individuals with CAI resulted in no significant differences in ankle plantar flexor-evertor strength, balance, and hop test performance compared to people with CAI who received fibularis muscles trigger point dry needling alone.

Evidence Synthesis and Rationale
Few studies currently exist to support the use of dry needling in people with CAI. Results of the included small RCTs and cohort studies were generally favorable for pain, function, strength, and balance.

2021 Recommendation
C
Clinicians may use dry needling of the fibularis muscle group in conjunction with a proprioceptive training program to reduce pain and improve function in individuals with CAI.

Combined Treatments

Combined treatments would include intervention plans that use at least two or more types of interventions.

2013 Recommendation
None

Evidence Update
I
In the systematic review and meta-analysis conducted by Powden and colleagues,[350] synthesis of seven RCTs that employed two or more targeted interventions, to include stretching, strength training, balance training, vestibular-ocular reflex training, soft tissue mobilization, dry needling, and strain-counterstrain techniques, were found to lead to large, statistically significant improvements in patient-reported function in individuals with CAI (summary effect size: 1.14). Combined intervention resulted in slightly improved functional outcomes but not statistically significant when compared to balance training alone.
I

A systematic review and network meta-analysis by Tsikopolous and colleagues[431] identified that a 4-week supervised rehabilitation program consisting of balance training, strengthening, functional tasks, and ROM exercises, resulted in statistically and clinically significant benefit compared to control interventions in people with CAI.

Evidence Synthesis and Rationale
Research evidence supports the clinical benefit of intervention plans that combine at least two or more treatments that are selected based on patient-centered factors, to supplement a balance training program. While these approaches appear statistically similar to balance training alone the adverse events associated with combined approaches were infrequent, transient, and mild. This literature may indicate the potential presence of treatment interactions and caution against one-size-fits-all approaches to clinical management.

2021 Recommendation
B
Clinicians may use multiple interventions to supplement balance training over an episode of care for individuals with CAI, to include a combination of exercise and manual therapy procedures as guided by patient's values and goals, clinician's judgement, and evidence-based clinical recommendations.

Interventions to Address Psychological Factors During the Course of Rehabilitation

2013 Recommendation: None

Evidence Update
I
In the systematic review of studies assessing the effects of the therapeutic alliance on pain conducted by Taccolini Manzoni and colleagues,[413] a lack of evidence pertaining to the therapeutic alliance in rehabilitation of musculoskeletal conditions was found. The authors of this review, which encompassed studies of mixed methodology, concluded that there is lack of evidence to support the effect of the therapeutic alliance on pain relief.
I
In a systematic review studying the effects of the therapeutic alliance in the treatment of patients with persistent pain syndromes, three studies suggested that a strong therapeutic alliance between the patient and treating physical therapist may improve outcomes in individuals with chronic musculoskeletal conditions.[134, 225] To facilitate a strong therapeutic alliance, physical therapists must understand factors that positively and negatively influence the relationship.[134, 225] These may include trust, communication, shared goal-setting, identification and mitigation of barriers to care seeking and compliance, individualized and flexible care, respect of persons, and other factors that influence the patient’s knowledge, skills, beliefs, and attitudes toward treatment.[134, 225]

II
In a retrospective case-control study, athletes with a history of recurrent ankle sprains were found to have the highest levels of fear-avoidance compared to patients with a first-time ankle

sprain or healthy controls.[191] To improve the quality of patient care, Houston and colleagues[191] recommended that clinicians use global, regional, and psychological measures to better evaluate patient status and treatment response, while considering functional deficits and psychological barriers during the rehabilitation course.

III
McCann and colleagues[296] detailed how self-efficacy and resiliency can influence outcomes in CAI and proposed a theoretical model of how both intrinsic and extrinsic psychological factors can influence functional outcomes following LAS. In the conceptual model, perceptions of LAS as a benign injury may limit care-seeking and negatively influences outcomes.[296] A consequence of non-resolving impairment and activity limitation following injury may contribute to lower self-efficacy and resiliency, further contributing to functional decline.[296] The authors advocate that patients struggling to adhere to rehabilitation may benefit from a repeated evaluation of self-efficacy, or an assessment of other personal and environmental factors.[296]

III
Patients that go on to develop chronic ankle-foot disability have been found to have higher levels of neuroticism,[386] anxiety,[386] depression,[386] and kinesiophobia.[260] Fraser and Hertel[13] outlined the importance for physical therapists to evaluate and employ mitigating strategies to address negative psycho-emotional factors during rehabilitation of individuals with LAS and CAI.

Evidence Synthesis and Rationale
Clinicians may take purposeful steps to build an effective therapeutic relationship with patients and use psychologically-informed elements in the plan of care. These include mutual trust, communication, shared goal-setting, identification and mitigation of barriers to care seeking and compliance, individualized and flexible care, respect of persons, and other factors that influence the patient's knowledge, skills, beliefs, and attitudes toward treatment. Global, regional, and psychological measures are recommended to comprehensively evaluate the patient status and treatment response. Targeted interventions, such as education, encouragement, goal setting, and fear mitigation, may help to improve these intrinsic factors and facilitate return to function in this patient population.

2021 Recommendation
E
Clinicians may use psychologically-informed techniques, such as motivational interviewing, to maximize patients' self-efficacy, address uncomplicated psychological correlates, and mediators of injury adjustment and recovery to maximize the effects of treatment in a positive manner for individuals with LAS and CAI.

Component 2: Classify condition

Patient Examination: Acute and Post Lateral Ankle Sprain (LAS)

- Sudden onset with an ankle inversion related injury
- Negative Ottawa Ankle Rules
- Positive reverse anterolateral drawer ligamentous test
- Positive anterolateral talar palpation test
- Positive anterior drawer test

Patient Examination: Chronic Ankle Instability (CAI)

- History of at least one significant ankle sprain
- Reports of 'giving way'
- Episode of a subsequent sprain and/or perceptions of ankle instability
- Decrease performance on functional performance tests
- Discriminative instrument scores: Identification of Functional Ankle Instability (IdFAI) ≥11; Cumberland Ankle Instability Tool (CAIT) ≤25; ≥ 4 answers of "Yes" on Ankle Instability Instrument (AII)

Component 3: Irritability

Acute LAS: identify level of tissue irritability

Component 4: Outcome measures

- LAS and CAI
- Patient-Reported Outcomes Measurement Information System Physical Function (PROMIS PF) computer adaptive test (CAT), Foot and aNkle Ability Measure (FAAM), and/or Lower Extrmeity Function Scale (LEFS) as a measure of self-reported activity limitation and participation restriction (A)
- TSK Tampa Scale of Kinesiophobia (TSK)--11 and (Fear Avoidance Belifs Quaetionnaire (FABQ) as a measure of fear of movement and reinjury, and fear-avoidance beliefs
- Pain visual anlalog scale (VAS) (F)

- Dorsiflexion ROM with the weight baering lunge test (WBLT) (A)
- Total ankle range of motion (A)
- Talar translation (A)
-
- Static balance with the single-leg balance test on a firm surface with eyes closed (A)
- Dynamic balance with the Star xcursion Balance Test (SEBT) anterior, anteromedial, posteromedial, and posterolateral reach directions (A)
- Clinical performance assessment with measures of single-limb hopping under timed conditions (A)

- Acute LAS
- Ankle swelling (A)

- CAI
- Hip strength (C)
-

Component 5: Intervention Strategies

LAS

- Progressively bear weight-bearing with bracing external supports (A)
- Structured rehabilitation programs that include therapeutic exercises, both in clinic and at home (A)
- Manual therapy procedures, such as lymphatic drainage, active and passive soft tissue and joint mobilization, and anterior-to-posterior talar mobilization procedures, within pain-free movement, to reduce swelling, improve pain-free ankle and foot mobility and normalize gait (A)
- Occupational and sport-related training and work hardening to mitigate activity limitation and participation restriction (B)
- Low-level laser therapy to reduce pain in those with acute symptms (C)
- Pulsating shortwave diathermy for reducing edema and gait deviations (C)
- Non-steroidal anti-inflammatory medications to reduce pain and swelling in those with acute symptms (C)
- Psychologically-informed techniques, such as motivational interviewing, to maximize patients' self-efficacy, address uncomplicated psychological correlates, and mediators of injury adjustment (E)

CAI

- Proprioceptive and neuromuscular therapeutic exercise to improve dynamic postural stability and patient perceived stability (A)
- Manual therapy procedures, such as graded joint mobilizations, manipulations, and non–weight-bearing and weight-bearing mobilization with movement, to improve ankle dorsiflexion, proprioception, and weight-bearing tolerance (A)
- Trigger point dry needling of the fibularis (peroneal) muscle group in conjunction with a proprioceptive training program to reduce pain and improve function (C)
- Psychologically-informed techniques, such as motivational interviewing, to maximize patients' self-efficacy, address uncomplicated psychological correlates, and mediators of injury adjustment (E)

Figure 1. Evidence-based interventions by level of prevention. Primary prevention refers to interventions to reduce the risk of a first-time lateral ankle sprain (LAS) in people exposed to risk factors, secondary prevention is to reduce the risk for recurrent LAS after a first-time LAS, and tertiary prevention is to reduce the effects and progression of a LAS.

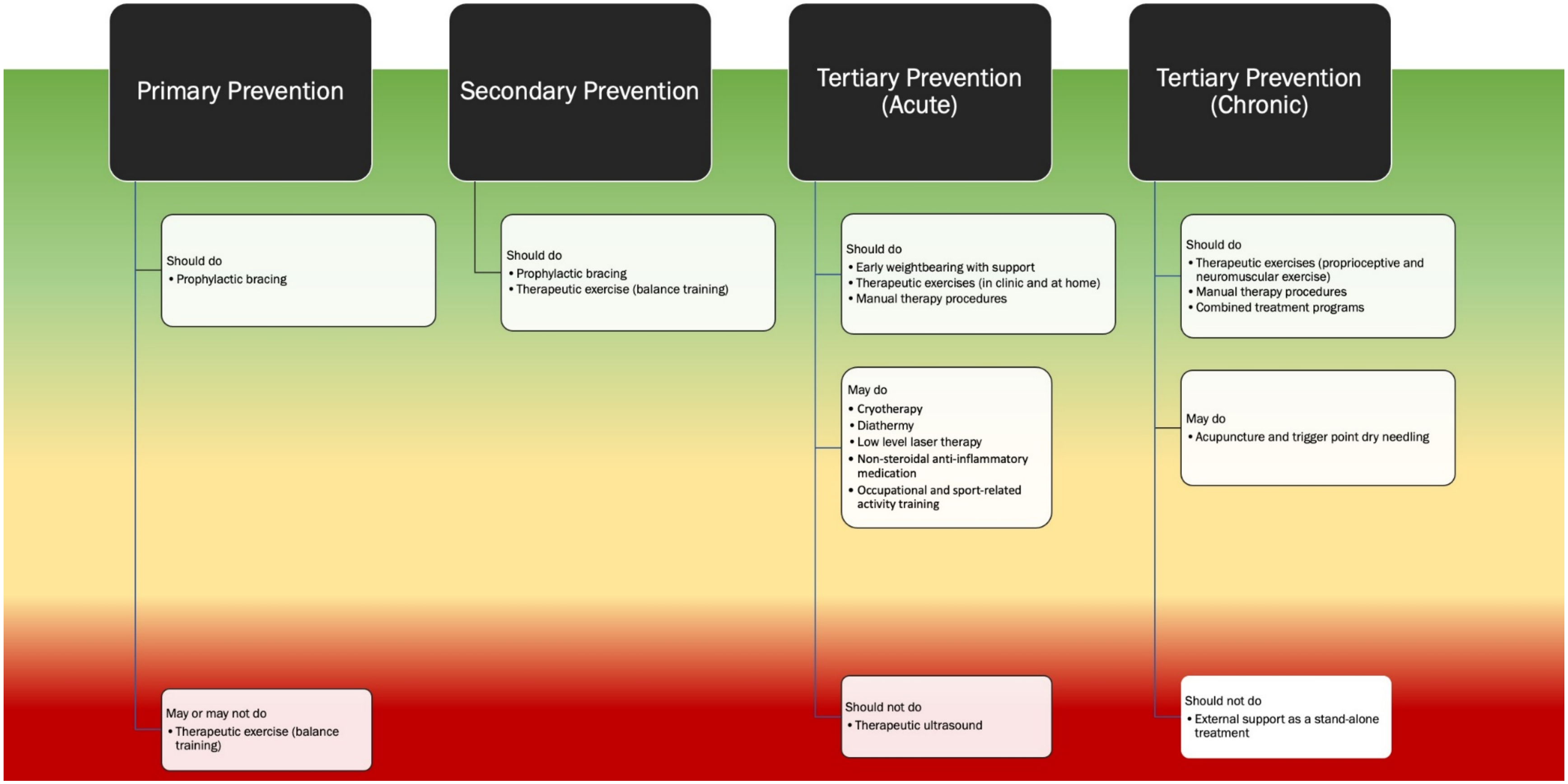
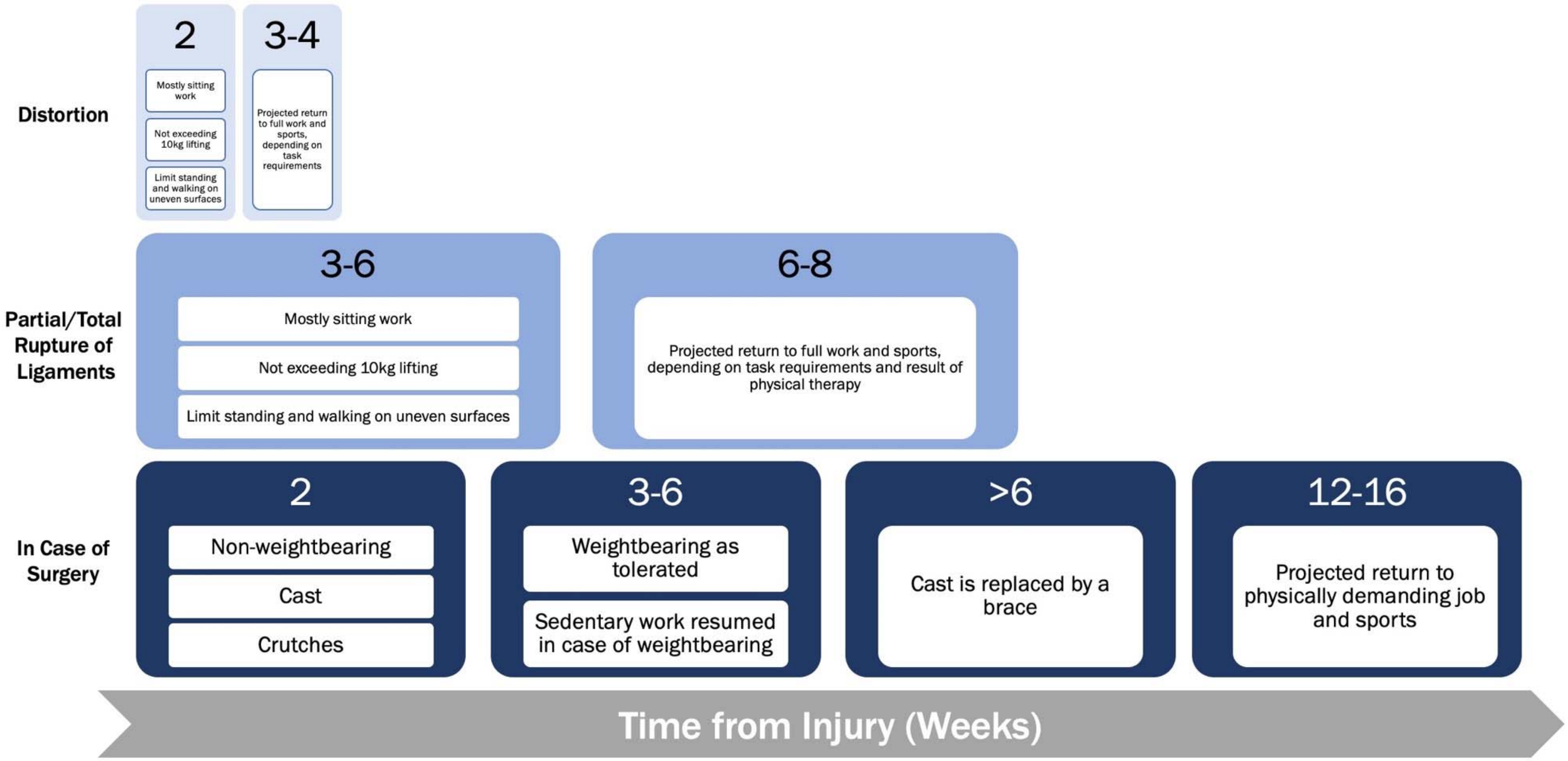


Figure 2. Evidence-based guidelines for return to physical occupations and sports activities. This schedule should be considered in context with injury severity, rehabilitation care, and task requirements. (Adapted from Vuurberg G, Hoorntje A, Wink LM, *et al*. Diagnosis, treatment and prevention of ankle sprains: update of an evidence-based clinical guideline. Br J Sports Med. 2018; 52(15):956-956. doi:10.1136/bjsports-2017-098106.)



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