ORIGINAL ARTICLE

The Cumberland Ankle Instability Tool: A Report of Validity and Reliability Testing

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ABSTRACT. Hiller CE, Refshauge KM, Bundy AC, Herbert RD, Kilbreath SL. The Cumberland Ankle Instability Tool: a report of validity and reliability testing. Arch Phys Med Rehabil 2006;87:1235-41.

Objective: To test the Cumberland Ankle Instability Tool (CAIT), a 9-item 30-point scale, for measuring severity of functional ankle instability.

Design: Cross-sectional study.

Setting: General community.

Participants: Volunteer sample of 236 subjects.

Interventions: Not applicable.

Main Outcome Measures: Concurrent validity by comparison with the Lower Extremity Functional Scale (LEFS) and a visual analog scale (VAS) of global perception of ankle instability by using the Spearman ρ. Construct validity and internal reliability with Rasch analysis using goodness-of-fit statistics for items and subjects, separation of subjects, correlation of items to the total scale, and a Cronbach α equivalent. Discrimination score for functional ankle instability by maximizing the Youden index and tested for sensitivity and specificity. Test-retest reliability by intraclass correlation coefficient, model 2,1 ($ICC_{2,1}$).

Results: There were significant correlations between the CAIT and LEFS (ρ=.50, P<.01) and VAS (ρ=.76, P<.01). Construct validity and internal reliability were acceptable (α=.83; point measure correlation for all items, >0.5; item reliability index, .99). The threshold CAIT score was 27.5 (Youden index, 68.1); sensitivity was 82.9% and specificity was 74.7%. Test-retest reliability was excellent ($ICC_{2,1}$=.96).

Conclusions: CAIT is a simple, valid, and reliable tool to measure severity of functional ankle instability.

Key Words: Ankle; Joint instability; Questionnaires; Rehabilitation; Sprains and strains.

UP TO 70% OF PEOPLE HAVE persisting symptoms of pain and instability after a simple ankle sprain.[1-3] Chronic ankle instability, among the most common symptoms, is debilitating and can lead to a wide spectrum of disability.[4] Chronic ankle instability can include recurrent sprain, mechanical instability in which a primary mechanical restraint is lost, and functional ankle instability.[4] Although mechanical instability can be measured, functional ankle instability has been difficult to measure. The term functional ankle instability is used to describe the perception that the ankle gives way, is weaker, more painful, or less functional than before injury.[5-7] Until recently, functional instability could not be reliably measured. This has hampered diagnosis of functional ankle instability, use of instability as an outcome measure in the clinic or in research, and selection of homogeneous groups of participants for research.

Two questionnaires have been developed for assessing functional ankle instability: the Functional Ankle Instability Questionnaire (FAIQ)[8] and the Ankle Joint Functional Assessment Tool (AJFAT).[9] The FAIQ has 11 questions, 9 of which are dichotomous. For this reason, the FAIQ is likely to be insensitive to gradations of severity. Reliability and validity of the FAIQ have not been reported. The AJFAT has 12 questions, and participants choose from 5 responses. Each question requires comparison between the affected and nonaffected ankle. Consequently, this tool is useful for people with unilateral instability but not for those with bilateral injuries or instability. Reliability data for the AJFAT have not been reported.

There is no tool to assess functional ankle instability that does not require comparison with the contralateral ankle and is capable of identifying different grades of severity of the instability. We therefore developed a questionnaire to reliably determine whether a subject had functional ankle instability and that could grade severity of the instability. Importantly, this questionnaire is independent of reference to the other leg. In this article, we describe a series of studies aimed at determining the validity and reliability of the Cumberland Ankle Instability Tool (CAIT) to measure functional ankle instability. Concurrent, construct, and discriminative validity, and test-retest and internal reliability were examined.

METHODS

Development

To devise the questionnaire, the CAIT, we first identified questions used in previous studies on ankle injury[8-13] and also derived questions from focus group interviews with people with chronic instability. From these sources, a 12-item questionnaire (CAIT 1) was devised and administered to a pilot group of subjects (N=18 subjects, resulting in 36 responses, one for each leg) with a mix of uninjured, sprained, and unstable ankles. For each item, a range of 4 or 5 responses was possible, representing an increasing level of difficulty for the activity concerned. Scores were assigned based on the rank of the chosen response and summated to generate a total score.

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From this pilot study, 2 questions were removed because all subjects gave the same response, which suggested that the question would not be useful for discriminating between subjects.

A field study was then undertaken in a group of subjects from the community (N=49) with the modified questionnaire (CAIT 2; maximum score, 37). There was a mix of subjects with uninjured, unilateral, and bilateral sprained ankles. The responses to each item were examined to determine the extent to which all response categories were used. This resulted in contraction of the range of responses for 3 questions. One question was discarded because it was dependent on knowledge and use of tape or brace as a treatment. Nine items remained and were retained for further study. The maximum score for the final version of the CAIT (CAIT 3; appendix 1) is 30, with a low score indicating more severe functional ankle instability.

Participants

To test the properties of the CAIT, a total of 236 subjects were recruited. No subject participated in all studies, although some subjects participated in more than 1 study. Subjects were recruited from the university campus, from the general community, and from among dance students at a performing arts high school. Ethics approval was gained from the institution's human research ethics committee for all aspects of the study before commencement of data collection.

Validity

Concurrent validity is usually tested by comparing a scale against the criterion standard for the condition tested. Because there is no criterion standard against which to measure functional ankle instability, we compared the CAIT score with a lower-limb reference standard, the Lower Extremity Functional Scale (LEFS),[14] and to self-reported perception of ankle stability by using a 10-cm visual analog scale (VAS). The LEFS was selected instead of the FAIQ or the AJFAT because the properties of these questionnaires are unknown. Additionally, the FAIQ includes a dichotomous yes-no assessment of functional ankle instability, and the AJFAT results in a score reflecting the difference between ankles and therefore cannot be directly compared with the CAIT.

The LEFS measures lower-extremity function across a wide range of lower-limb disability levels and conditions and although not specific to the ankle, it is a valid and reliable tool that has been used in rehabilitation settings and is sensitive to change of lower-limb function.[14] The VAS was included to provide a measure of a subject's overall perception of ankle instability. VASs have face validity and have been shown to be reliable for measuring a range of variables, including pain and perceived exertion.[15,16]

A self-reported ankle history, CAIT, LEFS, and a VAS for perceived ankle stability were administered to 92 university students with a mean age ± standard deviation (SD) of 23±6.1 years with or without ankle sprain but no other concurrent acute or chronic lower-limb problems. Subjects completed a separate questionnaire for each ankle. Five subjects with unilateral ankle sprains did not complete responses for their uninjured ankle, and 2 incomplete questionnaires were returned, resulting in 177 complete responses. There were 35 subjects with no history of ankle sprain, 27 with a history of unilateral sprain, and 30 subjects with a history of bilateral sprains. The CAIT score was compared with both the LEFS and VAS by using the Spearman ρ.

Construct validity was examined by the fit of items and people by Rasch analysis[17] by using the Winsteps program.[a] Rasch analysis is a means of converting ordinal data to interval data and creating a hierarchy (in this case from least to most stable) that is applied to each item and person. Unlike classical statistics used in test development, Rasch provides goodness-of-fit statistics for each person and item. Fit statistics allow researchers to examine the proportion of people whose data meet the Rasch assumption that people with greater ankle stability will be more likely to receive higher CAIT scores. Through the examination of fit statistics, Rasch enables preliminary examination of construct validity even in the case of relatively small sample sizes (≈200 subjects). In this study, only subjects with a history of ankle sprain were recruited as the construct of functional ankle instability after ankle sprain was being examined. Subjects completed the CAIT for each ankle that had sustained a sprain, and they also completed a brief history of the ankle injury. There were 146 subjects (age, 23±6.8y) from the university, general, and dance communities, 80 with a history of unilateral sprain and 66 with a history of bilateral sprains. This resulted in 212 questionnaires for analysis.

The unidimensionality of the 9 items in the CAIT scale was examined through goodness-of-fit statistics generated by the Rasch analysis. These fit statistics indicate how well the items in CAIT conformed to the assumptions of the Rasch model. Two pairs of mean square (the ratio of the difference between the observed score and the expected score) and t standard-fit statistics (standardized difference between the observed and expected score) were generated for each item, infit and outfit statistics. Infit statistics describe the fit of items near the middle of the scale, and outfit statistics describe the fit of items near the extremes of the scale. The desired values of the mean square and t statistic are 1 and 0, respectively. For this study, mean square values of 0.6 to 1.4 were considered acceptable, with a t statistic of ±2, because these correspond with 95% fit.[17]

To determine if the CAIT measured severity of functional instability, the fit of data for individual subjects to the expectations of the Rasch model was examined as a reflection of validity. If the scale is valid, then there should be consistency in responses across the 9 items so that subjects without functional ankle instability should score at the top of all items and those with severe functional ankle instability should score at the bottom of all items. It would be expected that data from fewer than 5% of subjects would fail to fit the Rasch model.[17] In the present study, those that did not fit were investigated to determine whether they shared any common characteristics. An item map was also constructed to determine whether the item difficulty captured the spread of instability reported by subjects.

Discriminative validity was tested to determine whether the CAIT could discriminate between subjects with and without functional ankle instability. The first step in this process was to determine the discrimination (or cutoff) score that best differentiated subjects with and without ankle sprains. Because there is no criterion standard for measuring functional ankle instability, we used a history of ankle sprain as the discriminative measure. People without ankle sprain should score at the top of the scale, and only those with functional ankle instability should score down the range of the scale.

One hundred fifty-one subjects (age, 23±6.8y) from the university, general, and dance communities completed both the CAIT and a brief ankle history questionnaire for each ankle. Five subjects with a unilateral ankle sprain did not complete the CAIT for their uninjured ankles, resulting in 297 responses. There were 56 subjects with no history of ankle sprain, 45 with a history of unilateral ankle sprain, and 50 subjects with a history of bilateral ankle sprain. The 297 responses were randomly allocated to 2 groups. The discrimina-

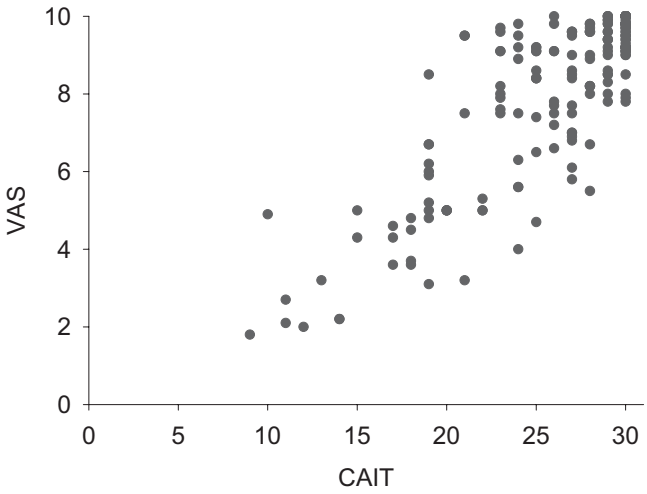

Fig 1. Relation between the CAIT and the global perception of ankle instability measured by using an 11-point VAS (range, 0–10) (r=.84, P<.01). Each point represents an individual subject (n=92).

tion score was determined from 1 group of subjects (training set), and the accuracy of the discrimination score was tested in the second (validation) group of subjects.[18] The discrimination score was determined by finding the score that yielded the maximum Youden index, calculated as sensitivity (%) + specificity (%) − 100.[18] This cutoff score was then tested on the second group for sensitivity, specificity, and likelihood ratios. A receiver operating curve (ROC) was constructed to confirm the cutoff point. The second step was to confirm that the cutoff point, as determined by ankle sprain history, was reflected in the Rasch item map. Because Rasch analysis reflects the construct of functional ankle instability, if a gap appears in the item map at the level of the cutoff point, then the cutoff point also reflects functional ankle instability cutoff. The item map was constructed in the same subjects as the construct validity.

Reliability

Test-retest reliability of the CAIT was determined by administering the CAIT to 18 subjects (age, 41±9.4y) from the general community on 2 separate occasions 2 weeks apart. All subjects completed a questionnaire for each ankle, resulting in 36 responses. No subject suffered any ankle injury between the 2 test occasions. There were 8 subjects with no history of ankle sprain, 5 subjects who had a history of unilateral ankle sprain,

Table 1: Infit and Outfit Statistics for CAIT

	Infit		Outfit	
Question	Mnsq	t	Mnsq	t
1	**2.66**	**7.4**	**2.37**	**6.2**
2	**1.51**	**4.1**	**1.51**	**3.9**
9	1.33	1.9	1.29	1.2
7	1.14	1.3	1.23	2.0
8	1.16	1.7	1.16	1.4
6	0.94	−0.5	0.79	−2.0
5	0.70	−3.6	0.76	−2.1
4	0.76	−2.4	0.73	−2.6
3	**0.53**	**−5.5**	**0.50**	**−5.6**

NOTE. Ideal mean square (Mnsq) is 0.6 to 1.4 and ideal t is −2 to 2. Questions in boldface are outside desired limits.

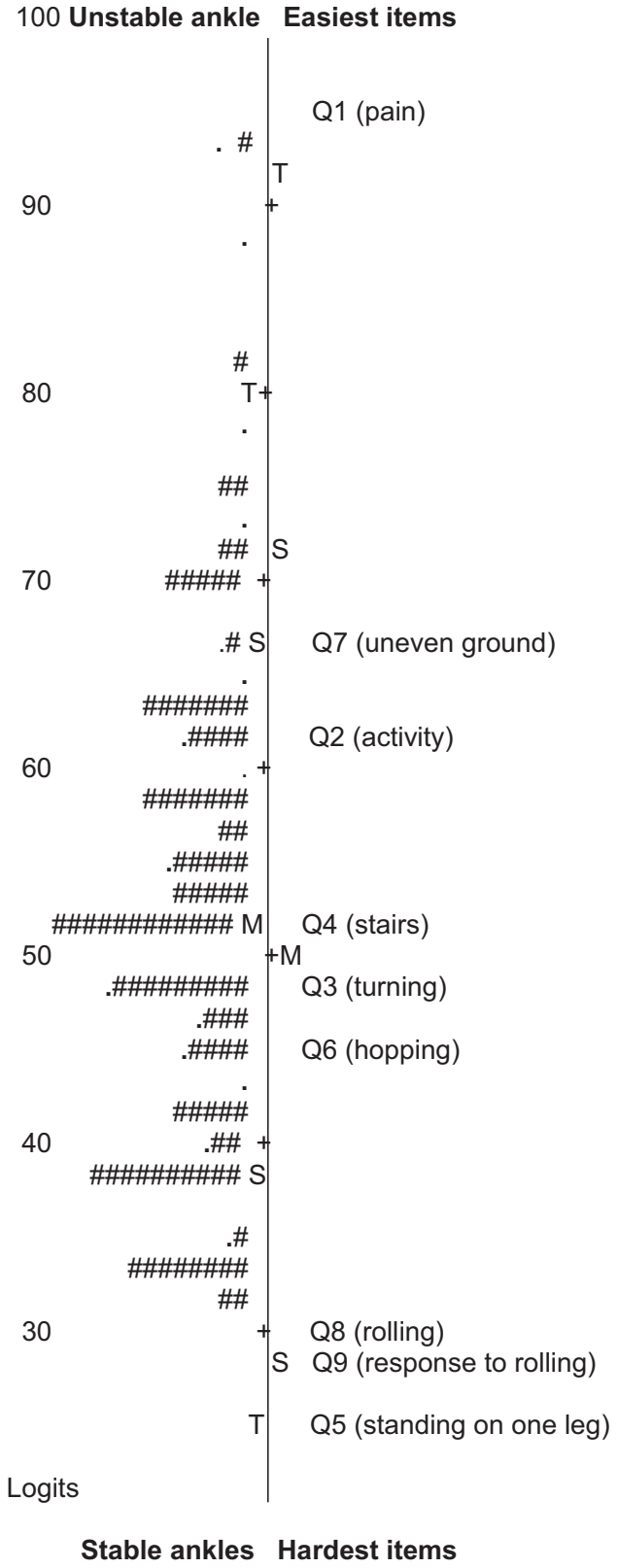

Fig 2. Map of CAIT items, from easiest to hardest for subjects, and stability of ankles by CAIT score converted to a log scale. Abbreviations: M, mean; S, standard deviation; T, 2 standard deviations. Legend: #, 2 ankles.

Table 2: Determination of Discrimination Score for Functional Ankle Instability

CAIT Score	29.5	28.5	27.5	26.5	25.5	24.5
Sensitivity	96.1	89.5	85.5	77.5	73.7	65.8
Specificity	49.3	65.2	82.6	89.9	91.3	94.2
Youden index*	45.3	54.7	68.1	67.4	65.0	60.0
+Likelihood ratio	1.89	2.55	4.89	7.64	8.34	11.35
−Likelihood ratio	0.08	0.17	0.18	0.25	0.30	0.36
Odds ratio	23.6	15.9	28.1	30.5	27.7	31.3

*Youden's index was maximum, with a discrimination score of 27.5.

and 5 with a history of bilateral ankle sprain. Reliability was analyzed by using intraclass correlation coefficients, model 2,1 ($ICC_{2,1}$), and percentage close agreement.

Internal reliability was determined by using Rasch analysis on the same group of subjects used to test construct validity (n=146 subjects with 212 responses). Internal reliability of CAIT was determined from the score for separation of subjects, subject reliability index, point-measure correlation coefficient of items with the total test score, and item reliability index. There should be at least 2 levels of subjects (subject separation), those who have functional ankle instability and those who do not, and this should be reflected in a subject separation score of 2 or more. The subject reliability index (Cronbach α equivalent) should be high, reflecting a range of instability with confidence in the consistency of the CAIT scores. The point-measure correlation coefficient indicates the coherence of each item within the CAIT and is the correlation between all responses to an item and the subjects' overall score. The point-measure correlation coefficient should be greater than 0.5 for each item.[19] The item reliability index should be high, reflecting replicability if the same items are given to another group of comparable subjects.

RESULTS

Validity

There was a strong correlation between the CAIT and VAS measures of subjects' overall perceptions of ankle instability (ρ=.76, P<.01; fig 1). There was a moderate correlation between the LEFS and the CAIT (ρ=.50, P<.01) with a clear ceiling effect of the LEFS in subjects with functional ankle instability (ie, many subjects with functional ankle instability scored the maximum possible on LEFS although their scores on the VAS and the CAIT were low).

Three questions included in the CAIT were outside the accepted parameters for the fit statistics (table 1). Fit statistics for question 3 (turning) were too low, suggesting that subjects did not use the full range of the scale. Question 1 (concerning pain) and question 2 (concerning perceived ankle instability during activity) had excessively high fit statistics, indicating that the responses to these questions were inconsistent with the scores on the remaining items.

In the item map (fig 2), the spread of items was greater than the spread of subjects, showing that the scale is broad enough to encompass the spread of severity of functional ankle instability. There were some gaps in the item continuum in which a large change in perception of ankle stability would potentially be required to show a change in a CAIT score.

There was a distinct discrimination score (27.5; maximum, 30) for determining whether or not a subject had experienced an ankle sprain, and this corresponded to the highest Youden's index (68.1; table 2). Subjects with a score of 28 or higher are unlikely to have functional ankle instability, whereas subjects with a score of 27 or lower are likely to have functional ankle instability (fig 3). In the validation group, the discrimination score of 27.5 had a sensitivity of 82.9% and a specificity of 74.7%, with a positive likelihood ratio of 3.27 and a negative likelihood ratio of 0.23. The ROC curve for the validation group is shown in figure 4. The item map (see fig 2) shows a distinct break between log 41.9 and 43.5, which corresponds to the break between the CAIT scores of 28 and 27.

To determine whether the CAIT could be used to determine severity of instability, bands of scores were identified visually and then assessed for utility by calculating likelihood ratios for each band from all data. Because the optimal discrimination score was 27.5, the bands were selected to be 2.5 points wide (ie, the bands were defined as scores of 30–27.5 points, 27–24.5, 24–21.5, and a score <21.5 points). The likelihood ratio associated with being in the highest band (ie, 30–27.5) was 0.20, and in the lowest band (<21.5) was 32.0 if the participant had a history of ankle sprain (table 3; see fig 3).

Reliability

The CAIT had excellent test-retest reliability ($ICC_{2,1}$=.96). There was exact agreement between the 2 test occasions for 12 (33.3%) responses. Thirty pairs (83.3%) of responses differed by 2 or fewer points (table 4). The Bland-Altman plot indicated that reliability did not change systematically with the CAIT score (fig 5).

Subject separation scores indicated that the CAIT can separate subjects into 2 groups: those with and those without

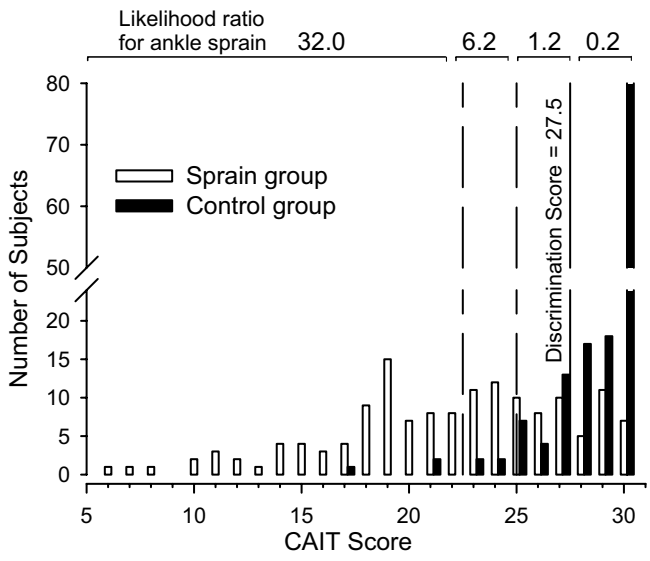

Fig 3. Distribution of subjects along the CAIT showing those with and those without a history of ankle sprain (N=297). Discrimination score for functional ankle instability was 27.5. Note break in *y* axis.

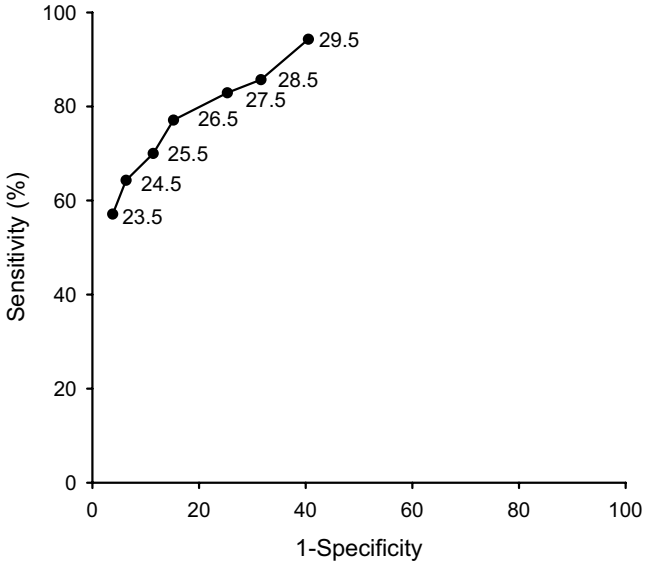

Fig 4. ROC curve for testing CAIT discrimination score (27.5) (N=147).

functional ankle instability. The CAIT showed a model separation of subjects of 2.23, with a subject reliability index of 0.83 (Cronbach α equivalent). All items had point-measure correlation coefficients greater than 0.5, with a range between .56 and .74, and an item reliability index of .99.

Twenty-one (10%) subjects failed to conform to the expectations of the Rasch model, which is higher than the desired 5%. The range of CAIT scores for these 21 subjects was 2 to 25, with 10 subjects feeling unstable during low level global activity but not feeling unstable during other specific activities included in the CAIT.

DISCUSSION

The CAIT is the first tool that has been shown to be a valid and reliable measure of functional ankle instability. We tested concurrent validity because there is no criterion standard for measuring functional ankle instability. The global perception of ankle instability showed a strong correlation with the CAIT but the correlation with the LEFS was only moderate, probably because of a ceiling effect with the LEFS. The ceiling effect with the LEFS shows that it is insufficiently sensitive to identify the problems of subjects with functional ankle instability. Subjects who feel unstable at their ankle may be able to participate in activities at a high level, with consequent high scores on the LEFS because most tasks included in the scale are not sufficiently challenging.

The Rasch analysis revealed that fit statistics for 3 questions (overall stability, turning, pain) fall outside the desired limits.

Table 3: Likelihood Ratios for Bands of CAIT Scores

Bands CAIT Score	Sprain Group (n)	Control Group (n)	Likelihood Ratio	95% CI for Likelihood Ratio
27.5–30.0	23	117	0.20	0.13–0.29
24.5–27.0	30	24	1.24	0.76–2.02
21.5–24.0	31	4	7.70	2.79–21.30
<21.5	65	3	21.52	6.91–66.79
Total	149	148		

Abbreviation: CI, confidence interval.

Table 4: Difference Between the CAIT Scores on 2 Test Occasions (n=36)

Difference	Count	%	Cumulative %
0	12	33.3	33.3
1	12	33.3	66.6
2	6	16.7	83.3
3	4	11.1	94.4
4	1	2.8	97.2
5	0	0.0	97.2
6	1	2.8	100.0

One explanation is that the CAIT is not a unidimensional construct for functional ankle instability. A more compelling explanation is that the poor fit of these statistics arose because some subjects were engaged in competitive activities that require very high level ankle stability (eg, dance), or subjects' perceived instability arose during activities not included in the CAIT. The erratic responses on question 2 were consistently lower than expected and lower than other item scores, potentially indicating that despite the range of activities included, some subjects had difficulty with activities not included in the CAIT. Another explanation could be that the concept of "sport" is ambiguous to some subjects and leads them to choose either the "activities of daily living" or "never" responses.

The low fit statistics for the item on instability while turning during gait (question 3), with few subjects using the lower scores, suggests it may be better to compress the scoring for this item. The fit statistics for the item concerning ankle pain (question 1) were extreme, suggesting that, as expected, pain is not part of the functional ankle instability construct. However, it is not essential to remove the item on pain, and we prefer to retain the question until there is further evidence that it is not a relevant symptom contributing to the functional instability complex. It may be premature to compress the scoring on question 3 until more subjects with very severe functional instability are tested.

The reliability of the CAIT was excellent on a number of measures. There was a clear delineation of 2 groups of subjects,

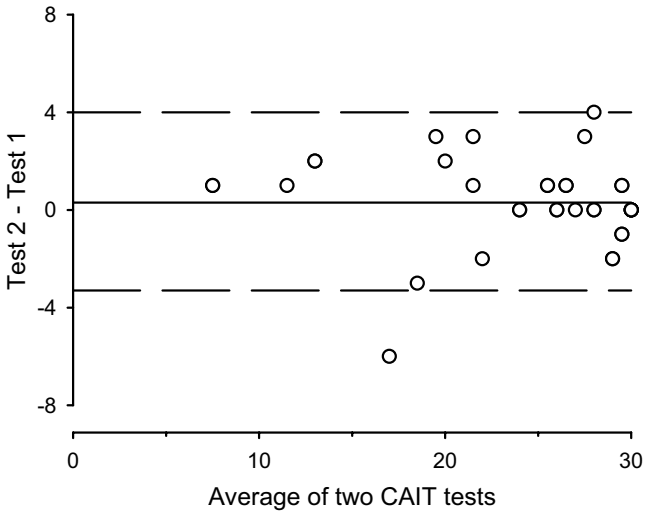

Fig 5. Bland and Altman plot showing the average of the 2 CAIT test occasions against the difference between the 2 tests (n=36). The solid line represents the mean of the difference between the 2 test occasions, and the dashed lines represent 1.96 times the SD of the difference between the 2 test occasions.

those with and without functional ankle instability. The item correlation and item reliability were excellent, showing that it is possible to identify a range in severity of functional ankle instability. There was a higher than expected number of subjects whose data failed to fit the model (10%), and it was found that 50% of these scored 0 or 1 on overall instability (question 2) while scoring the other items more highly. This indicates there may be other activities not included in the CAIT with which they have difficulty. Further study is underway to determine whether the gap reduces sensitivity to change or whether other activities are part of the construct and can be added to the CAIT.

The ability of the CAIT to discriminate between subjects with and without functional ankle instability renders it useful in both clinical and in research settings. In the clinic, the CAIT will enable assessment of the severity of instability and, for the first time, will enable monitoring of the outcome of rehabilitation of functional ankle instability. Although the CAIT was developed and tested for use on subjects with functional instability after ankle sprain, it may also be a useful measurement tool for assessment and management of functional ankle instability in other conditions such as Charcot-Marie-Tooth disease or after ankle fracture. People with such ankle conditions often report that their ankle feels unstable and gives way but the current lower-limb tools, such as the LEFS, are insensitive to measuring instability in these high-functioning groups of patients. Finally, the CAIT score has the potential to predict future sprain in those who have functional ankle instability. It may be that those people who have sprained an ankle and have a low CAIT score are more likely to resprain, and those with a high CAIT score may be less likely to resprain. We are currently investigating the predictive validity of the CAIT and its usefulness in other ankle conditions.

The CAIT is also an important measurement tool for research. It can be used to select more homogeneous groups of subjects for both control and instability groups. Research has often been undertaken on subjects with unilateral functional ankle instability with no means to determine either that the control ankle was in fact stable or that the control and unstable ankles were markedly different. Functional ankle instability is often assumed from a history of ankle sprain despite evidence that these ankles are not necessarily functionally unstable. We explored this post hoc and found virtually no correlation between CAIT scores and the number of ankle sprains in participants recruited into our series of studies (Pearson r=.18).

The CAIT has been designed and tested to be administered with the clinician or researcher present to review the items. Our experience with the CAIT, as with other questionnaires, has taught us that some subjects require clarity on some of the items. For the item concerning pain (question 1), the assessor should ensure that the respondent focuses on pain related only to the ankle disorder. In the item about feeling unstable during a sharp turn (question 3), "turn" refers to a change of direction rather than a spin on the spot. We found the "spin" interpretation unique to some dancers. For questions 8 and 9, "rolling over" refers to the ankle rolling into extreme inversion and not only to a spraining incident.

CONCLUSIONS

Our series of studies show that the CAIT (version 3) is a simple, reliable, and valid questionnaire for discriminating and measuring the severity of functional ankle instability. Clinically, the CAIT will be a useful tool for assessing the severity of functional ankle instability, measuring treatment outcome, and monitoring progress. In research, the CAIT will enable more homogenous subject groups to be identified, objectively defined, and compared.

APPENDIX 1: THE CAIT QUESTIONNAIRE

Please tick the ONE statement in EACH question that BEST describes your ankles.

	LEFT	RIGHT	Score
1. I have pain in my ankle			
Never	☐	☐	5
During sport	☐	☐	4
Running on uneven surfaces	☐	☐	3
Running on level surfaces	☐	☐	2
Walking on uneven surfaces	☐	☐	1
Walking on level surfaces	☐	☐	0
2. My ankle feels UNSTABLE			
Never	☐	☐	4
Sometimes during sport (not every time)	☐	☐	3
Frequently during sport (every time)	☐	☐	2
Sometimes during daily activity	☐	☐	1
Frequently during daily activity	☐	☐	0
3. When I make SHARP turns, my ankle feels UNSTABLE			
Never	☐	☐	3
Sometimes when running	☐	☐	2
Often when running	☐	☐	1
When walking	☐	☐	0
4. When going down the stairs, my ankle feels UNSTABLE			
Never	☐	☐	3
If I go fast	☐	☐	2
Occasionally	☐	☐	1
Always	☐	☐	0
5. My ankle feels UNSTABLE when standing on ONE leg			
Never	☐	☐	2
On the ball of my foot	☐	☐	1
With my foot flat	☐	☐	0
6. My ankle feels UNSTABLE when			
Never	☐	☐	3
I hop from side to side	☐	☐	2
I hop on the spot	☐	☐	1
When I jump	☐	☐	0
7. My ankle feels UNSTABLE when			
Never	☐	☐	4
I run on uneven surfaces	☐	☐	3
I jog on uneven surfaces	☐	☐	2
I walk on uneven surfaces	☐	☐	1
I walk on a flat surface	☐	☐	0
8. TYPICALLY, when I start to roll over (or "twist") on my ankle, I can stop it			
Immediately	☐	☐	3
Often	☐	☐	2
Sometimes	☐	☐	1
Never	☐	☐	0
I have never rolled over on my ankle	☐	☐	3
9. After a TYPICAL incident of my ankle rolling over, my ankle returns to "normal"			
Almost immediately	☐	☐	3
Less than one day	☐	☐	2
1–2 days	☐	☐	1
More than 2 days	☐	☐	0
I have never rolled over on my ankle	☐	☐	3

NOTE. The scoring scale is on the right. The scoring system is not visible on the subject's version.

References

1. McKay GD, Goldie PA, Payne WR, Oakes BW. Ankle injuries in basketball: injury rate and risk factors. Br J Sports Med 2001;35:103-8.

2. Braun BL. Effects of ankle sprain in a general clinical population 6 to 18 months after medical evaluation. Arch Fam Med 1999;8: 143-8.
3. 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: 653-60.
4. Hertel J. Functional anatomy, pathomechanics, and pathophysiology of lateral ankle instability. J Athl Train 2002;37:364-75.
5. Lentell G, Katzman LL, Walters MR. The relationship between muscle function and ankle stability. J Orthop Sports Phys Ther 1990;11:605-11.
6. Freeman MA. Instability of the foot after injuries to the lateral ligament of the ankle. J Bone Joint Surg Br 1965;47:669-77.
7. Tropp H. Commentary: functional ankle instability revisited. J Athl Train 2002;37:512-5.
8. Hubbard TJ, Kaminski TW. Kinesthesia is not affected by functional ankle instability status. J Athl Train 2002;37:481-6.
9. Rozzi SL, Lephart SM, Sterner R, Kuligowski L. Balance training for persons with functionally unstable ankles. J Orthop Sports Phys Ther 1999;29:478-86.
10. de Bie RA, de Vet HC, van den Wildenberg FA, Lenssen T, Knipschild PG. The prognosis of ankle sprains. Int J Sports Med 1997;18:285-9.
11. Lentell G, Baas B, Lopez D, McGuire L, Sarrels M, Snyder P. The contributions of proprioceptive deficits, muscle function and anatomic laxity to functional instability of the ankle. J Orthop Sports Phys Ther 1995;21:206-15.
12. Lofvenberg R, Karrholm J, Sundelin G, Ahlgren O. Prolonged reaction time in patients with chronic lateral instability of the ankle. Am J Sports Med 1995;23:414-7.
13. Konradsen L, Ravn JB. Ankle instability caused by prolonged peroneal reaction time. Acta Orthop Scand 1990;61:388-90.
14. Binkley JM, Stratford PW, Lott SA, Riddle DL. The Lower Extremity Functional Scale (LEFS): scale development, measurement properties, and clinical application. North American Orthopaedic Rehabilitation Research Network. Phys Ther 1999;79:371-83.
15. Flandry F, Hunt JP, Terry GC, Hughston JC. Analysis of subjective knee complaints using visual analogue scales. Am J Sports Med 1991;19:112-8.
16. Noble B, Robertson R. Perceived exertion. Champaign: Human Kinetics; 1996.
17. Bond TG, Fox CM. Applying the Rasch model: fundamental measurement in the human sciences. Mahwah: Lawrence Erlbaum Associates; 2001.
18. Straus SE, Richardson WS, Glasziou P, Haynes RB. Evidence-based medicine. 3rd ed. Philadelphia: Elsevier Churchill Livingston; 2005.
19. Streiner D, Norman G. Health measurement scales. A practical guide to their development and use. Oxford: Oxford Univ Pr; 1995.

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