

Developing a Framework for Ankle Function: A Delphi Study

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Context: Addressing clinical outcomes is paramount to providing effective health care, yet there is no consensus regarding the appropriate outcomes to address after ankle injuries. Compounding the problem is the repetitive nature of lateral ankle sprains, referred to as *functional* (FAI) or *chronic* (CAI) ankle instability. Although they are commonly used terms in practice and research, FAI and CAI are inconsistently defined and assessed.

Objective: To establish definitions of a healthy/normal/noninjured ankle, FAI, and CAI, as well as their characteristics and assessment techniques.

Design: Delphi study.

Setting: Telephone interviews and electronic surveys.

Patients or Other Participants: Sixteen experts representing the fields of ankle function and treatment, ankle research, and outcomes assessment and research were selected as panelists.

Data Collection and Analysis: A telephone interview produced feedback regarding the definition of, functional characteristics of, and assessment techniques for a healthy/normal/noninjured ankle, an unhealthy/acute injured ankle,

and FAI/CAI. Those data were compiled, reduced, and returned through electronic surveys and were either included by reaching consensus (80% agreement) or excluded.

Results: The definitions of a healthy/normal/noninjured ankle and FAI reached consensus. Experts did not agree on a definition of CAI. Eleven functional characteristics of a healthy/normal/noninjured ankle, 32 functional characteristics of an unhealthy/acute injured ankle, and 13 characteristics of FAI were agreed upon.

Conclusions: Although a consensus was reached regarding the definitions and functional characteristics of a healthy/normal/noninjured ankle and FAI, the experts could only agree on 1 characteristic to include in the FAI definition. Several experts did, however, provide additional comments that reinforced the differences in the interpretation of those concepts. Although the experts could not agree on the definition of CAI, its characteristics, or the preferred use of the terms *FAI* and *CAI*, our findings provide progress toward establishing consistency in those concepts.

Key Words: outcomes, ankle sprains, ankle instability

Key Points

- A working definition of a healthy/noninjured ankle was established, along with the functional characteristics of and assessment techniques for healthy and unhealthy ankles.
- Although a consensus was reached regarding the definition of functional ankle instability, disagreements emerged in the experts' comments. The definition that achieved consensus is very similar to the original Freeman definition.
- Consensus was not reached regarding the definition of chronic ankle instability.
- Future researchers should compare the experts' responses with feedback from patients who sustained ankle injuries and with ankle-outcome instruments.

The National Athletic Trainers' Association Research & Education Foundation has identified outcomes assessment as a professional priority.¹ There is no more vivid example of the barriers to the consistent assessment of outcomes than in the treatment of ankle and foot injuries. Specifically, lateral ankle sprains (LAS) continue to represent the single most common athletic injury² and have the highest reinjury rate among all injuries,^{2–4} yet outcomes that substantiate their treatment are limited. Further complicating outcomes assessment after LAS is the repetitive nature of ankle sprains, which has led to the identification of a phenomenon called *chronic* or *functional ankle instability* (CAI or FAI, respectively).^{5–7} Although a common entity in practice and research, FAI is inconsistently defined and assessed.^{8–10} Despite widespread support for its existence, there is currently no consensus regarding the definition of *FAI*^{8–10} or the characteristics of

those who have it. Researchers classify the existence of FAI inconsistently, and clinicians diagnose it arbitrarily. To substantiate the existence and relevance of any injury or condition, it must be definable and have a measurable effect on function. Neither of those is true regarding FAI, which has resulted in discrepancies in the research, making cross-study comparisons impossible, and the true effect of FAI remains largely unknown. The lack of standard outcomes and the inconsistencies in the identification of repetitive LAS have further complicated the reporting of ankle-injury outcomes. Therefore, athletic trainers are unable to address 1 of the most important issues identified in their profession (ie, outcomes) for the most common injury, LAS, of the patients in their care.

Following the model from the World Health Organization (WHO),¹¹ the first steps toward outcomes assessment after LAS are to (1) develop a framework of a healthy/normal/

Table 1. Expert Panel's Demographic Information, n = 16

Item	No. (%)
Credential	
Athletic training	8 (50)
Physical therapy	2 (12)
Athletic training and physical therapy (dual credentials)	4 (25)
General medicine	1 (6)
Strength and conditioning	1 (6)
Highest level of education	
Bachelor's	1 (6)
Master's	3 (19)
Doctorate	12 (75)
Experience, y	
1–10	2 (12)
11–20	8 (50)
21–30	3 (19)
30+	3 (19)

noninjured ankle, (2) establish a clear definition for the recurring ankle-sprain phenomenon, or FAI, and (3) identify the functional outcomes that should be assessed after LAS.¹¹ A common approach to this type of problem is to gather input from a panel of content experts in an effort to establish consensus regarding a certain topic. Therefore, we used the Delphi method to determine the definitions of a healthy/normal/noninjured ankle, FAI, and CAI, along with their characteristics and assessment techniques.

METHODS

Research Design

We used an observational, nonexperimental Delphi design. The Delphi method is a technique in which expert opinion is gathered to reach a consensus on a topic through multiple rounds of individual interviews and surveys.¹²

Participants

Although no published guidelines specifically define an *expert* or the ideal number of experts who should participate,¹³ general guidelines state that the panel of experts should be heterogeneous to allow for a variety of opinions.¹⁴ Therefore, for the scope of this project, we determined that a panel of 16 experts was sufficient because it could include experts from several fields. Our content experts had experience and expertise in at least 1 of the following fields: ankle function, ankle-injury care, general outcomes assessment or outcomes research, biomechanics, disablement models, functional movement assessment, or general sports medicine. We identified potential experts through a record of scholarship (>5 peer-reviewed publications in a content area), professional recommendations, and clinical experience (>5 years in their field). Once a person was identified as an expert, we e-mailed him or her an invitation to participate; those who agreed received an electronic consent document and the interview questions. Recruitment ended once we had a panel of 16 (Table 1), which included experts from athletic training (n = 8; 50%), physical therapy (n = 2; 12%), athletic training and physical therapy (dually credentialed, n = 4; 25%), general medicine (physician, n = 1; 6%), and strength and conditioning (n =

1; 6%). Experts were currently practicing (n = 4; 25%), serving in an academic position (n = 9; 56%), or both (n = 3; 19%). They resided in the United States (n = 14; 88%), Australia (n = 1; 6%), and Ireland (n = 1; 6%).

Instruments

We collected the initial round (round 1) of data using structured telephone interviews. We recorded the telephone interviews (model WS-210S digital voice recorder; Olympus America, Center Valley, PA). The questions addressed the definition and characteristics of and assessment techniques for a healthy/normal/noninjured ankle, unhealthy/acute injured ankle, FAI, and CAI. We combined and reduced the experts' responses and returned them in the form of electronic surveys (Survey Monkey, Palo Alto, CA) in subsequent rounds (rounds 2–5).

The following items were addressed:

1. The definition of a healthy/normal/noninjured ankle
2. The functional characteristics of someone with a healthy/normal/noninjured ankle
3. The functional characteristics of someone with an unhealthy/acute injured ankle
4. The assessment of functional characteristics
5. The definition of *FAI*
6. The functional characteristics of someone with *FAI*
7. The assessment of functional characteristics of someone with *FAI*
8. The appropriateness of the term *FAI*
9. The definition of *CAI*
10. The functional characteristics of someone with *CAI*
11. The assessment of functional characteristics of someone with *CAI*
12. The appropriateness of the term *CAI*

Delphi Procedures

Round 1. After an orientation, we interviewed the experts via telephone. We read their responses back to them and allowed them to review each answer before proceeding to the next question. We then compiled and reduced the responses qualitatively to detect common themes and to categorize the data. We calculated frequencies quantitatively. To minimize bias, all members of the research team assisted in the data reduction and review of the final product. A sample interview question was "How do you define a healthy/normal/noninjured ankle?" All interview responses then appeared in the subsequent electronic survey (round 2).

Round 2. We presented the reduced data back to the panel in the form of an electronic survey: they could agree or disagree with each of the 228 items. We excluded assessment techniques for the functional characteristics from this round because consensus had not been established yet. An example of a survey item was "Please indicate if you agree or disagree that each of the following items should be included in the definition of a healthy/normal/noninjured ankle."

When addressing consensus, no criteria are universally accepted. However, 80% agreement is often considered acceptable¹⁵ and has been used in other Delphi studies.¹⁶ After round 2 and all subsequent rounds, we retained items

Table 2. Initial Responses to “How Do You Define a Healthy/Normal/Noninjured Ankle?”

Initial Responses	Round 2 Responses, ^a n = 16	
	Agree, No. (%)	Disagree, No. (%)
Normal range of motion	16* (100)	0 (0)
Normal muscle strength	15* (94)	1 (6)
Normal gait pattern	14* (88)	2 (12)
Normal joint mechanics	15* (94)	1 (6)
Normal arthrokinematics	16* (100)	0 (0)
Normal joint position	13* (72)	3 (19)
Normal joint stability	16* (100)	0 (0)
Normal circulation	14* (88)	2 (12)
Normal sensation	15* (94)	1 (6)
Normal coordination of movement	14* (88)	2 (12)
No pain	15* (94)	1 (6)
No complaints	15* (94)	1 (6)
No complaints of instability	16* (100)	0 (0)
No perceived functional deficits	16* (100)	0 (0)
No restrictions in desired participation	15* (94)	1 (6)
No history of ankle injury	7 (44)	9 (56)
No mechanical laxity	14* (88)	2 (12)
No pathology	16* (100)	0 (0)
No swelling	15* (94)	1 (6)
No synovial changes	13* (81)	3 (19)
No osteoarthritis	16* (100)	0 (0)
No compensations in movement activities related to the ankle	13* (81)	3 (19)
Patient can complete full functional assessment	13* (81)	3 (19)
Patient can perform deep body squats without problems	10 (62)	6 (38)

^a Asterisk (*) means 80% consensus was reached.

that had reached 80% or greater agreement and removed those that did not.

Round 3. Based on round 2 feedback, we created a list of items the experts identified and which they agreed should be included in the definition of a healthy/normal/noninjured ankle. From that list, we derived the initial definition of a healthy/normal/noninjured ankle. We sent that definition to the experts via Survey Monkey (round 3) and asked them to agree or disagree. The subsequent rounds (rounds 4 and 5) consisted of a list of compiled, agreed-on items, followed by a brief survey.

Round 4. In the round 4 survey, we addressed the assessment techniques that were identified in the initial interview.

Round 5. In the round 5 survey, we addressed the definitions of *FAI* and *CAI*. We concluded data collection after round 5 because the panel’s responses were no longer moving toward agreement.

RESULTS

Definition of a Healthy/Normal/Noninjured Ankle

In round 1, we asked the experts, “How do you define a healthy/normal/noninjured ankle?” The experts (n = 16; 100%) provided various responses when asked to define a healthy/normal/noninjured ankle during the interview. Most listed components of a healthy/normal/noninjured ankle, rather than providing a definition. To achieve a consensus, we combined and reduced their responses to 24 items

(Table 2). Twenty-two items (92%) reached consensus for the definition of a healthy/normal/noninjured ankle. Of those 22 items, we reduced redundant items to 16 (73%). To form the definition, we identified 5 broader, inclusive categories under which each item fit: (1) function, (2) participation, (3) impairments, (4) pathology, and (5) pain. As noted by 3 experts (19%), pain is generally considered an impairment. However, we believed that pain was such an important and unique clinical entity that it should remain an individual component in the definition. Therefore, we established the working definition of a *healthy/normal/noninjured ankle* as “a person with a healthy/normal/noninjured ankle(s), either through self-report or clinical measurement, presents with full functional capacity and participation status, without pathology, pain, or impairments relative to the ankle(s).” Eighty-eight percent (n = 14) of the experts approved that definition. Therefore, we concluded data collection for the definition of a healthy/normal/noninjured ankle.

In addition to the comments regarding the classification of pain, panelists also emphasized that some components of a healthy/normal/noninjured ankle were not limited to only ankle function. For instance, a patient with a healthy/normal/noninjured ankle may experience limited functional capacity because of another injury. Another expert commented that he or she felt there was a difference between *healthy/normal* and *noninjured* and that an abnormality could be present in the absence of injury.

Functional Characteristics of a Healthy/Normal/Noninjured Ankle

In the interview, we asked each expert to “Describe the functional characteristics of someone with a healthy/normal/noninjured ankle.” We sent the preliminary responses back in a survey, and the experts were asked to agree or disagree (Table 3). Forty-three characteristics reached 80% consensus and were retained in the final list.

In addition, panelists noted that impairments may be required for function, even though the impairments themselves are not functions. For example, 1 expert wrote, “patients can be functional without full range of motion,” or “they can have pain and still be functional.” Another expert suggested adding “as related to the ankle” to each characteristic to clarify the meaning, including the term *decreased* with some of the characteristics because the reference point for “normal” was not clearly identified and suggested clarifying whether a patient must lack all or just 1 “healthy” characteristic to be considered “unhealthy.”

Functional Characteristics/Limitations of an Unhealthy/Acutely Injured Ankle

The third topic we addressed in the initial interview was an unhealthy/acutely injured ankle. We asked the experts to “Describe the functional characteristics or limitations of someone with an unhealthy/acutely injured ankle.” We again collected, combined, and reduced the responses and returned them in a survey. We retained only the items that reached 80% agreement (Table 4).

Table 3. Initial Responses to “Describe the Functional Characteristics of Someone With a Healthy/Normal/NonInjured Ankle”

Initial Responses	Round 2 Responses, ^a n = 16	
	Agree, No. (%)	Disagree, No. (%)
Normal active range of motion	12 (75)	4 (25)
Normal passive range of motion	12 (75)	4 (25)
Normal resistive range of motion	12 (75)	4 (25)
Full dorsiflexion	9 (56)	7 (44)
Normal inversion and eversion	10 (62)	6 (38)
Normal gait pattern	15* (94)	1 (6)
Normal muscular endurance	12 (75)	4 (25)
Normal muscle strength	12 (75)	4 (25)
Normal balance	14* (88)	2 (12)
Normal proprioception	11 (69)	5 (31)
Normal neuromuscular control	14* (88)	2 (12)
Normal arthrokinematic motion	12 (75)	4 (25)
Normal perceived postural stability	12 (75)	4 (25)
No disability	14* (88)	2 (12)
No apprehension or fear of performing desired activities	14* (88)	2 (12)
No swelling	12 (75)	4 (25)
No pain	11 (69)	5 (31)
No patient reports of giving way	15* (94)	1 (6)
Patient can bear 8 times body weight, age dependent	4 (25)	12 (75)
Patient can get into squat with heel on ground	7 (44)	9 (56)
Patient can ambulate stairs	15* (94)	1 (6)
Patient can run	14* (88)	2 (12)
Patient can perform all desired activities (including sport, work, and activities of daily living)	13* (81)	3 (19)
Patient feels at preinjury levels	14* (88)	2 (12)
Patient feels stable	12 (75)	4 (25)
Ankle is stable	12 (75)	4 (25)
It depends on what they want to do (it is based on patient’s perspectives and goals)	14* (88)	2 (12)

^a Asterisk (*) means 80% consensus was reached.

Assessment Techniques

The fourth topic we addressed in the preliminary interview was assessment techniques. We asked the experts, “How do you assess functional characteristics of the ankle (for unhealthy/acutely injured or healthy/normal/noninjured ankles)?” Of the 87 responses offered by the experts, 33 responses (38%) reached 80% agreement in the subsequent survey; these included items such as “gait analysis,” “figure-8 test,” and “history/subjective report” (Table 5).

Definition of FAI

The fifth topic we addressed in the interview was the definition of *FAI*. We asked the experts, “What is your definition of *functional ankle instability*?” Similar to their responses for the definition of a healthy/normal/noninjured ankle, the experts’ tendency was to provide lists of components rather than a concise definition. The initial responses, as well as the subsequent results that reached consensus, are presented in Table 6.

Table 4. Initial Responses to “Describe the Functional Characteristics or Limitations of Someone With an Unhealthy/Acutely Injured Ankle”

Initial Responses	Round 2 Responses, ^a n = 16	
	Agree, No. (%)	Disagree, No. (%)
Pain	13* (81)	3 (19)
Loss of range of motion	13* (81)	3 (19)
Loss of dorsiflexion	13* (81)	3 (19)
Loss of dorsiflexion/plantar flexion	13* (81)	3 (19)
Loss of inversion/eversion/pronation/supination during gait	12 (75)	4 (25)
Unable to engage in desired level of function	16* (100)	0 (0)
Unable to cut	15* (94)	1 (6)
Unable to do eccentric exercise	12 (75)	4 (25)
Unable to do slow-downs	12 (75)	4 (25)
Unable to do back pedals	14* (88)	2 (12)
Unable to jump	16* (100)	0 (0)
Unable to ascend and descend stairs	15* (94)	1 (6)
Unable to change directions	16* (100)	0 (0)
Unable to perform transitions	15* (94)	1 (6)
Unable to squat	14* (88)	2 (12)
Unable to run	15* (94)	1 (6)
Unable to plant	14* (88)	2 (12)
Unable to land from a jump	15* (94)	1 (6)
Unable to engage unpredictable surfaces	15* (94)	1 (6)
Unable to perform activities of daily living	14* (88)	2 (12)
Unable to single-leg balance	14* (88)	2 (12)
Decreased mobility	14* (88)	2 (12)
Decreased muscle strength	12 (75)	4 (25)
Decreased muscular endurance	11 (69)	5 (31)
Limited power	12 (75)	4 (25)
Muscles have increased tone	7 (44)	9 (56)
Increased range of motion	8 (50)	8 (50)
Increased pronation/supination	8 (50)	8 (50)
Increased joint laxity	12 (75)	4 (25)
Abnormal joint mechanics	13* (81)	3 (19)
Capsular tightness	9 (56)	7 (44)
Swelling	13* (81)	3 (10)
Neuromuscular inhibition	14* (88)	2 (12)
Altered neuromuscular drive	13* (81)	3 (19)
Reflex inhibition	13* (81)	3 (19)
Decreased proprioception	14* (88)	2 (12)
Decreased coordination	15* (94)	1 (6)
Decreased balance	16* (100)	0 (0)
Decreased postural stability	15* (94)	1 (6)
Movement compensation	14* (88)	2 (12)
Apprehension	13* (81)	3 (19)
Decreased confidence	13* (81)	3 (19)
Depends on patient’s desired or normal level of activity	15* (94)	1 (6)
Depends on the severity of injury	11 (69)	5 (31)
Costs related to income/health care	4 (25)	12 (75)

^a Asterisk (*) means 80% consensus was reached.

From the components that reached agreement, we established the working definition as “*Functional ankle instability* is a recurrent sense of giving way of the ankle.” We presented that definition to the experts and 12 of the 15 respondents (80%) agreed with that definition, so we closed data collection and accepted that as the definition of *FAI*.

Table 5. Initial Responses to “How Do You Assess Functional Characteristics of the Ankle (for Injured or Healthy Ankles)?”

Initial Responses	Round 4 Responses, ^a n = 15	
	Agree, No. (%)	Disagree, No. (%)
Motion analysis	9 (60)	6 (40)
Gait analysis	14* (93)	1 (7)
Weight-bearing ability/willingness	15* (100)	0 (0)
Ability to walk on uneven ground	13* (87)	2 (13)
Ability to jog without pain	12* (80)	3 (20)
Running	15* (100)	0 (0)
Stair ambulation	14* (93)	1 (7)
Functional analysis	10 (67)	5 (33)
Functional tests on different surfaces, n = 14	11 (79)	3 (21)
Watch patient during activity	12* (80)	3 (20)
Willingness to do activities	10 (67)	5 (33)
Jumping	15* (100)	0 (0)
Single-legged jumping	15* (100)	0 (0)
Ability to single-leg jump for distance	10 (67)	5 (33)
Double-legged jumping	10 (67)	5 (33)
Standing jumps	10 (67)	5 (33)
Hopping patterns	14* (93)	1 (7)
Hop for distance	11 (73)	4 (27)
Three-hop test	10 (67)	5 (33)
Hop-and-stop test	8 (53)	7 (47)
Ability to backpedal without pain	10 (67)	5 (33)
Lunge tests for dorsiflexion ROM	11 (73)	4 (27)
Agility tests	14* (93)	1 (7)
Ability to cut without pain	12* (80)	3 (20)
Changing directions	15* (100)	0 (0)
Obstacle course	7 (47)	8 (53)
Figure-8 test	14* (93)	1 (7)
Ability to repeat activity overtime without breaking down	10 (67)	5 (33)
Single-legged squatting	14* (93)	1 (7)
Double-legged squatting	12* (80)	3 (20)
Deep squatting with full dorsiflexion, n = 14	9 (64)	5 (36)
Postural control	10 (67)	5 (33)
Balance assessment	15* (94)	0
Single-legged stance	14* (88)	1 (6)
Single-legged stance for time (eyes closed)	13* (81)	2 (12)
Tandem stance	8 (50)	7 (44)
Tandem stance for time (eyes closed)	9 (56)	6 (38)
Romberg test	4 (27)	11 (69)
Balance Error Scoring System	11 (69)	4 (25)
Star Excursion Balance Test	14* (88)	1 (6)
Ability to land evenly from a jump	13* (81)	2 (12)
Jump landing with stabilization holds	12* (75)	3 (19)
Single-legged jump landings	12* (75)	3 (19)
Double-legged jump landings	9 (56)	6 (38)
Landing Error Scoring System	8 (53)	7 (47)
Step to stabilize	9 (56)	6 (38)
Manual muscle tests	11 (73)	4 (27)
Peroneal strength test	11 (73)	4 (27)
Gluteus maximus strength test	5 (33)	10 (67)
Gluteus medius strength test	5 (33)	10 (67)
Tibialis anterior strength test	8 (53)	7 (46)
Gastrocnemius strength test	10 (67)	5 (33)
Soleus strength test	8 (53)	7 (46)
Tibialis posterior strength test	8 (53)	7 (46)
Strength tests using a handheld dynamometer	3 (20)	12 (80)

Table 5. Continued.

Initial Responses	Round 4 Responses, ^a n = 15	
	Agree, No. (%)	Disagree, No. (%)
Isokinetic tests	3 (20)	12 (80)
ROM assessment	13* (87)	2 (13)
Active ROM assessment	13* (87)	2 (13)
Passive ROM assessment	12* (80)	3 (20)
Dorsiflexion ROM assessment	13* (87)	2 (13)
Special tests	13* (87)	2 (13)
Ligamentous testing of the ankle	12* (80)	3 (20)
Anterior drawer test	13* (87)	2 (13)
Kleiger (external-rotation) test	10 (67)	5 (33)
Talar tilt test	13* (87)	2 (13)
Squeeze test	8 (53)	7 (47)
Tap test	7 (47)	8 (53)
Arthrometer testing	6 (40)	9 (60)
Modified Ottawa ankle rules	10 (67)	5 (33)
Arthrokinematic assessment	11 (73)	4 (27)
Talocrural joint assessment (Maitland)	11 (73)	4 (27)
Proximal and distal tibial-fibular joint assessment	12* (80)	3 (20)
Mulligan fibular anterior-posterior excursion of inferior tibial-fibular joint	10 (67)	5 (33)
Neurologic examination	9 (60)	6 (40)
Circulation assessment	7 (47)	8 (53)
Sensation assessment	9 (60)	6 (40)
Swelling measurement	8 (53)	7 (47)
Electromyography	3 (20)	12 (80)
Footwear assessment	10 (67)	5 (33)
Palpate before and after activity for tenderness	5 (33)	10 (67)
Ask the coach if there has been a change in performance	6 (40)	9 (60)
History/subjective report	14* (93)	1 (7)
Foot and Ankle Disability Index	8 (53)	7 (47)
Foot and Ankle Ability Measure	10 (67)	5 (33)
Cumberland Ankle Instability Tool	10 (67)	5 (33)
Foot and Ankle Outcome Scale	7 (47)	8 (53)
Short Form-36	8 (53)	7 (47)

Abbreviation: ROM, range of motion.

^a Asterisk (*) means 80% consensus was reached. One expert did not address “Functional tests on different surfaces” and “Deep squatting with full dorsiflexion.”

However, even though the experts reached a consensus for the definition, their specific comments indicated that they had strong opinions about the topic. For example, 1 expert stated, regarding FAI, “if you must use that term,” another wrote “CAI is a bad term” and “FAI is the better term,” and still another would have preferred “not necessarily” rather than be forced to agree or disagree with the definition.

Functional Characteristics of FAI

The sixth topic we addressed during the interview focused on the functional characteristics of FAI. We asked the experts, “Describe the functional characteristics or limitations of someone with functional ankle instability; what are the functional costs or consequences?” Forty items were included in the survey and 13 (32%) reached agreement (Table 7). Examples of items that reached consensus included “unable to jump or hop,” “difficulty

Table 6. Initial Responses to “What Is Your Definition of Functional Ankle Instability?”

Initial Responses	Round 2 Responses, ^a n = 16	
	Agree, No. (%)	Disagree, No. (%)
I wish I knew	4 (25)	12 (75)
I am not sure what functional ankle instability is	3 (19)	13 (81)
I don't like the term “functional ankle instability”	6 (38)	10 (62)
Pain	3 (19)	13 (81)
Inability to perform upper-level activities without pain	5 (31)	11 (69)
Recurrent ankle sprains	12 (75)	4 (25)
History of at least 1 ankle sprain	1 (6)	15 (94)
History of at least 1 ankle sprain in the previous year	1 (6)	15 (94)
History of a moderate to severe ankle sprain at least 12 mo in the past that required crutches or nonweight bearing for at least 3 d	2 (12)	14 (88)
Subjective complaints	6 (38)	10 (62)
Subjective complaints that can be reproduced clinically	6 (38)	10 (62)
Recurrent sense of giving way	14* (88)	2 (12)
≥2 Episodes of giving way	8 (50)	8 (50)
Symptoms need to occur after perceived recovery	6 (38)	10 (62)
Perceived instability	12 (75)	4 (25)
Inability to participate in desired activities	10 (62)	6 (38)
Subjective feeling that ankle prevents them from participating in something	12 (75)	4 (25)
Fear avoidance/kinesiophobia	8 (50)	8 (50)
Lack of confidence	7 (44)	9 (56)
Loss of range of motion	4 (25)	12 (75)
Abnormal gait pattern	4 (25)	12 (75)
Swelling	4 (25)	12 (75)
Ligament laxity	4 (25)	12 (75)
Excessive joint motion	4 (25)	12 (75)
Decreased muscle strength	4 (25)	12 (75)
Decreased peroneal muscle strength	3 (19)	13 (81)
Decreased proprioception	4 (25)	12 (75)
Neuromuscular reeducation issues	6 (38)	10 (62)
Sensorimotor deficits	10 (62)	6 (38)
Foot and Ankle Disability Index score of ≤90	4 (25)	12 (75)
Foot and Ankle Disability Index-Sport Subscale score of ≤80%	5 (31)	11 (69)
Cumberland Ankle Instability Tool score of ≤24	7 (44)	9 (56)

^a Asterisk (*) means 80% consensus was reached.

walking on uneven ground,” and “it depends on what they want to do” (Table 7).

Nomenclature of FAI

We addressed FAI nomenclature with 3 different interview questions. We asked the experts, “Do you have a different title or name that you use for functional ankle instability?” Based on the lack of consensus from the survey, no other terms were consistently used in place of

Table 7. Initial Responses to “Describe the Functional Characteristics or Limitations of Someone With Functional Ankle Instability; What are the Functional Costs or Consequences?”

Initial Responses	Round 2 Responses, ^a n = 16	
	Agree, No. (%)	Disagree, No. (%)
There are no limitations	1 (6)	15 (94)
It is the same as for acute ankle injury	3 (19)	13 (81)
Pain	9 (56)	7 (44)
Decreased muscular endurance	9 (56)	7 (44)
Unable to plant/cut/change directions	14* (88)	2 (12)
Unable to jump or hop	13* (81)	3 (19)
Unable to function at desired level of activity	16* (100)	0 (0)
Unable to bear weight	6 (38)	10 (62)
Unable to participate in desired activities	14* (88)	2 (12)
Unable to complete sport-specific activities	13* (81)	3 (19)
Difficulty ambulating stairs or ladders	11 (69)	5 (31)
Difficulty walking on uneven ground	13* (81)	3 (19)
Difficulty with single-legged landing	13* (81)	3 (19)
Inhibited eccentric muscle contraction	8 (50)	8 (50)
Repetitive ankle sprains	10 (62)	6 (38)
Repetitive episodes of giving way	14* (88)	2 (12)
Poor ligament stability	7 (44)	9 (56)
Abnormal gait	11 (69)	5 (31)
Fear avoidance/apprehension	12 (75)	4 (25)
Decreased confidence	13* (81)	3 (19)
Limited Star Excursion Balance Test	12 (75)	4 (25)
Limited Balance Error Scoring System	11 (69)	5 (31)
Inhibited balance (single and double legged)	12 (75)	4 (25)
Inhibited postural control	10 (62)	6 (38)
Inhibited neuromuscular control	13* (81)	3 (19)
Inhibited proprioception	11 (69)	5 (31)
Inhibited muscular endurance	10 (62)	6 (38)
Perceived weakness	10 (62)	6 (38)
Diminished performance	16* (100)	0 (0)
Decreased range of motion	10 (62)	6 (38)
Range of motion is shifted away from dorsiflexion and toward plantar flexion	9 (56)	7 (44)
Increased inversion	7 (44)	9 (56)
Chronic swelling	7 (44)	9 (56)
Decreased flexibility	7 (44)	9 (56)
Synovial changes	7 (44)	9 (56)
Arthrokinematic changes	10 (62)	6 (38)
Ligament laxity	9 (56)	7 (44)
Degenerative changes	8 (50)	8 (50)
There is a continuum	13* (81)	3 (19)
It depends on what they want to do	14* (88)	2 (12)

^a Asterisk (*) means 80% consensus was reached.

FAI. We also asked, “Do you feel that there is a name more appropriate than functional ankle instability?” Based on the experts’ survey responses, there was no other name more appropriate than FAI.

Table 8. Initial Responses to “What Is Your Definition of Chronic Ankle Instability?”

Initial Responses	Round 2 Responses, ^a n = 16	
	Agree, No. (%)	Disagree, No. (%)
It is not different than functional ankle instability	3 (19)	13 (81)
Series of injuries to the ankle over time	10 (62)	6 (38)
It is a syndrome	8 (50)	8 (50)
Recurrent episodes of instability	15* (94)	1 (6)
Perceived instability	10 (62)	6 (38)
Recurrent sprains	14* (88)	2 (12)
First sprain occurred >1 y ago, and there are still symptoms related to that injury	5 (31)	11 (69)
Pain	8 (50)	8 (50)
Swelling	8 (50)	8 (50)
Apprehension	9 (56)	7 (44)
Functional deficits	12 (75)	4 (25)
Self-reported functional deficits	11 (69)	5 (31)
Functional ankle instability that occurs for a long period	9 (56)	7 (44)
Ligament laxity	7 (44)	9 (56)

^a Asterisk (*) means 80% consensus was reached.

Additionally, we asked the experts, “Do you feel that functional and chronic ankle instability are the same thing?” Although 9 of the 16 experts (56%) indicated that *CAI* is an umbrella term and *FAI* is a component, consensus was not reached on any single response. Additionally, 3 experts (19%) responded *no* and the 4 remaining experts (25%) responded *yes*, indicating that they agreed that *CAI* and *FAI* were the same.

Definition of CAI

To address CAI, we asked the experts, “What is your definition of chronic ankle instability?” Similar to the previous definition questions, the experts provided lists of components rather than a single definition (Table 8). We reduced their responses to 14 items and, from the survey, we established the working definition as “*Chronic ankle instability* is recurrent episodes of ankle instability and sprains.” Only 11 of the 16 respondents (69%) agreed with the definition, so consensus was not achieved, and no definition of *CAI* was generated.

Functional Characteristics of CAI

To address the functional characteristics of CAI, we asked the experts, “What are the functional characteristics of someone with chronic ankle instability; what are the functional costs or consequences?” Although 6 different items were identified through the interview, none were functional. The list included 1 item that could be considered a characteristic (ankle-ligament laxity) and 5 items that were not. The other 5 responses were “I am not sure if there is a performance decrease or cost,” “Same as functional ankle instability,” “Same as functional ankle instability, just a longer period of time,” “It depends on the sport/activity they participate in,” and “Everyone is different.” None of the responses from that interview question reached consensus. The only issue on which the experts did reach consensus was that CAI was different from FAI.

Nomenclature of CAI

The next interview question addressed CAI nomenclature. We asked the experts, “Do you have a different title or name that you use to describe chronic instability?” Most of the experts (13 of 16; 81%) used the term *CAI*.

The final interview question presented an alternative to the terms *functional* or *chronic* when addressing ankle instability. We asked the following closed-ended question, “Do you feel that ‘persistent ankle instability’ is an appropriate substitute for the title or name that you use (eg, functional ankle instability, chronic ankle instability, ankle instability)?” Most of the experts (9 of 16; 56%) indicated that “persistent ankle instability” was not an appropriate substitute, and 4 (25%) indicated that it was appropriate, whereas 3 (19%) indicated that “it all means the same thing, just different words.”

DISCUSSION

Our purpose was to establish definitions for a healthy/normal/noninjured ankle, FAI, and CAI, as well as to identify the functional characteristics of and assessment techniques for each. Our motivation grew from a need for consistency in the language used to describe ankle injuries and their characteristics as a first step in identifying appropriate measures for assessing outcomes.

Definitions

To properly measure health care outcomes, the element of health that is of interest must be determined, along with an instrument to measure it.¹¹ Based on the model established by the WHO International Classification of Function,¹¹ the first step is to identify and define *health* or, in this case, a *healthy/normal/noninjured ankle*. The WHO defines *health* as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”¹⁷ An element of health that is often addressed is level of health, which has been described as *function*,¹⁸ *activity limitation*,¹¹ *disability*,¹⁸ *impairment*,^{11,18} and *participation status*.¹¹ Models, such as those developed by Nagi¹⁸ and the WHO,¹¹ have been created to provide a common language that can be used by all health care practitioners. Those models provide a broader perspective of the patient’s health status to include social well-being, in addition to the physical limitations of the disability.^{19,20} The definition of a healthy (normal/noninjured) ankle has not, to our knowledge, been previously established; rather, the literature is focused on injury and instability. Therefore, our first step was to define a healthy ankle. Our definition of a healthy ankle included full functional capacity and participation status. That seems to coincide with the operational definition of an *acute lateral ankle sprain* presented by Delahunt and colleagues,⁹ which includes disability and deficits in function. This reinforces the concept that the definition of an *unhealthy ankle*, or in this case, the Delahunt et al⁹ definition of a *lateral ankle sprain*, should contain language similar to that in the definition of a “healthy” ankle.

Although the experts reached a consensus for the definition of a healthy ankle in 3 Delphi rounds, several factors became apparent. Multiple experts emphasized that some components with which they agreed were not limited

to only ankle function and that function could be affected for reasons unrelated to the ankle. Another cautioned that *healthy/normal* and *noninjured* were not necessarily synonymous, and there could, in fact, be an abnormality in the absence of injury.

In addition to debating several components that ultimately reached consensus, several experts raised concerns about the inclusion of pain. They emphasized that pain is an impairment and suggested that it not be listed separately within the definitions. However, we decided to leave pain within our definition of a healthy/normal/noninjured ankle for several reasons. First, because *no pain* was agreed on by 15 (94%) of the experts, we felt it was important enough to include in the definition, even though pain is an impairment. Second, 14 of 16 experts (88%) agreed with the definition, which included both pain and impairment. Third, the WHO International Classification of Functioning, Disability and Health language is not yet universal to all health care providers. Those who are unfamiliar with this language may not appreciate that pain is universally included in the definition of the term *impairment*. Although this definition may evolve with additional research, it represents progress toward establishing a common definition.

Once the definition of a healthy ankle was established, the experts were asked to define FAI. We expected the panel to reach a consensus for FAI, and they did. Of the 32 components that were initially offered by the experts, however, only “a recurrent sense of giving way of the ankle” reached agreement. Therefore, our definition includes only “recurrent sense of giving way of the ankle.” Our definition is very similar to that of Freeman (1965)²¹ and the operational definition of Delahunt et al (2010),⁹ which included “giving way,” and “frequent episodes of giving way and feelings of ankle joint instability,” respectively. Absent from these definitions are terms related to function or functional capacity. Although the definition of a *healthy/normal/noninjured ankle* included items that address function, the definition of FAI did not. It would then seem that the diagnostic criteria for FAI should include only 1 question specific to recurrent episodes of giving way. Yet the inclusion criteria for FAI research seem to include multiple impairments¹⁰ that are often not associated with a self-reported sense of giving way. Those impairments include anatomic differences, decreased inversion strength, decreased balance, altered foot mechanics during gait, and jump-landing deficits,¹⁰ all of which represent clinician-measured impairments.

Other authors have described *functional instability* as “the disabling loss of reliable static and dynamic support of a joint.”^{22(p692)} Hertel^{6(p364)} defined *lateral ankle instability* as “the existence of an unstable ankle due to lateral ligamentous damage caused by excessive supination or inversion of the rearfoot” and *CAI* as “the occurrence of repetitive bouts of lateral ankle instability, resulting in numerous ankle sprains.”^{6(p363)} In his own research, Hertel⁶ did not use the term *functional ankle instability* but instead supported a paradigm in which mechanical and functional insufficiencies were subcomponents of CAI. Tropp⁷ also supported the concept that functional and mechanical instabilities are components of CAI but described FAI as “the subjective feeling of ankle instability or recurrent,

symptomatic ankle sprains (or both) due to proprioceptive and neuromuscular deficits.”⁷⁽⁵¹²⁾

Although we successfully defined *healthy/normal/noninjured ankle* and *FAI*, we were not able to define *CAI*. In 2010, through a systematic review, Delahunt et al^{9(p2117)} provided an operational definition of CAI as “an encompassing term” and included “mechanical and functional instability” as well as “residual symptoms of giving way and ankle joint instability present for a minimum of 1 year post-initial sprain.” During our interviews, the experts offered their own definitions and listed components of chronic instability to include in the definition, as they did for the *healthy ankle* and *FAI* definitions. However, unlike for the previous concepts, the experts could not agree on a definition of CAI. Some indicated that they felt that FAI and CAI had the same meaning. Others suggested that *CAI* was a broader term under which *FAI* was a component, a concept that was supported by Delahunt et al,⁹ Hertel,⁶ and Tropp.⁷ Still, some insisted that *FAI* was the appropriate title, whereas others offered the same support for *CAI*. One expert’s comment about *FAI* was “if you must use that term.” Yet another stated that *CAI* “is a bad term” and *FAI* “is the better term.” Based on the brevity of our definition of *FAI*, the lack of agreement on its components, and our failure to define *CAI*, it is apparent that the meanings of *FAI* and *CAI* are not clear. Yet “the sense of giving way,” which is exclusively a patient-reported impairment, seemed to be the 1 identifier that was consistently agreed upon in the definition and description of FAI.

Functional Characteristics

Once the definitions were established, we then identified the characteristics of a healthy ankle, FAI, CAI, and an unhealthy ankle. Although the experts agreed on 11 of 27 characteristics (41%) of a healthy ankle, several of the 11 characteristics did not represent functions but rather the absence of impairments (ie, range of motion, strength, pain, balance). Although some experts noted and commented on those discrepancies, most did not. These overlapping concepts reinforce our opinion that these terms and language are not yet universal. However, as 1 expert stated, the resolution of impairments may be necessary to achieve full functional capacity, even though the impairments themselves are not truly considered measures of function. Others indicated that “patients can be functional without full range of motion,” and “they can have pain and still be functional.” Those comments highlight the divergent opinions specific to ankle health and injury and reinforce the need for clarity.

An additional trend appeared as we attempted to reach consensus for the final list of healthy ankle characteristics. Many of the impairments that were initially identified during the interviews did not reach consensus. We believe this reinforces 2 points. First, the language common in health care outcomes is not universally understood or applied. Second, our Delphi design and the selection of a diverse panel of experts, for the most part, was successful. Specifically, the inclusion of panelists with backgrounds in general outcomes assessment and outcomes research who did not specialize in ankle-injury care or ankle-injury research, was appropriate and necessary. Those panelists

consistently reinforced the use of outcomes terminology, such as *function* and *impairment*.

In addition to the classification of the characteristics, the relative specificity of the characteristics of the ankle was questioned. Several panelists emphasized that the functional characteristics were not necessarily exclusive to the ankle. Normal gait, for example, can be affected by any problem linked to the lower extremity functional chain, which raises the larger issue of whether it is appropriate or necessary to have outcomes instruments specific to injuries, regions, or articulations. Because those characteristics are ultimately used to address ankle-injury outcomes, it could be appropriate to add “as related to the ankle” before each item, as was recommended by 1 panelist.

The panel also identified patient values as a key component in addressing function. In contrast to some characteristics of healthy ankles, a comment such as “It depends on what they want to do; it is based on [a] patient’s perspectives and goals” is not specific to the ankle or any other injury. It does, however, emphasize each patient’s unique values and priorities because it highlights the personal effect that injury can have on function. Considering this aspect is vital when addressing the effects of injury on function and is paramount when monitoring recovery and outcomes.^{19,20} We also believe that including this important characteristic reflects the diversity among the experts’ perspectives and backgrounds.

Next, we addressed the characteristics of an unhealthy (acutely injured) ankle. One difference between the healthy and unhealthy ankle is that the characteristics of the latter included not only more items but also more impairments. Although *impairment* does not carry the same meaning as *function*, including impairments within the list of functional characteristics reinforces the lack of clarity regarding these terms. Several impairments were included in the list of functional characteristics of an unhealthy ankle, and again, many more overall characteristics were included in the final list. “Depends on the patient’s desired or normal level of activity” was also on both the unhealthy and healthy lists, which emphasizes the importance of considering the patient’s values and goals when addressing the functional cost of an injury. Other comments and concerns pertained to the term *decreased*. Similar to the list of characteristics of a healthy ankle, the reference point for “normal” was not clearly identified. In addition, it is not clear whether a patient must have all characteristics or just a single characteristic on the list to be considered “unhealthy.” As with the healthy ankle, characteristics such as “decreased confidence” are not specific to the ankle, which again suggests the need to add “as related to the ankle” to each characteristic.

When the experts identified the functional characteristics of FAI, several items on the final list also appeared on the final list of unhealthy characteristics. Because both an unhealthy ankle and FAI are deviations from “healthy,” similarities should be expected. Similar items included “unable to complete sport-specific activities,” “difficulty walking on uneven ground/engaging unpredictable surfaces,” and “decreased confidence.” As with the first 2 lists, “it depends on what they want to do” was included as well. There were, however, a few differences: the most notable were that “repetitive episodes of giving way” and “there is

a continuum” appeared on the FAI list but not the unhealthy list.

Another interesting comparison is with previously published FAI inclusion criteria.^{23–30} Our final list showed some similarities yet was not an exact match to any of them. Another item that was included in the final list but not in any previous publications or in our “unhealthy” list, was “there is a continuum.” This seems to represent the comments made by 1 expert who suggested that FAI “is a syndrome” and “not all patients are heterogeneous.”

In contrast to FAI, none of the functional characteristics of CAI reached consensus. Some of the experts stated that the functional characteristics of CAI were the same as for FAI, whereas others stated that the condition was the same but over a longer period. Interestingly, 3 experts (19%) chose “I am not sure if there is a performance decrease or cost” as related to the functional characteristics of CAI. That implies persistent misconceptions and misunderstandings about CAI. Because the definition of CAI did not reach consensus, it was not surprising that the functional characteristics did not reach consensus.

Assessment Techniques

Although the final lists of techniques for assessing the characteristics of a healthy or unhealthy ankle were not a perfect match, the assessments did generally align with the characteristics of a healthy or unhealthy ankle. When the experts were asked to agree on assessment techniques, pain again was the focus of several discussion points. One expert suggested that “can perform without pain” should be added to the assessments. Another noted that it is possible to function with pain. Perhaps those comments and the debate about pain identify an opportunity to improve our methods of assessing function. The existence or absence of pain could complement existing functional rating assessments and instruments. Regardless, when addressing function, the presence of pain certainly warrants additional attention.

In addition to pain, the importance of self-reported functional assessments was again emphasized. One expert commented, “What I really like about this is that it seems as though laboratory-oriented, clinician-oriented, and patient-oriented measures have emerged as being relevant for assessment. This is a great sign that we’re looking for context among the patient, clinician, and researcher!” Similarly, Wiklund³¹ stated that patient-reported outcomes, linked with clinician-reported outcomes, add important information that cannot be collected by using clinician-reported techniques alone. Patient-reported outcomes also facilitate communication between the patient and clinician and may reveal patient concerns or conditions that might have gone unnoticed.³² Furthermore, discrepancies often appear between the clinician’s and the patient’s impressions of readiness to return to activity.³³ Laboratory-oriented, clinician-oriented, and patient-oriented assessments did, indeed, emerge throughout the experts’ responses to the various questions in our results.

Clarity

The final question we posed to the panel addressed other terms that they use in addition to or in place of *FAI* or *CAI*. Our goal was to achieve clarity and allow the experts to express their opinions. We asked if they felt *persistent*

ankle instability was an appropriate substitute for *FAI* or *CAI* or both. The experts did not agree on any term as an alternate to *FAI* or *CAI*, but some terms emerged from the comments. They included *recurrent ankle instability*, *recurrent ankle dysfunction*, and *dysfunction*. Some respondents emphasized that the terms *FAI* and *CAI* should be changed to something different, whereas others indicated that *FAI* and *CAI* were interchangeable terms. One expert commented that that no single term will encompass all patients and that clinical prediction rules should be explored. Ultimately, however, those results indicate that inconsistencies and contradictions about the concept of ankle instability persist, whether it is classified as chronic or functional.

Summary

We established a working definition of a healthy ankle, along with the functional characteristics and assessment techniques of healthy and unhealthy ankles. Consensus was also reached regarding the definition of *FAI*; however, many disagreements remain, as described in the experts' comments. The definition of *CAI* did not reach 80% consensus, but most experts did agree on the definition. Although the experts voiced mixed opinions regarding the definitions of both *FAI* and *CAI*, these results offer a good starting point for the working definitions.

CONCLUSIONS

We established the definition of a healthy ankle and identified 11 characteristics. Experts agreed on 16 components of the definition, which we condensed into 5 categories, including pain. These are important steps in creating a unified outcomes model for advancing the care of patients with ankle injuries. Future researchers should build upon the definition, components, and assessment techniques of a healthy ankle and compare the experts' opinions with those of patients with ankle injuries and with existing ankle-outcomes instruments. Furthermore, the effect of pain during function should be explored as a factor in the assessment of function.

In addition, although we were able to establish a definition for *FAI*, the experts could agree on only 1 of the 32 components (3%) of *FAI* that they initially identified. Therefore, the definition includes only "recurrent sense of giving way of the ankle." That definition is surprisingly similar to the original Freeman²¹ definition of 47 years ago. It could then be argued that the only criterion necessary to classify a patient with *FAI* is the presence of the sense of giving way. This suggestion highlights the complexity of *FAI*, but it does not clarify how the term should be identified in practice or research. Future investigators should continue to address the nature of *FAI* specific to its identification and effect on function.

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