早稲田大学審査学位論文

博士（スポーツ科学）

Patient-Rated Assessment of Acute Ankle Sprains among Competitive College Athletes

大学競技選手における急性足関節捻挫の患者立脚型評価

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Abbreviations

ADL	Activity of Daily Living
CAI	Chornic Ankle Instability
CI	Confidence Interval
DF	Dorsiflexion
DOE	Disease-Oriented Evidence
EBP	Evidence Based Practice
EV	Eversion
FAAM	Foot and Ankle Ability Measure
FPT	Functional Performance Tests
GRF	Global Rating of Function
HR-QOL	Health Related Quolity of Life
ICF	International Classification of Functioning
MDC	Minimum Detectable Change
POEM	Patient-Oriented Evidence that Matters
RTP	Return-To-Play
SEM	Standard Error of Measurement

SLHT	Single Leg Hop Test
VAS	Visual Analogue Scale

Chapter 1:

Introduction/Background

SECTION 1-1: ABSTRACT

In the previous decades, the evidence based practice (EBP) has been emphasized in the field of sports medicine as well as athletic training. Disease Oriented Evidence (DOE) focuses on the disease or injury and may not necessarily be related to the improvement of the patient's function. Therefore, it may not be as meaningful to the patient. On the other hand, Patient-Oriented Evidence that Matters (POEM) are related to morbidity, mortality, and symptom improvement. Therefore, it is directly important and meaningful to Heath Related Quality of Life (HR-QOL) of the patient.

The World Health Organization's International Classification of Functioning (ICF) provides a theoretical framework that looks at functioning and disability in a dynamic or complex interaction between various health conditions and contextual factors. In the ICF, functioning is divided in 3 levels; functioning at the body parts, the whole person, and the whole person in their complete environment. Correspondingly, the disability is described as impairment, activity limitation, and participation restriction.

Similar impairments may result in different degrees of activity limitations and participation restrictions, or disability, depending on environmental and personal factors. Therefore, it is imperative for clinicians to look at impacts of a health condition not only in terms of impairments, but also activity limitations and participation restrictions.

Along with the EBP, patient-centered medicine is the guiding principle in the modern medicine. Accordingly, the emphasis in outcome measure is shifting from clinician-based to patient-based outcome measure in recent years. Despite its importance, the lack of patient-based outcome measures in the fields of Sports Medicine and Athletic Training has been reported in the literature.

A self-reported outcome instrument allows clinicians to include patient's values into the medical treatment and to evaluate the effectiveness of interventions from the patient's perspective. The Foot and Ankle Ability Measure (FAAM) is a region specific self-reported outcome instrument and developed by the American Physical Therapy Association Foot and Ankle Special Interest Group. The use of the FAAM is recommended to be included in the RTP decision making process and outcome measure of acute ankle sprains by the National Athletic Trainers' Association and American Physical Therapy Association.

Ankle sprains are frequently reported to be one of the most common types of athletic injuries in the literature. Often times, the severity of the ankle sprain is misjudged, and inappropriate management results in recurrent ankle sprains and chronic conditions.

Functional performance tests (FPTs) have been used to assess functional recovery and patient confidence in the limb, help RTP decisions, and identify those who are at risk of re-injury. FPTs of single-limb hop maneuvers have been found to be effective in achieving these intended purposes by challenging the lateral aspect of the ankle. However, previous studies have been mostly conducted on general adult populations with chronic conditions, and hence the applicability of FPTs to athletic populations after traumatic lateral ankle sprains is unknown.

Largely based upon impairment measures, traumatic lateral ankle sprains are typically classified as mild, moderate, or severe despite that there is relatively limited evidence is available to support such a classification system. Furthermore, prediction of RTP after traumatic lateral ankle sprains has been reported to be more accurate and valid when it is based upon patient-rated measures such as activity limitations and weight bearing status, rather than clinician-rated measures.

SECTION 1-2: Patient-Rated Outcome Measure

Evidence Based Practice

In the previous decades, the evidence based practice (EBP) has been emphasized in the fields of sports medicine and athletic training.[128,144,148,159] The EBP is the fundamental principle that the quality of patient care is dependent on the clinician's ability to make sound clinical decisions based upon the best evidence currently available.[132,139]

There are two kinds of evidence that guide the EBP; Disease Oriented Evidence (DOE) and Patient-Oriented Evidence that Matters (POEM).[41,42,78] The DOEs focus on the disease or injury itself, and gain the information about the cause, pathomechanics, prevalence, and etiology. Therefore, DOEs inherently may not be as meaningful to the patient. Also, DOEs are not always applicable for use in practice as they may or may not be related to the improvement of the patient's function.[42,78] On the other hand, POEMs focus on the information that is directly important and meaningful to Heath Related Quality of Life (HR-QOL) of the patient.[41,42,78] The examples of the POEMs include information such as morbidity, mortality, symptom improvement, and cost reduction.[41,42,78] POEMs are gained only from the studies that include the outcome measure that is important to the patient. Therefore, it is crucial to the EBP in that it incorporate the patient's perspective into the assessment of the intervention given to the patient.

International Classification of Functioning

The World Health Organization's (WHO's) International Classification of Functioning (ICF), modified from Nagi's disablement model, provides a theoretical framework that describes how globally a health condition impacts the patent's HR-QOL.[82,81,84,152,182] The ICF provides a unifying framework of disablement concepts and terminology which allows efficient communications among clinicians and scientists. The ICF looks at functioning and disability in a dynamic or complex interaction between various health conditions and contextual factors.[84,82,152,182] (**FIGURE1-1**) Therefore, the ICF synthesizes biological, personal, and social perspectives of functioning and disability, and provides a biopsychosocial comprehensible framework.[182] Definitions of key concepts in the ICF are presented in **TABLE 1-1**.

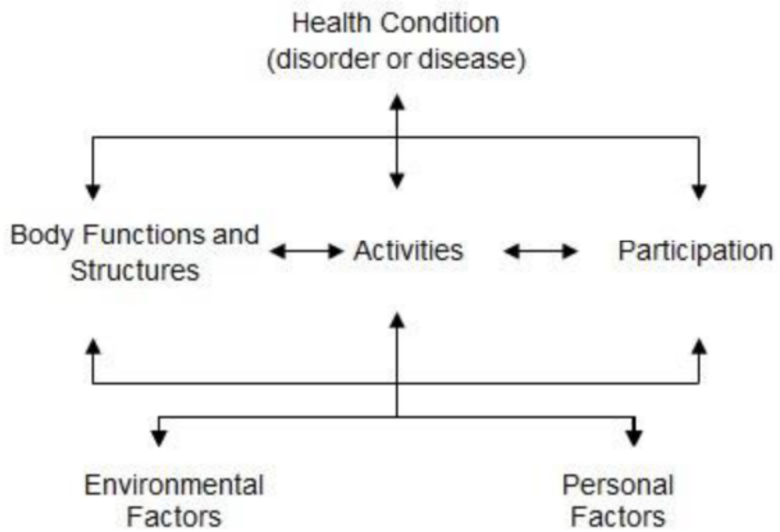

FIGURE 1-1 Interactions between the components of ICF

(from World Health Organization, Fig 1[182])

TABLE 1-1 Definitions of key concepts[182]

Health condition – an umbrella term for disease (acute or chronic), disorder, injury or trauma.
Functioning – an umbrella term encompassing all body functions, activities and participation
Disability – an umbrella term for impairments, activity limitations or participation restrictions
Body function – the physiological functions of body systems
Body structure – anatomical parts of the body such as organs, limbs and their components
Impairment – problems in body function or structure such as a significant deviation or loss
Activity – the execution of a task or action by an individual
Participation – involvement in a life situation
Activity limitations – difficulties an individual may have in executing activities
Participation restrictions – problems an individual may experience in involvement in life situations

In the ICF, functioning is divided in 3 levels; functioning at the body parts, the whole person, and the whole person in their complete environment.[84,182] Correspondingly, the ICF describes the disability in terms of 3 interrelated factors; impairment, activity limitation, and participation restriction.[81,84,163,182] Impairments are loss of or abnormalities of an anatomical, physiological nature and problems in body functions and structures due to the active pathologic condition.[81,84,182] Activity limitations are difficulties experienced by a person in executing relatively simple activities and tasks as a person, regardless of the context in which simple tasks and activities are being performed, and vary in degrees according to the levels of the functions expected to each person.[81,84,182] Participation restrictions are problems a patient may experience performing socially defined roles in a life situation.[84,81,163,182] Therefore, although activity and participation are interrelated and difficult to differentiate, a single level of activity limitations may result in different participation restrictions to different individuals.[84]

ICF-based patient evaluations allow clinicians to look at impacts of a health condition not only in terms of body functions and structures, or impairments, but also activity limitations and participation restrictions, providing a comprehensive framework for the assessment of the effect of a health condition on a patient's overall HR-QOL.[48,84,144] This is important as two patients with similar impairments may have different degrees of activity limitations and participation restrictions, or disability, depending on environmental and personal factors.[84,182] Furthermore, the reduction of impairments does not necessarily correlate with the reduction of disability.[83] Additionally, impairments, besides pain, are not associated with long-term goals of patients.[159] Therefore, goals of treatment and rehabilitation should be directed at reducing disability and improving HR-QOL by relieving symptoms and restoring functions and abilities of patients.[11]

Patient-Rated Outcome Measure

Outcome measures are essential to EBP in that they offer a basis for clinical decisions.[16,83,85,115,159] Clinical outcome measures can be clinician-based and patient-based depending on the way in which outcomes are collected. Clinician-based outcome is gained from clinician's perspective; on the other hand, patient-based outcome measure is acquired through the patient's view.[42,50,115,159]

Along with the EBP, patient-centered medicine is the guiding principle in the modern medicine.[7,79,95,140] Patient-centered care is defined by the Institute of Medicine as "identify, respect, and care about patients' differences, values, preferences and expressed needs…"[79] Accordingly, the emphasis in outcome measure is shifting from clinician-based to patient-based outcome measures in recent years.[16,42,78,140] Furthermore, patient-based outcome measures include patient's view of his or her HR-QOL, and hence helps provide POEMs.[16,83,159]

Most clinician-based outcome measures in the Sports Medicine and Athletic Training fields relate to impairment measures such as muscle strength, range of motion, pain, swelling, ligament integrity and so forth.[50] They are measured by clinician. On the other hand, patient-based outcome measures are granted by the patient through a questionnaire or self-reported outcome instrument, and relate to symptoms, activity limitations, and participation restrictions that the he or she is experiencing in ADL and sports activities from a health condition.[16,83,159]

Previous studies suggest that clinician-rated measures and patient-rated measures capture different aspects of HR-QOL.[2,42,137] Therefore, it is imperative for clinicians to incorporate both clinician- and patient-rated measures to effectively assess the whole impact of a health condition on patients.

Despite its importance, the lack of patient-based outcome measures in the fields of Sports Medicine and Athletic Training has been reported in the literature.[50,114,115,127,128,144,159] Likewise, the predominant use of the impairment measures in the treatment and rehabilitation process as well as Return-to-Play (RTP) decisions were criticized in sport rehabilitation fields.[19,50,115]

Self-Reported Outcome Instrument and the Foot Ankle Ability Measure

A self-reported outcome instrument allows clinicians to include patient's values into the medical treatment and to evaluate the effectiveness of interventions from the patient's perspective. There are various types of self-reported outcome instruments, which can be generic or specific.[53,63] The specificity of self-reported outcome instruments includes disease, body region, dimension, summary item, and individualized measures.[53] Clinicians need to choose a self-reported outcome instrument based upon the intended use. Before a self-reported outcome instrument is used for the above mentioned purposes, evidence must be provided. Such evidence includes, but not limited to: face validity, content validity, construct validity, internal consistency, and reliability.[53,101,133,169] Furthermore, a self-reported outcome instrument needs to be translated and cross-culturally adapted if it is to be used in another language or culture.[6]

There have been more than a dozen types of self-reported outcome instruments developed for the foot and ankle region.[46,59,105] The Foot and Ankle Ability Measure (FAAM) was developed by the American Physical Therapy Association Foot and Ankle Special Interest group, with involvement from actual patients.[106] This development process gives the FAAM a higher content validity as well as construct validity.[105] The original version of the FAAM is one of the four instruments that provided evidence of content validity, construct validity, reliability, and responsiveness.[46,105] The 29-item questionnaire is divided into two subscales; a 21-item ADL and an 8-item Sports subscales. Each item is scored on a 5-point Likert scale. The FAAM measures activity limitations and participation restrictions that patients are experiencing from foot and ankle disorders.

The use of the FAAM is recommended to be included in the RTP decision making process and outcome measure of acute ankle sprains by the National Athletic Trainers' Association and American Physical Therapy

Association.[89,103]

Patient-Rated Outcome Measure of Physically Active Individuals and Athletes

Patient-rated outcome measures need to be specific to the nature of the patient as it has been reported that HR-QOL of athletes may be impacted by an injury differently than that of general population.[50,109,159,163] Therefore, the evidence from the patient-rated outcome measures that is specific to athletes is necessary to effectively guide the treatment and rehabilitation process to the successful RTP. [159]

SECTION 1-3: Ankle Sprains

Epidemiology

Ankle sprains are frequently reported to be one of the most common types of athletic injuries among the literatures.[74,88,110] A recent meta-analysis revealed that indoor, court sports carry the highest risk of ankle sprain, with lateral ankle sprain being the most frequently observed ankle injury.[38] The greater risk of suffering an ankle sprain is a previous injury[47,157] and as high as

73 % of re-injury rate has been reported.[184] Furthermore, POEMs concerning common clinical conditions, such as ankle sprains, are considered to have the greatest value.[41]

Chronic Ankle Instability

Often times, the severity of the ankle sprain is misjudged and inappropriate management such as premature RTP results in recurrent ankle sprain and chronic ankle instability, or CAI.[33,58,67,77,113,160] Middelkoop et al reported self-reported pain at rest and re-sprains for the first 3 months following the initial ankle sprain have been associated chronic symptoms.[160] Such chronic symptoms can extend more than decades while associated symptoms can progressively deteriorate.[98,166] As a result, repetitive ankle sprains and chronic symptoms have been reported to be associated with higher risk of osteoarthritis.[62]

Traditionally, CAI has been reported to be composed of two major subgroups; mechanical instability and functional instability.[67] (**FIGURE 1-2**) Although the mechanical instability has been generally defined and accepted as the pathologic ligamentous laxity, the functional instability has been vaguely characterized.[68] A recent study suggested that "*sensations of instability are the most commonly reported and perhaps the most serious symptom of CAI,*" and yet it has not been sufficiently addressed in the literatures despite the staggering prevalence of this symptoms with the CAI.[175] The term functional instability has been proposed to be replaced by "perceived instability" as the "functional instability" has been used to express widely different meanings.[68] Similarly, feeling of ankle joint instability is separately defined as *"situation whereby during ADL and sporting activities the subject feels that the ankle joint is unstable and is usually associated with the fear of sustaining an acute ligament sprain"* whereas "giving way" of the ankle joint is defined as *"uncontrolled and unpredictable episodes of excessive inversion of the rear foot…, which do not result in an acute lateral ankle sprain."*[28]

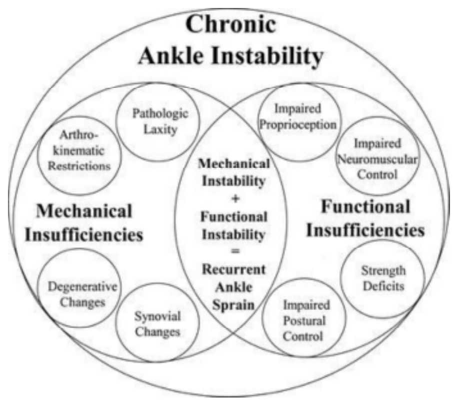

FIGURE 1-2. Multifactorial Nature of CAI (from Hertel et al. Fig5.[67])

Functional Performance Tests

Recent systemic review and meta-analysis showed that postural control is impaired as a result of acute ankle sprains, contributing to increased risk of re-injury and development of CAI.[111,173] Adverse effects of this impairment may influence contralateral uninjured limbs due to centrally mediated motor control pattern alterations, and therefore contralateral uninjured limbs may not be appropriate as a reference of normal postural control.[174,173] Furthermore, it is suggested that static single-limb stance tasks may not be "challenging enough" to detect these postural control deficits, and hence more challenging dynamic tasks may be more appropriate as an outcome measure.[112,111].

Although predominantly investigated on the patients with the anterior cruciate ligament deficient and reconstructed knee, functional performance tests (FPTs) challenge various aspects of the sensory motor system to assess functional recovery, and confidence in the limb, help RTP decisions, and identify those who are at risk of re-injury.[35,61,99,100,117,121,123,136,141,153,154] Often, the limb symmetry index of <90% or more than 10% difference between the injured and noninjured limbs is considered as unsatisfactory following ACL injury.[153] A positive correlation between the single leg hop limb symmetry index and self-reported functions, and prognostic ability of single leg hop limb symmetry index for long term outcome have been reported.[61,99]

Numerous studies have reported FPTs are able to effectively identify individuals with ankle sprains and CAI.[13,14,30,37,43,45,44,58,86,119,118,142,176] although a few studies have demonstrated otherwise.[31,120,183] Furthermore, a few studies found its effectiveness when a feeling of instability or "giving way" during FPTs was included in the analysis.[13,14,37] Similarly, Eechaute et al reported a FPT can reliably detect individuals with CAI based upon perceived difficulty with the FPT as rated the visual analogue scale (VAS).[43,45,44]

Typical mechanisms of injury of lateral ankle sprains involve excessive supination of the rearfoot, coupled with external rotation of the lower leg immediately after initial contact to the ground during athletic activities.[67] FPTs achieve the intended purposes by replicating the stress that is placed on the body during sports activities. As expected, those FPTs which found to be effective typically involve single-limb hop maneuvers, challenging the lateral aspect of the ankle.[13,14,30,37,43,45,44,58,86,119,118,142,176,180] Summary of the findings from those studies is presented in the **TABLE 1-2**.

As most of the studies, except three studies, were conducted on general adult populations or recreational athletes with chronic conditions, their applicability to competitive athletes are unknown. Also, prior to their participations in these studies, participants did not receive formal rehabilitation[30,119,142,176,180] or such information was not provided in most of studies.[13,14,43,45,44,119,142,176,180] Furthermore, only two studies provided self-reported outcome scores of their participants.[86,176] Therefore, severities of disability of participants were unknown and difficult to compare, and the relationship between performance in FPTs and disabilities cannot be elucidated.

TABLE 1-2. Summary of the studies on Functional Performance Test of Ankle Joint

	Subjects	Rehabilitation	Self-reported outcome score	FPT	Findings
Buchanan AS, et al. 2008.[13]	20 physically active, college-aged individuals with FAI vs. 20 controls	Not reported.	Not reported.	Single-limb hopping test (for Agility)(Lateral Direction) Single-Limb Hurdle Test (for Agility) (Lateral Direction)	No significant differences between the FAI and control groups for the Single-limb hopping or Single-Limb Hurdle Tests. Nearly 50 % the individuals with FAI and none of the individuals in the control reported a feeling of instability during the tests. Significant differences between the FAI with a feeling of instability and both the controls and the FAI without a feeling of instability.
Caffrey EC 2009.[14]	30 physically active young adults with FAI vs. 30 controls	Not reported.	Not reported.	6-meter crossover hop (for Agility) Figure-of-8 hop (for Agility) Side hop (for Agility) Square hop (for Agility)	Although relatively small, significant functional performance deficits were present in the individuals with FAI who also had a feeling of instability during the tests.

Delahunt E, et al. 2007.[30]	26 young adults with FAI vs. 24 controls	Not receiving formal rehabilitation at the time of testing	Not reported.	Side hop test (for Agility)	The individuals with FAI had a significantly less-everted position of the ankle joint before and following initial contact with the ground. The ankle joint neuromuscular control system might be challenged in the lateral hopping. Clinicians may be able to identify altered kinematic, kinetic and muscle activity patterns in individuals with FAI. Frontal, sagittal or transverse plane movements or velocities at the hip or knee joints were not significantly different been the groups
Docherty CL, et al. 2005.[37]	42 healthy college students with unilateral FAI vs. 18 controls	Not reported.	Not reported.	Figure-of-8 hop test (for Agility) Side-hop test (for Agility) Up-down hop test (for Agility) Single-hop test (for Distance)	The individuals with higher FAI index had greater performance deficits on the figure-of-8 hop and side hop tests. There were significant correlations between the FAI index and the side hop (r = .35) and FAI index and the figure-of-8 hop (r = .31). There was a correlation between the FAI index and the presence of perceived instability during the FPTs(r = .43).

Eechaute C, et al. 2012.[43]	29 adults who participate in recreational or competitive sports with CAI vs. 29 controls	Not reported.	Not reported.	Multiple hop test for agility (for Agility) (with balance error scoring system)	Multiple hop test might be appropriate as a discriminative tool for CAI.
Eechaute C, et al. 2008.[45]	29 adults who participate in recreational or competitive sports with CAI vs. 29 controls	Not reported.	Not reported.	Multiple hop test for agility (for Agility) (with balance error scoring system)	The individuals with CAI needed significantly longer time to complete the test. VAS scores of difficulty with Multiple hop test of CAI were significantly higher when compared with contralateral side.
Eechaute C, et al. 2009.[44]	29 adults who participate in recreational or competitive sports with CAI vs. 29 controls	Not reported.	Not reported.	Multiple hop test for agility (for Agility) (with balance error scoring system)	CAI used significantly more a change-in-support strategy. The number of balance errors was significantly correlated with the time to complete the test and VAS score of perceived difficulty of the test.
Gerber JP, et al. 1998.[58]	96 young adults (cadets) with various degree of ankle sprains	Formal Rehabilitation	Not reported.	Lateral Hop (for Distance) Forward Hop Test (for Distance)	At 6 week post injury, 23% had > 20% deficits in the FPTs when compared uninjured limbs. Subjects regained forward hopping ability sooner than lateral hop ability.
Johnson MR, et al. 2007[86]	29 young adults (cadets) with lateral sprain within 5 days from the injury	Formal Rehabilitation	Sports Ankle Rating System	Lateral Hop (for Distance) Forward Hop Test (for Distance)	The lateral hop had a slightly higher correlation to SARS score.

Monteleone BJ, et al. 2012.[119]	12 young adults with no history of previous ankle injury	Not reported.	Not reported.	Side hop test	The lateral hop movement was effective in quantifying ankle kinematics, forces, moments, and muscle activities in normal subjects. Inversion of the ankle joint increased during contact in the medial direction while eversion increased during contact in the lateral direction.
Sekir U, et al. 2008.[142]	24 healthy, male recreational athletes	Not receiving formal rehabilitation at the time of testing	Not reported.	Single limb hopping course Single legged Lateral hop for distance Triple legged hop for distance 6 meter hop for time Cross 6 meter hop for time	Excellent reliabilities (ICC 0.94-0.98)
Wikstrom EA et al, 2009.[176]	24 young adult copers, 24 with CAI, vs. 24 controls	No formal habilitation allowed	FADI	Figure-8 hop (for Agility) Side-to-side hop(for Agility) Triple-crossover hop (for Agility) Single-leg hop (for Distance)	Self-assessed disability is significantly greater in those with CAI. Although the FPTs did not differ among groups, individuals with CAI perceived ankle instability more frequently. Perceived instability with the FPTs may better differentiate copers from patients with CAI.

Witchalls JB, et al. 2013.[180]	18 young adults with varying degrees of the ligament laxity with the anterior drawer test (unspecified ankle sprain history)	Not reported.	Not reported.	Single hop (for Distance) Hexagon hop test (for Agility) Hop-and-hold test	A significant difference between lax and stable ankles in the hexagon hop test. Although non-significant, the legs with ligament laxity scored approximately 10% less distance than healthy legs in the single hop for distance.

Prognosis of Ankle Sprains

Traumatic lateral ankle sprains are typically classified as mild, moderate, or severe, which correspond to first, second and third degree sprains. Traditionally, those classifications are based upon various clinician-rated measures, and are vaguely determined.[8,58] These measures typically include swelling, range of motion, muscle strength, palpation, and ligamentous laxity.[3,147] However, there is relatively limited evidence to support such classification system's prognostic ability, which guides the treatment and rehabilitation process.[23,161] This is detrimental to the quality of care as successful RTP with minimal symptoms is the primary concern of the injured athlete and the goal of the athletic rehabilitation process.[163] If clinicians can provide athletes with a more realistic estimation of RTP, and expectations and requirements of the rehabilitation process, athletes will follow the rehabilitation program better, which will subsequently result in a better outcome.[60,69]

Furtheremore, clinical evaluation and RTP decisions have been criticized as being predominantly based upon clinician-rated measures in sport rehabilitation fields.[19,50,115,144,159] In fact, it has been reported that prediction of RTP after traumatic lateral ankle sprains is more accurate and valid when it is based upon patient-rated measures in addition to clinician-rated measures.[23,178,179]

Cross et al reported that global function question, the SF-36 Health Survey Physical Function scale as well as the athlete's ambulation status, measured within 24 hours following injury, are valid in predicting the duration of the time to RTP following traumatic lateral ankle sprains among twenty NCAA Division II college athletes.[23] On the other hand, visual analog pain scale, combination of plantarflexion and dorsiflexion AROM, dorsiflexion muscle strength, and plantarflexion muscle strength measures were not correlated with the duration of the time to RTP.[23]

Similarly, Wilson and Gansneder reported that the impairment measures, which consisted of passive dorsiflexion range of motion and swelling, explained only one third of the variance in the disability duration (r^2 = 0.34) following traumatic lateral ankle sprains among twenty-one NCAA Division I college athletes.[178] By combining the activity limitation measures with the impairment measures, it improved the prediction of disability duration (r^2 = 0.67). However, activity limitation measures alone explained nearly 66% (r^2 = 0.66) of the variance in the duration of the duration of the time to RTP.

In both of the studies by Cross[23] and Wilson,[178] the investigators made up the actability limitation measures on their own. It can reasonably be speculated that self-reported outcome instruments with higher construct validity, such as the FAAM, will have a better prognostic ability for the duration of disability following traumatic lateral ankle sprains.

SECTION 1-4: Aims of this thesis

The primary purposes of the following investigations were:

1. To provide the evidence of validity of the Japanese version of the Foot and Ankle Ability Measure.
2. To investigate self-reported functions and single-limb hop test performance at return-to-play phase following traumatic lateral ankle sprains among competitive college basketball players.
3. To investigate the prognostic ability of patient- and clinician-rated measures for traumatic lateral ankle sprains among competitive collegiate basketball players.

Chapter 2:

Evidence of validity for the Japanese version of the Foot and Ankle Ability Measure

SECTION 2-1: ABSTRACT

Context: The Foot and Ankle Ability Measure (FAAM) is a valid and reliable, self-reported, outcome instrument for the foot and ankle region.

Objective: The aim of this study was to provide the evidence of translation, cross-cultural adaptation, validity, and reliability of the Japanese version of the FAAM (FAAM-J).

Design: Cross-sectional study.

Setting: Collegiate athletic training/sports medicine clinical setting.

Patients or Other Participants: Eighty-three collegiate athletes.

Main Outcome Measure(s): All participants completed the activities of daily living and sports subscales of the FAAM-J and the physical functioning and mental health subscales of the Japanese version of the short form-36v2 (SF-36). Also, 19 participants (23%), whose conditions were expected to be stable, completed another FAAM-J 2 to 6 days later for test-retest reliability. We

analyzed the scores of those subscales for the convergent and divergent validity, internal consistency, and test-retest reliability.

Results: Our results showed that the activities of daily living and sports subscales of the FAAM-J had 0.86 and 0.75 correlation coefficients with the physical functioning section of the SF-36 for convergent validity. For divergent validity, the correlation coefficients with mental health of the SF-36 were 0.29 and 0.27 f le. Cronbach α for internal consistency was 0.99 for the activities of daily living and 0.98 for the sports subscale. A 95% confidence interval with a single measure was +/- 8.1 and +/- 14.0 points for each subscale. The test-retest reliability measures revealed intraclass correlation coefficient values of 0.87 for the activities of daily living and 0.91 for the sports subscales with minimal detectable changes of +/- 6.8 and +/- 13.7 for respective subscale.

Conclusions: The FAAM was successfully translated for a Japanese version, and the FAAM-J was adapted cross-culturally. Thus, the FAAM-J can be used as a self-reported outcome measure for Japanese-speaking individuals; however, the scores must be interpreted with caution, especially when applied to different populations and other types of injury than those included in this study.

SECTION 2-2: INTRODUCTION

To the author's knowledge, the FA translated for its use in German, Persian, and French.[9,108,124] As of this writing, it has not been translated into Japanese. Thus, the primary objective of this study was to provide evidence of validity and reliability of the Japanese version of the FAAM (FAAM-J).

SECTION 2-3: METHODS

The Instrument

The FAAM, originally developed by Martin et al, has a total of 29 items on its questionnaire with 21 items in the ADL subscale and 8 items in the Sports subscale.[106] Each item is scored on a 5-point Likert scale, 4 representing "no difficulty at all", 3 "slight difficulty", 2 "moderate difficulty", 1 "extreme difficulty" and 0 "unable to do" respectively. Therefore, the highest possible scores are 84 for the ADL subscale and 32 for the Sports subscale. Unanswered items or N/A responses are not counted to the total score, and hence with every item without a response or N/A, 4 points are subtracted from the highest potential score. To get percentage values, each total subscale scores are divided by the highest potential scores. A higher score represents a higher level of physical function. At the end of each subscale, global ratings of functions for ADL (GRF-ADL) and sports rela-ted activities (GRF-SP) are also rated with 0% indicating the inability to perform any of the usual daily activities and 100 % indicating the level of function before injury. Additionally, at the end of the form, patients are asked to rate the current level of function with a 4-point Likert scale (normal, nearly normal, abnormal, or severely abnormal). The patients rate each item according to the difficulty they feel with each task due to their foot and ankle condition.

SF-36

The SF-36v2 Health Survey (SF-36) is a generic self-reported outcome instrument to measure a wide range of effects of a condition or disease on patients.[170,171] It consists of 8 subscales, including Physical Functioning (PF), Role-Physical, Bodily Pain, General Health perception, Vitality, Social Functioning, Role-Emotional, and Mental Health (MH). Each subscale has a 0 to 100 score range and a higher score represents a better health status. The Japanese version of the SF-36 was validated by Fukuhara et al.[56,57]

Translation & Cross Cultural Adaptation process

Translation and cross cultural adaptation process in the current study was conducted in accordance with the guidelines set by the International Society for Quality of Life Assessment.[6] The forward translation of the original version of the FAAM was conducted by two independent native Japanese translators (T1 & T2) with extensive English expertise without any medical background. In a consensus meeting, T1 and T2 discussed the discrepancies and agreed on the preliminary version of the FAAM-J. Translator 3, a native Japanese with medical expertise and broad experience in translating medical literature, rated the preliminary version of the FAAM-J in terms of clarity, common language use and conceptual equivalence, creating the forward-translation version of the FAAM-J. Translators 4 and 5, native Japanese with extensive translation experience, then translated the forward-translation version of the FAAM-J back into English (back-translation version of the FAAM-J). Translator 6, a native American English speaker with no medical background, compared the back-translation version of the FAAM-J with the original FAAM in terms of conceptual equivalence to make further adjustments as needed. A committee reviewed and discussed the disagreements and possible modifications, agreeing on the pre-final version of the FAAM-J. A pilot study of the pre-final version of the FAAM-J on 20 collegiate students was conducted for accuracy of wording and ease of understanding, and no difficulties were noted during this process.

Participants/Subjects

Eighty three competitive athletes (59 males and 24 females, 20.3 ±3.7 yoa) with foot and ankle pathologies from 7 competitive collegiate varsity teams (1 men's basketball, 3 women's basketball, 1 men's rugby, 1 men's soccer and 1 men's gymnastics) from 3 institutions volunteered to participate in the study. Foot and ankle pathologies were included in the study if they were musculoskeletal in origin and sustained during their sport participation. Subjects were excluded if they had injuries to the lower back, hip, knee, lower leg, ankle or foot regions within the previous 6 months prior to the condition they were measured on. Other exclusion criteria were a history of surgery to the above mentioned areas, co-existing musculoskeletal injuries in other body parts, and chronic conditions such as systematic inflammatory rheumatic disease, neurological or vascular conditions, cancer, diabetes mellitus, alcohol abuse and psychiatric disorders.[106]

Injury Classification

The location and type of injury were categorized in a classification system, which was modified from the previous literature.[87] The locations of injury included Achilles tendon, ankle, foot and toes. The types of injury were;

fracture(traumatic), stress fracture(overuse), other bone injuries, dislocation/subluxation, tendon rupture, sprain (injury of joint and/or ligaments), lesion of meniscus or cartilage, strain/muscle rupture/tear, contusion/hematoma/bruise, tendinosis/tendinopathy, bursitis, laceration/abrasion/skin lesion, muscle cramps or spasm, and others.[87]

Data Collection

Prior to participating in the study, all subjects read and signed a consent form, approved by the Institutional Review Board of Waseda University. They were then given the FAAM-J and SF-36 and asked to complete the forms. The forms were given to the subject once they had a condition with an acute or chronic onset, and sought a medical attention from their respective team medical personnel while the nature of the conditions and the inclusion and exclusion criteria were confirmed. For reliability testing, 19 participants, whose conditions were expected to remain stable (i.e. chronic state, no treatments), were requested to fill out the forms again 2 to 6 days after the initial recording. This study was approved by the institutional review board of Waseda University.

Statistical Analysis

To examine the convergent validity, the correlations between the ADL and Sports subscales of the FAAM-J, and the PF subscale of the SF-36 were analyzed with Pearson correlation coefficients. Likewise, the correlations between the ADL and Sports subscales of the FAAM-J and the MH Subscale of the SF-36 were analyzed to acquire the divergent validity. The a priori alpha level for this analysis was set at 0.05. Also, Pearson Correlation Coefficients between the ADL Subscale of the FAAM-J and the GRF-ADL, and the Sports subscale of the FAAM-J and the GRF-SP, were calculated.

Cronbach's coefficient alpha was acquired for the assessment of the internal consistency. The Standard Error of Measurement (SEM) of each subscale scores were calculated as SEM = $\sigma\sqrt{1-r}$ where σ was the standard deviation of the scores and r was the coefficient alpha. The error associated with a score at a single point in time was acquired by calculating a 95% Confidence Interval (CI).

Test-retest reliability was examined with Intra-class correlation coefficients (ICC 2,1). To confirm there was no systemic bias between the test and retest sessions, paired t-test was performed. We determined the SEM using the ICC test retest reliability coefficient. The SEM was multiplied by $\sqrt{2}$ and a 95% CI was calculated to determine the minimal detectable change (MDC). All statistical analyses were performed using the SPSS 20.0 (SPSS Japan Inc., Tokyo, Japan).

SECTION 2-4: RESULTS

Participants/Subjects

The demographic information, injury types, and locations are presented in **TABLE 2-1**. While the predominant body part involved was the ankle, the most frequent injury type was a sprain.

TABLE 2-1. Demographic Information of the Subjects, and the Types and Locations of the Injury

Age, y	20.3 (range = 18-24, SD = ± 3.7)
Gender	
Male	59/83 (71 %)
Female	24/83 (29 %)
FAAM Score (%)	
ADL Subscale	74.2% (range = 0-100, SD = ± 29.4%)
Sports Subscale	52.1% (range = 0-100, SD = ± 35.7%)
Location	
Ankle	63/83 (76%)
Foot	19/83 (23%)
Toe	1/83 (1%)
Classification	
Sprain (injury of joint and/or ligaments)	71
Fracture (traumatic)	2
Lesion of meniscus or cartilage	2
Other bone injuries	2
Stress fracture (overuse)	2
Tendinosis/tendinopathy	2
Contusion/hematoma/bruise	1
Others	1

Translation and Cross Cultural Adaptation

No major difficulties were encountered during the translation and cross cultural adaptation process. As expected, a few minor discrepancies were found during the forward translation process, however, the translators could decide on the agreements without any difficulties. In item 5 of the Sports subscale, "Cutting" was translated as "*Katteinngu*" in *katakana* (a set of Japanese alphabets for foreign words) by one translator and as "*Houkoutenkan*", (literally "change of direction" in Japanese) by the other translator. We decided to use "*Houkoutenkan*" rather than "*Katteinngu*" as we thought "*Katteinngu*" is a sport specific maneuver and appropriate if the FAAM was intended to be used only on athletes and physically active individuals. Furthermore, "*Katteinngu*" seemed too technical a term for the general population in Japanese and therefore may be misinterpreted by many individuals who do not understand the meaning of the word. Also, we thought that as "*Houkoutenkan*" is listed in the Sports subscale, people will take the word "*Houkoutenkan*" in the sport activity context. Therefore, "*Houkoutenkan*" is more correctly interpreted by respondents. In contrast, in item 7 of Sports subscale, the word "Technique" was translated as "*Gihou*" by one translator, yet we agreed to use "*Tekunikku*", literally written as "technique" in katakana, as it is more commonly used in the Japanese language than “*Gihou*”. After initial corrections of the minor discrepancies, no further difficulties were noted during the translation, evaluation or pilot testing processes.

Convergent and Divergent Validity

Statistical analysis revealed correlation coefficients of 0.86 between the ADL Subscale and PF of the SF-36 ($p < .001$), and 0.75 between the Sports Subscale and PF of the SF-36 ($p < .001$). On the other hand, the ADL Subscale had a correlation coefficient of 0.29 with MH of the SF-36 ($p = .007$) and the Sports Subscale had a correlation coefficient of 0.27 with MH of the SF-36 ($p = .013$). Also, the ADL Subscale showed a correlation coefficient of 0.89 ($p < .001$) and 0.80 ($p < .001$) with the GRF ADL and SP respectively while the Sports Subscale had 0.80 ($p < .001$) and 0.87 ($p < .001$) correspondingly.

Internal consistency

Cronbach’s alpha for internal consistency was 0.99 for the ADL Subscale ($p < .001$) and 0.98 for the Sports subscale ($p < .001$). The SEM for the ADL Subscale was 2.9 with a 95% CI of +/- 8.1 whereas the SEM for the Sports Subscale was 5.0 with a 95% CI of +/- 14.0.

Test-Retest Reliability

Paired t-test revealed no systemic bias between the test and retest scores for both ADL (p = .096) and Sports (p = .848) Subscales. Both subscales were shown to have an excellent reliability. The MDC at 95% CI was +/- 6.8 for the ADL Subscale, and +/- 13.7 for the Sports subscale.

SECTION 2-5: DISCUSSION

Clinician-rated measures relate to impairment-oriented data such as strength, pain, swelling and ROM, and provide information of an uncertain clinical utility.[78,83] Though valuable in many ways, they should not be used as the sole outcome measure.[115] On the other hand, patient-rated measures reflect on patient's values, perceptions of the condition they suff [53,159] and provide the patient-oriented evidence that is directly related to the interest of patients. Moreover, a recent study indicates that clinician- and patient-rated outcome measures assess two different aspects of health status.[137] Thus, it is important to incorporate both types of outcome measures into the clinical decision making process.

The current study provided the evidence of translation and cross cultural adaption as well as the evidence of convergent validity, divergent validity, internal consistency and test-retest reliability of both subscales of the FAAM-J. Therefore, the use of the FAAM-J as a self-reported outcome measure for the foot and ankle region was validated with some limitations.

Although interrelated, face validity relates more to whether an instrument is measuring what it is designed to measure, whereas content validity is concerned with adequacy, or the extent to which the items in an instrument measure the domain of interest.[63,133] It is important that not only the experts, but also the patients, participate in developing an instrument.[53,101] The original version of the FAAM went through a rigorous item selection process in which both of the expert clinicians and patients participated, utilizing the item reduction theory (IRT).[106] Although the evaluation of face and content validity is qualitative and subjective in nature, this meticulous process in the original version of the FAAM, which incorporated both of the expert clinicians' and the patients' values and opinions, provided the evidence of the face and content validity of the FAAM. Construct validity relates to the ability of an instrument to measure a construct, an unobservable, abstract concept.[53,133]

The construct validity of an instrument is acquired by evaluating the correlation between the tested instrument and other measures, which is logically hypothesized from a relationship between the patient's health status and the construct. Also, there are two types of construct validity; convergent and discriminant, or divergent.[133] Evidence of convergent validity is provided when the instrument being tested, is shown to have a strong correlation with other measures of the same construct. Whereas, divergent validity is granted when there is shown to be a weaker or no relationship at all between the score on the tested instrument and measures of a different construct. The constructs that the FAAM is intended to measure are functional limitations to the foot and ankle region, and activity restrictions. In the current study, as expected, both subscales of the FAAM-J were shown to have high correlations with PF and low correlations with MH of the SF-36. The correlation coefficients with PF were 0.86 for the ADL subscale and 0.75 for the Sports subscale while those with MH were 0.29 for the ADL Subscale and 0.27 for the Sports Subscale. Furthermore, the results of the current study were in accordance with the original and French versions of the FAAM.[9,106] Thus, the subscales of the FAAM-J were correlated with the physical functioning aspect of the patients' health status, but not the mental health aspect, granting the evidence of the convergent and divergent validity of the FAAM-J.

The extent to which the items in an instrument are measuring different aspects of the construct is referred as internal consistency and associated with an error within a single measure. Internal consistency is commonly assessed with the correlation between all items in the instrument. In this study, Cronbach's alphas for the internal consistency were found to be 0.99 with a SEM of 2.9 for the ADL subscale, and 0.98 with a SEM of 5.0 for the Sports subscale. The 95% CI with a single measure was +/- 8.1 and +/- 14.0 for respective subscales. The 95% CI value for the Sports subscale of the FAAM-J was found to be different from the values in the original version and French version.[9,106] Although speculative, a couple sources of the discrepancy were conceivable. First, the patient population could be a source of the discrepancy; general adults (41.2 ± 16.3 years for the original version and 50.5 ± 14.6 years for the French version) were the subjects of the other two studies whereas the young, competitive athletes (20.3 ± 3.7 years) were the subjects of the current study. Second, the proportions of the injury location and type varied among the studies. Especially in the current study, the location and type of injury were largely acute ankle sprains. This was, however, expected considering the nature of the population in the current study, which were competitive collegiate athletes.[74]

Reliability relates to the stability of the scores at repeated measures when no change to the health status is expected. It is assessed by the test retest measure. The evidence of the reliability of the FAAM-J was provided with the excellent ICCs for the ADL and Sports subscales. The MDC value for the Sports Subscale was substantially smaller in this study compared with those of the original and French versions. A possible explanation, along with the above-mentioned sources of the discrepancies, may be the time period between the test and retest; it was 4 weeks in the original version and 2 days in the French version while it was 2-6 days in this study.

The FAAM has been widely utilized as a self-reported outcome measure to assess functional limitations and activity restrictions caused by various pathological conditions to the foot and ankle region, and to assess the effectiveness of interventions that clinicians provide. Such conditions include foot and ankle trauma,[59] acute ankle sprain,[19] plantar heel pain,[17] plantar fasciitis,[39] ankle arthrodesis,[66] ankle arthritis,[22] chronic ankle instability,[15,69,181] recurrent peroneal subluxation,[10] and diabetes.[90,104] The original version of the FAAM, along with three other questionnaires, provided evidence of content validity, construct validity, reliability and responsiveness to support its use.[105] Also, the FAAM and the Foot and Ankle Disability Index, a prototype of the FAAM, were considered to be the most suitable self-reported outcome instrument for the chronic ankle instability by a systemic review.[46] Therefore, it was deemed appropriate and valuable to cross-culturally adapt and translate the FAAM for its use in Japanese.

Furthermore, a standard method of assessment allows comparisons of different treatment methods.[80] The prevalent use of the FAAM allows clinicians to make such comparisons for better clinical decisions. Thus, a cross-culturally adapted version of the FAAM is beneficial not only for those individuals who speak that language, but also for those who use the other language versions of the FAAM.

A recent study showed that the individuals with functionally ankle instability (FAI) had significantly lower FAAM scores and SF-36 Physical Component Summary (PCS).[4] In addition, both ADL and Sports subscales of the FAAM of the FAI were positively correlated with the SF-36 PCS and related subscales, but not with Mental Component Summary (MCS). Furthermore, the scores of the FAAM were correlated with the PF subscale to a greater degree than with the PCS itself or other subscales of the PCS. Therefore, although the functional limitations caused by FAI contributes to the Health Related Quality of life (HR-QOL), the FAAM primarily captured and was more specific to a physical dimension, and other factors contributed to the overall HR-QOL. Therefore, clinicians need to be careful with the dimensions they intended to capture with the FAAM.

There are some limitations in the current study. Firstly, although our translation process was in accordance with the guideline in the previous literature, there were limitations to our validation process with the classical test theory. Namely, the classical test theory focuses only on the whole test score and disregards the interaction between a respondent's ability and the characteristics of the item, such as difficulty, and each item's sensitivity to the respondent's ability level while the IRT can account for these factors. A study utilizing the IRT indicated that some items in a self-reported outcome instrument are more culture specific than others,[25] while the current study did not address this issue as the classical test theory was applied. Additionally, the FAAM-J was compared with the original version of the FAAM and SF-36 in our method, and hence the reliability and validity of the FAAM-J was confined to those of the instruments. Therefore, though our method was similar to that of the French version of the FAAM, future research needs to address these limitations with the FAAM-J.

Secondly, the characteristics of the subjects of the current study were different from those of the original and French version of the FAAM. Specifically, the current study was conducted on young, competitive athletes while the previous two studies were on regular adults in a general population. A previous study showed that the scores of SF-36 of noninjured elite athletes slightly differed from the age matched norm values and this trend was more substantial among females.[109] Another study onphysically active individuals showed that the uninjured control individuals, as well as those with FAI, had better PF subscale scores than the general population, while only the uninjured control had better PF scores than the age-matched population.[4] On the other hand, both control and FAI groups had similar MCS scores with the general population although they were below the age-matched population. Furthermore, the magnitudes of functional limitations, participation restrictions, and disabilities experienced by injured individuals might vary according to the expected normal levels for each individuals.[163] Therefore, further evidence is needed on this aspect of the

FAAM-J and the scores of the FAAM-J must be interpreted with caution when applied to a general population.

SECTION 2-6: CONCULUSION

This study provides the evidence of cross-cultural adaptation and translation along with convergent and divergent validity, internal consistency, and test-retest reliability of the FAAM-J. Thus, the FAAM-J can be used as a self-reported outcome measure of an athletic population of Japanese-speaking individuals with acute ankle injuries; however, the scores of the FAAM-J must be interpreted with caution especially when applied to a different population and other types of injury.

Chapter 3:

Self-reported functions and single-limb hop test performance at return-to-play phase following traumatic lateral ankle sprains among competitive college basketball players.

SECTION 3-1: ABSTRACT

STUDY DESIGN: Prospective case control study.

OBJECTIVES: To determine if functional deficits are present in college basketball players at RTP phase following traumatic lateral ankle sprain in the activities of daily living (ADL) and Sports subscale of the FAAM-J (FAAM-J ADL, FAAM-J SP) as well as in single-limb hop tests (SLHTs).

BACKGROUND: Literature suggests an absence of self-reported outcome measures in the field of sports medicine. Little evidence is available to show functional performance deficits are present in college basketball players following traumatic lateral ankle sprains.

METHODS: Thirty-one college basketball players with traumatic lateral ankle sprains and Thirty-one healthy controls participated in the study. Upon a successful RTP, subjects completed the FAAM-J ADL and SP. Also, subjects performed two SLHTs; side hop and square hop tests, and rated the instability and pain they felt while performing the SLHTs on the visual analogue scale. The involved limbs were compared with the contralateral, healthy, and control limbs.

RESULTS: Significantly lower FAAM-J ADL and SP scores were found with the involved limbs compared with the contralateral limbs, and control group ($p<.05$). A significant finding was found only with the time measures of the side hop test. Subjects felt significantly higher instability and stronger pain with the SLHTs on the involved limbs than the contralateral, and control limbs ($p<.01$).

CONCLUSION: Based upon the scores of FAAM-J ADL and SP, collegiate basketball players were cleared for RTP without full recovery following traumatic lateral ankle sprains. Subjects had significantly higher perceived instability and greater pain with the SLHTs with the involved limbs.

SECTION 3-2: INTRODUCTION

To date, no study has shown that functional deficits in self-reported outcome measures as well as single-limb hop tests (SLHTs) are present among college basketball players at RTP phase following traumatic lateral ankle sprains despite that the use of those examinations are recommended to be included in RTP decision making process.[89,103] Therefore, the purpose of this study was to elucidate if the ADL and Sports subscale of the FAAM-J (FAAM-J ADL, FAAM-J SP) as well as SLHTs can demonstrate functional deficits in the injured limbs of those subjects when compared to their contralateral uninjured limb and healthy control subjects.

SECTION 3-3: METHODS

Thirty-one Japanese college basketball players of four small institutions (21 males, 10 females, height 175.8 ±9.8 cm, weight 68.9 ±9.0 kg, age 19.0 ±3.7 yoa, 9.5 ±1.8 years of experience in competitive basketball), who sustained a traumatic lateral ankle sprain during a game or practice session, participated in the study. A traumatic lateral ankle sprain was defined as an ankle sprain that was sustained with inversion mechanism, resulting in at least one day of absence from game or practice participation (“time loss” definition of injury).[64] The exclusion criteria for the study were: concurrent fractures, a history of surgery to the lower extremity or lower back, any preexisting athletic injury requiring medical attention at the time of the ankle injury, any injury to either foot, ankle, knee, hip or lower back region that resulted in any restrictions from practice/game participation in the previous six months. Additionally, ankle sprains were not included in the study when clinical evaluation revealed that signs and symptoms were not limited to the lateral aspect of the joint, but also present in other areas such as metatarsal bones, medial aspect of the joint, and anterior tibiofibular ligament.

Thirty-one gender, dominance matched, healthy college basketball players (height 173.9 ±11.1 cm, weight 67.7 ±12.1kg, age 19.5 ±3.8 yoa, 10.1 ±2.0 years of participation in competitive basketball) also participated in the study. Subjects in the control group had not sustained any injury to the lower extremity or lower back region resulting in restriction from participation in the previous six months, had no prior history of surgery to the lower extremity or lower back region, and had no conditions that required medical attention at the time of participation. Prior to participating in the study, all subjects read and signed the consent form approved by the Institutional Review Board of Waseda University. This was a part of a larger investigation on the effects of traumatic lateral ankle sprains among college athletes.

Rehabilitation/RTP decisions

Rehabilitation was supervised by medical personnel of respective teams. After acute inflammation signs and symptoms subsided, rehabilitation and treatment were intended to restore range of motion, muscle strength, proprioception, static and dynamic balance, and ambulatory status, following conventional guidelines.[12] Once subjects were judged to have achieved normal ranges in those variables based upon conventional clinical evaluations, subjects were progressed to perform generic athletic movements, and gradually allowed restricted sport participation. When subjects did not aggravate signs and symptoms during restricted sport participation and gained confidence to resume full participation, subjects were allowed RTP. All subjects achieved RTP with athletic taping on the injured ankle.[89] RTP was operationally defined as medically cleared participation in a practice or game session without any restriction, in which decisions are made by medical personnel of respective teams.[21] RTP was confirmed on the following day by verifying subjects could complete the practice or game session without any restrictions. The mean number of days the subjects were restricted from full participation was 13.7 ±9.3 days. Once successful RTP was confirmed, subjects were scheduled to participate in a testing session at the subject's earliest convenience. The mean duration between the date of RTP and the testing session was 4.8 ±3.8 days. At three months post-RTP, it was confirmed that subjects were able to continue to participate in game and practice sessions without reinjury or restrictions after RTP.[160]

SLHTs

In the Side Hop (SH) test, subjects were instructed to hop laterally 30 cm and back for a total of 10 repetitions as quickly as possible (**FIGURE 3-1**). In the Square Hop (SQ) test, from the starting position, subjects were instructed to hop in and out around a 40 x 40 cm square back to the starting position, which constitutes one repetition (**FIGURE 3-1**). Subjects completed 5 repetitions as quickly as possible. Using the right limb, subjects hopped in a clockwise direction; subjects hopped in a counter clockwise direction using the left limb. With both tests, subjects were required to repeat the trial if they stepped on the line, missed the stopwatch pad, or touched down with the opposite limb. Detailed descriptions of the SH and SQ tests are available in previous literature.[14,37] Based upon a pilot study on healthy college students, the reliability of the SH and SQ tests is excellent with $ICC_{2,1}$ of .94 and .93 respectively. The SEM and minimal detectable change (MDC_{95}) are: .8 sec and 2.3 sec for the SH test and

1.6 sec and 4.3 sec for the SQ test. Furthermore, the dominant and non-dominant limbs were analyzed with paired t test. Likewise, the perceived instability and pain with the SLHTs was analyzed with the Mann–Whitney U test. Limb dominance was defined as the limb used to kick a ball. We found no significant differences between the dominant and non-dominant limbs for all variables. (**TABLE 4-1**)

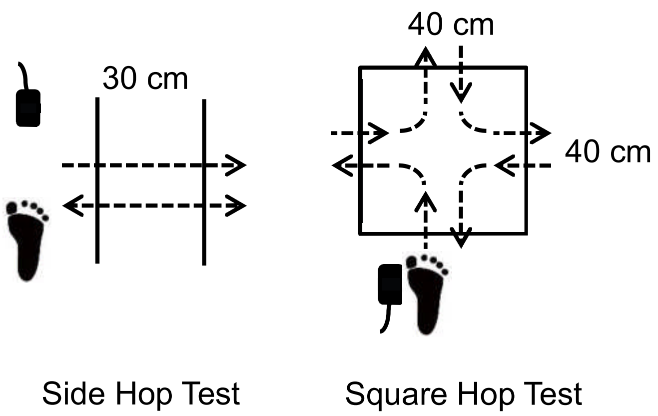

FIGURE 3-1. Single Leg Hop Tests

TABLE 3-1. Comparison between the dominant and non-dominant limbs of the control group

	Dominant	Non-Dominant	p
SH Time (sec)	8.1 ± 1.2	8.1 ± 1.1	.96
SQ Time (sec)	14.9 ± 2.4	14.9 ± 2.4	.64
SH Instability (cm)	0.6 ± 1.6	0.5 ± 1.2	.87
SH Pain (cm)	0.1 ± 0.4	0.1 ± 0.5	.59
SQ Instability (cm)	0.3 ± 1.2	0.4 ± 1.1	.47
SQ Pain (cm)	0.1 ± 0.3	0.0 ± 0.0	.18

Abbreviations: SH; Side hop test, SQ; Square hop test, SH Time; Time measures of the SH test, SQ Time; Time measures of the SQ test, SH Instability: VAS score of the perceived instability with the SH test, SH Pain; VAS score of the pain with SH test, SQ Instability; VAS score of the perceived instability with the SQ test, SQ Pain; VAS score of the pain with SQ test.

Procedures

After signing a consent form, subjects completed both subscales of the FAAM-J. Subjects were also asked to “please rate your current level of pain with activities of daily living on the line below” and “please rate your current level of pain with your sports activities on the line below” on the VAS scales. The left end of the 10 cm VAS was labeled as “no pain at all” and the right end was labeled as “unbearable pain.”

After the five minute warm-up session, subjects were given verbal instructions as well as demonstrations by the investigators, and asked to perform a maximum of two practice trials of each SLHT to familiarize themselves with the SLHTs. A 30-second rest period between trials was included to prevent fatigue. Subjects with a traumatic lateral ankle sprain performed the SLHTs with the injured (Involved) and healthy, uninjured (Uninvolved) limbs. The order in which subjects performed the two SLHTs was counterbalanced. All SLHTs were performed barefoot. The time to complete the SLHTs was recorded with an electronic timer (Speedtrap 2, Brower Timing Systems, Draper, UT). The means of the two successful trials for each SLHT were used in statistical analysis.

After successfully completing two testing trials of each SLHT, subjects were asked if they felt instability and pain while performing each SLHT. When subjects indicated “yes” to the questions, they were required to rate the extent of their instability and pain on the 10 cm VAS, respectively. On the instability VAS, the left end of the scale was labeled as “Not unstable at all” while the right end was labeled as “Too unstable to complete the task”. On the pain VAS, the left end of the scale was labeled as “No pain at all” while the right end of the scale was labeled as “Unbearable pain”.

STATISTICAL ANALYSIS

For the time measures of the SLHTs, the one way ANOVA with Tukey’s post hoc analysis was performed to find any significant differences among the Involved, Uninvolved, and control groups. In addition, a subgroup was formed with those individuals who felt instability with the SLHTs, and separately analyzed with Uninvolved and control limbs.

The Welch ANOVA was performed on the scores of the FAAM-J ADL and SP, and all the VAS scores for any significant differences among the limbs. Games-Howell post-hoc test was conducted on any significant findings.

Spearman's correlation coefficients between the perceived instability and pain with SLHTs and the FAAM-J ADL and SP of the Involved limbs were acquired. All statistical analyses were performed with SPSS 22.0 (SPSS Japan Inc., Tokyo, Japan). The alpha level was set at $p < .05$ for all analysis.

SECTION 3-4: RESULTS

Self-Reported Outcome Measures

The Welch ANOVA analysis revealed significant differences among the groups for the FAAM-J ADL ($F = 10.85$, $p < .01$), FAAM-J SP ($F = 19.94$, $p < .01$), Pain ADL ($F = 15.63$, $p < .01$), and Pain SP ($F = 24.59$, $p < .01$). For the FAAM-J ADL, FAAM-J SP, Pain ADL, and Pain SP, Games-Howell post-hoc analysis found significant differences between the Involved and Uninvolved limbs, and between the Involved and control limbs. (**TABLE 3-2**)

SLHTs

With time measures, the one way ANOVA found a significant differences among the limbs for the SH test ($F = 3.30$, $p < .05$), but not with the SQ test ($F = 1.50$, $p = .23$). Games-Howell post-hoc analysis found a significant difference between the Involved and control limbs with SH test ($p < .05$). (**TABLE 3-3**) The secondary analysis, in which those who indicated “yes” to the perceived instability question with each SLHT were separately compared with the Uninvolved and control limbs, revealed the same results; a significant difference with time measures of the SH ($F = 3.62$, $p < .05$), but not with the SQ test ($F = 1.26$, $p < .05$). (**TABLE 3-3**) Games-Howell post-hoc analysis found a significant difference between the Involved and control limbs with SH test ($p < .05$).

For the subjective evaluation of the SLHTs, we found significant differences among the limbs with the Perceived Instability with the SH test ($F = 14.29$, $p < .01$) and the SQ test ($F = 7.13$, $p < .01$). Similarly, we found significant differences among the limbs for Pain with the SH test ($F = 9.61$, $p < .01$) and the SQ test ($F = 4.94$, $p < .01$). (**TABLE 3-4**) The results of the post hoc analyses are presented in **TABLE 3-4**.

Spearman's rank rho revealed significant associations between Perceived Instability with the SH test and the FAAM-J ADL and SP scores, respectively. However, no significant associations were found with the SQ test. (**TABLE 3-5**)

TABLE 3-2. FAAM ADL and SP and Pain ADL and SP

		Mean	S.D.	CI^{95}		
	Involved	82.0	3.2	80.9	83.2	
FAAM ADL	Uninvolved	84.0	0.2	83.9	84.0	* †
	Control	83.9	0.4	83.8	84.0	
	Involved	28.1	4.0	26.7	29.6	
FAAM SP	Uninvolved	31.7	0.9	31.3	32.0	* †
	Control	31.7	1.6	31.1	32.3	
	Involved	0.3	0.3	0.1	0.4	
Pain ADL	Uninvolved	0.0	0.1	0.0	0.0	* †
	Control	0.0	0.0	0.0	0.0	
	Involved	1.4	1.5	0.9	2.0	
Pain SP	Uninvolved	0.1	0.2	0.0	0.1	* †
	Control	0.1	0.4	-0.1	0.2	

* indicates post hoc analysis revealed a significant difference between the Involved and Uninvolved groups ($p < .05$).

† indicates post hoc analysis revealed a significant difference between the Involved and control groups ($p < .05$).

Abbreviations: FAAM-J ADL; FAAM-J ADL subscale, FAAM-J SP; FAAM-J Sports subscale, Pain ADL; VAS scores of pain associated with ADL, Pain SP; VAS scores of pain associated with sports activities.

TABLE 3-3. Time measures of the Single Leg Hop Tests (sec)

		Mean	S.D.	CI_{95}	
SH	Involved	8.85	1.24	8.40	9.30
	Uninvolved	8.74	1.21	8.30	9.18
	Control	8.16	0.95	7.81	8.51
	Involved with Instability(n=24)	8.94	1.26	8.40	9.47
SQ	Involved	15.87	2.35	15.01	16.74
	Uninvolved	15.55	2.20	14.74	16.35
	Control	14.92	2.02	14.18	15.66
	Involved with Instability(n=20)	15.87	2.40	14.74	16.99

Abbreviations: SH Time; the time measure for the Side hop test, SQ Time; the time measure for the Square hop test, Involved with instability; those individuals who felt instability with the single leg hop tests.

Table 3-4. Perceived Instability and pain of the Single Leg Hop Tests (cm)

			Mean	S.D.	CI95		
SH	Instability	Involved	1.9	2.0	1.2	2.7	
		Uninvolved	0.3	0.8	0.0	0.5	* †
		Control	0.4	1.0	0.0	0.8	
	Pain	Involved	1.1	1.6	0.5	1.7	
		Uninvolved	0.1	0.5	-0.1	0.3	* †
		Control	0.1	0.4	0.0	0.3	
SQ	Instability	Involved	0.8	1.6	0.2	1.4	
		Uninvolved	0.1	0.4	-0.1	0.3	* †
		Control	0.1	0.5	0.0	0.3	
	Pain	Involved	1.7	1.8	1.1	2.4	
		Uninvolved	0.5	1.1	0.1	0.9	* †
		Control	0.5	1.4	0.0	1.0	

* indicates post hoc analysis revealed a significant difference between the Involved and Uninvolved groups. ($p < .01$)

† indicates post hoc analysis revealed a significant difference between the Involved and control groups. ($p < .01$)

Abbreviations: SH; Side hop test, SQ; Square hop test, Instability; the perceived instability with the single leg hop tests, Pain; the perceived pain with the single leg hop tests.

Table 3-5. Spearman's rank correlation coefficients between Single Leg Hop Tests and the perceived instability

	SH		SQ	
	Instability	Pain	Instability	Pain
FAAM ADL	-.57*	-.26	-.25	-.31
FAAM SP	-.43†	-.25	-.10	-.14

SH; Side hop test, SQ; Square hop test,

* indicates the significant level is at p < .01.

† indicates the significant level is at p < .05.

SECTION 3-5: DISCUSSION

Self-Reported Outcome Measure

The results of this study provide evidence that functional deficits were present in both of the subscales of the FAAM-J with injured limbs of college basketball players at the RTP phase following traumatic lateral ankle sprains. In fact, the mean differences between the Involved and Uninvolved limbs, and between the Involved and control limbs were larger than MDC of the FAAM-J SP.[158] Furthermore, the lower bounds of confidence intervals of the FAAM-J ADL and SP of the Uninvolved and control limbs were higher than the upper bounds of those of the Involved limbs. Therefore, it is unlikely that the mean differences in this study were caused by chance.

The literature reveals a paucity of self-reported outcome measures in the sports medicine field despite that they are integral to patient-centered medical practice.[19,34,50,115] Furthermore, the literature has suggested patient- and clinician-rated measures assess different aspects of health-related quality of life.[96,137] Therefore, lack of patient-rated outcome measures will significantly diminish the quality of outcome measures as assessed by health care professionals in the sports medicine field.

Additionally, there have been few studies to show that athletes are in fact achieving RTP with functional deficits although premature RTP has been implicated as one of the causes for the development of CAI.[113] To the authors' knowledge, this study was the first to provide the self-reported outcome scores of competitive college basketball players at the RTP phase following traumatic lateral ankle sprains. Based upon the self-reported outcome scores in this study, competitive college basketball players were indeed cleared for RTP without full recoveries.

Of the four studies that utilized the SLHTs similar to the current study,[13,14,37,176] only one study reported the scores of a self-reported outcome instrument.[176] In agreement with the results of the current investigation, the previous study on young adults reported that the time measure of the SLHTs could not demonstrate a difference of functional performance among the CAI, coper, and control groups whereas the Foot Ankle Ability Index, a former version of the FAAM, was able to identify functional deficits of the CAI.[176]

There is little evidence available for RTP guidelines for self-reported outcome scores following traumatic lateral ankle sprains in the literature[19] although the use of self-reported outcome scores is recommended to be included in the RTP decision making process.[89] Cosby and Hertel recommended that basketball players should achieve scores of 95% or better on the FAAM ADL and 80 % or better on the FAAM Sports subscale at RTP.[19] In contrast, a previous study on National Collegiate Athletic Association Division II athletes reported subjects with CAI had scores of 88 ± 7.7 % and 76 ± 12.7 % of the FAAM ADL and Sports subscales, respectively.[15] Indeed, the mean scores of both subscales of the FAAM-J in this study were above those values. (**TABLE 3-2**) However, cross-sectional design of the current study cannot elucidate whether or not subjects in the current study would develop CAI or become copers following RTP. Furthermore, whether or not RTP with higher self-reported outcome scores will prevent subsequent recurrent sprains and development of CAI needs to be addressed in future research.

SLHTs

One of the primary purposes of this study was to reveal that functional performance deficits are present in college basketball players at RTP phase following traumatic lateral ankle sprain in the SLHTs. Based upon the time measure of the SLHTs in this study, functional performance deficits were found in the involved limbs only with the SH test when compared with healthy control limbs, but not with their contralateral uninjured limbs. Furthermore, when the Involved limbs were divided into the subgroups according to the presence of unstable feeling while performing the SLHTs, the results remained the same; only the SH test produced a significant difference between the Involved and control limbs ($p < .05$) with the mean differences of .8 sec. (**TABLE 3-3**) However, MDC of the SH test (2.3 sec) was far larger than this value. Therefore, even though it reached a significant level, it may have a limited clinical value.

Literature has shown the effectiveness of FPTs that specifically involve single-limb hop with agility maneuvers.[13,14,37,176] The findings of the current study only partly supported the results of these studies. Possible explanations for this discrepancy might include the nature and state of subjects. Specifically, recreational athletes or physically active individuals were the subjects in previous studies.[13,14,37,176] Since subjects did not go through a formal rehabilitation process in one study[176] and such information was not provided in the other studies,[25-27] subjects with CAI in those studies might have residual symptoms and have not completed rehabilitation to perform demanding activities like SLHTs. Subjects of this study, on the other hand, were competitive collegiate athletes who participated in the formal rehabilitation process supervised by respective medical personnel immediately after the injury until they achieved RTP. Therefore, subjects in this study, despite their lower self-reported outcome scores, might have been able to create compensation patterns to execute the task. In fact, the mean time measures of the FPTs in this study were faster than those in the previous studies.[13,14,37,176]

Furthermore, there was a tendency for the contralateral, healthy limbs to take longer to complete the SLHT than the control group. Although hypothetical, this may be because the contralateral, healthy limbs might have had postural balance deficits as bilateral balance impairments may develop after lateral ankle trauma.[174] Therefore, it may not be recommended that the SLHTs in the current study be used clinically for competitive athletes solely based upon the time values.[14]

In contrast, subjects felt significantly greater pain and higher instability performing the SLHTs with the Involved limbs when compared with Uninvolved and control. A greater percentage of the subjects in this study reported perceived instability of the involved limbs with the SLHTs. With the SH test, 77% (24 of 31) reported feelings of instability, compared with 47% (14 / 30),[14] 60% (25 / 42),[37] 71% (17 / 24),[176] 38% (9 / 24)[176], and 50% (10 / 20)[13] among the individuals with

CAI in previous literature. With SQ test, 65% (20/31) of subjects reported feelings of instability, compared with 33% (11/30) of the previous study on CAI.[14]

Although speculative, this may be because subjects of this study might have had a greater fear of reinjury as the feeling of ankle instability is generally associated with fear of reinjury[28] and the testing sessions were immediately after RTP (4.8 ±3.8 days). Research has shown that pain-related fear of movement, or kinesiophobia, is associated with RTP and disabilities of various musculoskeletal disorders.[2,26,97,134] A previous study on various foot and ankle pathologies, including lateral ankle sprains, suggested that kinesiophobia and intensity of pain were associated with self-reported functions and disabilities of patients.[97] Similarly, a previous study of general adults reported that patients continued to have a fear of re-injury at the time of discharge and the patient's judgment of their functional recovery was lower than that of the clinician's.[96] Furthermore, patients continued to have a fear of re-injury until they actually performed tasks that they deemed as difficult.[96] Therefore, it is important that patients go through high demand activities and tasks such as the SLHTs in the current study so that not only clinicians but also patients can evaluate how the injured ankle functions with those activities in a controlled situation, and estimate their own functional recovery. This process will help patients to conquer a fear of re-injury.[96]

The concept of the feeling of instability has not been well defined in previous studies. Various terms, such as giving-way, functional instability, recurrent sprains, and perceived instability, have been used to express the concept.[28,68,111] This has contributed to the difficulty in comparing studies and inconsistent results.[28] The term “giving way” has been the most commonly used term, however, it can be either perceived or actual twisting of the ankle.[68] Therefore, the term “perceived instability” was used in this study.[28] Additionally, to the authors’ knowledge, this was the first attempt to quantify the perceived instability with the SLHTs whereas previous studies reported only about the presence or absence of such feeling among CAI.

A previous study reported a significant association between self-reported recovery and the sensation of “giving way” as well as pain intensity during high ankle load activities at a short-term follow up after acute ankle sprain.[162] Another study on CAI subjects reported a significant correlation between the functional ankle instability index and presence of feelings of instability during FPTs.[37] Similarly, there were significant associations between the intensity of perceived instability with the SH test and the scores of the FAAM-J ADL and SP in this study this was not the case with the SQ test. The authors believe this was because the SH test more strongly challenges the lateral aspect of the ankle complex and exposed the functional deficits that subjects had. Although it is speculated that the FAAM-J SP has a higher association with perceived instability with the SLHTs, it is unknown why the FAAM-J ADL had a stronger association in this study.

The use of FPTs is recommended to be a component of the RTP decision making process by the literature.[89,103] To the authors' knowledge, this was the first study in which the FPTs were utilized at the RTP phase of traumatic lateral ankle sprains whereas the previous studies were on CAI.[13,14,37,176] Based upon the results of this study, clinicians can discriminate the acutely sprained ankle at RTP phase against the opposite healthy limbs and control limbs based upon perceived instability with the SH and SQ tests.

Limitations

Several limitations with the current study should be noted. First, RTP decisions were made by respective team medical personnel without a uniform objective guideline. Clinician-rated data such as ROM, muscle strength, and swelling were not included in the study. Therefore, it is unknown if this might have influenced the results of the current study.

Second, a successful RTP is not well defined in the literature and various factors can influence the decision.[21,153] Furthermore, length of full participation before it is considered a successful RTP can vary.[153] In this study, successful RTP was determined on the following day that subjects achieved full participation. This was necessary because the primary purposes of this study were to evaluate if functional deficits are present among college basketball players at RTP phase following traumatic lateral ankle sprains. To counter this constrains, it was confirmed at three months post-RTP that subjects were able to maintain full participation without reinjury or any restrictions to their participations following RTP.

Third, the time between RTP and the testing session was not consistent. This was because the subjects were competitive athletes as well as college students with very limited schedule flexibility due to the team's practice schedule and academic duties. Therefore, the flexibility of scheduling the testing session was necessary.

Lastly, although all subjects did not have injuries or conditions in the six months prior to their participation in the study or preexisting medical conditions that required medical treatment at the time of ankle sprain, previous history of ankle sprains was not among the exclusion criteria. Hence, the result of this study needs to be interpreted with caution as the effects of previous ankle sprains may extend over as long as one year.[165] Nonetheless, this criteria was employed because history of ankle sprains is prevalent and common in competitive basketball players[55,125] and it would have been extremely difficult to gather groups of subjects otherwise.

SECTION 3-6: CONCLUSION

We found that competitive college basketball players at RTP phase following traumatic lateral sprains had functional deficits in the ADL and Sports subscale of the FAAM-J when compared with contralateral healthy limbs and healthy controls. Subjects had significantly higher perceived instability and greater pain with the SLHTs whereas they had functional performance deficits with the SH test based upon the time measures. Results from this investigation support the use of a self-reported outcome measure and functional performance tests in RTP decision making process.

Chapter 4:

Prognostic ability of patient- and clinician-rated measures for traumatic lateral ankle sprains among collegiate basketball players

SECTION 4-1: ABSTRACT

Context: Patient-rated measures have been reported to be more valid in the prognosis of traumatic lateral ankle sprain among competitive athletes than clinician-rated measures.

Objective: The purpose of this study was to evaluate the prognostic ability of clinician-rated measures and the Japanese version of the Foot Ankle Ability Measure (FAAM-J) for the duration of disability after traumatic lateral ankle sprains among competitive, collegiate basketball players.

Design: Prospective cohort study.

Setting: Collegiate Athletic Training/Sports Medicine clinical setting.

Patients or Other Participants: Twenty one collegiate athletes.

Main Outcome Measure(s): Following a traumatic lateral ankle sprain, subjects completed the ADL and Sports subscales of the FAAM-J (FAAM-J ADL, SP). We

also measured pain associated with ADL and Sports (Pain ADL, SP), passive dorsiflexion ROM (PROM), swelling, dorsiflexion strength, and eversion strength. For clinician-rated measures, the values of injured limbs were normalized to those of uninjured limbs for statistical analysis. Simple regression and multiple regression analyses were performed to identify the correlations of all the measures with the number of days subjects needed to the return-to-play (RTP).

Results: Simple regression analysis revealed a statistically significant correlations of the FAAM-J SP ($r = -.69$, $p < .01$), Pain SP ($r = .50$, $p < .01$), and PROM ($r = -.70$, $p < .01$) with the number of days to the RTP. A multiple regression model of the FAAM-J, Pain SP and PROM produced a correlation coefficient of .78 and explained 54.5 % of the variance of the number of days needed to achieve RTP ($p < .01$).

Conclusions: The Sports subscale score of the FAAM-J, the VAS score of pain associated sports activities and dorsiflexion PROM deficit were relevant in predicting the number of days needed for competitive, collegiate basketball players to achieve RTP after traumatic lateral ankle sprain.

Section 4-2: INTRODUCTION

The primary purpose of this study was to evaluate the prognostic ability of patient-rated measures and the FAAM-J for the duration of participation restriction following a traumatic lateral ankle sprain among competitive, collegiate basketball players. It was hypothesized that RTP following a traumatic lateral ankle sprain among collegiate basketball players is more valid and predictable when based upon the FAAM-J than clinician-rated measures. This was a part of a larger study which investigated patient-rated evaluation of traumatic lateral ankle sprain.

Section 4-3: METHODS

Subjects

Subjects (n= 36) were collegiate basketball players of a small Japanese college, who each sustained a traumatic lateral ankle sprain during a game or practice participation. (**FIGURE 4-1**) A traumatic lateral ankle sprain was defined as a sprain that occurred with inversion mechanism, resulting in at least one day of restriction from a game or practice participation ("time loss" definition of injury).[64] The exclusion criteria for the study were; concurrent fractures, a history of surgery to the lower extremity or lower back, any preexisting athletic injury requiring medical attention at the time of the ankle injury, any injury to either foot, ankle, knee, hip, or lower back region that resulted in any restrictions from practice/game participation in the previous 6 months. Those who were unable to schedule a testing session within 72 hours post injury due to scheduling difficulties were also excluded. Additionally, ankle sprains were not included in the study when clinical evaluation revealed that signs and symptoms were not limited to the lateral aspect of the joint, but also present in other areas such as metatarsal bones, medial aspect of the joint, and anterior tibiofibular ligament, or syndesmosis sprains. Thirty-six subjects sustained a traumatic lateral ankle sprain during the study period. Fifteen subjects were excluded from the study due to; scheduling difficulties (n = 5), a history of injury within previous 6 months (n = 4), history of surgery (n = 2), syndesmosis ankle sprain (n = 1), and symptoms not limited to the lateral aspect of the joint (n = 3). Thus, 21 subjects (18 males, 3 females, height = 177.2 ± 9.1 cm, mass = 70.9 ± 7.9 kg, 19.2 ± 1.2 yoa) entered the study, two of whom were not available for the RTP testing session. (**FIGURE 4-1**) This was a prospective cohort study.

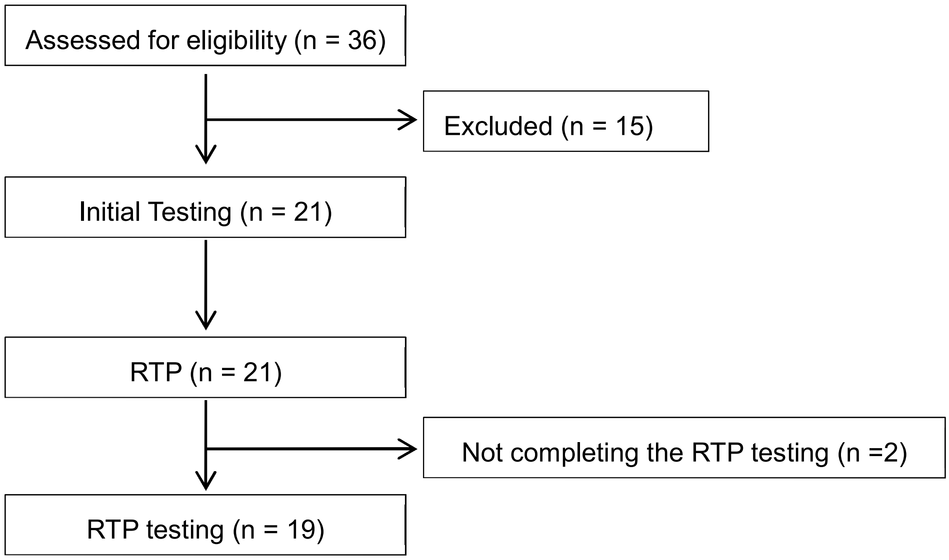

FIGURE 4-1. Flow of participants

Procedure

Following a lateral ankle sprain, subjects were evaluated by the primary author (D.U.), an ATC with 9 years of clinical experience, to confirm eligibility and exclusion criteria. No subjects showed signs or symptoms of concurrent fractures.[149] The initial testing session was scheduled within 72 hours post injury with subjects' earliest convenience. The RTP testing session was scheduled once subjects achieved a successful RTP, defined as participation in a practice or game session without any restriction. Successful RTP was confirmed on the following day by ensuring that subjects could maintain their participation status.

Prior to participating in the study, all subjects read and signed a consent form, approved by the Institutional Review Board of Waseda University.

Outcome Measure

The primary outcome measure was the number of days that subjects needed to achieve RTP.

Patient-Rated Measures

Self-Reported Function

Subjects completed both the ADL and Sports subscales of the FAAM-J[158] (FAAM-J ADL and SP) at the testing sessions.

Pain

Subjects rated their pain on the 10 cm visual analogue scale (VAS).[177] Each subject was asked to "please rate your current level of pain with activities of daily living on the line below" and "please rate your current level of pain with your sports activities on the line below". The left end of the VAS was labeled as "no pain at all" and the right end was labeled as "unbearable pain".

Clinician-Rated Measures

Swelling

Swelling was measured using the figure-8 method, in which subjects were asked to lie supine on the table with ankles to 20˚ plantar-flexed with a custom-made device.[49,138] A tape measure was placed from the midpoint between the lateral malleolus and the tibialis anterior to the navicular tuberosity, the base of fifth metatarsal, the medial malleolus, the lateral malleolus, and the starting point in a figure-8 manner.[135] A mark was placed on each anatomic landmark prior to tape measurements for reliability.[138] The length was recorded in millimeters. The mean of 3 measurements was used for the analysis.[138]

Ankle dorsiflexion range of motion

Ankle dorsiflexion passive ROM (PROM) was measured with a generic plastic goniometer. Subjects were prone on the table with the knee joint flexed to 90˚. The axis of the goniometer was placed on the lateral aspect of the calcaneus while the stationary arm of the goniometer was aligned with the fibular head and the moving arm was aligned with the fifth metatarsal. The examiner passively moved the ankle into dorsiflexion while minimizing the subject's ankle motion in the frontal plane to avoid pronation or supination motion.[156] Subjects were instructed to notify the examiner of any pain they experienced during the measurement. If pain was felt during dorsiflexion, the range of motion prior to pain onset was used for measurement. If no pain was felt, the examiner passively dorsiflexed the ankle until a firm end point was felt. The mean of 3 measurements was used for the analysis.

Strength

Ankle dorsiflexion (DF) and eversion (EV) isometric strength tests, or make tests, were conducted with a hand held dynamometer (HHD) (PowerTrack II Commander, JTECH Medical, Salt lake City, Utah). Assessment of muscle strength with the HHD is regarded as reliable and valid for muscle strength assessment in the clinical setting.[145,146] Subjects were asked to lie supine on the table, holding on to the sides of the table with their hands for stability. The HHD was placed against the lateral aspect of the 5th metatarsal for EV and the dorsum of the navicular for DF.[168] The ankle joint was kept in the neutral position for both of EV and DF testing. Subjects were instructed to exert 5-second isometric maximum voluntary contractions against the stationary resistance applied by the investigator.[151] A standard verbal instruction of "go ahead-push-push-push-push and relax'' was given to subjects.[155] To reduce a possible learning effect, subjects were asked to perform one sub-maximal practice trial prior to the four testing trials in each direction. Measurements of the injured limb were taken within subjects' pain tolerance. The obtained data (in

Newton, or N) were divided by subjects' body weights. The mean of the best three of four testing trials was used for the statistical analysis.[155]

We recorded all clinician-rated measurements on the injured and uninjured limb of each subject. The order of the measurements was randomized. The FAAM-J ADL and SP as well as Pain ADL and SP were recorded only on the injured limb. The primary author (D.U.) collected all the data to ensure reliability. The intersession test-retest reliabilities for all clinician-rated measures were determined by calculating the intraclass correlation coefficients (ICC) based upon a pilot study of 16 healthy college students. Standard Error of Measurement (SEM) was calculated as SEM = $\alpha \sqrt{1 - \mathrm{ICC}}$ where α was the standard deviation of the measurements.[76] The minimal detectable change, using 95% confidence intervals (MDC_{95}), was calculated with the equation of 1.96 x SEM x $\sqrt{2}$.[138] ICC, SEM, and MDC for all clinician-rated measures were; ICC = .89, SEM = 2.7°, MDC = 7.4° for PROM; ICC = .99, SEM = .3 cm, MDC = .7 cm for swelling; ICC = .81, SEM = .2 N/bw, MDC = .7 N/bw, for DF; and ICC = .92, SEM = .2 N/bw, MDC = .5 N/bw, for EV. There was one week between the two measurement sessions. SEM for the FAAM-J ADL and SP were 2.9 and 5.0 points, respectively whereas the MDC at 95% confidence interval was +/- 8.1

point for the ADL Subscale, and +/- 14.0 point for the Sports subscale.[158]

Athletic Rehabilitation

The secondary author (H.S.), an ATC with 9 years of clinical experience, supervised the athletic rehabilitation of subjects and made the RTP decisions. The treatment and rehabilitation process followed conventional guidelines.[12] Subjects participated in rehabilitation for approximately 90 minutes once a day, 6 days per week. In the acute phase, the injured ankle was immobilized and subjects were instructed to apply ice, compression, and elevation for 30 minutes several times throughout the day until acute inflammation signs and symptoms subsided. Ambulatory assistance such as crutches was given to the subjects as needed. Once acute inflammation signs and symptoms diminished, therapeutic exercises were initiated to restore range of motion, muscle strength, proprioception, static and dynamic postural control, and weight bearing and ambulatory status while utilizing various therapeutic modalities. In the advanced phase, more dynamic and generic athletic movements such as jumping, change of direction, cutting, sprinting, and stopping were performed. Then, the rehabilitation was gradually progressed and more sport specific movements were incorporated according to subjects' recovery levels while swelling and pain were minimized. Restricted sport participation was allowed once clinical examinations revealed subjects achieved good ankle strength, pain-free full ROM, and static and dynamic postural controls compared uninjured limbs, and could perform sport specific movements safely. RTP was allowed by the ATC when subjects a) did not aggravate signs and symptoms during restricted sport participation and b) gained confidence to resume full athletic participation. RTP was confirmed on the following day of full participation.

STATISTICAL ANALYSIS

All clinician-rated data from subjects' injured limbs were normalized to the opposite healthy limbs (injured / healthy x 100). Subscales of the FAAM-J were divided by the highest possible scores to calculate percentage values.[23] A simple regression analysis was performed to determine the correlation coefficients between the dependent variables and the number of days to RTP. A multiple regression analysis was performed on the variables that were found to be statistically significant. The level of significance was set at $p < .05$ for all statistical analysis. Additionally, for the 19 subjects who were measured after RTP, the effect sizes were calculated with the equation of (post – pre score) / pooled standard deviation.[122,167]

Section 4-4: RESULTS

The number of days needed to achieve RTP was 11.7 ±6.4 days. The descriptive statistics are presented in the **TABLE 4-1**. The mean difference values exceeded the MDCs for all of the clinician rated measures except for PROM. Simple regression analysis revealed that PROM ($r = -.70$, $p < .01$), Pain SP ($r = .50$, $p = .01$) and the FAAM-J SP ($r = -.69$, $p < .01$) had significant correlations with the number of days to RTP. The FAAM-J ADL ($r = -.04$, $p = .43$), Pain ADL ($r = .09$, $p = .34$), swelling ($r = .23$, $p = .16$), DF ($r = -.25$, $p = .13$), and EV ($r = .23$, $p = .16$) did not have significant relationships with the number of days to RTP. The multiple regression model of the FAAM-J SP, Pain SP, and PROM produced a correlation efficient of .78 with adjusted r^2 of .545 with the number of days needed to achieve RTP ($p < .01$). (**TABLE 4-2**) A comparison of the initial and RTP testing sessions of the injured ankle as well as corresponding effect sizes are presented in **TABLE 4-3**. The mean duration between the date of injury and the initial testing session was 1.5 ±0.9 days whereas the mean duration between the date of RTP and the RTP testing session was 4.9 ±4.0.

TABLE 4-1. Descriptive Statistics at the Acute Testing Session

	Injured	Uninjured	Mean Difference	Symmetry
FAAM ADL	60.1 ± 13.6	na	na	na
FAAM SP	14.3 ± 7.3	na	na	na
Pain ADL (cm)	3.0 ± 1.9	na	na	na
Pain SP (cm)	6.0 ± 2.6	na	na	na
PROM (deg.)	16.9 ± 5.8	20.4 ± 6.1	3.5 ± 4.9	0.83 ± 0.28
Swelling (cm)	53.1 ± 2.5	52.1 ± 2.7	-1.0 ± 0.7	1.02 ± 0.01
DF (N/bw)	2.2 ± 0.7	3.0 ± 0.5	0.8 ± 0.6	0.73 ± 0.21
EV (N/bw)	2.1 ± 0.9	3.0 ± 0.8	0.9 ± 0.8	0.71 ± 0.25

TABLE 4-2. Correlation Values from the Multiple Regression Analysis

	r	Adjusted r^2	p
PROM	-.70	.465	$p < .01$
FAAM-J SP	-.69	.453	$p < .01$
Pain SP	.50	.214	$p = .02$
Combination of the FAAM-J SP, Pain SP and PROM	.78	.545	$p < .01$

TABLE 4-3. Values at the Acute and RTP Testing Sessions and Effect Sizes

	Acute	RTP	Mean Difference	Effect Size(CI_{95})
FAAM ADL	59.7 ± 14.3	81.9 ± 3.5	-22.2 ± 13.9	1.5 (1.0, 1.9)
FAAM SP	14.1 ± 3.5	28.3 ± 3.9	-14.2 ± 7.9	1.5 (1.1, 2.0)
Pain ADL (cm)	3.0 ± 1.9	0.3 ± 0.4	-2.7 ± 1.8	1.4 (1.0, 1.9)
Pain SP (cm)	6.1 ± 2.7	1.3 ± 1.5	-4.7 ± 3.0	1.5 (1.0, 1.9)
PROM (deg.)	16.7 ± 5.9	22.2 ± 6.2	5.5 ± 4.9	0.8 (0.5, 1.2)
Swelling (cm)	53.2 ± 2.2	52.5 ± 2.4	-0.7 ± 0.5	0.3 (0.2, 0.4)
DF (N/bw)	2.2 ± 0.6	3.2 ± 0.6	1.0 ± 0.5	1.3 (1.0, 1.6)
EV (N/bw)	2.1 ± 0.9	3.2 ± 0.8	1.1 ± 0.7	1.1 (0.7, 1.4)

The values were from 19 subjects who were available for both of the acute and RTP testing sessions.

Section 4-5: DISCUSSION

In the current study, we found that only the FAAM-J SP, Pain SP and PROM had significant correlations with the duration of participation restriction after a traumatic lateral ankle sprain among collegiate basketball players. A combination of the FAAM-J SP, Pain SP, and PROM explained 54.5 % of the variance. The results of this study were compatible with previous reports that RTP following traumatic lateral ankle sprain is more valid and predictable when it is based upon patient-rated measures, or activity limitations, and participation restrictions.[23,178]

The FAAM-J SP had the second highest correlation, r = .69, with duration of the disability in this study. It is reasonable to see the FAAM-J SP had a high correlation with disability encountered in the current study because the FAAM-J SP was intended to be more specific to activity limitations and participation restrictions associated with sports activities.[106] This finding provided evidence of the FAAM-J SP's validity in predicting RTP following traumatic lateral ankle sprain among competitive basketball players. In fact, the mean difference between the acute and RTP testing sessions was 14.2 ±7.9, which was larger than the MDC of the FAAM-J SP, or 14.0 points.

Pain-related fear of movement, or kinesiophobia, has been reported to be associated with disabilities, or RTP, of various musculoskeletal disorders[26,134] although this has been predominantly demonstrated in patients with Anterior Cruciate Ligament reconstruction.[2,26,94] A previous report suggested that kinesiophobia and intensity of pain with various foot and ankle pathologies, including lateral ankle sprains, were associated with self-reported functions and disabilities of patients while kinesiophobia was the strongest contributor to disability.[97] Therefore, although pain intensity is not a direct measurement of kinesiophobia, our finding that Pain SP had a significant correlation with the duration of disability in the current study deemed reasonable.

The finding that PROM loss was correlated with the number of days to RTP was in agreement with a study by Wilson and Gansneder[178] although the PROM loss at the acute testing session in the current study was smaller than MDC. Several literatures have reported that restricted dorsiflexion ROM is associated with traumatic lateral ankle sprain and chronic ankle instability.[18,32,40,60,72,131,167,185] Furthermore, restricted dorsiflexion ROM has been reported to be associated with gross motor control alterations in various tasks[29,54,143] and dynamic balance capabilities.[5,71] Altered joint kinematics of the talocrural joint has been considered as a plausible mechanism for limited dorsiflexion ROM.[32,167,172] Consequently, restoration of arthrokinematic movement of the talocrural joint after traumatic lateral ankle sprain has been shown to result in increased dorsiflexion ROM and improved function.[18,20,24,60,70,130] Furthermore, dorsiflexion ROM reflects capsuloligamentous structures when measured with the knee flexed 90°.[36,92,93] Therefore, it is plausible that PROM loss measured with the knee flexed 90° was correlated with the number of days to RTP in the current study. Nonetheless, clinicians need to interpret the result of the current study with caution as responsiveness of ankle joint ROM was questioned in a literature review.[107]

That swelling did not correlate with the number days to RTP in the current study was in agreement with a previous study.[178] Other literatures have also reported that swelling does not correlate with self-reported functions.[102,135] Although Figure-8 method may be a reliable and valid method to measure the extent of swelling and inflammation and the mean difference of swelling at the acute testing session matched the MDC of .7cm, it may not reflect the severity of perceived activity limitations and participation restrictions at the initial post-injury stage.[135] And hence, it may not be suitable to predict the improvements of those variables. In fact, subjects in the current study went through a large change in their activity limitation and participation restriction status, from unable to continue sports activities with the FAAM-J SP of 14.1 ±3.5 to full participation with the FAAM-J SP of 28.3 ±3.9, however, the effect size of swelling was small. (**TABLE 4-3**)

Our finding that DF and EV strength loss did not correlate with the number days to RTP, was in agreement with a previous investigation.[23] To the authors' knowledge, the study by Cross et al[23] is the only study which examined the prognostic ability of ankle joint strength measures for RTP after traumatic lateral ankle sprain. Although strength deficits have been reported following traumatic lateral ankle sprains,[1,73] previous reports from various populations and settings conflict over the effects of traumatic lateral ankle sprains and simulated swelling on muscular function, or arthrogenic muscle response.[65,91,126] Contrary to the common belief that periarticular muscles are inhibited by acute joint injuries,[75,150] previous studies reported no effect or even facilitation of certain muscles surrounding the ankle joint, attributing it to the protective mechanism.[91]

Furthermore, a previous investigation showed that VAS scores of current level of pain explained a large amount of variance in the motor-neuron pool excitability of the tibialis anterior, however, the scores did not explain those of the soleus or peroneus longus muscles in the acutely sprained ankles.[91] Although it is common to assume an adverse relationship between pain and muscle inhibition, a previous report showed muscle activation was not affected in the presence of pain after knee injury[116] and little evidence is available for the acutely sprained ankle joint. Additionally, to the authors' knowledge, few researches are available to show improvement in the ankle strength result in improvements in activity limitations and participation restrictions. Thus, although the DF and EV strength deficits at the acute testing session were larger than the respective MDC, they were not necessarily proportional to the duration of disability and may have little prognostic value after traumatic lateral ankle sprain. Further research is needed in this area

The FAAM-J ADL did not have a significant correlation with the number of days to RTP in this study although the mean differences at the acute testing session as well as the improvement from the acute testing to the RTP testing sessions were larger than the MDC of the FAAM-J ADL. (**TABLE 4-1 & 4-3**) Because the FAAM-J ADL is not specific to sports activity limitations and participation restrictions, it may not be effective in predicting the number of days to RTP.

Based upon the measurements from 19 subjects who completed the RTP testing session, the effect sizes ranged from .3 to 1.5. In fact, the effect size for every measure except for swelling exceeded .8, showing large improvement during the course of the athletic rehabilitation process. (**TABLE 4-3**) The FAAM-J ADL and SP showed the largest improvement with the effect size of 1.5

while swelling showed the least improvement with the effect size of .3.

Clinicians need to interpret the results of the current study with cautions. In the patient-center medicine, where patient's values, preferences and needs are respected, patient oriented outcome measures are considered as the gold-standard in the assessment of musculoskeletal conditions.[27,129] However, they should not be considered the sole outcome measures, nor the significance of clinician-rated measures should be underestimated as clinician-rated measures are valuable in many aspects. Therefore, the FAAM-J SP should be considered a necessary but not sufficient measure in the assessment of traumatic lateral ankle sprains.

There were a couple limitations to be noted in this study. First, the rehabilitation process and RTP decisions in this study were not strictly controlled. Although the purpose of this study was not to evaluate the effectiveness of a specific rehabilitation protocol or RTP guidelines, this might have influenced the results of the current study.

Second, the subject pool consisted only of a small number of competitive collegiate basketball players although the number of subjects in the current study is comparable to those in previous studies, n= 21[178] and 20.[23] This was necessitated because a relative large percentage of potential subjects (41.6%) were excluded from the study. we performed a post hoc power analysis with a statistical software.[51,52] The variance of the duration of disability explained by valid three measures was .545 with α set at 0.05. The analysis produced a power of .958. Therefore, we believe the subject pool of the current study is sufficient although the results of the current study are only applicable to the specific population of the current study.

Furthermore, an injury can have different effects on the HR-QOL of physically active individuals and athletes than on that of the general population.[109,159,163] Therefore, clinicians need to be cautious to apply the results of the current study to different populations such general and/or youth populations. Future research should address these limitations by including a larger number of subjects from various sports, ages and different competitive levels.

Third, based upon the number of days to RTP, 11.7 ±6.4 days, majority of the traumatic lateral ankle sprains in the study are considered relatively minor. Therefore, clinicians need to be careful in applying the results of the current study to relatively severe traumatic lateral ankle sprains.

Section 4-6: CONCLUSION

The results of this study provide evidence of the prognostic values of the Sports subscale score of the FAAM-J, the VAS score of pain associated sports activities, and dorsiflexion PROM deficit measured with the knee flexed 90˚ to predict the duration of disability following traumatic lateral ankle sprain among competitive collegiate basketball players.

Chapter 5:

Discussions

Crucial to EBP and patient-centered medicine, POEMs can be provided only through studies that include patient-rated outcome measures.[159] However, the lack of such approaches in the profession of athletic training and in the sports medicine field has been reported in the literature.[50,127,128,144,159] This is detrimental to the quality of care provided to the athlete as POEMs directly relate to the HR-QOL of the athletes. Contrary to the POEM, DOE is of uncertain clinical utility unless evidence of how it contributes to the overall activity limitations and disabilities is provided.[78,83]

Furthermore, physically active individuals and athletes have been reported to perceive activity limitations and disabilities from a health condition differently than general populations as they have different expectations on their normal functions and social roles.[4,109,163,164] Therefore, POEMs specific to the athletic population need to be provided by those who are involved in the care of such population. The primary purpose of this dissertation was to provide POEMs to guide the treatment and rehabilitation process as well as RTP decisions following traumatic lateral ankle sprain in competitive college athletes.

Patient-rated outcome measures allow clinicians to assess the outcome of the intervention through the patient's eyes.[53] They are the primary outcome measures in patient-centered medicine as the patient provides the information that he or she perceives to be most important.[140]

The first part of this series of investigations provide evidence of cross cultural adaptation, translation, convergent and divergent validity, internal consistency, and test-retest reliability of the FAAM-J based upon various collegiate competitive athletes. The original version of the FAAM is a self-reported outcome instrument which measures activity and participation limitations caused by a condition of the foot and ankle region.[106]

No major difficulties were encountered during the translation and cross cultural adaptation process in this investigation. For convergent validity, the results showed that the ADL and Sports Subscales of the FAAM-J had 0.86 and 0.75 correlation coefficients with Physical functioning of the Short Form-36 (SF36). For divergent validity, correlation coefficients with MH of the SF-36 were 0.29 and 0.27 for each subscale. Cronbach's alpha for internal consistency was 0.99 for the ADL and 0.98 for the Sports Subscale. The SEM for the ADL Subscale was 2.9 and the MDC at 95% CI was +/- 8.1 while the SEM for the Sports Subscale was 5.0 and the MDC at 95% CI of +/- 14. Test retest reliability measures revealed the ICC values of 0.87 for the ADL and 0.90 for the Sports Subscales. The MDC at 95% confidence was +/- 6.8 for the ADL Subscale, and +/- 13.7 for the Sports subscale.

In the literature, the FAAM has been validated for its use in a variety of health conditions. Furthermore, the FAAM has been translated into French, German, and Persian.[9,108,124] Therefore this study will allow Japanese speaking clinicians and researchers to assess the outcome of their interventions and clinical decisions based upon studies that used other language versions of the FAAM, and vice versa.[80]

Following traumatic athletic injuries, the most important outcome is full

RTP with minimal symptoms.[163] In particular this is the case for traumatic lateral ankle sprains as premature RTP has been indicated as one of the causes for re-injury and subsequent development of CAI.[113,160] However, there are few studies that show athletes are in fact allowed RTP with functional deficits. Therefore, in the second investigation, we investigated if functional deficits are present in college basketball players at RTP phase following traumatic lateral ankle sprains with the FAAM-J ADL and SP, and the SLHTs.

Significantly lower FAAM-J ADL and SP scores were found among the involved limbs. Subjects had significantly higher perceived instability and greater pain on SLHTs with the involved limbs although no significant findings were found among the time measures of the SLHTs. Furthermore, there are significant correlations between perceived instability and scores on the FAAM-J subscales.

Based upon the results of the current study, collegiate basketball players were in fact cleared for RTP without full recovery following traumatic lateral ankle sprain. This investigation was the first to show college basketball players are achieving RTP with functional deficits. Whether RTP without full recovery in fact leads to re-injury or development of CAI needs to be investigated in future research.

In the third investigation, we examined the prognostic values of the FAAM-J as well as other clinical impairment measures with traumatic lateral ankle sprain. This is crucial as successful RTP is the primary concern of the injured athlete and the goal of the athletic rehabilitation process.[163] Also, this will provide information on the degree to which the FAAM-J and other impairment measures relate to the severity of the disability caused by traumatic lateral ankle sprains. With this evidence provided, these measures can be validated to be used to predict RTP.

Following a traumatic lateral ankle sprain, 21 collegiate basketball players completed the FAAM-J ADL and SP. We also measured Pain ADL and SP, PROM, swelling, dorsiflexion strength, and eversion strength. The values of injured limbs were normalized to those of uninjured limbs for statistical analysis. The results indicated a statistically significant correlations of PROM ($r = -.70$, $p < .01$), Pain SP ($r = .50$, $p = .02$) and FAAM-J SP ($r = -.69$, $p < .01$) with the number of days to RTP. A multiple regression model of the FAAM-J, Pain SP and PROM produced a correlation coefficient of .78 and explained 54.5 % of the variance of the number of days needed to achieve RTP ($p < .01$). The FAAM-J SP, Pain SP, and dorsiflexion PROM were relevant in predicting the number of days needed for competitive, collegiate basketball players to achieve RTP after traumatic lateral ankle sprains. On the other hand, other impairment measures were questioned for their prognostic values although they are reliable impairment measures.

To the author's knowledge, there are only a few studies that compared the effectiveness of clinician-rated measures and patient-rated measures in predicting the duration of disability following traumatic lateral ankle sprains, which also reported prognostic abilities of patient-rated measures following traumatic lateral ankle sprains.[23,178] The results of this study further emphasize the importance of patient-rated measures.

Collectively, these investigations showed the effectiveness of patient-rated measures as prognostic and outcome evaluation tools of collegiate basketball players following traumatic lateral ankle sprains, providing the POEM for such population and condition. An emerging concept in recent years is that clinician-rated measures and patient-rated measures portray different aspects of HR-QOL. In the patient-center medicine, patient oriented outcome measures are considered as the gold-standard in the assessment of musculoskeletal conditions.[27,129]

However, patient oriented outcome measures should not be considered the sole outcome measure, nor the significance of clinician-rated measures should be underestimated as clinician-rated measures are valuable in many aspects. Therefore, the FAAM-J SP should be considered a necessary but not sufficient measure in the assessment of traumatic lateral ankle sprains. The results of the current studies provided further evidence, emphasizing the importance of incorporating patient's perspectives in assessment of traumatic lateral ankle sprains in addition to more prevalent clinician-rated measures.

This series of investigations have limitations. First of all, the subjects of these investigations were competitive, collegiate athlete of relatively small sample. It is reported in the literature that an injury can have different effects on the HR-QOL of physically active individuals and athletes than on those of the general population.[109,159,163] Therefore, clinicians need to be cautious to apply the results of the current investigations to different populations such as general and/or youth populations.

Second, in the second and third investigations, majority of the traumatic lateral ankle sprains in the study were considered relatively minor. Therefore, the results of this these studies are only relevant to those minor traumatic lateral ankle sprains. Clinicians need to be careful in relating the results of the current investigations to relatively severe traumatic lateral ankle sprains.

Future research should address these limitations by including a larger number of subjects from various sports, ages, as well as different competitive levels.

Chapter 6:

Conclusions

The followings are the conclusions;

1. The Japanese version of the Foot Ankle Ability Measure (FAAM-J) is a valid, reliable self-reported outcome instrument for the young, competitive athlete with acute foot and ankle lesions.

2. Based upon the scores of FAAM-J ADL and SP, collegiate basketball players were cleared for RTP without full recovery following traumatic lateral ankle sprains. There is a significant association between the severity of the perceived instability with a functional performance test and the scores of the subscales of the FAAM-J.

3. The FAAM-J, intesnisity of pain associated with sports sctvities, and ankle dorsiflexion passive range of motion limitaions had prognostic values of, and hence validity in estimating, the severity of disability caused by the traumatic lateral ankle sprain among collegiate basketball players while swelling, ankle eversion strength, and ankle dorsiflexion strength did not.

Reference

1. Aiken AB, Pelland L, Brison R, Pickett W, Brouwer B. Short-term natural recovery of ankle sprains following discharge from emergency departments. *J Orthop Sports Phys Ther.* 2008;38(9):566-571.
2. Ardern CL, Webster KE, Taylor NF, Feller JA. Return to sport following anterior cruciate ligament reconstruction surgery: a systematic review and meta-analysis of the state of play. *Br J Sports Med.* 2011;45(7):596-606.
3. Arnheim DD, Prentice WE. *Arnheim's Principles of Athletic Training.* Boston: Mcgraw-Hill College; 1999.
4. Arnold BL, Wright CJ, Ross SE. Functional ankle instability and health-related quality of life. *J Athl Train.* 2011;46(6):634-641.
5. Basnett CR, Hanish MJ, Wheeler TJ, et al. Ankle dorsiflexion range of motion influences dynamic balance in individuals with chronic ankle instability. *Int J Sports Phys Ther.* 2013;8(2):121-128.
6. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine (Phila Pa 1976).* 2000;25(24):3186-3191.
7. Bensing J. Bridging the gap. The separate worlds of evidence-based medicine and patient-centered medicine. *Patient education and counseling.* 2000;39(1):17-25.
8. Beynnon BD, Renstrom PA, Haugh L, Uh BS, Barker H. A prospective, randomized clinical investigation of the treatment of first-time ankle sprains. *Am J Sports Med.* 2006;34(9):1401-1412.
9. Borloz S, Crevoisier X, Deriaz O, Ballabeni P, Martin RL, Luthi F. Evidence for validity and reliability of a French version of the FAAM. *BMC Musculoskelet Disord.* 2011;12:40.
10. Boykin RE, Ogunseinde B, McFeely ED, Nasreddine A, Kocher MS. Preliminary results of calcaneofibular ligament transfer for recurrent peroneal subluxation in children and adolescents. *Journal of pediatric orthopedics.* 2010;30(8):899-903.
11. Brinker MR, O'Connor DP. Stakeholders in outcome measures: review from a clinical perspective. *Clinical orthopaedics and related research.* 2013;471(11):3426-3436.
12. Brody LT, Hall CM. *Therapeutic Exercise: Moving Toward Function.* Third edition ed. Boltimore, MD: Lippincott Williams & Wilkins; 2010.
13. Buchanan AS, Docherty CL, Schrader J. Functional performance testing in participants with functional ankle instability and in a healthy control group. *J Athl Train.* 2008;43(4):342-346.
14. Caffrey E, Docherty CL, Schrader J, Klossner J. The ability of 4 single-limb hopping tests to detect functional performance deficits in individuals with functional ankle instability. *J Orthop Sports Phys Ther.* 2009;39(11):799-806.
15. Carcia CR, Martin RL, Drouin JM. Validity of the Foot and Ankle Ability Measure in athletes with chronic ankle instability. *J Athl Train.* 2008;43(2):179-183.
16. Clancy CM, Eisenberg JM. Outcomes research: measuring the end results of health care. *Science (New York, N.Y.).* 1998;282(5387):245-246.
17. Cleland JA, Abbott JH, Kidd MO, et al. Manual physical therapy and exercise versus electrophysical agents and exercise in the management of plantar heel pain: a multicenter randomized clinical trial. *J Orthop Sports Phys Ther.* 2009;39(8):573-585.
18. Collins N, Teys P, Vicenzino B. The initial effects of a Mulligan's mobilization with movement technique on dorsiflexion and pain in subacute ankle sprains. *Manual*

therapy. 2004;9(2):77-82.
19. Cosby NL, Hertel J. Clinical assessment of ankle injury outcomes: case scenario using the foot and ankle ability measure. *J Sport Rehabil.* 2011;20(1):89-99.
20. Cosby NL, Koroch M, Grindstaff TL, Parente W, Hertel J. Immediate effects of anterior to posterior talocrural joint mobilizations following acute lateral ankle sprain. *J Man Manip Ther.* 2011;19(2):76-83.
21. Creighton DW, Shrier I, Shultz R, Meeuwisse WH, Matheson GO. Return-to-play in sport: a decision-based model. *Clin J Sport Med.* 2010;20(5):379-385.
22. Criswell BJ, Douglas K, Naik R, Thomson AB. High revision and reoperation rates using the Agility Total Ankle System. *Clinical orthopaedics and related research.* 2012;470(7):1980-1986.
23. Cross KM, Worrell TW, Leslie JE, Van Veld KR. The relationship between self-reported and clinical measures and the number of days to return to sport following acute lateral ankle sprains. *J Orthop Sports Phys Ther.* 2002;32(1):16-23.
24. Cruz-Diaz D, Lomas Vega R, Osuna-Perez MC, Hita-Contreras F, Martinez-Amat A. Effects of joint mobilization on chronic ankle instability: a randomized controlled trial. *Disability and rehabilitation.* 2014:1-10.
25. Custers JW, Hoijtink H, van der Net J, Helders PJ. Cultural differences in functional status measurement: analyses of person fit according to the Rasch model. *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation.* 2000;9(5):571-578.
26. Czuppon S, Racette BA, Klein SE, Harris-Hayes M. Variables associated with return to sport following anterior cruciate ligament reconstruction: a systematic review. *Br J Sports Med.* 2014;48(5):356-364.
27. Dawson J, Doll H, Fitzpatrick R, Jenkinson C, Carr AJ. The routine use of patient reported outcome measures in healthcare settings. *BMJ.* 2010;340:c186.
28. Delahunt E, Coughlan GF, Caulfield B, Nightingale EJ, Lin CW, Hiller CE. Inclusion criteria when investigating insufficiencies in chronic ankle instability. *Med Sci Sports Exerc.* 2010;42(11):2106-2121.
29. Delahunt E, Cusack K, Wilson L, Doherty C. Joint mobilization acutely improves landing kinematics in chronic ankle instability. *Med Sci Sports Exerc.* 2013;45(3):514-519.
30. Delahunt E, Monaghan K, Caulfield B. Ankle function during hopping in subjects with functional instability of the ankle joint. *Scandinavian journal of medicine & science in sports.* 2007;17(6):641-648.
31. Demeritt KM, Shultz SJ, Docherty CL, Gansneder BM, Perrin DH. Chronic Ankle Instability Does Not Affect Lower Extremity Functional Performance. *J Athl Train.* 2002;37(4):507-511.
32. Denegar CR, Hertel J, Fonseca J. The effect of lateral ankle sprain on dorsiflexion range of motion, posterior talar glide, and joint laxity. *J Orthop Sports Phys Ther.* 2002;32(4):166-173.
33. Denegar CR, Miller SJ, 3rd. Can Chronic Ankle Instability Be Prevented? Rethinking Management of Lateral Ankle Sprains. *J Athl Train.* 2002;37(4):430-435.
34. Denegar CR, Vela LI, Evans TA. Evidence-based sports medicine: outcomes instruments for active populations. *Clin Sports Med.* 2008;27(3):339-351, vii.
35. Di Stasi SL, Logerstedt D, Gardinier ES, Snyder-Mackler L. Gait patterns differ between ACL-reconstructed athletes who pass return-to-sport criteria and those who fail. *Am J Sports Med.* 2013;41(6):1310-1318.
36. DiGiovanni CW, Kuo R, Tejwani N, et al. Isolated gastrocnemius tightness. *J*

Bone Joint Surg Am. 2002;84-A(6):962-970.
37. Docherty CL, Arnold BL, Gansneder BM, Hurwitz S, Gieck J. Functional-Performance Deficits in Volunteers With Functional Ankle Instability. *J Athl Train.* 2005;40(1):30-34.
38. Doherty C, Delahunt E, Caulfield B, Hertel J, Ryan J, Bleakley C. The incidence and prevalence of ankle sprain injury: a systematic review and meta-analysis of prospective epidemiological studies. *Sports Med.* 2014;44(1):123-140.
39. Drake M, Bittenbender C, Boyles RE. The short-term effects of treating plantar fasciitis with a temporary custom foot orthosis and stretching. *J Orthop Sports Phys Ther.* 2011;41(4):221-231.
40. Drewes LK, McKeon PO, Kerrigan DC, Hertel J. Dorsiflexion deficit during jogging with chronic ankle instability. *J Sci Med Sport.* 2009;12(6):685-687.
41. Ebell MH, Barry HC, Slawson DC, Shaughnessy AF. Finding POEMs in the medical literature. *The Journal of family practice.* 1999;48(5):350-355.
42. Ebell MH, Siwek J, Weiss BD, et al. Strength of recommendation taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. *American family physician.* 2004;69(3):548-556.
43. Eechaute C, Bautmans I, De Hertogh W, Vaes P. The multiple hop test: a discriminative or evaluative instrument for chronic ankle instability? *Clin J Sport Med.* 2012;22(3):228-233.
44. Eechaute C, Vaes P, Duquet W. The dynamic postural control is impaired in patients with chronic ankle instability: reliability and validity of the multiple hop test. *Clin J Sport Med.* 2009;19(2):107-114.
45. Eechaute C, Vaes P, Duquet W. Functional performance deficits in patients with CAI: validity of the multiple hop test. *Clin J Sport Med.* 2008;18(2):124-129.
46. Eechaute C, Vaes P, Van Aerschot L, Asman S, Duquet W. The clinimetric qualities of patient-assessed instruments for measuring chronic ankle instability: a systematic review. *BMC Musculoskelet Disord.* 2007;8:6.
47. Ekstrand J, Tropp H. The incidence of ankle sprains in soccer. *Foot & ankle.* 1990;11(1):41-44.
48. Escorpizo R, Stucki G, Cieza A, Davis K, Stumbo T, Riddle DL. Creating an interface between the International Classification of Functioning, Disability and Health and physical therapist practice. *Phys Ther.* 2010;90(7):1053-1063.
49. Esterson PS. Measurement of ankle joint swelling using a figure of 8*. *J Orthop Sports Phys Ther.* 1979;1(1):51-52.
50. Evans TA, Lam KC. Clinical outcomes assessment in sport rehabilitation. *J Sport Rehabil.* 2011;20(1):8-16.
51. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behavior research methods.* 2009;41(4):1149-1160.
52. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior research methods.* 2007;39(2):175-191.
53. Fitzpatrick R, Davey C, Buxton MJ, Jones DR. Evaluating patient-based outcome measures for use in clinical trials. *Health Technol Assess.* 1998;2(14):i-iv, 1-74.
54. Fong CM, Blackburn JT, Norcross MF, McGrath M, Padua DA. Ankle-dorsiflexion range of motion and landing biomechanics. *J Athl Train.* 2011;46(1):5-10.
55. Fong DT, Hong Y, Chan LK, Yung PS, Chan KM. A systematic review on ankle injury and ankle sprain in sports. *Sports Med.* 2007;37(1):73-94.
56. Fukuhara S, Bito S, Green J, Hsiao A, Kurokawa K. Translation, adaptation, and

validation of the SF-36 Health Survey for use in Japan. *J Clin Epidemiol.* 1998;51(11):1037-1044.
57. Fukuhara S, Ware JE, Jr., Kosinski M, Wada S, Gandek B. Psychometric and clinical tests of validity of the Japanese SF-36 Health Survey. *J Clin Epidemiol.* 1998;51(11):1045-1053.
58. Gerber JP, Williams GN, Scoville CR, Arciero RA, Taylor DC. Persistent disability associated with ankle sprains: a prospective examination of an athletic population. *Foot Ankle Int.* 1998;19(10):653-660.
59. Goldstein CL, Schemitsch E, Bhandari M, Mathew G, Petrisor BA. Comparison of different outcome instruments following foot and ankle trauma. *Foot Ankle Int.* 2010;31(12):1075-1080.
60. Green T, Refshauge K, Crosbie J, Adams R. A randomized controlled trial of a passive accessory joint mobilization on acute ankle inversion sprains. *Phys Ther.* 2001;81(4):984-994.
61. Grindem H, Logerstedt D, Eitzen I, et al. Single-legged hop tests as predictors of self-reported knee function in nonoperatively treated individuals with anterior cruciate ligament injury. *Am J Sports Med.* 2011;39(11):2347-2354.
62. Gross P, Marti B. Risk of degenerative ankle joint disease in volleyball players: study of former elite athletes. *Int J Sports Med.* 1999;20(1):58-63.
63. Guyatt GH, Feeny DH, Patrick DL. Measuring health-related quality of life. *Annals of internal medicine.* 1993;118(8):622-629.
64. Hagglund M, Walden M, Bahr R, Ekstrand J. Methods for epidemiological study of injuries to professional football players: developing the UEFA model. *Br J Sports Med.* 2005;39(6):340-346.
65. Hall RC, Nyland J, Nitz AJ, Pinerola J, Johnson DL. Relationship between ankle invertor H-reflexes and acute swelling induced by inversion ankle sprain. *J Orthop Sports Phys Ther.* 1999;29(6):339-344.
66. Hendrickx RP, Stufkens SA, de Bruijn EE, Sierevelt IN, van Dijk CN, Kerkhoffs GM. Medium- to long-term outcome of ankle arthrodesis. *Foot Ankle Int.* 2011;32(10):940-947.
67. Hertel J. Functional Anatomy, Pathomechanics, and Pathophysiology of Lateral Ankle Instability. *J Athl Train.* 2002;37(4):364-375.
68. Hiller CE, Kilbreath SL, Refshauge KM. Chronic ankle instability: evolution of the model. *J Athl Train.* 2011;46(2):133-141.
69. Hoch MC, Andreatta RD, Mullineaux DR, et al. Two-week joint mobilization intervention improves self-reported function, range of motion, and dynamic balance in those with chronic ankle instability. *J Orthop Res.* 2012.
70. Hoch MC, Andreatta RD, Mullineaux DR, et al. Two-week joint mobilization intervention improves self-reported function, range of motion, and dynamic balance in those with chronic ankle instability. *Journal of orthopaedic research : official publication of the Orthopaedic Research Society.* 2012;30(11):1798-1804.
71. Hoch MC, Staton GS, McKeon PO. Dorsiflexion range of motion significantly influences dynamic balance. *J Sci Med Sport.* 2011;14(1):90-92.
72. Hoch MC, Staton GS, Medina McKeon JM, Mattacola CG, McKeon PO. Dorsiflexion and dynamic postural control deficits are present in those with chronic ankle instability. *J Sci Med Sport.* 2012.
73. Holme E, Magnusson SP, Becher K, Bieler T, Aagaard P, Kjaer M. The effect of supervised rehabilitation on strength, postural sway, position sense and re-injury risk after acute ankle ligament sprain. *Scandinavian journal of medicine & science in sports.* 1999;9(2):104-109.

74. Hootman JM, Dick R, Agel J. Epidemiology of collegiate injuries for 15 sports: summary and recommendations for injury prevention initiatives. *J Athl Train.* 2007;42(2):311-319.
75. Hopkins JT, Ingersoll CD. Arthrogenic muscle inhibition: a limiting factor in joint rehabilitation. / Inhibition des muscles arthrogeniques: un facteur limitant la reeducation physique de l'articulation. *J Sport Rehabil.* 2000;9(2):135-159.
76. Hopkins WG. Measures of reliability in sports medicine and science. *Sports Med.* 2000;30(1):1-15.
77. Hubbard TJ. Ligament laxity following inversion injury with and without chronic ankle instability. *Foot Ankle Int.* 2008;29(3):305-311.
78. Hurwitz SR, Slawson D, Shaughnessy A. Orthopaedic information mastery: applying evidence-based information tools to improve patient outcomes while saving orthopaedists' time. *J Bone Joint Surg Am.* 2000;82(6):888-894.
79. Institute of Medicine. *Health Professions Education: A Bridge to Quality.* Washington (DC): National Academies Press (US); 2003.
80. Irrgang JJ, Anderson AF, Boland AL, et al. Development and validation of the international knee documentation committee subjective knee form. *Am J Sports Med.* 2001;29(5):600-613.
81. Jette AM. The changing language of disablement. *Phys Ther.* 2005;85(2):118-119.
82. Jette AM. Invited commentary on the ICF and physical therapist practice. *Phys Ther.* 2010;90(7):1064-1065; author reply 1066-1067.
83. Jette AM. Outcomes research: shifting the dominant research paradigm in physical therapy. *Phys Ther.* 1995;75(11):965-970.
84. Jette AM. Toward a common language for function, disability, and health. *Phys Ther.* 2006;86(5):726-734.
85. Jette AM, Keysor JJ. Uses of evidence in disability outcomes and effectiveness research. *The Milbank quarterly.* 2002;80(2):325-345.
86. Johnson MR, Stoneman PD. Comparison of a lateral hop test versus a forward hop test for functional evaluation of lateral ankle sprains. *J Foot Ankle Surg.* 2007;46(3):162-174.
87. Junge A, Engebretsen L, Alonso JM, et al. Injury surveillance in multi-sport events: the International Olympic Committee approach. *Br J Sports Med.* 2008;42(6):413-421.
88. Junge A, Langevoort G, Pipe A, et al. Injuries in team sport tournaments during the 2004 Olympic Games. *Am J Sports Med.* 2006;34(4):565-576.
89. Kaminski TW, Hertel J, Amendola N, et al. National Athletic Trainers' Association position statement: conservative management and prevention of ankle sprains in athletes. *J Athl Train.* 2013;48(4):528-545.
90. Kivlan BR, Martin RL, Wukich DK. Responsiveness of the foot and ankle ability measure (FAAM) in individuals with diabetes. *Foot (Edinb).* 2011;21(2):84-87.
91. Klykken LW, Pietrosimone BG, Kim KM, Ingersoll CD, Hertel J. Motor-neuron pool excitability of the lower leg muscles after acute lateral ankle sprain. *J Athl Train.* 2011;46(3):263-269.
92. Kovaleski JE, Norrell PM, Heitman RJ, Hollis JM, Pearsall AW. Knee and ankle position, anterior drawer laxity, and stiffness of the ankle complex. *J Athl Train.* 2008;43(3):242-248.
93. Krause DA, Cloud BA, Forster LA, Schrank JA, Hollman JH. Measurement of ankle dorsiflexion: a comparison of active and passive techniques in multiple positions. *J Sport Rehabil.* 2011;20(3):333-344.
94. Kvist J, Ek A, Sporrstedt K, Good L. Fear of re-injury: a hindrance for returning to

sports after anterior cruciate ligament reconstruction. *Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA.* 2005;13(5):393-397.
95. Laine C, Davidoff F. Patient-centered medicine. A professional evolution. *JAMA : the journal of the American Medical Association.* 1996;275(2):152-156.
96. Larmer PJ, McNair PJ, Smythe L, Williams M. Ankle sprains: patient perceptions of function and performance of physical tasks. A mixed methods approach. *Disability and rehabilitation.* 2011;33(23-24):2299-2304.
97. Lentz TA, Sutton Z, Greenberg S, Bishop MD. Pain-related fear contributes to self-reported disability in patients with foot and ankle pathology. *Arch Phys Med Rehabil.* 2010;91(4):557-561.
98. Lofvenberg R, Karrholm J, Lund B. The outcome of nonoperated patients with chronic lateral instability of the ankle: a 20-year follow-up study. *Foot Ankle Int.* 1994;15(4):165-169.
99. Logerstedt D, Grindem H, Lynch A, et al. Single-legged hop tests as predictors of self-reported knee function after anterior cruciate ligament reconstruction: the Delaware-Oslo ACL cohort study. *Am J Sports Med.* 2012;40(10):2348-2356.
100. Logerstedt D, Lynch A, Axe MJ, Snyder-Mackler L. Symmetry restoration and functional recovery before and after anterior cruciate ligament reconstruction. *Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA.* 2013;21(4):859-868.
101. Lohr KN, Aaronson NK, Alonso J, et al. Evaluating quality-of-life and health status instruments: development of scientific review criteria. *Clinical therapeutics.* 1996;18(5):979-992.
102. Man IO, Morrissey MC. Relationship between ankle-foot swelling and self-assessed function after ankle sprain. *Med Sci Sports Exerc.* 2005;37(3):360-363.
103. Martin RL, Davenport TE, Paulseth S, Wukich DK, Godges JJ, Orthopaedic Section American Physical Therapy A. Ankle stability and movement coordination impairments: ankle ligament sprains. *J Orthop Sports Phys Ther.* 2013;43(9):A1-40.
104. Martin RL, Hutt DM, Wukich DK. Validity of the Foot and Ankle Ability Measure (FAAM) in Diabetes Mellitus. *Foot Ankle Int.* 2009;30(4):297-302.
105. Martin RL, Irrgang JJ. A survey of self-reported outcome instruments for the foot and ankle. *J Orthop Sports Phys Ther.* 2007;37(2):72-84.
106. Martin RL, Irrgang JJ, Burdett RG, Conti SF, Van Swearingen JM. Evidence of validity for the Foot and Ankle Ability Measure (FAAM). *Foot Ankle Int.* 2005;26(11):968-983.
107. Martin RL, McPoil TG. Reliability of ankle goniometric measurements: a literature review. *J Am Podiatr Med Assoc.* 2005;95(6):564-572.
108. Mazaheri M, Salavati M, Negahban H, et al. Reliability and validity of the Persian version of Foot and Ankle Ability Measure (FAAM) to measure functional limitations in patients with foot and ankle disorders. *Osteoarthritis Cartilage.* 2010;18(6):755-759.
109. McAllister DR, Motamedi AR, Hame SL, Shapiro MS, Dorey FJ. Quality of life assessment in elite collegiate athletes. *Am J Sports Med.* 2001;29(6):806-810.
110. McCarthy MM, Voos JE, Nguyen JT, Callahan L, Hannafin JA. Injury profile in elite female basketball athletes at the Women's National Basketball Association combine. *Am J Sports Med.* 2013;41(3):645-651.
111. McKeon PO, Hertel J. Systematic review of postural control and lateral ankle instability, part I: can deficits be detected with instrumented testing. *J Athl Train.* 2008;43(3):293-304.

112. McKeon PO, Hertel J. Systematic review of postural control and lateral ankle instability, part II: is balance training clinically effective? *J Athl Train.* 2008;43(3):305-315.
113. Medina McKeon JM, Bush HM, Reed A, Whittington A, Uhl TL, McKeon PO. Return-to-play probabilities following new versus recurrent ankle sprains in high school athletes. *J Sci Med Sport.* 2014;17(1):23-28.
114. Merrick MA. "I Can't Believe We Don't Know That!". *J Athl Train.* 2006;41(3):231-232.
115. Michener LA. Patient- and clinician-rated outcome measures for clinical decision making in rehabilitation. *J Sport Rehabil.* 2011;20(1):37-45.
116. Mizner RL, Petterson SC, Stevens JE, Vandenborne K, Snyder-Mackler L. Early quadriceps strength loss after total knee arthroplasty. The contributions of muscle atrophy and failure of voluntary muscle activation. *J Bone Joint Surg Am.* 2005;87(5):1047-1053.
117. Moksnes H, Snyder-Mackler L, Risberg MA. Individuals with an anterior cruciate ligament-deficient knee classified as noncopers may be candidates for nonsurgical rehabilitation. *J Orthop Sports Phys Ther.* 2008;38(10):586-595.
118. Monteleone BJ, Ronsky JL, Meeuwisse WH, Zernicke RF. Ankle kinematics and muscle activity in functional ankle instability. *Clin J Sport Med.* 2014;24(1):62-68.
119. Monteleone BJ, Ronsky JL, Meeuwisse WH, Zernicke RF. Lateral hop movement assesses ankle dynamics and muscle activity. *Journal of applied biomechanics.* 2012;28(2):215-221.
120. Munn J, Beard DJ, Refshauge KM, Lee RWY. Do Functional-Performance Tests Detect Impairment in Subjects With Ankle Instability? *J Sport Rehabil.* 2002;11(2):40-50.
121. Myer GD, Schmitt LC, Brent JL, et al. Utilization of modified NFL combine testing to identify functional deficits in athletes following ACL reconstruction. *J Orthop Sports Phys Ther.* 2011;41(6):377-387.
122. Nakagawa S, Cuthill IC. Effect size, confidence interval and statistical significance: a practical guide for biologists. *Biological reviews of the Cambridge Philosophical Society.* 2007;82(4):591-605.
123. Narducci E, Waltz A, Gorski K, Leppla L, Donaldson M. The clinical utility of functional performance tests within one-year post-acl reconstruction: a systematic review. *Int J Sports Phys Ther.* 2011;6(4):333-342.
124. Nauck T, Lohrer H. Translation, cross-cultural adaption and validation of the German version of the Foot and Ankle Ability Measure for patients with chronic ankle instability. *Br J Sports Med.* 2011;45(10):785-790.
125. Nelson AJ, Collins CL, Yard EE, Fields SK, Comstock RD. Ankle injuries among United States high school sports athletes, 2005-2006. *J Athl Train.* 2007;42(3):381-387.
126. Palmieri RM, Ingersoll CD, Hoffman MA, et al. Arthrogenic muscle response to a simulated ankle joint effusion. *Br J Sports Med.* 2004;38(1):26-30.
127. Parsons JT, Snyder AR. Health-related quality of life as a primary clinical outcome in sport rehabilitation. *J Sport Rehabil.* 2011;20(1):17-36.
128. Parsons JT, Valovich McLeod TC, Snyder AR, Sauers EL. Change is hard: adopting a disablement model for athletic training. *J Athl Train.* 2008;43(4):446-448.
129. Patrick DL, Burke LB, Powers JH, et al. Patient-reported outcomes to support medical product labeling claims: FDA perspective. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research.* 2007;10 Suppl 2:S125-137.

130. Pellow JE, Brantingham JW. The efficacy of adjusting the ankle in the treatment of subacute and chronic grade I and grade II ankle inversion sprains. *J Manipulative Physiol Ther.* 2001;24(1):17-24.
131. Plante JE, Wikstrom EA. Differences in clinician-oriented outcomes among controls, copers, and chronic ankle instability groups. *Phys Ther Sport.* 2013;14(4):221-226.
132. Portney LG, Watkins MP. *Foundations of clinical research : applications to practice.* 2nd ed. Upper Saddle River, NJ2000.
133. Portney LG, Watkins MP. Validity of measurements. In: Portney LG, Watkins MP, eds. *Foundations of clinical research : applications to practice*. 2nd ed. Upper Saddle River, NJ: Prentice Hall; 2000:79-110.
134. Prugh J, Zeppieri G, Jr., George SZ. Impact of psychosocial factors, pain, and functional limitations on throwing athletes who return to sport following elbow injuries: a case series. *Physiother Theory Pract.* 2012;28(8):633-640.
135. Pugia ML, Middel CJ, Seward SW, et al. Comparison of acute swelling and function in subjects with lateral ankle injury. *J Orthop Sports Phys Ther.* 2001;31(7):384-388.
136. Reid A, Birmingham TB, Stratford PW, Alcock GK, Giffin JR. Hop testing provides a reliable and valid outcome measure during rehabilitation after anterior cruciate ligament reconstruction. *Phys Ther.* 2007;87(3):337-349.
137. Roddey TS, Cook KF, O'Malley KJ, Gartsman GM. The relationship among strength and mobility measures and self-report outcome scores in persons after rotator cuff repair surgery: impairment measures are not enough. *Journal of shoulder and elbow surgery / American Shoulder and Elbow Surgeons ... [et al.].* 2005;14(1 Suppl S):95S-98S.
138. Rohner-Spengler M, Mannion AF, Babst R. Reliability and minimal detectable change for the figure-of-eight-20 method of, measurement of ankle edema. *J Orthop Sports Phys Ther.* 2007;37(4):199-205.
139. Sackett DL, Rosenberg WM, Gray JA, Haynes RB, Richardson WS. Evidence based medicine: what it is and what it isn't. *BMJ.* 1996;312(7023):71-72.
140. Sacristan JA. Patient-centered medicine and patient-oriented research: improving health outcomes for individual patients. *BMC medical informatics and decision making.* 2013;13:6.
141. Schmitt LC, Paterno MV, Hewett TE. The impact of quadriceps femoris strength asymmetry on functional performance at return to sport following anterior cruciate ligament reconstruction. *J Orthop Sports Phys Ther.* 2012;42(9):750-759.
142. Sekir U, Yildiz Y, Hazneci B, Ors F, Saka T, Aydin T. Reliability of a functional test battery evaluating functionality, proprioception, and strength in recreational athletes with functional ankle instability. *Eur J Phys Rehabil Med.* 2008;44(4):407-415.
143. Sigward SM, Ota S, Powers CM. Predictors of frontal plane knee excursion during a drop land in young female soccer players. *J Orthop Sports Phys Ther.* 2008;38(11):661-667.
144. Snyder AR, Parsons JT, Valovich McLeod TC, Curtis Bay R, Michener LA, Sauers EL. Using disablement models and clinical outcomes assessment to enable evidence-based athletic training practice, part I: disablement models. *J Athl Train.* 2008;43(4):428-436.
145. Spink MJ, Fotoohabadi MR, Menz HB. Foot and ankle strength assessment using hand-held dynamometry: reliability and age-related differences. *Gerontology.* 2010;56(6):525-532.

146. Stark T, Walker B, Phillips JK, Fejer R, Beck R. Hand-held dynamometry correlation with the gold standard isokinetic dynamometry: a systematic review. *PM R.* 2011;3(5):472-479.
147. Starkey C, Ryan J. *Evaluation of orthopedic athletic injuries.* 2nd ed. Philadelphia: F.A. Davis Company; 2008.
148. Steves R, Hootman JM. Evidence-Based Medicine: What Is It and How Does It Apply to Athletic Training? *J Athl Train.* 2004;39(1):83-87.
149. Stiell I, Wells G, Laupacis A, et al. Multicentre trial to introduce the Ottawa ankle rules for use of radiography in acute ankle injuries. Multicentre Ankle Rule Study Group. *BMJ.* 1995;311(7005):594-597.
150. Stokes M, Young A. The contribution of reflex inhibition to arthrogenous muscle weakness. *Clin Sci (Lond).* 1984;67(1):7-14.
151. Stratford PW, Balsor BE. A comparison of make and break tests using a hand-held dynamometer and the Kin-Com. *J Orthop Sports Phys Ther.* 1994;19(1):28-32.
152. Stucki G. International Classification of Functioning, Disability, and Health (ICF): a promising framework and classification for rehabilitation medicine. *Am J Phys Med Rehabil.* 2005;84(10):733-740.
153. Thomee R, Kaplan Y, Kvist J, et al. Muscle strength and hop performance criteria prior to return to sports after ACL reconstruction. *Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA.* 2011;19(11):1798-1805.
154. Thomee R, Neeter C, Gustavsson A, et al. Variability in leg muscle power and hop performance after anterior cruciate ligament reconstruction. *Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA.* 2012;20(6):1143-1151.
155. Thorborg K, Petersen J, Magnusson SP, Holmich P. Clinical assessment of hip strength using a hand-held dynamometer is reliable. *Scandinavian journal of medicine & science in sports.* 2010;20(3):493-501.
156. Tiberio D. Evaluation of functional ankle dorsiflexion using subtalar neutral position. A clinical report. *Phys Ther.* 1987;67(6):955-957.
157. Tyler TF, McHugh MP, Mirabella MR, Mullaney MJ, Nicholas SJ. Risk factors for noncontact ankle sprains in high school football players: the role of previous ankle sprains and body mass index. *Am J Sports Med.* 2006;34(3):471-475.
158. Uematsu D, Suzuki H, Sasaki S, et al. Evidence of validity for the Japanese version of the Foot and Ankle Ability Measure. *J Athl Train.* in press.
159. Valovich McLeod TC, Snyder AR, Parsons JT, Curtis Bay R, Michener LA, Sauers EL. Using disablement models and clinical outcomes assessment to enable evidence-based athletic training practice, part II: clinical outcomes assessment. *J Athl Train.* 2008;43(4):437-445.
160. van Middelkoop M, van Rijn RM, Verhaar JA, Koes BW, Bierma-Zeinstra SM. Re-sprains during the first 3 months after initial ankle sprain are related to incomplete recovery: an observational study. *Journal of physiotherapy.* 2012;58(3):181-188.
161. van Rijn RM, van Os AG, Bernsen RM, Luijsterburg PA, Koes BW, Bierma-Zeinstra SM. What is the clinical course of acute ankle sprains? A systematic literature review. *Am J Med.* 2008;121(4):324-331 e326.
162. van Rijn RM, Willemsen SP, Verhagen AP, Koes BW, Bierma-Zeinstra SM. Explanatory variables for adult patients' self-reported recovery after acute lateral ankle sprain. *Phys Ther.* 2011;91(1):77-84.
163. Vela LI, Denegar C. Transient disablement in the physically active with

musculoskeletal injuries, part I: a descriptive model. *J Athl Train.* 2010;45(6):615-629.
164. Vela LI, Denegar CR. The Disablement in the Physically Active Scale, part II: the psychometric properties of an outcomes scale for musculoskeletal injuries. *J Athl Train.* 2010;45(6):630-641.
165. Verhagen E, van der Beek A, Twisk J, Bouter L, Bahr R, van Mechelen W. The effect of a proprioceptive balance board training program for the prevention of ankle sprains: a prospective controlled trial. *Am J Sports Med.* 2004;32(6):1385-1393.
166. Verhagen RA, de Keizer G, van Dijk CN. Long-term follow-up of inversion trauma of the ankle. *Arch Orthop Trauma Surg.* 1995;114(2):92-96.
167. Vicenzino B, Branjerdporn M, Teys P, Jordan K. Initial changes in posterior talar glide and dorsiflexion of the ankle after mobilization with movement in individuals with recurrent ankle sprain. *J Orthop Sports Phys Ther.* 2006;36(7):464-471.
168. Wang CY, Olson SL, Protas EJ. Test-retest strength reliability: hand-held dynamometry in community-dwelling elderly fallers. *Arch Phys Med Rehabil.* 2002;83(6):811-815.
169. Ware JE, Jr., Brook RH, Davies AR, Lohr KN. Choosing measures of health status for individuals in general populations. *American journal of public health.* 1981;71(6):620-625.
170. Ware JE, Jr., Gandek B. Overview of the SF-36 Health Survey and the International Quality of Life Assessment (IQOLA) Project. *J Clin Epidemiol.* 1998;51(11):903-912.
171. Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care.* 1992;30(6):473-483.
172. Wikstrom EA, Hubbard TJ. Talar positional fault in persons with chronic ankle instability. *Arch Phys Med Rehabil.* 2010;91(8):1267-1271.
173. Wikstrom EA, Naik S, Lodha N, Cauraugh JH. Balance capabilities after lateral ankle trauma and intervention: a meta-analysis. *Med Sci Sports Exerc.* 2009;41(6):1287-1295.
174. Wikstrom EA, Naik S, Lodha N, Cauraugh JH. Bilateral balance impairments after lateral ankle trauma: a systematic review and meta-analysis. *Gait Posture.* 2010;31(4):407-414.
175. Wikstrom EA, Tillman MD, Chmielewski TL, Cauraugh JH, Naugle KE, Borsa PA. Discriminating between copers and people with chronic ankle instability. *J Athl Train.* 2012;47(2):136-142.
176. Wikstrom EA, Tillman MD, Chmielewski TL, Cauraugh JH, Naugle KE, Borsa PA. Self-assessed disability and functional performance in individuals with and without ankle instability: a case control study. *J Orthop Sports Phys Ther.* 2009;39(6):458-467.
177. Williamson A, Hoggart B. Pain: a review of three commonly used pain rating scales. *J Clin Nurs.* 2005;14(7):798-804.
178. Wilson RW, Gansneder BM. Measures of functional limitation as predictors of disablement in athletes with acute ankle sprains. *J Orthop Sports Phys Ther.* 2000;30(9):528-535.
179. Wilson RW, Gieck JH, Gansneder BM, Perrin DH, Saliba EN, McCue FC, 3rd. Reliability and responsiveness of disablement measures following acute ankle sprains among athletes. *J Orthop Sports Phys Ther.* 1998;27(5):348-355.
180. Witchalls JB, Newman P, Waddington G, Adams R, Blanch P. Functional performance deficits associated with ligamentous instability at the ankle. *J Sci*

Med Sport. 2013;16(2):89-93.
181. Woodman R, Berghorn K, Underhill T, Wolanin M. Utilization of mobilization with movement for an apparent sprain of the posterior talofibular ligament: A case report. *Manual therapy.* 2012.
182. World Health Organization. International Classification of Functioning, Disability, and Health: ICF. Geneva, Switzerland: World Health Organization; 2001.
183. Worrell TWB, L. D., Hench KM. Closed kinetic chain assessment following inversion ankle sprain. *J Sport Rehabil.* 1994;3(3):197-203.
184. Yeung MS, Chan KM, So CH, Yuan WY. An epidemiological survey on ankle sprain. *Br J Sports Med.* 1994;28(2):112-116.
185. Youdas JW, McLean TJ, Krause DA, Hollman JH. Changes in active ankle dorsiflexion range of motion after acute inversion ankle sprain. *J Sport Rehabil.* 2009;18(3):358-374.

Appendix

Uematsu D, Suzuki H, Sasaki S, et al. Evidence of validity for the Japanese version of the Foot and Ankle Ability Measure. J Athl Train. in press

The Original Version of the Foot and Ankle Ability Measure

The Japanese Version of the Foot and Ankle Ability Measure

The Japanese Version of the SF-36

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original research

Evidence of Validity for the Japanese Version of the Foot and Ankle Ability Measure

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Context: The Foot and Ankle Ability Measure (FAAM) is a valid, reliable, and self-reported outcome instrument for the foot and ankle region.

Objective: To provide evidence for translation, cross-cultural adaptation, validity, and reliability of the Japanese version of the FAAM (FAAM-J).

Design: Cross-sectional study.

Setting: Collegiate athletic training/sports medicine clinical setting.

Patients or Other Participants: Eighty-three collegiate athletes.

Main Outcome Measure(s): All participants completed the Activities of Daily Living and Sports subscales of the FAAM-J and the Physical Functioning and Mental Health subscales of the Japanese version of the Short Form-36v2 (SF-36). Also, 19 participants (23%) whose conditions were expected to be stable completed another FAAM-J 2 to 6 days later for test-retest reliability. We analyzed the scores of those subscales for convergent and divergent validity, internal consistency, and test-retest reliability.

Results: The Activities of Daily Living and Sports subscales of the FAAM-J had correlation coefficients of 0.86 and 0.75, respectively, with the Physical Functioning section of the SF-36 for convergent validity. For divergent validity, the correlation coefficients with Mental Health of the SF-36 were 0.29 and 0.27 for each subscale, respectively. Cronbach α for internal consistency was 0.99 for the Activities of Daily Living and 0.98 for the Sports subscale. A 95% confidence interval with a single measure was $\pm$5.1 and $\pm$3.2 points for each subscale. The test-retest reliability measures revealed intraclass correlation coefficient values of 0.87 for the Activities of Daily Living and 0.90 for the Sports subscales with minimal detectable changes of $\pm$4.9 and $\pm$9.9 for the respective subscales.

Conclusions: The FAAM was successfully translated for a Japanese version, and the FAAM-J was adapted cross-culturally. Thus, the FAAM-J can be used as a self-reported outcome measure for Japanese-speaking individuals; however, the scores must be interpreted with caution, especially when applied to different populations and other types of injury than those included in this study.

Key Words: self-reported outcome measures, questionnaires, outcome assessments

Key Points

- The Japanese version of the Foot and Ankle Ability Measure (FAAM-J) was successfully translated and cross-culturally adapted.
- Evidence of convergent validity, divergent validity, internal consistency, and test-retest reliability for both subscales of the FAAM-J was obtained.
- The FAAM-J can be used as a self-reported outcome measure for Japanese speakers.

Foot and ankle injuries are common in sport activities. Ankle sprains are the most frequent of all athletic injuries.[1,2] The greatest risk factor for an ankle sprain is a previous ankle sprain, and chronic ankle instability is a concerning and common result of an initial ankle sprain.[3] With recurrent injuries, such as ankle sprains, athletes frequently suffer from residual symptoms.[4,5]

Outcome measures are essential to evidence-based practice because they offer a basis for clinical decisions.[6–8] There are 2 types of outcome measures: clinician rated and patient rated.[8,9] Clinician-rated measures are acquired by clinicians and primarily collect information about the disease or injury. Clinician-rated measures address impairments. In contrast, patient-rated measures focus on the data provided by patients including information about how patients perceive the effect of the disease or injury on their function and participation in Activities of Daily Living (ADL) and sports. Incorporating patient-based outcome measures into health care is imperative to fully appreciate the effect of pathologic conditions on the patient's overall health.[8,10] A self-reported outcome instrument allows clinicians to incorporate a patient's values into the medical treatment and to evaluate the effectiveness of interventions from the patient's perspective.

Self-reported outcome instruments can be generic or specific.[10] Specific self-reported outcome instruments address disease, body region, dimension, summary items, and individual measures.[10] Clinicians need to choose a self-reported outcome instrument based on its intended use. However, before a self-reported outcome instrument is used for that purpose, evidence must be provided that includes, among other items, face validity, content validity, construct validity, internal consistency, and reliability.[10–13] Furthermore, a self-reported outcome instrument needs to be translated and cross-culturally adapted if it is to be used in another culture or by speakers of another language.[14]

More than a dozen self-reported outcome instruments have been developed for the foot and ankle region.[15–17] The original version of the Foot and Ankle Ability Measure (FAAM) is 1 of the 4 instruments that provides evidence of content validity, construct validity, reliability, and responsiveness.[15,16] To our knowledge, the FAAM has been translated into German, Persian, and French.[18–20] Before this writing, it had not been translated into Japanese. Thus, the primary objective of our study was to provide evidence of the validity and reliability of the Japanese version of the FAAM (FAAM-J).

METHODS

The Instrument

The FAAM, originally developed by Martin et al[21] has 29 items in its questionnaire, with 21 items (72%) in the ADL subscale and 8 items (28%) in the Sports subscale. Each item is scored on a 5-point Likert scale, with 4 representing *no difficulty at all*; 3, *slight difficulty*; 2, *moderate difficulty*; 1, *extreme difficulty*; and 0, *unable to do*. Therefore, the highest possible scores are 84 for the ADL subscale and 32 for the Sports subscale. Unanswered items or *N/A* responses are not counted in the total score, and for every item without a response or with an *N/A*, 4 points are subtracted from the highest potential score. To calculate percentage values, each total subscale score is divided by the highest potential score. A higher score represents a higher level of physical function. At the end of each subscale, global ratings of functions for ADL (GRF-ADL) and sport-related activities (GRF-SP) are also calculated, with 0% indicating the inability to perform any of the usual daily activities and 100% indicating the level of function before injury. Additionally, at the end of the form, patients are asked to rate the current level of function with a 4-point Likert scale (*normal*, *nearly normal*, *abnormal*, or *severely abnormal*). Patients rate each item according to the difficulty they encounter with each task because of their foot and ankle condition.

Short-Form 36, Version 2, Health Survey

The Short-Form 36, Version 2 (SF-36v2, commonly known as the SF-36) Health Survey is a generic, self-reported outcome instrument for measuring a range of the effects of a condition or disease on patients.[22,23] It consists of 8 subscales: (1) Physical Functioning (PF), (2) Role-Physical, (3) Bodily Pain, (4) General Health Perception, (5) Vitality, (6) Social Functioning, (7) Role-Emotional, and (8) Mental Health (MH). Each subscale has a 0 to 100 score range, and a higher score represents a better health status. The Japanese version of the SF-36 was validated by Fukuhara et al.[24,25]

Translation and Cross-Cultural–Adaptation Process

We conducted the translation and cross-cultural–adaptation process in accordance with the guidelines set by the International Society for Quality of Life Assessment.[14] The forward translation of the original version of the FAAM was performed by 2 independent, native Japanese translators (T1 and T2) with extensive English expertise, who had no medical background. In a consensus meeting, T1 and T2 discussed the discrepancies and agreed on the preliminary version of the FAAM-J. Translator 3, a native Japanese speaker with medical expertise and broad experience in translating medical literature, rated the preliminary version of the FAAM-J in terms of clarity, common language use, and conceptual equivalence, creating the forward-translation version of the FAAM-J. Translators 4 and 5, native Japanese speakers with extensive translation experience, then translated the forward-translation version of the FAAM-J back into English (back-translation version of the FAAM-J). Translator 6, a native American-English speaker with no medical background, compared the back-translation version of the FAAM-J with the original FAAM for conceptual equivalence to make further adjustments as needed. A committee reviewed and discussed the disagreements and possible modifications and agreed on the prefinal version of the FAAM-J. We pilot tested the prefinal version of the FAAM-J on 20 collegiate students for accuracy of wording and ease of understanding; no difficulties were noted during that process.

Participants

Competitive athletes with foot and ankle injuries, from 7 competitive, collegiate varsity teams (men's basketball [n = 1; 14%], women's basketball [n = 3; 43%], men's rugby [n = 1; 14%], men's soccer [n = 1; 14%], and men's gymnastics [n = 1; 14%]) from 3 institutions participated in the study. Athletes' foot and ankle injuries included in the study were musculoskeletal and originated during sports participation. Participants were excluded if they had injuries to the lower back, hip, knee, lower leg, ankle, or foot regions within the previous 6 months before the study. Other exclusion criteria were a history of surgery to the above-mentioned areas, coexisting musculoskeletal injuries in other body parts, and chronic conditions, such as systematic inflammatory rheumatic disease, neurologic or vascular conditions, cancer, diabetes mellitus, alcohol abuse, or psychiatric disorders.[21]

Injury Classification

The locations and injury types were categorized in a system modified from previous literature.[26] The locations of injury were the Achilles tendon, ankle, foot, and toes. The types of injuries included fractures (traumatic); stress fractures (overuse); other bone injuries, dislocations or subluxations; tendon ruptures; sprains (injury of joint or ligaments or both); lesions of meniscus or cartilage; strains or muscle ruptures or tears; contusions, hematomas, or bruises; tendinosis or tendinopathy; bursitis; lacerations, abrasions, or skin lesions; and muscle cramps or spasms.[26]

Table. **Participants' Demographic and Injury Information**

Participants	Values, No. (% or range, SD)
Age, y	20.3 (18–24, ±3.7)
Sex, n = 83	
Male	59 (71)
Female	24 (29)
Foot and Ankle Ability Measure score, %	
Activities of Daily Living subscale	74.2 (0–100, ±29.4)
Sports subscale	52.1 (0–100, ±35.7)
Injury location (n = 83)	
Ankle	63 (76)
Foot	19 (23)
Toe	1 (1)
Injury Classification (n = 83)	
Sprain (injury of joint and/or ligaments)	71 (86)
Fracture (traumatic)	2 (2)
Lesion of meniscus or cartilage	2 (2)
Other bone injuries	2 (2)
Stress fracture (overuse)	2 (2)
Tendinosis/tendinopathy	2 (2)
Contusion/hematoma/bruise	1 (1)
Others	1 (1)

Data Collection

Before the study, each participant signed an informed-consent release and were asked to complete the FAAM-J and SF-36. The forms were given to the participant once he or she had a condition with an acute or chronic onset and sought medical attention from team medical personnel while the nature of the condition and the inclusion-exclusion criteria were confirmed. For reliability testing, 19 of the 83 participants (23%), whose conditions were expected to remain stable (ie, chronic state, no treatments), were asked to fill out the forms again 2 to 6 days after the initial recording. This study was approved by the institutional review board of Waseda University.

Statistical Analysis

To examine the convergent validity, we analyzed correlations between the ADL and Sports subscales of the FAAM-J and the PF subscale of the SF-36 with the Pearson product moment correlation coefficient. Similarly, we analyzed the correlations between the ADL and Sports subscales of the FAAM-J and the MH subscale of the SF-36 to assess the divergent validity. The a priori α level for this analysis was set at .05. Also, the Pearson product moment correlation coefficients between the ADL subscale of the FAAM-J and the GRF-ADL and the Sports subscale of the FAAM-J and the GRF-SP were calculated.

A Cronbach α coefficient was determined to assess the internal consistency. The standard error of measurement (SEM) for each subscale score was calculated as $SEM = \alpha\sqrt{1 - r}$, where σ was the standard deviation of the score, and r was the coefficient α. The error associated with a score at a single time point was acquired by calculating a 95% confidence interval (95% CI).

Test-retest reliability was examined with the intraclass correlation coefficient (ICC [2,1]). To confirm there was no systemic bias between the test and retest sessions, a paired t test was performed. We determined the SEM using the ICC test-retest reliability coefficient. The SEM was multiplied by $\sqrt{2}$, and a 95% CI was calculated to determine the minimal detectable change (MDC). All statistical analyses were performed using SPSS (version 20.0; IBM Corp, Armonk, NY).

RESULTS

Participants

Eighty-three participants (59 men [71%] and 24 women [29%]) with foot and ankle injuries volunteered for the study. The demographic information, injury types, and injury location are presented in the Table. The predominant body part involved was the ankle, and the most- frequent injury type was a sprain.

Translation and Cross-Cultural Adaptation

No major difficulties were encountered during the translation and cross-cultural adaptation process. As expected, we found a few minor discrepancies during the forward-translation process; however, the translators reached agreement. In item 5 of the Sports subscale, *cutting* was translated as *kattinngu* in katakana (a Japanese alphabet for foreign words) by 1 translator and as *houkoutenkan* (literally "change of direction" in Japanese) by the other translator. We decided to use *houkoutenkan* rather than *kattinngu* because we thought *kattinngu* described a sport-specific maneuver and was appropriate if the FAAM was intended only for athletes and physically active individuals. Furthermore, *kattinngu* seemed too technical a term in Japanese for the general population, which, therefore, might be misinterpreted by many individuals who did not understand the meaning of the word. In addition, we thought that because *houkoutenkan* was listed in the Sports subscale, people would understand the word *houkoutenkan* within a sports activity context. Therefore, *houkoutenkan* would be correctly interpreted by respondents. In contrast, in item 7 of the Sports subscale, the word *technique* was translated as *gihou* by 1 translator, but we agreed to use *tekunikku*, literally written as *technique* in katakana, because it is more often used in the Japanese language than *gihou* is. After initial corrections of the minor discrepancies, no further difficulties were noted during the translation, evaluation, or pilot-testing processes.

Convergent and Divergent Validity

Statistical analyses revealed correlation coefficients of 0.86 between the ADL subscale and the PF section of the SF-36 ($P < .001$) and 0.75 between the Sports subscale and the PF section of the SF-36 ($P < .001$). On the other hand, the ADL subscale had a correlation coefficient of 0.29 with the MH section of the SF-36 ($P = .007$), and the Sports subscale had a correlation coefficient of 0.27 with MH section of the SF-36 ($P = .013$). In addition, the ADL subscale showed correlation coefficients of 0.89 ($P < .001$) and 0.80 ($P < .001$) with the GRF-ADL and GRF-SP, respectively, whereas the Sports subscale correlation coefficients were 0.80 ($P < .001$) and 0.87 ($P < .001$), respectively.

Internal Consistency

The Cronbach α for internal consistency was 0.99 for the ADL subscale ($P < .001$) and 0.98 for the Sports subscale

($P < .001$). The SEM for the ADL subscale was 2.6 and the MDC at 95% CI was +/– 5.1, whereas the SEM for the Sports subscale was 1.6 and the MDC at 95% CI was +/– 3.2.

Test-Retest Reliability

A paired *t* test revealed no systemic bias between the test and retest scores for both ADL ($P = .096$) and sports ($P = .848$) subscales. Both subscales were shown to have excellent reliability. The MDC at 95% confidence was +/– 4.9 for the ADL subscale and +/– 9.9 for the Sports subscale.

DISCUSSION

Clinician-rated measures relate to impairment-oriented data, such as strength, pain, swelling, and range of motion, and provide information of an uncertain clinical utility.[6,27] Although valuable in many ways, those measures should not be used alone.[9] Patient-rated measures reflect patients' values and their perceptions of the condition they suffer from,[8,10] and they provide the patient-oriented evidence that is directly related to the interests of the patients. Moreover, a recent study[28] indicated that clinician-rated and patient-rated outcome measures assess different aspects of health status. Thus, it is important to incorporate both types of outcome measures into the clinical decision-making process.

Our study provided evidence for translation, cross-cultural adaptation, convergent validity, divergent validity, internal consistency, and test-retest reliability for both subscales of the FAAM-J. Therefore, the use of the FAAM-J as a self-reported outcome measure for the foot and ankle region was validated with some limitations.

Although the concepts are related, *face validity* addresses whether an instrument is measuring what it is designed to measure, whereas *content validity* is concerned with adequacy, or the extent to which the items in an instrument measure the domain of interest.[13,29] Not only experts but also patients need to participate in developing an instrument.[10,11] The original version of the FAAM went through a rigorous item-selection process in which both expert clinicians and patients participated, using item-reduction theory.[21] The evaluation of face and content validity is qualitative and subjective, but the meticulous process in the development of the original version of the FAAM, which incorporated both the expert clinicians' and the patients' values and opinions, provided evidence for its face and content validity.

The construct validity of an instrument is determined by evaluating the correlation between the tested instrument and other measures that are logically hypothesized from a relationship between the patient's health status and the construct. Also, there are 2 types of construct validity: convergent and discriminant (divergent).[13] Evidence for convergent validity is provided when the instrument is shown to have a strong correlation with other measures of the same construct. Divergent validity occurs when the relationship is weak or nonexistent between the score on the tested instrument and measures of a different construct. The constructs that the FAAM is intended to measure are functional limitations to the foot and ankle regions and activity restrictions. In this study, as expected, both subscales of the FAAM-J had high correlations with the PF and low correlations with the MH sections of the SF-36. The correlation coefficients with PF were 0.86 for the ADL subscale and 0.75 for the Sports subscale, whereas those with MH were 0.29 for the ADL subscale and 0.27 for the Sports subscale. Furthermore, our results were in accordance with the original and French versions of the FAAM.[20,21] Thus, the subscales of the FAAM-J were correlated with the PF aspect of the patients' health status but not with the MH aspect, providing evidence for the convergent and divergent validity of the FAAM-J.

Internal consistency is the extent to which the items in an instrument are measuring different aspects of the construct and is associated with an error within a single measure. Internal consistency is commonly assessed with correlations between all items in the instrument. In this study, the Cronbach α for internal consistency was 0.99, with an SEM of 2.56 for the ADL subscale, and 0.98, with an SEM of 1.58 for the Sports subscale. The 95% CI with a single measure was $\pm$5.1 and $\pm$3.2 for respective subscales. The 95% CI value for the Sports subscale of the FAAM-J was considerably smaller than the values found for the original and French versions of the FAAM.[20,21] Although speculative, several sources of the discrepancy were possible. First, the patient population could be a source of the discrepancy; adults (age = 41.2 $\pm$ 16.3 years for the original version and 50.5 $\pm$ 14.6 years for the French version) were the participants in the other 2 studies, whereas young, competitive athletes (age = 20.3 $\pm$ 3.7 years) were the participants in this study. Second, the proportions of various injury locations and types varied among the studies. In our study, the locations and types of injuries were largely acute ankle sprains, which was expected because of the nature of the population in this study—competitive collegiate athletes.[1]

Reliability relates to the stability of the scores with repeated measures when no change to the health status is expected and is assessed by the test-retest measure. The evidence for the reliability of the FAAM-J was provided with the high ICCs for the ADL and Sports subscales. The MDC value for the Sports subscale was substantially smaller in this study than it was in the original and French versions. A possible explanation, along with the above-mentioned sources of discrepancies, may be the time between the test and retest; it was 4 weeks in the original version and 2 days in the French version, whereas it was 2–6 days in this study.

The FAAM has been widely used as a self-reported outcome measure to assess (1) the functional limitations and activity restrictions caused by various pathologic conditions of the foot and ankle region and (2) the effectiveness of interventions that clinicians provide. Such conditions include foot and ankle trauma,[17] acute ankle sprain,[30] plantar heel pain,[31] plantar fasciitis,[32] ankle arthrodesis,[33] ankle arthritis,[34] chronic ankle instability,[35–37] recurrent peroneal subluxation,[38] and diabetes.[39,40] The original version of the FAAM, along with 3 other questionnaires, provided evidence for content validity, construct validity, reliability, and responsiveness to support their use.[16] Also, the FAAM and the Foot and Ankle Disability Index, a prototype of the FAAM, were considered to be the most-suitable self-reported outcome instruments for chronic ankle instability during a systemic review.[15] Therefore, we deemed it appropriate and valuable to translate and cross-culturally adapt the FAAM for its use in Japanese.

Furthermore, a standard method of assessment allows comparisons of different treatment methods.[41] The prevalent use of the FAAM enables clinicians to make such comparisons for better clinical decisions. Thus, a cross-culturally adapted version of the FAAM is beneficial not only for the individuals who speak that language but also for those who speak the languages used in the other versions of the FAAM.

A recent study[42] showed that people with functional ankle instability (FAI) had lower FAAM scores and SF-36 physical component summaries. In addition, both the ADL and Sports subscales of the FAAM for FAI were positively correlated with the SF-36 Physical Component Summary and related subscales but not with the Mental Component Summary. Furthermore, the scores of the FAAM were correlated with the PF subscale to a greater degree than with the Physical Component Summary or other subscales of the Physical Component Summary. Therefore, although the functional limitations caused by FAI contribute to the health-related quality-of-life score, the FAAM primarily captured, and was more specific to, a physical dimension, and other factors contributed to the overall health-related quality of life. Thus, clinicians need to be careful about the dimensions they intend to capture with the FAAM.

The current study had some limitations. First, although our translation process was in accordance with the guidelines in previous literature,[14] there were limitations to our validation process with classic test theory; namely, classic test theory focuses only on the whole test score and disregards the interaction between a respondent's ability and the characteristics of the item, such as difficulty, and each item's sensitivity to the respondent's ability level, whereas item-reduction theory can account for those factors. A study using item-reduction theory indicated that some items in a self-reported outcome instrument are more culture specific than others are,[43] whereas our study did not address that issue because the classic test theory was applied. Additionally, the FAAM-J was compared with the original version of the FAAM and the SF-36, and hence, the reliability and validity of the FAAM-J were confined to those instruments. Therefore, although our method was similar to that of the development of the French version of the FAAM, future researchers need to address those limitations within the FAAM-J.

Second, the characteristics of our participants were different than those tested for the original and French versions of the FAAM. Specifically, this study was conducted on young, competitive athletes, whereas the previous 2 studies were of adults in a general population. A previous investigation[44] showed that the SF-36scores of uninjured, elite athletes differed slightly from the age-matched norm values, and that trend was more substantial among women. Another study of physically active individuals showed that the uninjured control group, as well as the FAI group, had better PF subscale scores than the general population did, whereas only the uninjured controls had better PF scores than the age-matched population.[42] However, both the control and FAI groups had Mental Component Summary scores similar to those of the general population, although they were below those of the age-matched population. Furthermore, the magnitudes of functional limitations, participation restrictions, and disabilities experienced by injured individuals might vary according to the expected normal levels for each person.[45] Therefore, further evidence is needed on this aspect of the FAAM-J, and the scores of the FAAM-J must be interpreted with caution when applied to a general population.

CONCLUSIONS

This study provides evidence for translation, cross-cultural adaptation, convergent and divergent validity, internal consistency, and test-retest reliability for the FAAM-J. Thus, the FAAM-J can be used as a self-reported outcome measure of an athletic population of Japanese-speaking individuals with acute ankle injuries; however, the scores of the FAAM-J must be interpreted with caution, especially when applied to different populations and other types of injury.

REFERENCES

1. Hootman JM, Dick R, Agel J. Epidemiology of collegiate injuries for 15 sports: summary and recommendations for injury prevention initiatives. *J Athl Train*. 2007;42(2):311–319.
2. Junge A, Langevoort G, Pipe A, et al. Injuries in team sport tournaments during the 2004 Olympic Games. *Am J Sports Med*. 2006;34(4):565–576.
3. Hertel J. Functional anatomy, pathomechanics, and pathophysiology of lateral ankle instability. *J Athl Train*. 2002;37(4):364–375.
4. Anandacoomarasamy A, Barnsley L. Long term outcomes of inversion ankle injuries. *Br J Sports Med*. 2005;39(3):e14.
5. Gerber JP, Williams GN, Scoville CR, Arciero RA, Taylor DC. Persistent disability associated with ankle sprains: a prospective examination of an athletic population. *Foot Ankle Int*. 1998;19(10): 653–660.
6. Jette AM. Outcomes research: shifting the dominant research paradigm in physical therapy. *Phys Ther*. 1995;75(11):965–970.
7. Jette AM, Keysor JJ. Uses of evidence in disability outcomes and effectiveness research. *Milbank Q*. 2002;80(2):325–345.
8. Valovich McLeod TC, Snyder AR, Parsons JT, Curtis Bay R, Michener LA, Sauers EL. Using disablement models and clinical outcomes assessment to enable evidence-based athletic training practice, part II: clinical outcomes assessment. *J Athl Train*. 2008; 43(4):437–445.
9. Michener LA. Patient- and clinician-rated outcome measures for clinical decision making in rehabilitation. *J Sport Rehabil*. 2011; 20(1):37–45.
10. Fitzpatrick R, Davey C, Buxton MJ, Jones DR. Evaluating patient-based outcome measures for use in clinical trials. *Health Technol Assess*. 1998;2(14):i–iv, 1–74.
11. Lohr KN, Aaronson NK, Alonso J, et al. Evaluating quality-of-life and health status instruments: development of scientific review criteria. *Clin Ther*. 1996;18(5):979–992.
12. Ware JE Jr, Brook RH, Davies AR, Lohr KN. Choosing measures of health status for individuals in general populations. *Am J Public Health*. 1981;71(6):620–625.
13. Portney LG, Watkins MP. Validity of measurements. In: Portney LG, Watkins MP, eds. *Foundations of Clinical Research: Applications to Practice*. 2nd ed. Upper Saddle River, NJ: Prentice Hall; 2000:79–110.
14. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine (Phila Pa 1976)*. 2000;25(24):3186–3191.

15. Eechaute C, Vaes P, Van Aerschot L, Asman S, Duquet W. The clinimetric qualities of patient-assessed instruments for measuring chronic ankle instability: a systematic review. *BMC Musculoskelet Disord*. 2007;8:6.
16. Martin RL, Irrgang JJ. A survey of self-reported outcome instruments for the foot and ankle. *J Orthop Sports Phys Ther*. 2007;37(2):72–84.
17. Goldstein CL, Schemitsch E, Bhandari M, Mathew G, Petrisor BA. Comparison of different outcome instruments following foot and ankle trauma. *Foot Ankle Int*. 2010;31(12):1075–1080.
18. Nauck T, Lohrer H. Translation, cross-cultural adaption and validation of the German version of the Foot and Ankle Ability Measure for patients with chronic ankle instability. *Br J Sports Med*. 2011;45(10):785–790.
19. Mazaheri M, Salavati M, Negahban H, et al. Reliability and validity of the Persian version of Foot and Ankle Ability Measure (FAAM) to measure functional limitations in patients with foot and ankle disorders. *Osteoarthritis Cartilage*. 2010;18(6):755–759.
20. Borloz S, Crevoisier X, Deriaz O, Ballabeni P, Martin RL, Luthi F. Evidence for validity and reliability of a French version of the FAAM. *BMC Musculoskelet Disord*. 2011;12:40.
21. Martin RL, Irrgang JJ, Burdett RG, Conti SF, Van Swearingen JM. Evidence of validity for the Foot and Ankle Ability Measure (FAAM). *Foot Ankle Int*. 2005;26(11):968–983.
22. Ware JE Jr, Gandek B. Overview of the SF-36 health survey and the international quality of life assessment (IQOLA) project. *J Clin Epidemiol*. 1998;51(11):903–912.
23. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36), I: conceptual framework and item selection. *Med Care*. 1992;30(6):473–483.
24. Fukuhara S, Bito S, Green J, Hsiao A, Kurokawa K. Translation, adaptation, and validation of the SF-36 health survey for use in Japan. *J Clin Epidemiol*. 1998;51(11):1037–1044.
25. Fukuhara S, Ware JE Jr, Kosinski M, Wada S, Gandek B. Psychometric and clinical tests of validity of the Japanese SF-36 health survey. *J Clin Epidemiol*. 1998;51(11):1045–1053.
26. Junge A, Engebretsen L, Alonso JM, et al. Injury surveillance in multi-sport events: the International Olympic Committee approach. *Br J Sports Med*. 2008;42(6):413–421.
27. Hurwitz SR, Slawson D, Shaughnessy A. Orthopaedic information mastery: applying evidence-based information tools to improve patient outcomes while saving orthopaedists' time. *J Bone Joint Surg Am*. 2000;82(6):888–894.
28. Roddey TS, Cook KF, O'Malley KJ, Gartsman GM. The relationship among strength and mobility measures and self-report outcome scores in persons after rotator cuff repair surgery: impairment measures are not enough. *J Shoulder Elbow Surg*. 2005;14(suppl 1): 95S–98S.
29. Guyatt GH, Feeny DH, Patrick DL. Measuring health-related quality of life. *Ann Intern Med*. 1993;118(8):622–629.
30. Cosby NL, Hertel J. Clinical assessment of ankle injury outcomes: case scenario using the foot and ankle ability measure. *J Sport Rehabil*. 2011;20(1):89–99.
31. Cleland JA, Abbott JH, Kidd MO, et al. Manual physical therapy and exercise versus electrophysical agents and exercise in the management of plantar heel pain: a multicenter randomized clinical trial. *J Orthop Sports Phys Ther*. 2009;39(8):573–585.
32. Drake M, Bittenbender C, Boyles RE. The short-term effects of treating plantar fasciitis with a temporary custom foot orthosis and stretching. *J Orthop Sports Phys Ther*. 2011;41(4):221–231.
33. Hendrickx RP, Stufkens SA, de Bruijn EE, Sierevelt IN, van Dijk CN, Kerkhoffs GM. Medium- to long-term outcome of ankle arthrodesis. *Foot Ankle Int*. 2011;32(10):940–947.
34. Criswell BJ, Douglas K, Naik R, Thomson AB. High revision and reoperation rates using the agility total ankle system. *Clin Orthop Relat Res*. 2012;470(7):1980–1986.
35. Hoch MC, Andreatta RD, Mullineaux DR, et al. Two-week joint mobilization intervention improves self-reported function, range of motion, and dynamic balance in those with chronic ankle instability. *J Orthop Res*. 2012;30(11):1798–1804.
36. Woodman R, Berghorn K, Underhill T, Wolanin M. Utilization of mobilization with movement for an apparent sprain of the posterior talofibular ligament: a case report. *Man Ther*. 2013;18(1):e1–e7.
37. Carcia CR, Martin RL, Drouin JM. Validity of the Foot and Ankle Ability Measure in athletes with chronic ankle instability. *J Athl Train*. 2008;43(2):179–183.
38. Boykin RE, Ogunseinde B, McFeely ED, Nasreddine A, Kocher MS. Preliminary results of calcaneofibular ligament transfer for recurrent peroneal subluxation in children and adolescents. *J Pediatr Orthop*. 2010;30(8):899–903.
39. Martin RL, Hutt DM, Wukich DK. Validity of the Foot and Ankle Ability Measure (FAAM) in diabetes mellitus. *Foot Ankle Int*. 2009; 30(4):297–302.
40. Kivlan BR, Martin RL, Wukich DK. Responsiveness of the Foot and Ankle Ability Measure (FAAM) in individuals with diabetes. *Foot (Edinb)*. 2011;21(2):84–87.
41. Irrgang JJ, Anderson AF, Boland AL, et al. Development and validation of the international knee documentation committee subjective knee form. *Am J Sports Med*. 2001;29(5):600–613.
42. Arnold BL, Wright CJ, Ross SE. Functional ankle instability and health-related quality of life. *J Athl Train*. 2011;46(6):634–641.
43. Custers JW, Hoijtink H, van der Net J, Helders PJ. Cultural differences in functional status measurement: analyses of person fit according to the Rasch model. *Qual Life Res*. 2000;9(5):571–578.
44. McAllister DR, Motamedi AR, Hame SL, Shapiro MS, Dorey FJ. Quality of life assessment in elite collegiate athletes. *Am J Sports Med*. 2001;29(6):806–810.
45. Vela LI, Denegar C. Transient disablement in the physically active with musculoskeletal injuries, part I: a descriptive model. *J Athl Train*. 2010;45(6):615–629.

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足部・足関節能力評価票

この一週間のあなたの状態を表すのにもっとも適当な答ひとつに印をつけてください。質問の中の動作が足や足首以外のことで制限される場合は「該当なし」（N/A）をマークしてください。

日常生活について

	ぜんぜん難しくない	少し難しい	中くらいに難しい	非常に難しい	実行不能	該当なし（N/A）
立っていること	☐	☐	☐	☐	☐	☐
平らな地面を歩くこと	☐	☐	☐	☐	☐	☐
靴を履かずに平らな地面を歩くこと	☐	☐	☐	☐	☐	☐
上り坂を歩くこと	☐	☐	☐	☐	☐	☐
下り坂を歩くこと	☐	☐	☐	☐	☐	☐
階段を上がること	☐	☐	☐	☐	☐	☐
階段を下りること	☐	☐	☐	☐	☐	☐
でこぼこした地面を歩くこと	☐	☐	☐	☐	☐	☐
縁石に上がったり下りたりすること	☐	☐	☐	☐	☐	☐
しゃがむこと	☐	☐	☐	☐	☐	☐
つま先立ちすること	☐	☐	☐	☐	☐	☐
歩き始め	☐	☐	☐	☐	☐	☐
5分以内の歩行	☐	☐	☐	☐	☐	☐
約10分間の歩行	☐	☐	☐	☐	☐	☐
約15分間の歩行	☐	☐	☐	☐	☐	☐

足・足首の状態のために、以下の動作にどのくらいの困難さがありますか。

	ぜんぜん難しくない	少し難しい	中くらいに難しい	非常に難しい	実行不能	該当なし（N/A）
家事	☐	☐	☐	☐	☐	☐
日常生活動作	☐	☐	☐	☐	☐	☐
身の回りの世話	☐	☐	☐	☐	☐	☐
軽度から中程度の作業（立っていること、歩くこと）	☐	☐	☐	☐	☐	☐
きつい作業（押す/引くこと、登ること、運ぶこと）	☐	☐	☐	☐	☐	☐
余暇活動	☐	☐	☐	☐	☐	☐

日常生活動作に関する総合機能評価

通常の日常生活動作における現在の足・足首の機能レベルを0から100の数値で評価してください。あなたの足・足首の怪我をする前の機能レベルを100、一般的な日常活動を行うことが不可能なレベルを0とします。

.0%

スポーツ活動について

足・足首の状態のために、以下の動作にどのくらいの困難さがありますか。

	ぜんぜん難しくない	少し難しい	中くらいに難しい	非常に難しい	実行不能	該当なし（N/A）
走ること	☐	☐	☐	☐	☐	☐
ジャンプすること	☐	☐	☐	☐	☐	☐
着地すること	☐	☐	☐	☐	☐	☐
素早く動いて、止まること	☐	☐	☐	☐	☐	☐
方向転換、横方向へ動くこと	☐	☐	☐	☐	☐	☐
衝撃の小さい動作	☐	☐	☐	☐	☐	☐
普段のテクニックで運動する能力	☐	☐	☐	☐	☐	☐
行おうとしているスポーツを好きなだけ続ける能力	☐	☐	☐	☐	☐	☐

スポーツ動作に関する総合機能評価

スポーツ関連の動作における現在の足・足首の機能レベルを0から100の数値で評価してください。あなたの足・足首の怪我をする前の機能レベルを100、一般的な日常活動を行うことが不可能なレベルを0とします。

.0%

全体的にあなたの足・足首の現在の機能レベルをどのように評価しますか？

☐普段通り　☐ほぼ普段通り　☐異常　☐極めて異常

Foot and Ankle Ability Measure (FAAM)
Activities of Daily Living Subscale

Please Answer **every question** with **one response** that most closely describes your condition within the past week.
If the activity in question is limited by something other than your foot or ankle mark "Not Applicable" (N/A).

	No Difficulty	Slight Difficulty	Moderate Difficulty	Extreme Difficulty	Unable to do	N/A
Standing	☐	☐	☐	☐	☐	☐
Walking on even Ground	☐	☐	☐	☐	☐	☐
Walking on even ground without shoes	☐	☐	☐	☐	☐	☐
Walking up hills	☐	☐	☐	☐	☐	☐
Walking down hills	☐	☐	☐	☐	☐	☐
Going up stairs	☐	☐	☐	☐	☐	☐
Going down stairs	☐	☐	☐	☐	☐	☐
Walking on uneven ground	☐	☐	☐	☐	☐	☐
Stepping up and down curbs	☐	☐	☐	☐	☐	☐
Squatting	☐	☐	☐	☐	☐	☐
Coming up on your toes	☐	☐	☐	☐	☐	☐
Walking initially	☐	☐	☐	☐	☐	☐
Walking 5 minutes or less	☐	☐	☐	☐	☐	☐
Walking approximately 10 minutes	☐	☐	☐	☐	☐	☐
Walking 15 minutes or greater	☐	☐	☐	☐	☐	☐

Foot and Ankle Ability Measure (FAAM)
Activities of Daily Living Subscale
Page 2

Because of your foot and ankle how much difficulty do you have with:

	No Difficulty at all	Slight Difficulty	Moderate Difficulty	Extreme Difficulty	Unable to do	N/A
Home responsibilities	☐	☐	☐	☐	☐	☐
Activities of daily living	☐	☐	☐	☐	☐	☐
Personal care	☐	☐	☐	☐	☐	☐
Light to moderate work (standing, walking)	☐	☐	☐	☐	☐	☐
Heavy work (push/pulling, climbing, carrying)	☐	☐	☐	☐	☐	☐
Recreational activities	☐	☐	☐	☐	☐	☐

How would you rate your current level of function during you usual activities of daily living from 0 to 100 with 100 being your level of function prior to your foot or ankle problem and 0 being the inability to perform any of your usual daily activities.

__ __ __ . 0 %

Martin, R; Irrgang, J; Burdett, R; Conti, S; VanSwearingen, J: Evidence of Validity for the Foot and Ankle Ability Measure. Foot and Ankle International. Vol.26, No.11: 968-983, 2005.

Foot and Ankle Ability Measure (FAAM)
Sports Subscale

Because of your foot and ankle how much difficulty do you have with:

	No Difficulty at all	Slight Difficulty	Moderate Difficulty	Extreme Difficulty	Unable to do	N/A
Running	☐	☐	☐	☐	☐	☐
Jumping	☐	☐	☐	☐	☐	☐
Landing	☐	☐	☐	☐	☐	☐
Starting and stopping quickly	☐	☐	☐	☐	☐	☐
Cutting/lateral Movements	☐	☐	☐	☐	☐	☐
Ability to perform Activity with your Normal technique	☐	☐	☐	☐	☐	☐
Ability to participate In your desired sport As long as you like	☐	☐	☐	☐	☐	☐

How would you rate your current level of function during your sports related activities from 0 to 100 with 100 being your level of function prior to your foot or ankle problem and 0 being the inability to perform any of your usual daily activities?

__ __ __ . 0%

Overall, how would you rate your current level of function?

☐ Normal ☐ Nearly Normal ☐ Abnormal ☐ Severely Abnormal

Martin, R; Irrgang, J; Burdett, R; Conti, S; VanSwearingen, J: Evidence of Validity for the Foot and Ankle Ability Measure. Foot and Ankle International. Vol.26, No.11: 968-983, 2005.

あなたの健康について

このアンケートはあなたがご自分の健康をどのように考えているかをおうかがいするものです。あなたが毎日をどのように感じ、日常の活動をどのくらい自由にできるかを知るうえで参考になります。お手数をおかけしますが、何卒ご協力のほど宜しくお願い申し上げます。

以下のそれぞれの質問について、一番よくあてはまるものに印（☑）をつけてください。

問１　あなたの健康状態は？（一番よくあてはまるものに☑印をつけて下さい）

最高に良い	とても良い	良　い	あまり良くない	良くない
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

問２　１年前と比べて、現在の健康状態はいかがですか。
（一番よくあてはまるものに☑印をつけて下さい）

１年前より、はるかに良い	１年前よりは、やや良い	１年前と、ほぼ同じ	１年前ほど、良くない	１年前より、はるかに悪い
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

問３　以下の質問は、日常よく行われている活動です。あなたは健康上の理由で、こうした活動をすることがむずかしいと感じますか。むずかしいとすればどのくらいですか。
（ア～コまでのそれぞれの質問について、一番よくあてはまるものに☑印をつけて下さい）

	とても むずかしい	少し むずかしい	ぜんぜん むずかしくない
ア）激しい活動、例えば、一生けんめい走る、重い物を持ち上げる、激しいスポーツをするなど	□ 1	□ 2	□ 3
イ）適度の活動、例えば、家や庭のそうじをする、１～２時間散歩するなど	□ 1	□ 2	□ 3
ウ）少し重い物を持ち上げたり、運んだりする（例えば買い物袋など）	□ 1	□ 2	□ 3
エ）階段を数階上までのぼる	□ 1	□ 2	□ 3
オ）階段を１階上までのぼる	□ 1	□ 2	□ 3
カ）体を前に曲げる、ひざまずく、かがむ	□ 1	□ 2	□ 3
キ）１キロメートル以上歩く	□ 1	□ 2	□ 3
ク）数百メートルくらい歩く	□ 1	□ 2	□ 3
ケ）百メートルくらい歩く	□ 1	□ 2	□ 3
コ）自分でお風呂に入ったり、着がえたりする	□ 1	□ 2	□ 3

問４　過去１ヵ月間に、仕事やふだんの活動（家事など）をするにあたって、身体的な理由で次のような問題がありましたか。（ア～エまでのそれぞれの質問について、一番よくあてはまるものに☑印をつけて下さい）

	いつも	ほとんどいつも	ときどき	まれに	ぜんぜんない
ア）仕事やふだんの活動をする時間をへらした	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
イ）仕事やふだんの活動が思ったほど、できなかった	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
ウ）仕事やふだんの活動の内容によっては、できないものがあった	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
エ）仕事やふだんの活動をすることがむずかしかった（例えばいつもより努力を必要としたなど）	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

問５　過去１ヵ月間に、仕事やふだんの活動（家事など）をするにあたって、心理的な理由で（例えば、気分がおちこんだり不安を感じたりしたために）、次のような問題がありましたか。（ア～ウまでのそれぞれの質問について、一番よくあてはまるものに☑印をつけて下さい）

	いつも	ほとんどいつも	ときどき	まれに	ぜんぜんない
ア）仕事やふだんの活動をする時間をへらした	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
イ）仕事やふだんの活動が思ったほど、できなかった	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
ウ）仕事やふだんの活動がいつもほど、集中してできなかった	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

問６　過去１ヵ月間に、家族、友人、近所の人、その他の仲間とのふだんのつきあいが、身体的あるいは心理的な理由で、どのくらい妨（さまた）げられましたか。
（一番よくあてはまるものに☑印をつけて下さい）

ぜんぜん、妨げられなかった	わずかに、妨げられた	少し、妨げられた	かなり、妨げられた	非常に、妨げられた
▼	▼	▼	▼	▼
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

問７　過去１ヵ月間に、体の痛みをどのくらい感じましたか。
（一番よくあてはまるものに☑印をつけて下さい）

ぜんぜんなかった	かすかな痛み	軽い痛み	中くらいの痛み	強い痛み	非常に激しい痛み
▼	▼	▼	▼	▼	▼
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6

問８　過去１ヵ月間に、いつもの仕事（家事も含みます）が痛みのために、どのくらい妨（さまた）げられましたか。（一番よくあてはまるものに☑印をつけて下さい）

ぜんぜん、妨げられなかった	わずかに、妨げられた	少し、妨げられた	かなり、妨げられた	非常に、妨げられた
▼	▼	▼	▼	▼
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

問９　次にあげるのは、過去１ヵ月間に、あなたがどのように感じたかについての質問です。
（ア～ケまでのそれぞれの質問について、一番よくあてはまるものに☑印をつけて下さい）

	いつも	ほとんどいつも	ときどき	まれに	ぜんぜんない
ア）元気いっぱいでしたか	□1	□2	□3	□4	□5
イ）かなり神経質でしたか	□1	□2	□3	□4	□5
ウ）どうにもならないくらい、気分がおちこんでいましたか	□1	□2	□3	□4	□5
エ）おちついていて、おだやかな気分でしたか	□1	□2	□3	□4	□5
オ）活力(エネルギー)にあふれていましたか	□1	□2	□3	□4	□5
カ）おちこんで､ゆううつな気分でしたか	□1	□2	□3	□4	□5
キ）疲れはてていましたか	□1	□2	□3	□4	□5
ク）楽しい気分でしたか	□1	□2	□3	□4	□5
ケ）疲れを感じましたか	□1	□2	□3	□4	□5

問 10　過去１ヵ月間に、友人や親せきを訪ねるなど、人とのつきあいが、身体的あるいは心理的な理由で、時間的にどのくらい妨(さまた)げられましたか。
（一番よくあてはまるものに☑印をつけて下さい）

いつも	ほとんどいつも	ときどき	まれに	ぜんぜんない
□1	□2	□3	□4	□5

問 11　次にあげた各項目はどのくらいあなたにあてはまりますか。（ア～エまでのそれぞれの質問について、一番よくあてはまるものに☑印をつけて下さい）

	まったく そのとおり	ほぼ あてはまる	何とも 言えない	ほとんど あてはまらない	ぜんぜん あてはまらない
ア）私は他の人に比べて病気になりやすいと思う	□ 1	□ 2	□ 3	□ 4	□ 5
イ）私は、人並(ひとな)みに健康である	□ 1	□ 2	□ 3	□ 4	□ 5
ウ）私の健康は､悪くなるような気がする	□ 1	□ 2	□ 3	□ 4	□ 5
エ）私の健康状態は非常に良い	□ 1	□ 2	□ 3	□ 4	□ 5

これでこのアンケートはおわりです。
ご協力ありがとうございました。