Original Research

The reliability, and discriminative ability of the identification of functional ankle instability questionnaire, Japanese version

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ABSTRACT

Objective: To assess the discriminability as well as the reliability, and internal consistency of the Identification of Functional Ankle Instability questionnaire translated into Japanese (IdFAI-J).
Design: Cross-sectional study.
Setting: Collegiate athletic training/sports medicine clinic.
Participants: Twenty bilingual and sixty-five collegiate athletes including participants with and without functional instability (FI).
Main outcome measures: The sensitivity, specificity, test retest reliability, and internal consistency of IdFAI-J.
Results: The optimal cutoff score between the FI and non-FI participants was >10, with an area under the curve of 0.92. We calculated high sensitivity (0.94) and specificity (0.77) at the cutoff point. For the test-retest reliability, the intraclass correlation coefficient value of the IdFAI-J was 0.96; the standard error of measurement and minimal detectable change value was 1.69 and 3.60, respectively. Cronbach's α was 0.87; there was no improvement when a particular item was deleted from the scale.
Conclusions: The IdFAI-J has excellent discriminability, test-retest reliability, and internal consistency. Hence, the IdFAI-J significantly contribute to clinical practice and future research related to ankle instability in Japan.

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1. Introduction

Increasing functional ankle instability (FI) is a common sequel after lateral ankle sprain (LAS)(Hiller, Kilbreath, & Refshauge, 2011) which occur in about 40% patients (Anandacoomarasamy & Barnsley, 2005). It is known that patients with FI have impaired postural control,(Arnold, De La Motte, Linens, & Ross, 2009) and decreasing ankle eversion strength, (Thompson et al., 2017) these functional impairments are risk factor for LAS (Kobayashi, Tanaka, & Shida, 2015; Witchalls, Blanch, Waddington, & Adams, 2012). Hence, assessing FI during rehabilitation of LAS and ensuring full recovery of FI is valuable to prevent resprain.

FI is assessed using a self-reported questionnaire such as Identification of ankle instability (IdFAI), Cumberland ankle instability tool (CAIT), Ankle instability instruments (AII);(Gribble et al., 2014) these questionnaires can reflect FI related functional deficits such as impaired postural control and (Houston, Hoch, Gabriner, Kirby, & Hoch, 2015; Rosen, Ko, & Brown, 2016) impaired proprioceptive function(Houston et al., 2015). Hence, these are recommended when assessing FI at international ankle consortium (IAC)(Gribble et al., 2014). In addition, evaluating patient-related outcome (PRO) is essential to comprehend the effect of pathologic condition on the patient's overall health,(Fitzpatrick, Davey, Buxton, & Jones, 1998; Valovich McLeod et al., 2008) and a self-reported questionnaire allows clinicians to understand PRO, which is related to disease and to evaluate the effectiveness of interventions from the patient's perspective(Uematsu et al., 2015). Therefore, these questionnaires are an effective tool to assess FI related PRO.

The IdFAI has the highest accuracy to assessing FI when using

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only one questionnaire(Kunugi et al., 2017). The discriminability (area under the curve: [AUC] = 0.91, sensitivity = 0.83, specificity = 0.94, positive likelihood ratio = 13.83, negative likelihood ratio = 0.18)(Simon, Donahue, & Docherty, 2012). and reliability (intraclass correlation coefficients [2, 1] = 0.96, standard error mean [SEM] = 2.76).(Donahue, Simon, & Docherty, 2013) are also high. Additionally, to assess the extent of FI in individuals who are not native English speakers, the IdFAI was translated into Korean (IdFAI-K),(Ko, Rosen, & Brown, 2017) Brazilian Portuguese (IdFAI-B),(Martinez et al., 2017) Persian (IdFAI-P)(Mohamadi et al., 2018). However, the importance of using multiple questionnaire when assessing PRO is known(Houston et al., 2015). In Japan, the CAIT was already translated into Japanese and assured discriminability, validity, and reliability,(Kunugi et al., 2017) but other questionnaires has not been translated into Japanese. Hence translating the IdFAI into Japanese is important to assess FI-related PRO in Japan.

The purpose of this study was translating IdFAI into Japanese (IdFAI-J) and assessing discriminability, test retest reliability, and internal consistency. We hypothesized that IdFAI-J has high discriminability, test retest reliability, and internal consistency because these were confirmed in case of the original IdFAI.

2. Methods

2.1. Participants

Twenty bilingual Japanese people with extensive English expertise who did not have a medical background (Bi group) and 65 competitive athletes belonging to the soccer team and competing in national-level competitions (JPN group) were recruited (Fig. 1). All participants in the Bi group were native Japanese students who had attended a college, university, or graduate school in the United States of America, and were recreationally active, that is, performed three sports activities per week for a total of 90 min(Ko et al., 2017). In addition, all participants assessed their ability to comprehend English by giving themselves a score from 1 (very little comprehension) to 4 (perfect comprehension) for each of four components: 1: I understand English; 2: I read English; 3: I write English; 4: I speak English. We included participants with a score of 11 or more and having 2 or more years of experience living overseas in the Bi group(Kristjansson, Desrochers, & Zumbo, 2003).

Additionally, we excluded participants if they had 1: a history of lower extremity injury within the past 6 months or 2: a history of lower extremity surgery, neurological disorders, neuropsychiatric disorders, or rheumatoid arthritis(Uematsu et al., 2015). This exclusion criteria were applied to both Bi and JPN groups. We did not assess the ankle condition such as the LAS history and severity of FI on recruitment. The Bi group was recruited for the analysis of translational validity, and the JPN group was recruited for assessing the discriminability, test retest reliability, and internal consistency of the IdFAI-J. The anthropometric data of the participants are shown in Table 1.

IdFAI-J: Japanese version of the identification of functional ankle instability questionnaire, IdFAI: original version of the Identification of Functional Ankle Instability questionnaire.

2.2. Translation and cross-cultural adaptation process

We performed the translation and cross-cultural adaptation referring to the guidelines of the International Society for Quality of Life Assessment (Fig. 2) (Beaton, Bombardier, Guillemin, & Ferraz, 2000) but there are some differences between our protocol and the guidelines. Two bilingual Japanese experts (T1 and T2) forward-translated the original IdFAI into Japanese separately. T1 is the Japan Sports Association certified Athletic trainer (JASA-AT) and a PhD in physical education with a history of residence in the United States of America for over 2 years, T2 is a PhD in physical education with a history of residence in the United States of America for over 5 years. In a consensus meeting, T1 and T2 discussed the discrepancies and agreed upon the Japanese-translated IdFAI. A native Japanese person who had a PhD in physical education and a broad experience in translating medical literature (T3) rated the Japanese-translated IdFAI in terms of clarity, common language use, and conceptual equivalence, creating the forward-translated IdFAI. A bilingual American who is a native English speaker and has extensive translation experience but does not have a medical background (T4) translated the forward-translated IdFAI back into English (back-translated IdFAI). T4 translated the forward-translated IdFAI questionnaire using a blinded version of the original questionnaire. A second American who is a native English speaker with no medical background (T5) compared the back-translated IdFAI questionnaire with the original IdFAI
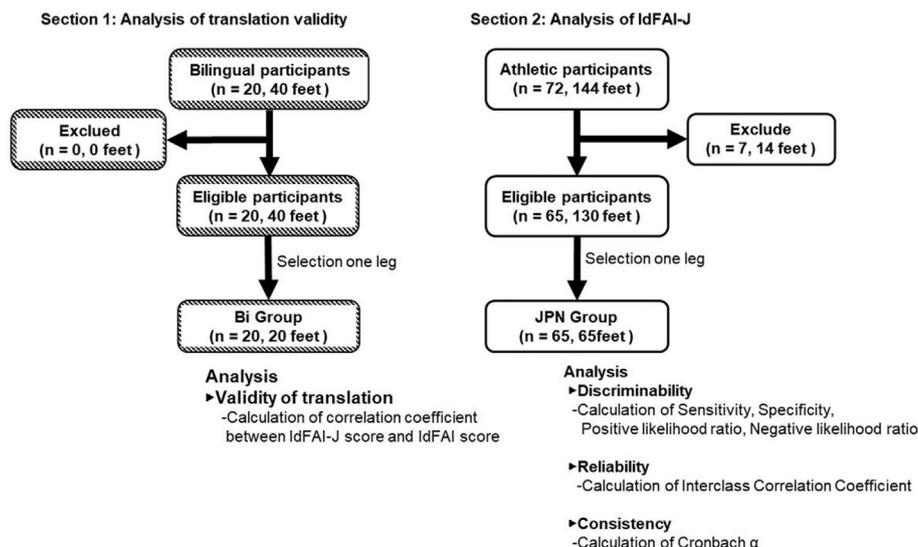

Fig. 1. Flow chart of the recruitment of participants.

Table 1
Anthropometric Data and LAS History of the Participants in this Study.

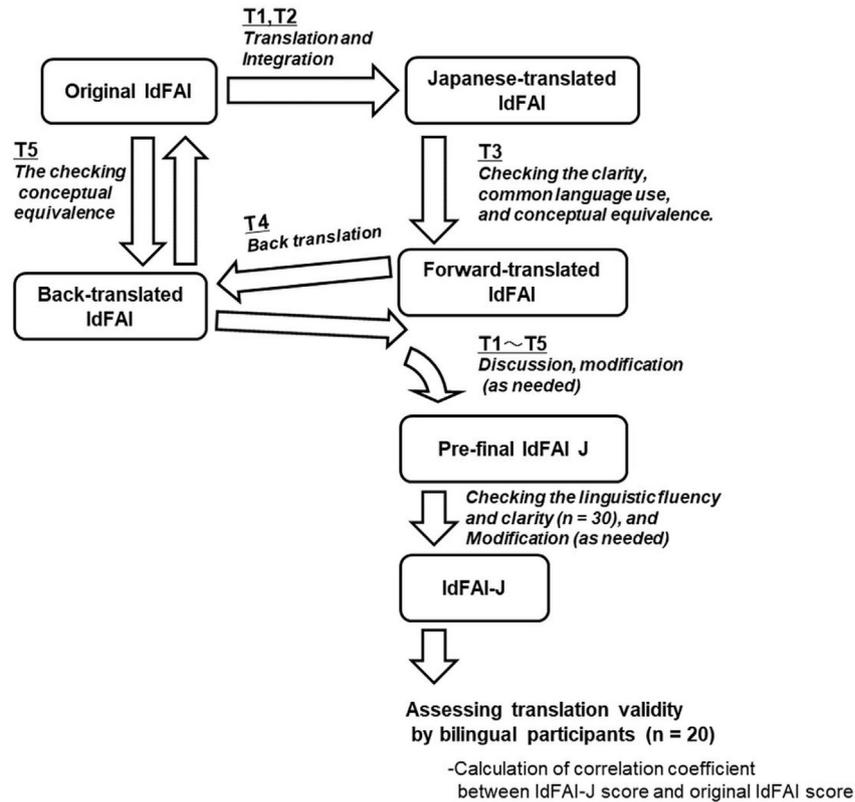|	n	Anthropometric data			LAS history						Existense	
		Age	Height(cm)	Weight(kg)	0	1	2	3	4	>5	Positive	Negative
Bi-Group	20	23.3 ± 1.3	164.1 ± 9.0	62.4 ± 9.5	6	5	4	3	0	2	12	8
JPN-Group	65	19.6 ± 1.0	167.1 ± 8.0	61.5 ± 8.3	12	10	15	11	4	13	34	31

LAS: lateral ankle sprain.

Fig. 2. Back-translation of the questionnaire and cultural adaptation protocol.

questionnaire for conceptual equivalence to make further adjustments as needed. All translators (T1-T5) reviewed and discussed disagreements and possible modifications, and agreed on the pre-final version of the IdFAI questionnaire (Pre-final IdFAI-J). We pilot-tested the Pre-final IdFAI-J on 30 college students (male: 15, female: 15, age: 18.9 ± 0.6 years, height: 166.8 ± 8.3 cm, weight: 61.0 ± 8.3 kg, number of sprains: 0: n = 7, 1: n = 5, 2: n = 7, 3: n = 3, 4: n = 2, more than 5: n = 6) to check the linguistic fluency and clarity. Since we did not note any difficulties during this process, we regarded the IdFAI-J-Pre as the completed version of the IdFAI-J questionnaire.

IdFAI: IdFAI: Identification of Functional Ankle Instability questionnaire, IdFAI J: Identification of Functional Ankle Instability questionnaire, Japanese version.

2.3. General procedure

First, we assessed the translational validity in the Bi group. Subjects belonging to the Bi group were randomly divided into two groups that completed the IdFAI-J (JE group) and the IdFAI (EJ group) on the first day. After 30 days from the previous trial, participants were asked to re-test the other language versions of IdFAI. Moreover, the participants who injured any of their lower extremities during this procedure were excluded.

Second, we assessed the discriminability and test-retest reliability and internal consistency of the IdFAI-J in the JPN group by referring to previous studies(Ko et al., 2017). We asked the JPN group to fill in the IdFAI-J and retested it after 30 days. The discriminability and internal consistency were assessed by using the IdFAI-J score of the first day, and test-retest reliability was assessed by using score of the first and 30 days.

IdFAI: Identification of Functional Ankle Instability questionnaire.

2.4. Statistical analysis

2.4.1. Analysis of discriminability

We set the level of significance a priori at $p < 0.05$ using the statistical software program SPPS (version 24.0; IBM Corp., Chicago, IL, USA). The discriminability of FI also analyzed by using a receiver operating characteristic (ROC) curve,(Ko et al., 2017; Martinez et al., 2017) and calculated the AUC, sensitivity, specificity, positive likelihood ratio (LR+), and negative likelihood ratio (LR-). We defined FI based on the consensus statement of the IAC(Gribble et al., 2014), as follows: 1: patients having a history of at least one LAS within the past year and 2: those with at least two or more episodes of giving

way within the past 6 months and/or those with feelings of instability. We defined giving way as "a temporary, uncontrollable sensation of instability or rolling over of the ankle". The LAS was defined as "an acute traumatic injury of the lateral ankle joint as a result of excessive inversion, which caused swelling, pain, and temporary loss of function for at least one day"(Gribble et al., 2014). We constructed an ROC curve with the "IdFAI-J score" as the dependent variable and "presence of FI" as the independent variable. To identify a significant ROC curve, we calculated the AUC. After calculating the diagnostic sensitivity and specificity of each potential cutoff score, we determined the ideal cutoff point using the maximum Youden index value, which we calculated as follows: sensitivity + specificity-1(Kunugi et al., 2017).

2.4.2. Analysis of translational validity

We assessed the translational validity by calculating the correlation coefficients of the IdFAI-J and IdFAI scores. Each score comprised the scores on the first day and on day 30. (Fig. 3). The non-parametric Spearman's rank-order correlational coefficients were calculated to assess the translation validity. The non-parametric Spearman's rank-order correlational coefficients were as follows: poor, < 0.00; slight, 0.00–0.20; fair, 0.21–0.40; moderate, 0.41–0.60; substantial, 0.61–0.80; and almost perfect, > 0.81(Landis & Koch, 1977).

2.4.3. Analysis of test retest reliability and internal consistency

The test-retest reliability was assessed by using the score on the first day and that after 30 days and internal consistency was assessed by using the score on the first day. We calculated the ICC (2,1) to assess the test-retest reliability. The ICC (2.1) scores were poor, < 0.00; slight, 0.00–0.20; fair, 0.21–0.40; moderate, 0.41–0.60; substantial, 0.61–0.80; and almost perfect, > 0.81(Landis & Koch, 1977). Furthermore, we calculated the SEM and minimal detectable change (MDC), as follows: SEM = standard deviation*$\sqrt{(1-ICC)}$(de Vet et al., 2006; Martinez et al., 2017); MDC = 1.96*$\sqrt{2}$*SEM(de Vet et al., 2006; Ko et al., 2017). Additionally, internal consistency was analyzed by calculating Cronbach's α using the JPN group's IdFAI-J score on the first day.

3. Result

3.1. Discriminability

The ROC curve was significant (AUC = 0.92, p < 0.001). The Youden index indicated that an IdFAI-J score of 10.5 was the cutoff score (Fig. 4). We found high sensitivity (0.94) and specificity (0.77) at the cutoff point. The values of LR+ and LR-were 4.17 and 0.08,
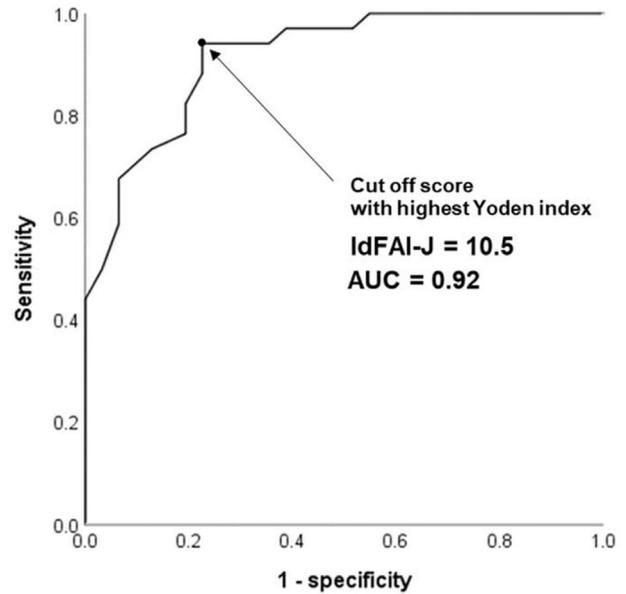
Fig. 4. Receiver operating characteristic (ROC) curve for the IdFAI-J score.

respectively. The details of discriminative ability are represented in Table 2.

IdFAI: Identification of ankle instability tool, AUC: Area under curve.

3.2. Validity of the translation

All scores of each item of the IdFAI-J were significantly and almost perfectly correlated with those of the IdFAI (p < 0.001,

Table 2
Discriminatory ability of the Japanese version of the identification of ankle instability questionnaire.

Cut off score	Sensitivity	Specificity	LR+	LR−	Youden index
7.0	0.97	0.61	2.51	0.05	0.58
8.5	0.94	0.65	2.65	0.09	0.59
9.5	0.94	0.71	3.24	0.08	0.65
10.5	**0.94**	**0.77**	**4.17**	**0.08**	**0.72**
11.5	0.88	0.77	3.91	0.15	0.66
12.5	0.82	0.81	4.25	0.22	0.63
13.5	0.76	0.81	3.95	0.29	0.57

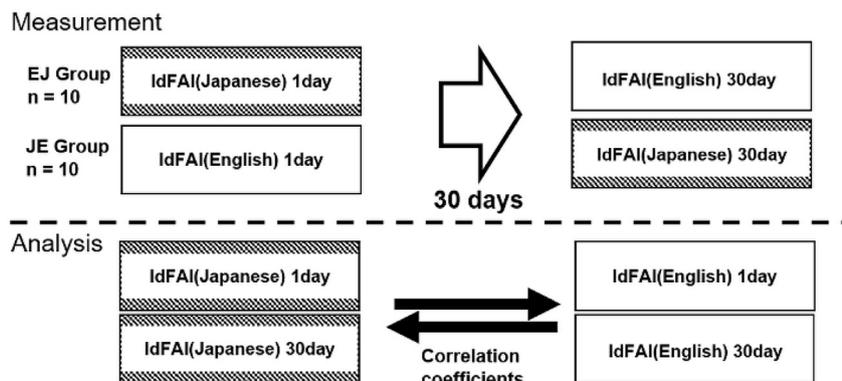Abbreviations: LR+, positive likelihood ratio, LR-, negative likelihood ratio.

Fig. 3. The protocol to assess the validity of the translation.

Table 3
The translation validity and ICC (2, 1), Cronbach's α Coefficient for Each Item of the Japanese Version of the Identification of Ankle Instability Tool.

	Translation Validity ρ	Cronbach's α if an item was deleted	ICC(2,1)	Lower 95% CI	Upper 95%CI	SEM	MDC
Variable 1	0.96	0.84	0.90	0.84	0.94	0.74	2.38
Variable 2	1.00	0.84	0.90	0.83	0.94	0.52	2.00
Variable 3	0.91	0.86	0.89	0.82	0.93	0.35	1.65
Variable 4	1.00	0.86	0.89	0.82	0.93	0.50	1.96
Variable 5	0.98	0.84	0.90	0.84	0.94	0.63	2.19
Variable 6	1.00	0.84	0.94	0.91	0.97	0.24	1.36
Variable 7	0.98	0.85	0.92	0.87	0.95	0.31	1.55
Variable 8	0.98	0.85	0.89	0.81	0.93	0.52	2.00
Variable 9	0.94	0.86	0.93	0.89	0.96	0.23	1.34
Variable 10	0.94	0.85	0.86	0.77	0.91	0.43	1.82
Total	0.98	—	0.96	0.93	0.97	1.69	3.60

Table 3).

3.3. Test-retest reliability and internal consistency

The ICC (2.1), 95% confidence interval, SEM, and MDC of each item are shown in Table 3. All items of the IdFAI-J had almost perfect reliability (ICC [2,1] = 0.86—0.96). Cronbach's α coefficient for the IdFAI-J questionnaire showed high internal consistency ($\alpha = 0.87$). The Cronbach's α coefficients for each item that was deleted are shown in Table 3. In this analysis, we did not observe an improvement in each particular item that was deleted from the scale.

Translation validity ρ: correlation coefficient between Japanese version IdFAI and original vaerion IdFAI, ICC: intraclass correlation coefficient (2, 1), SEM: standard error of the mean, MDC: minimal detectable change, CI: confidence interval.

4. Discussion

In this study, the discriminability of the IdFAI-J questionnaire as the functional ankle instability assessment tool was investigated. As a result, the discriminability of the IdFAI-J was confirmed, and the IdFAI-J questionnaire has excellent test-retest reliability, internal consistency, and translation validity. However, only specificity was insufficient.

The cutoff value of the IdFAI-J and AUC were approximately equivalent to those of versions of the questionnaire in other languages (IdFAI-J: 10.5 point, IdFAI-K: 10 point, IdFAI: 10 point)(Ko et al., 2017; Simon et al., 2012). However, the sensitivity of the IdFAI-J questionnaire was higher than that of other versions, and its specificity was lower than that of other language versions(Ko et al., 2017; Simon et al., 2012). It is possible that this result was caused by the rigorous definition of FI in this study. Our definition of FI is set based on consensus statement of IAC as follows: 1: patients having a history of at least one LAS within the past year and 2: those with at least two or more episodes of giving way within the past 6 months and/or those with feelings of instability(Gribble et al., 2014). On the other hand, minimal definition of FI was set at previous study (Ko et al., 2017; Simon et al., 2012). Namely, the characteristics of the IdFAI-J questionnaire (higher sensitivity and lower specificity than the questionnaires that were used in previous studies) may have been caused by these rigorous criteria. From the view point of clinical use, it is clear that 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 (Fitzpatrick et al., 1998; Uematsu et al., 2015; Valovich McLeod et al., 2008). Our result showed that positive IdFAI-J score means that about 94% people has clinical symptoms in FI. This result might suggest that the IdFAI-J is effective as self-reported outcome instrument of FI.

We assessed the test-retest reliability by calculating the ICC (Donahue et al., 2013; Martinez et al., 2017). The ICC (2,1) of the total score of the IdFAI-J questionnaire was almost perfect in one study(Landis & Koch, 1977). The SEM values represented 1.69. It is about 5% of the total score. Thus it can be concluded that the IdFAI-J effective tool which can assess FI with minimal standard error. In addition, the MDC value was 3.6. This finding indicates that a change of at least 4 points is necessary to be confident that this change is true and not due to measurement errors. Namely, the change of more than four point means meaningful change when using IdFAI-J as patient-based outcome measures during rehabilitation. We can conclude that the IdFAI-J questionnaire has high test retest reliability.

The internal consistency which analyzed using Cronbach's α. The IdFAI-J questionnaire demonstrated excellent internal consistency. No variables would have increased internal consistency if they had been deleted. The consistency of the IdFAI-J was demonstrated to be approximately equivalent to that of the questionnaires that were used in prior studies(Donahue et al., 2013; Ko et al., 2017; Martinez et al., 2017). In addition, the α value of 0.7—0.95 indicates excellent internal consistency,(Hinkle DE, Wiersma W, & SG., 2003) and the IdFAI-J clearly has excellent internal consistency.

5. Limitations

The current study has three limitations. First, the translation protocol does not completely match the guidelines of the International Society for Quality of Life Assessment[Beaton et al., 2000] Guidelines recommend that two translators conduct back translation, but only one translator conducted back translation in this study. However, we confirmed translation validity, and the validity of the questionnaire was confirmed as well ($\rho = 0.94$—1.00, Table 3). Hence, we thought the effect of this limitation on our result was slight.

Second, we could not compare the discriminatory ability of our Japanese version of the questionnaire and versions in other languages because of the difference of the definition of FI. We used different criteria of FI because it is important to confirm that a patient "has at least two episodes of LAS and experiences giving way during a certain time period."(Gribble et al., 2014) Thus, it is still unclear if there is a difference between the discriminatory ability of the IdFAI-J questionnaire and that of other versions. It is desirable to use various criteria of FI to compare the discriminatory ability that was found in previous studies.

Last, all participants were highly trained athletes who were in their early twenties. The intensity of daily activities may depend on the participants' ages; thus, the IdFAI-J score was possibly affected by age. Therefore, a study that recruits participants of a variety of ages is required. However, the validity and reliability of the IdFAI questionnaire was confirmed in a study that recruited participants

in their twenties to sixties(Gurav, Ganu, & Panhale, 2014). Thus, we supposed that the effect of age on the validity and reliability of IdFAI-J are as slight as those of the IdFAI questionnaire.

6. Conclusions

In this study, the correlation coefficients of the IdFAI-J and IdFAI questionnaire were almost perfect; thus, we obtained high discriminability and reliability of the IdFAI-J questionnaire. These provided evidence of the usefulness of the IdFAI-J for assessing Japanese patients with FI, can contribute to develop the research regarding FI in Japan.

Ethical statement

This study was carried out in accordance with the principles outlined in the Declaration of Helsinki of the World Medical Association and was approved by the ethics committee of Medical and Health Research Involving Human Subjects of X University (2017-243), and all the participants signed an informed consent form.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ptsp.2018.10.013.

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