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A novel brief questionnaire using a face rating scale to assess dental anxiety and fear

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PURPOSE. This study aimed to evaluate the reliability and validity of a four-item questionnaire using a face rating scale to measure dental trait anxiety (DTA), dental trait fear (DTF), dental state anxiety (DSA), and dental state fear (DSF). **MATERIALS AND METHODS.** Participants were consecutively selected from patients undergoing scaling (S-group; n = 47) and implant placement (I-group; n = 25). The S-group completed the questionnaire both before initial and second scaling, whereas the I-group responded on the pre-surgery day (Pre-day), the day of implant placement (Imp-day), and the day of suture removal (Post-day). **RESULTS.** The reliability in the S-group was evaluated using the test-retest method, showing a weighted kappa value of DTA, 0.61; DTF, 0.46; DSA, 0.67; DSF, 0.52. Criterion-related validity, assessed using the State-Trait Anxiety Inventory's trait anxiety and state anxiety, revealed positive correlations between trait anxiety and DTA/DTF (DTA, ρ = 0.30; DTF, ρ = 0.27, ρ: correlation coefficient) and between state anxiety and all four items (DTA, ρ = 0.41; DTF, ρ = 0.32; DSA, ρ = 0.25; DSF, ρ = 0.25). Known-group validity was assessed using the initial data and Imp-day data from the S-group and I-group, respectively, revealing significantly higher DSA and DSF scores in the I-group than in the S-group. Responsiveness was gauged using I-group data, showing significantly lower DSA and DSF scores on post-day compared to other days. **CONCLUSION.** The newly developed questionnaire has acceptable reliability and validity for clinical use, suggesting its usefulness for research on dental anxiety and fear and for providing patient-specific dental care. [J Adv Prosthodont 2024;16:244-54]

KEYWORDS
Dental anxiety; Anxiety disorders; Surveys; Questionnaires; Validation study; Phobia

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INTRODUCTION

The prevalence rate of dental phobia, spanning across various age groups and occupations, is reported to be 5%-22% in adults.[1-4] These patients struggle with dental treatments due to strong emotional or physical reactions, affecting their oral health and oral health-related quality of life.[5-7] The general public often feels anxious before surgical procedures such as wisdom tooth extraction or implants, leading to increased pain sensitivity.[8-10] Anxiety and fear of dental treatment affect cognitive function and decrease comprehension of the dentist's explanation.[11] In other words, fear and anxiety may lead to decreased analgesic effects and insufficient information-sharing between dentists and patients, extending beyond those diagnosed with dental phobia. Despite these challenges, dentists still find it difficult to assess a patient's anxiety level solely through observation. Therefore, it is imperative for dentists to quantitatively assess the level of anxiety and fear in all dental patients using questionnaires.[12,13]

While there is ongoing debate among researchers regarding the definitions of anxiety and fear, and a consensus remains elusive, both these conditions are generally recognized as distinct concepts.[14] Anxiety and fear are further subdivided into trait anxiety or trait fear, representing inherent aspects of a person's personality, and state anxiety or state fear, arising in response to perceived threats.[14] Corah's Dental Anxiety Scale (DAS),[15,16] Dental Anxiety Inventory (DAI),[17] and Dental Fear Survey (DFS)[18,19] have been well-known for measuring dental anxiety and fear. While these questionnaires effectively gauge a patient's predisposition to anxiety or fear related to dental treatment,[20,21] their ability to validly capture variations in anxiety and fear associated with dental procedures remains uncertain,[22] given that anxiety and fear cannot be distinguished based on traits and states.

In medicine, the State-Trait Anxiety Inventory (STAI) is recognized as a tool for assessing varying anxiety levels in different situations.[23] This questionnaire measures trait and state anxiety separately[24] and is useful for diagnosing psychiatric disorders.[25,26] In dentistry, the STAI has been used as a gold standard in the development of questionnaires that primarily measure anxiety and fear of dental treatment.[21] However, the STAI is rarely used in clinical dental practice due to its extensive questioning and complexity. Therefore, we developed a new questionnaire that can easily measure dental trait anxiety (DTA), dental trait fear (DTF), dental state anxiety (DSA), and dental state fear (DSF). This study aimed to develop and evaluate the reliability and validity of our novel brief questionnaire using a face rating scale, capable of evaluating the magnitude of anxiety and fear. Furthermore, it aims to distinguish between "dental anxiety and fear as a patient's personality tendency" and "transitory dental anxiety and fear that changes depending on the situation faced."

We hope that such a questionnaire will make it easier to identify patients' anxiety and fear traits during their initial visit. Furthermore, for individuals predisposed to anxiety and fear, it may be possible to easily identify state anxiety and fear on a treatment-by-treatment basis. Separately measuring trait anxiety, trait fear, state anxiety, and fear of dental treatment could offer utility in future research on anxiety and fear related to dental treatment.

MATERIALS AND METHODS

Our newly developed questionnaire comprises four distinct subscales: 1) DTA, 2) DSA, 3) DTF, and 4) DSF. The questionnaire was derived from the Japanese version of the Dental Fear Survey (DFS),[27] wherein we considered four scales commonly utilized in the medical field for measuring anxiety and fear related to dental treatment: the Face scale,[28] the Wong-Backwer Faces pain rating scale,[29] the visual analog scale, and the 6-point Likert scale.[26, 30-32]

Surface validity was assessed by dentists and three cooperating patients. The draft of the questionnaire was checked and revised to ensure that all dentists and patients understood the questions. At this stage, all participants found the Wong-Backwer Facial Pain Rating Scale easier to answer and express their feelings. Therefore, this scale was selected for the present study. Draft questions were included in the final version of the questionnaire. To make it easier to answer, the authors added the words "not anxious" and "anxious to escape" to DTA items and "not fearful" and

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"fearful to escape" to DTF items. Scores were recorded on a 6-point scale from 0 to 5, with higher scores indicating greater anxiety and fear (Fig. 1). We adopted the State-Trait Anxiety Inventory (STAI) as the gold standard for this study because it can assess trait and state anxiety separately.[33]

The blank space in the two underlined items, dental state anxiety and dental state fear, allows the measurer to arbitrarily enter treatment details to measure anxiety and fear that vary depending on the actual situation the patient faces. The questionnaire consisted of one to four pages for each question so that the responses to each question did not influence each other.

Participants were selected from a consecutive pool of patients scheduled for either ultrasonic scaling to remove calculus or for oral implant placement at the prosthodontics clinic of Okayama University Hospital. The study protocol was approved by the Ethics Committee of Okayama University Graduate School of Medicine, Dentistry, and Pharmaceutical Sciences and Okayama University Hospital (Approval No. 371). The participants examined in this study were provided with written information about the study and asked to sign an informed consent form.

All patients seen by three dentists (with 3, 13, and 20 years of clinical experience) in the Department of Prosthodontics at Okayama University Hospital from November 14th to 22nd, 2007, were enrolled in the scaling group (S-group). The participants were provided with written information about the study and asked to sign an informed consent form. The exclusion criteria were as follows: 1) patients receiving psychotropic drugs; and 2) patients with complete edentulism.

Each dentist presented the actual ultrasonic scaler (Solfy Optical, Morita Corp.) before the procedure, explaining how to use it for calculus removal. Subsequently, participants were asked to complete the STAI and a newly developed questionnaire before scaling. Two weeks after the initial scaling, the participants were requested to complete the questionnaire again using the same process and then underwent the second scaling.

Patients who visited the Department of Prosthodontics, Okayama University Hospital, for an explanation before oral implant surgery between July 17th and

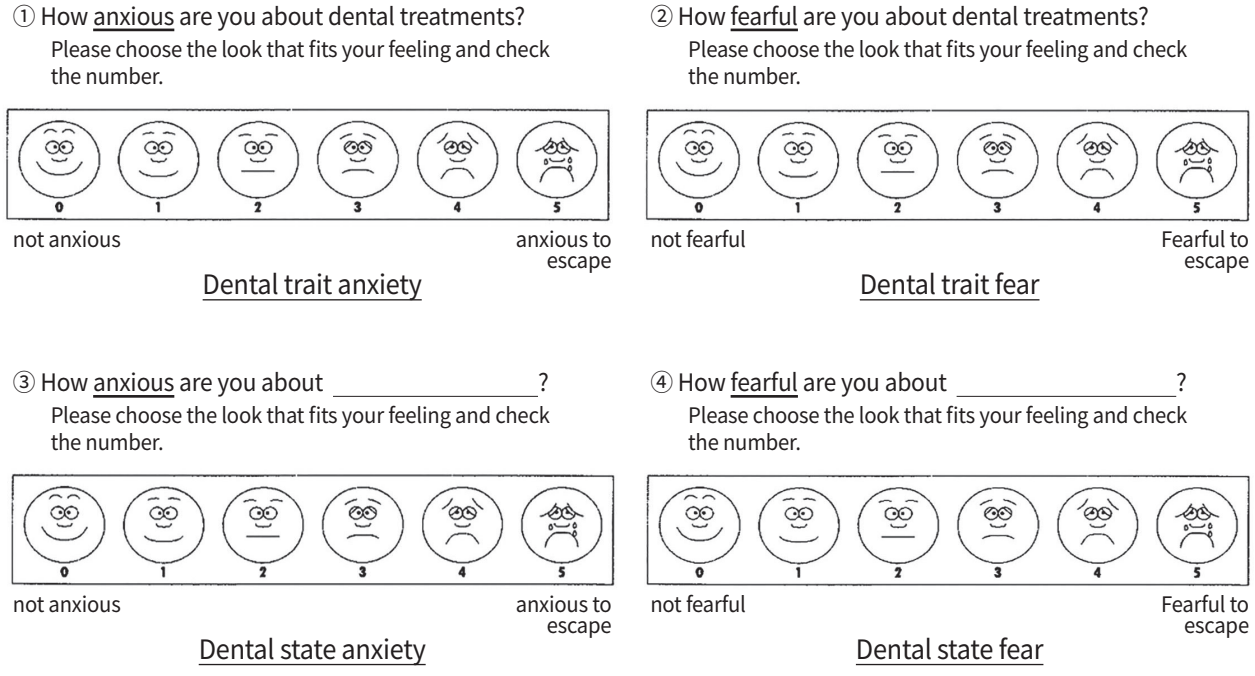

Fig. 1. Final draft of the questionnaire.

October 8th, 2009, and between January 8th and February 24th, 2010, were enrolled in the implant group (I-group). The participants were provided with written information about the study and asked to sign an informed consent form. The exclusion criteria were as follows: 1) patients taking psychotropic medications, and 2) patients who canceled the implant placement procedure.

Shared materials were used to ensure the quality of explanations regarding implant placement procedures. Each explanation was provided by the dentist in charge of the surgery from the Oral Implant Section within the Department of Prosthodontics. The participants were requested to answer the new questionnaire on three occasions: on the day of explanation before surgery, on the day of implant placement, and on the day of suture removal. Additionally, on the day of surgery, they were asked to answer the STAI questions (Fig. 2).

The reliability of the new questionnaire was assessed using the test-retest method with answers obtained before ultrasonic scaling in the S-group (Fig. 2). The test-retest consistency of the new questionnaire was assessed using the weighted kappa value (Kw). Reliability was assessed according to the Landis and Koch criteria.[34]

Criterion-related validity was assessed using the trait and state anxiety scores of the STAI as the gold standard (Fig. 2). Correlations between STAI and DTA scores and between STAI traits and DTF scores were analyzed. In addition, correlations between the STAI state and DSA scores and between the STAI state scores and DSF scores were also analyzed. Validity was assessed using Spearman's rank correlation coefficient.

Known-group validity was assessed by comparing the median DTA and DTF scores of the S-group and I-group using the Mann-Whitney U test (Fig. 2).

Responsiveness was assessed by comparing the change in each score along the three I-group time points (day of explanation before the surgery, day of implant placement, and day of suture removal) using the Friedman test (Fig. 2). The Bonferroni correction was performed for statistically significant items. The median value of each item was used as the outcome.

Differences between the DTA and DTF scores were compared using the Wilcoxon signed-rank test for four situations: before ultrasonic scaling in the S-group, the day of explanation before the surgery, the day of implant placement, and the day of suture removal in

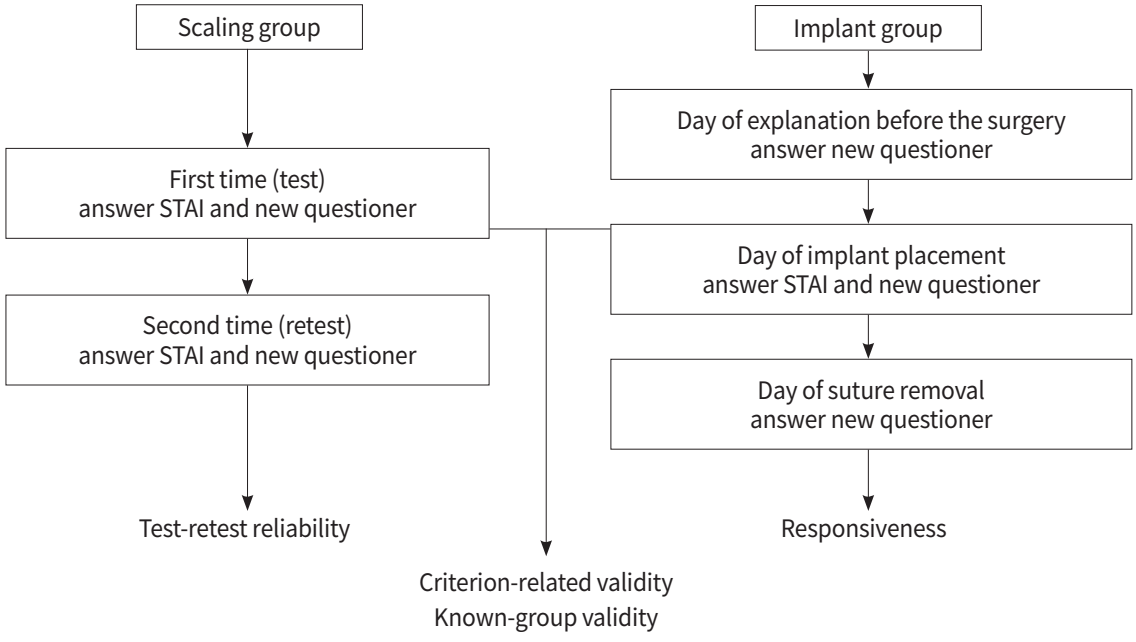

Fig. 2. Study design.

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the I-group. Differences between DSA and DTF scores were analyzed using the Wilcoxon signed-rank test.

All statistical analyses were performed using SPSS software (version 25.0; IBM, Tokyo, Japan). Statistical significance was set at $P < .05$.

RESULTS

Forty-seven patients who met the selection criteria were enrolled in the S-group. All S-group participants completed the initial questionnaire and enrolled as actual subjects to examine criterion-related and known-group validity. Of these, 28 S-group participants were enrolled as test-retest participants and asked to complete the questionnaire again (Fig. 3). Table 1 presents the demographic data for the S-group. There were no significant differences between the actual and test-retest subjects (Table 1).

Twenty-five patients who met the selection criteria were enrolled in Group I. All I-group participants completed the newly developed questionnaire on the day of the explanation before surgery; however, five participants were excluded: three who did not complete the questionnaire on the day of implant placement and two whose responses were incomplete. To examine criterion-related validity, known-group validity, and responsiveness, 20 participants completed the STAI and all the newly developed questionnaires, all of whom were enrolled as actual participants. The demographic data of the I-group are presented in Table 1. There were no significant differences between the demographic data of the S- and I-groups (Table 1).

In terms of the test-retest reliability assessment, the weighted kappa values (Kw) for each item in the newly developed questionnaire were as follows: DTA, 0.61; DTF, 0.46; DSA, 0.67; and DSF, 0.52. According to Landis and Koch, these values indicated sufficient agreement in clinical settings.[34]

In terms of criterion-related validity, the DTA and DTF scores were significantly positively correlated with STAI trait anxiety levels (DTA, $\rho = 0.30$, $P = 0.02$; DTF, $\rho = 0.27$, $P = 0.03$, ρ: correlation coefficient). The DTA, DTF, DSA, and DSF scores were also significantly and positively correlated with STAI state anxiety lev-

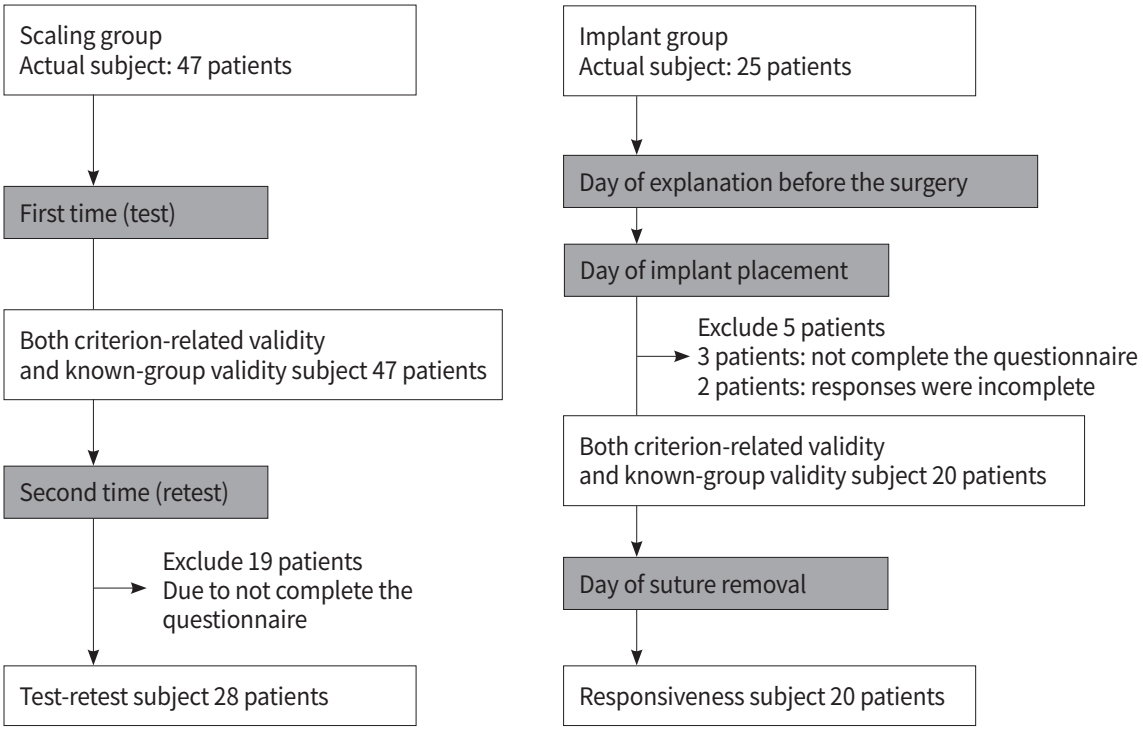

Fig. 3. Flow diagram of the study.

els (DTA, ρ = 0.41, P < 0.01; DTF, ρ = 0.32, *P* = 0.01, DSA, ρ = 0.25, *P* = 0.04; DSF, ρ = 0.25, *P* = 0.04). The DSA and DSF scores did not significantly correlate with STAI trait anxiety levels (DSA, ρ = 0.07, *P* = 0.57; DSF, ρ = 0.09, *P* = 0.45).

In the S-group, the median (95% confidence interval) scores for the new questionnaire and STAI were as follows: DTA, 2 [1.64-2.44]; DTF, 2 [1.17-1.98]; DSA, 2 [1.26-2.06]; DSF, 2 [1.22-1.98]; trait anxiety, 3 [3.05-3.42]; state anxiety, 4 [3.24-3.78]. In the I-group, the

Table 1. Demographic data

	Scaling group		Implant group		Intended subject of scaling group vs Test-retest subject	Intended subject of implant group vs Actual subject of implant group	Intended subject of scaling group vs Actual subject of implant group
	Actual subject	Test-retest subject	Intended subject	Actual subject	*P*-value	*P*-value	*P*-value
Number of patients	47	28	25	20	-	-	-
Mean age (years)	57.6 ± 14.0	59.1 ± 13.0	62.6 ± 8.9	61.0 ± 9.0	.64*	.89*	.32*
Sex (male/female)	13 / 34	8 / 20	7 / 18	4 / 16	.93†	.54†	.51†
Experience of scaling (yes/no/unknown)	42 / 4 / 1	27 / 1	25 / 0	20 / 0	.39†	-	.32†
Experience with impression taking (yes/no)	47 / 0	28 / 0	24 / 1	20 / 0	-	.37†	-
Experience of tooth drilling (yes/no)	46 / 1	27 / 1	25 / 0	20 / 0	.71†	-	.51†
Experience of tooth extraction (yes/no)	46 / 1	28 / 0	25 / 0	20 / 0	.44†	-	.51†
Everyday medicine (yes/no/unknown)	25 / 21 / 1	16 / 12	17 / 7 / 1	14 / 5 / 1	.81†	.97†	.48†
Case or medical history (yes/no/unknown)	23 / 22 / 2	15 / 12 / 1	9 / 15 / 1	7 / 12 / 1	.59†	.99†	.58†
Intravenous sedation for surgery (yes/no/unknown)	-	-	5 / 19 / 1	4 / 15 / 1	-	.99†	-
Experience of dental implants (yes/no/unknown)	-	-	1 / 23 / 1	1 / 19	-	.66†	-
Interval of first test and second test (days)	-	25.6 ± 14.3	-	-	-	-	-
Interval of explanation before the surgery and implant placement (days)	-	-	-	25.5 ± 20.4	-	-	-
Interval of implant placement and suture removal (days)	-	-	-	9.4 ± 3.5	-	-	-
Interval of explanation before the surgery and suture removal (days)	-	-	-	34.9 ± 19.5	-	-	-

Intended subject of scaling group: It is the same subject with actual subject, criterion-related validity subject, and known-group validity subject.
Actual subject of implant group: It is the same subject with criterion-related validity subject, known-group validity subject, and responsiveness subject.
Mean ± SD
* t-test
† χ2 test

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median (95% confidence interval) scores for the new questionnaire and STAI were as follows: DTA, 2 [1.82-2.88]; DTF, 3 [1.87-3.03]; DSA, 3 [2.14-3.16]; DSF, 2.5 [1.91-2.99]; trait anxiety, 3 [2.73-3.47]; state anxiety, 4 [3.41-4.19]. In terms of known-group validity, the Mann-Whitney U test indicated that the DTF, DSA, and DSF scores in the I-group were significantly higher than those in the S-group (DTF, P = 0.02; DSA, *P* = 0.01; DSF, *P* = 0.02). The DTA, trait anxiety, and state anxiety levels of the STAI did not differ significantly between the I-group and S-group (DTA, *P* = 0.48; trait anxiety, *P* = 0.33; state anxiety, *P* = 0.24).

In terms of responsiveness, the Friedman's test indicated significant differences between the median scores for DTA, DSA, and DSF on the days before surgery, implant placement, and suture removal. However, there were no significant differences in DTF between the three time points. Bonferroni correction revealed significant differences in the median DSA and DSF scores between the days of explanation before surgery and suture removal and in the median DSA scores between the days of implant placement and suture removal (Table 2).

The Wilcoxon signed-rank test showed significant differences only in the DTA and DTF scores in the S-group (Table 3).

Table 2. Responsiveness

	Day of explanation before the surgery	Day of implant placement	Day of suture removal	*P*-value	Day of explanation before the surgery vs Day of implant placement *P*-value	Day of explanation before the surgery vs Day of suture removal *P*-value	Day of implant placement vs Day of suture removal *P*-value
Dental trait anxiety	2.5 (1.77–2.73)	2 (1.82–2.88)	1.5 (1.19–2.21)	< .01*	1.00	.12	.08
Dental trait fear	2 (1.58–2.62)	3 (1.87–3.03)	2 (1.22–2.18)	.07	-	-	-
Dental state anxiety	3 (2.26–3.44)	3 (2.14–3.16)	2 (1.34–2.36)	< .01*	1.00	< .01†	.02†
Dental state fear	3 (2.18–3.42)	2.5 (1.91–2.99)	2 (1.25–2.25)	< .01*	.71	< .01†	.05

Median (95% confidence interval)
Friedman's test (*P < .05)
Bonferroni correction (†P < .05)

Table 3. Difference between the anxiety and fear scores

	Scaling group (first time)			Implant group (Day of explanation before the surgery)			Implant group (Day of implant placement)			Implant group (Day of suture removal)		
	Anxiety	Fear	*P*-value	Anxiety	Fear	*P*-value	Anxiety	Fear	*P*-value	Anxiety	Fear	*P*-value
Dental trait	2 (1.64–2.44)	2 (1.17–1.98)	< .01*	2.5 (1.77–2.73)	2 (1.58–2.62)	.41	2 (1.82–2.88)	3 (1.87–3.03)	.48	1.5 (1.19–2.21)	2 (1.22–2.18)	.99
Dental state	2 (1.26–2.06)	2 (1.22–1.98)	.37	3 (2.26–3.44)	3 (2.18–3.42)	.71	3 (2.14–3.16)	2.5 (1.91–2.99)	.19	2 (1.34–2.36)	2 (1.25–2.25)	.32

Median (95% confidence interval)
Wilcoxon rank sum test (*P < .05)

DISCUSSION

In this study, a new questionnaire was developed to determine the magnitude of the dental treatment-specific anxiety and fear in terms of both "dental treatment anxiety and fear as a patient's personality tendency" and "transient dental treatment anxiety and fear that varies depending on the situation faced." Therefore, the questionnaire had to be sufficiently reliable and valid. The test-retest method was used to assess reliability. To ensure that this questionnaire could assess mental status, a two-week measurement interval was established to prevent potential interference with data reliability. In addition, the same dentist provided explanations and scaling on the day of answering the questionnaire to ensure that patients were placed in the same environment as much as possible. Consequently, the weighted kappa values of each item in the newly developed questionnaire were evaluated in accordance with the criteria set by Koch *et al*.,[34] and each item showed moderate or substantial coincidence. Of the 47 scaling patients from the consecutive sampling, 19 were excluded from the test-retest subjects because of conflicting appointments in the following 2 weeks. This may be attributed to the characteristics of the university hospital, where many patients travel from far away, and busy patients may have been excluded from the test-retest subjects. However, we do not believe this had a significant impact on the interpretation of the results. Thus, this questionnaire was considered highly reliable and suitable for clinical use.

Validity assessment is the process of examining whether a questionnaire measures its intended constructs. Anxiety and fear, being latent emotions, cannot be detected directly. Therefore, validity must be inferred by examining whether a correlation exists between the questionnaire and other observable responses. To evaluate face validity, we first checked whether the questionnaire covered the concepts of anxiety and fear of dental treatment among specialists and patients who used the questionnaire. Although the scales needed to be improved, a consistent view was ultimately obtained from the participants, and the face validity of this questionnaire was considered good. The face validity results also suggested that a face rating scale that uses facial expressions to express anxiety and fear could be superior to a visual analog or point scale that uses numbers and lengths to express anxiety and fear. The emotions expressed by facial expressions are said to be common across countries and cultures,[35] and from the perspective of cultural adaptation, which is one of the criteria for the quality of a measurement scale,[36] the use of a face evaluation scale was considered appropriate. The face scale is also said to be a measurement scale that can be used with children with communication difficulties and patients with advanced illnesses,[37,38] which is an advantage when this questionnaire is widely used with patients in clinical settings.

Criterion-related validity assessment demonstrated that the two items in the newly developed questionnaire, dental state anxiety and fear, could specifically measure changes in emotions depending on the situation. Meanwhile, two items, i.e., dental trait anxiety and fear, were used to measure patient characteristics but were not highly specific. In this regard, we originally recognized a relationship between trait anxiety and state anxiety[14] and agreed with the notion that trait anxiety influences the intensity of state anxiety.[24] As the main objective of developing this questionnaire was to distinguish and measure patients' personality tendencies and transient emotions, the STAI was considered a gold standard. The STAI has a proven track record in the development of questionnaires measuring anxiety and fear of dental treatment and has been considered a gold standard until now.[21,26] In the assessment of criterion-related validity, when two similar questionnaires are measured simultaneously, they are said to affect each other. However, the STAI and the newly developed questionnaire are very different in terms of question content and response methods, so it is considered that the mutual influence was minimized. Therefore, we consider that the choice of STAI as the gold standard in this study was appropriate. The questionnaire's ability to assess transient emotions depends on its known-group validity and responsiveness. The dental state anxiety and fear items demonstrated good known-group validity and responsiveness. The assessment of known-group validity allowed us to detect differences in anxi-

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ety and fear of dental treatment that varied according to the situation between the scaling and implantation groups. In the assessment of known-group validity, the new questionnaire was able to detect differences in anxiety and fear of dental treatment that varied by situation in both the scaling and implant groups. However, state anxiety levels on the STAI were not significantly different between the two groups. STAI may have failed to detect any differences between the two groups. In other words, the new questionnaire may be more sensitive than the STAI in identifying transitory dental anxiety and fear.

The responsiveness assessment confirmed that the two items of the new questionnaire, dental state anxiety and fear, could measure changes in anxiety and fear due to the situation faced. Because learning by experience has been reported to significantly affect the degree of anxiety and fear,[21,24] it was appropriate that dental state anxiety and fear decreased only on the day of suture removal after the patient experienced surgery. However, the fact that the items do not change depending on the situation can indicate one aspect of the validity of the dental trait anxiety and fear items capturing patient characteristics. In terms of known-group validity, no significant difference were noted in the trait anxiety levels of the STAI between the scaling and implantation groups, suggesting that the two groups were equally likely to be anxious. Nevertheless, the dental trait fear score for the implant group was intentionally set higher between the two groups. In the responsiveness assessment, there was a tendency for dental trait anxiety and fear items to increase on the day of surgery. In other words, the dental trait anxiety and fear items in the newly developed questionnaire may have been slightly influenced by dental anxiety and fear, which changed depending on the situation. Questionnaires measuring dental anxiety and fear, as represented by the DAS and DFS, were also consistent with previous reports suggesting that they are influenced by dental treatment.[21,39] Therefore, attention should be paid to the timing of responses to new questionnaires to assess dental trait anxiety and fear with greater validity. To assess whether both anxiety and fear items were needed in the new questionnaire, differences in scores on anxiety and fear items were analyzed. The results showed that the ratings of dental anxiety and fear differed only in terms of dental trait anxiety and fear in the scaling group. These findings are consistent with previous reports that fear and anxiety are partially related.[14,40] However, dental anxiety and fear may be intentionally measured differently depending on the environment in which the questionnaire is completed and the nature of the respondents. Therefore, we believe that the new questionnaire addresses both dental anxiety and fear.

This study has some limitations. First, the sample size may have been inadequate, as previous studies designed to evaluate questionnaires typically required at least 100 participants.[41] Insufficient sample size results in low statistical power. The Bonferroni correction for responsiveness showed items with *P*-values close to 0.05. These items are likely to become statistically significant if the sample size is increased. However, these results are unlikely to have a significant impact on the conclusions and discussion of this study. Second, patients with severe dental phobia were not included, as the study was conducted on outpatients attending the prosthodontics department of a university hospital. However, we do not consider this limitation to be significant since the questionnaire aimed to assess the general outpatient population rather than specifically targeting individuals with severe dental phobia.

CONCLUSION

In this study, we developed a new questionnaire that can assess the magnitude of anxiety and fear, which can be divided into “the dental anxiety and fear as a patient’s personality tendency” and “transient dental anxiety and fear that changes depending on the situation faced” using a face rating scale. The new questionnaire demonstrated acceptable reliability and validity for clinical use. This new questionnaire, which can easily assess dental traits and status anxiety or fear, will facilitate personalized dental care provision and prove valuable for research on dental anxiety or fear.

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