Patient-Evaluated Dentistry: Development and Validation of a Patient Satisfaction Questionnaire for Fixed Prosthodontic Treatment

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Purpose: The aim of this study was to develop and verify the reliability and validity of a questionnaire to assess patient satisfaction with fixed dental prostheses (FDPs). ***Materials and Methods:*** A questionnaire was developed, pilot-tested, and modified. It assessed esthetics, masticatory function, phonetics, cleansibility, and cost satisfaction using a visual analog scale and whether patients would elect to undergo the same treatment again (yes/no). It was sent to patients with a known evidence-based outcome (survival) who received FDPs from 1984 to 2005 (n = 986) in one private prosthodontic practice. Reliability and validity were analyzed using the Student *t*, Mann-Whitney *U*, Kruskal Wallis, Cronbach alpha, Spearman-Brown, Correlation matrix, Bartlett sphericity, Kaiser-Meyer-Olkin (KMO), and factor analysis tests. Significance was set at $P = .05$. ***Results:*** Five hundred patients responded (50.7%). A Cronbach alpha value of 0.8 and split-sample Spearman-Brown value of 0.7 indicated good reliability. Stepwise removal of items did not improve internal consistency. Discriminant construct validity assessment showed no item redundancy. Satisfaction of patients who had experienced prosthesis failure (n = 52) was significantly less than their counterparts (73% ± 3% vs 83% ± 0.6%, $P = .004$), ascertaining convergent construct validity. Factor analysis (Bartlett sphericity, $P < .001$; KMO = 0.84) identified two components (Eigenvalues ≥ 1.0) that explained 93.18% (varimax rotation) of variations. Component 1 included satisfaction with function (esthetics, mastication, phonetics, and cleansibility); component 2 included satisfaction with costs and whether patients would undergo the same treatment again. ***Conclusions:*** The Patient Satisfaction Questionnaire developed proved reliable and valid for assessing patient-evaluated outcomes of FDPs. Use of this questionnaire in further research is justified. *Int J Prosthodont 2011;24:332–341.*

Evidence-based dentistry is the practice of applying the best available scientific results to guide clinical management.[1] Patient-evaluated dentistry can be defined as the practice of applying subjective data reported by patients to guide that management. Modern scientific literature provides an ample source of objective outcomes to assist evidence-based dentistry, but the long-term subjective evaluation of such treatment remains largely unexplored.[2]

Long-term outcome studies of fixed prosthodontic treatments give relevant information on the biologic and mechanical outcome of prostheses. However, there is an increasing realization that patient evaluation of the satisfaction with and the worth of such treatment must be a consideration in any measure of overall prosthodontic success.[3,4] Do patients (and vested third parties) perceive that the treatment imparts value relative to the overall oral comfort, quality of life, esthetics, and oral functions, and do they perceive that they have gained economic value from the treatment? This is particularly relevant in fixed prosthodontic treatment, which is often perceived as expensive with limited application to the overall population.

Methods of evaluating quality of life were first developed for social and economic research and have been adopted by the medical community to assess the impact of health on various functional and psychosocial domains. Eleven such oral-specific instruments were reviewed internationally in 1996.[5] The General Oral Health Assessment Index[6] was developed in 1990, and the Oral Health Impact Profile (OHIP-49)[7] was developed in 1994 for use in patient-based outcome studies to assess the degree of impairment, discomfort,

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limitation, disability, and handicap experienced. The OHIP-49 has since been modified to a shorter OHIP-14[8,9] and an edentulous-specific OHIP-EDENT.[10] These instruments are invaluable patient evaluation measures of treatment experience but are restrictive in the specific evaluation of patient satisfaction with their prostheses. Oral health–related quality of life is not equivalent to patient prosthesis satisfaction.[11,12]

Early prosthodontic patient satisfaction studies focused on removable prostheses, while most current studies have focused on implant treatment for the edentulous patient. Verbal, numeric, Likert (combined verbal/numeric), and visual analog scales (VASs) are employed routinely to record responses in questionnaire-based studies. No one scale is accepted universally as the gold standard, and all four have been used to assess prosthodontic patient satisfaction.[7,8,13–23] Verbal scales are limited by the chosen descriptors, while numeric scales can suffer from gravitation toward "favorite numbers"; both record results in intervals, which are not necessarily ratio in nature.[23]

Direct scaling procedures, such as a VAS, have been in use in the pain-related literature for more than 3 decades.[22] They are simple, versatile, and relatively insensitive to bias effects; the measured values have been shown to be valid, reliable, and on a ratio scale; and the anchor points can be modified to assess different parameters.[23] The VAS has also been shown to give reliable data in mailed questionnaires in the wider medical literature,[24] allowing researchers more freedom in study design.

Patient-evaluated prosthesis satisfaction questionnaires should be simple to understand and short enough to facilitate compliance but broad enough to evaluate treatment objectives. They should gather information without causing duress (limiting invasive questions, ensuring nonidentity), be easy to use in other study centers, and provide data that is simple to collate.

The choice of which questions to ask has been previously derived empirically, with reference to research aims. Patients are likely to measure prosthesis satisfaction by being pleased with their appearance, feeling comfortable and pain free, being able to eat what they wish, being able to pronounce words in a socially acceptable manner, and being able to adapt easily to required hygiene routines. Questions should also explore value satisfaction. Do the patients perceive that they have gained value for the financial outlay for their initial treatment? Have they experienced long-term durability without repair or replacement? With the benefit of hindsight, would they elect to undergo the same treatment again?

The empiric nature of existing patient prosthesis satisfaction questionnaires makes it difficult to compare results between various studies. This lack of continuity is also associated with outcome studies of prostheses, where there is no consensus of varying parameters such as failure, routine maintenance, and what represents major and minor complications. The authors consider that there is a need for a valid, reliable questionnaire that is sensitive and specific for prosthesis evaluation by patients. This, along with other more general oral health and quality of life questionnaires, can provide a practical basis for patient-evaluated dentistry, which is increasingly being recognized as a necessary consideration of overall prosthodontic success.

The aim of this study was to develop and verify the reliability and validity of a questionnaire to assess patient satisfaction with fixed dental prostheses (FDPs).

Materials and Methods

An English-language postal questionnaire to explore patients' satisfaction with fixed prosthodontic treatment was developed, with reference to guidelines published by the International Epidemiology Association European Questionnaire Group.[25,26] The questionnaire was formulated from literature-based evidence, nominal group expertise,[27,28] and revision of the pilot test.

Initial Questionnaire Development

Peer-reviewed journal articles assessing patient satisfaction with prosthodontics were identified[2,13,15–21,29–35] and searched by the authors. It was not a systematic review.

The review identified 46 outcome measures, including questions exploring patient satisfaction with oral functions and treatment costs, whether patients would undergo the same treatment again, as well as a retrospective assessment of changes in mastication since undergoing dental treatment. Items assessing dentures (eg, retention, stability), quality of life, and generalized satisfaction/problems/pain were excluded from the questionnaire. This resulted in a 10-point pilot questionnaire exploring satisfaction across 7 domains (appearance, comfort, mastication, phonetics, cleansibility, maintenance, and costs).

Study Population

A patient population with an already known evidence-based outcome (survival) was invited to participate in the study. These patients attended a private

prosthodontic practice in Sydney, Australia. The practice accepts referred patients of nonspecific socioeconomic backgrounds and is not related to a university or hospital facility. Patients cover all treatment costs. Maintenance (review, prophylaxis, repairs/failures) was completed by the treating prosthodontist.

All living patients who received tooth and implant FDPs between January 1984 and June 2005 (n = 986) were mailed a cover letter and the questionnaire. Patients were advised that the questionnaire related specifically to their fixed prosthodontic treatment (crowns and FDPs supported by teeth and implants) and that any information obtained would be used to help assess and improve, if indicated, current treatment protocols. Patients were provided a stamped, return-addressed envelope. Patients who did not initially respond were sent two follow-up requests over 6 months. There were no markings on the questionnaire that patients could perceive would identify them.

Reliability

The questionnaire reliability was assessed with the Cronbach alpha coefficient for the entire data set and the equal-length Spearman-Brown coefficient for a split-half sample. A coefficient ≥ 0.7 indicates good internal reliability.[36]

Validity

The questionnaire content validity and construct (discriminant and convergent) validity were assessed.

Content validity was assessed by a nominal expert group[27,28] comprising four prosthodontists with private and academic experience. The pilot questionnaire and data from the first 100 respondents was reviewed, with responses to two questions (oral comfort and maintenance costs) identified as inconsistent. It was probable that these topics were interpreted differently by individual respondents, contributing to this response inconsistency. Oral comfort could relate to initial tissue discomfort or systemic factors including salivary flow, oral pathology, or altered deglutition rather than adaptation to the prostheses. Maintenance could relate to any complication or repair as well as individually tailored routine professional review and prophylaxis, and it was considered that respondents might not focus specifically on the prostheses in their answers. Therefore, these two questions were removed, and the data were excluded from further analysis.

Construct validity[37] was assessed using a correlation matrix, comparing the questionnaire results with already known outcomes, and factor analysis. Discriminant construct validity was examined through a correlation matrix where an agreement of ≥ 0.85 between questions was considered to indicate redundancy. Items that were considered redundant were removed. Convergent construct validity was explored by examining whether the outcome of the patient satisfaction questionnaire was in agreement with an already known outcome. Patient groups who had experienced prosthesis failure (known outcome) would theoretically be less satisfied than their counterparts; differences between these groups were analyzed. Factor analysis was used to explore the dimensionality of the instrument.

The Patient Satisfaction Questionnaire (PSQ)

The final questionnaire is depicted in Fig 1. Questions sought patients' satisfaction with appearance, mastication, phonetics, and cleansibility of their prostheses at the time the questionnaire was sent. Two retrospective questions sought patients' remembered satisfaction with appearance and cost when their prostheses were inserted initially. With the benefit of hindsight, the complications experienced, or the lack of intervention required, current satisfaction with the initial cost of the prostheses at the time of the questionnaire was reported. Patients answered the questions using a VAS. They were directed to cross a 10-cm line at the point representing the appropriate response between the worst possible satisfaction/discontent (left anchor) and the best possible satisfaction (right anchor). A single question (yes/no response) sought whether the patients would undergo the same treatment again.

Overall current satisfaction was calculated as the mean of current appearance, mastication, phonetics, cleansibility, and cost satisfaction. Satisfaction with remembered initial appearance and cost were not included.

Data Analysis and Statistics

Demographic and treatment data were gathered from patient files (Table 1). All variables analyzed were patient-based not prosthesis-based.

A computer program was developed to facilitate collation and analysis of the data. VAS responses were converted to a percent (0% to 100%). Average satisfaction for parameters was reported as mean ± standard error.

Data were analyzed with the Student *t* test, Mann-Whitney *U* test, and Kruskal-Wallis test for differences in the defined parameters. Reliability was assessed with Cronbach alpha and equal-length

Please answer the following questions by placing a cross on the line at the point at which you feel represents the answer. Note the start of the line on the left side represents the worst possible result or experience that you could imagine whereas the end of the line of the right side represents the absolute best possible result or experience that you could imagine. Place a tick in the appropriate box for the last question.

1. How would you rate the appearance of your teeth immediately after their treatment?
   Extremely poor _____ Excellent
2. How would you rate the appearance of those teeth today?
   Extremely poor _____ Excellent
3. How would you rate your present capacity to chew?
   Extremely poor _____ Excellent
4. How would you rate your present capacity to speak?
   Extremely poor _____ Excellent
5. How easy do you find it to clean your teeth and gums?
   Extremely difficult _____ Extremely easy
6. What did you think about the financial cost of your treatment at the time of treatment?
   Extremely costly _____ Extremely reasonable
7. In hindsight how would you rate the initial financial cost of your dental treatment?
   Extremely unjustified _____ Extremely justified
8. In hindsight would you undergo the treatment you had for your mouth and teeth again?
   ☐ YES
   ☐ NO

Fig 1 The Patient Satisfaction Questionnaire (questionnaire is not to scale; VAS line requires 10 cm in length). Note: The term "appearance" was used in the questionnaire as it is a more easily understood lay term than esthetics. However, appearance was equated with the professionally accepted term "esthetics" throughout the paper.

Spearman-Brown coefficients. A Cronbach alpha above 0.7 was considered a good correlation. Factor analysis was by principal component analysis with varimax rotation, Kaiser normalization, and maximum likelihood extraction. Factor analysis requirements included a statistically significant Bartlett test of sphericity and a Kaiser-Meyer-Olkin (KMO) measure of greater than 0.50. Eigenvalues ≥ 1.0 were conserved for factor analysis. Statistical significance for all data analysis was set at $P = .05$. The SPSS statistical package (IBM) was used for analyses.

Results

Five hundred (309 women, 61.8%; 191 men, 38.2%) of 986 treated patients (617 women, 62.6%; 369 men, 37.4%) returned the questionnaire. This was a response rate of 50.7%. Within the returned questionnaires, 8 of the 4,000 questions (0.2%) were unanswered.

Reliability

The Cronbach alpha coefficient for the entire data set was 0.8, indicating internal consistency.[36] The equal-length Spearman-Brown coefficient for the split-half sample (part 1: initial esthetics, current esthetics, mastication, and phonetics; part 2: cleansibility, initial costs, costs in hindsight, and treatment again) was 0.7. Stepwise removal of each item from the reliability calculation resulted in Cronbach alpha coefficients of less than 0.8 for all items (range: 0.73 to 0.79), indicating that the internal consistency of the questionnaire could not be improved through elimination of items.

Validity

Content validity was assessed by the nominal expert group, with the original 10-point pilot questionnaire revised to the final 8-point patient satisfaction questionnaire, as described previously.

Discriminant construct validity assessed through a correlation matrix showed no item redundancy, with all values below 0.8 (Table 2).

Convergent construct validity was assessed by comparing reported satisfaction between patients who had experienced prosthesis failure and those who had not. The overall satisfaction of patients who had experienced failure (n = 52, 10.4%) was significantly less than their counterparts (73% ± 3% vs 83% ± 0.6%, $P = .004$). These patients were also significantly less satisfied with four individual parameters: current esthetics (71% ± 4% vs 83% ± 0.8%, $P = .014$), mastication

Table 1 Patient Demographic and Treatment Data

Demographic data	
Sex	
Women	309 (61.8%)
Men	191 (38.2%)
Patient age when survey was mailed	
Mean (y)	59.1 ± 13.58
19–29 years	18
30–44 years	50
45–59 years	163
≥ 60 years	269
Treatment data	
Prosthesis age*	
1–5 years	206
6–10 years	142
11–15 years	96
16–20 years	56
Prosthesis type	
Tooth only	385
Full-arch implant reconstruction	23
Other implant-only treatment	54
Combination of tooth/implant treatment	38
Survival (patient-based)†	
Success	391, examined as successful
Survival	31, reported as successful
Repaired	26, required professional intervention
Failed	52, loss of prosthesis/esthetics/marginal integrity
Lost to follow-up	0
Dead	0

*Length of time between the issue of the first or only prosthesis and the date the questionnaire was sent.
†An outcome for the six-fields protocol[38] was allocated to each patient. Outcome was patient-based, not prosthesis-based. If patients received more than one prosthesis, outcome was determined by the worst-performing prosthesis.

Table 2 Interitem Correlation Matrix

	Esthetics (initial)	Esthetics (current)	Mastication	Phonetics	Cleansibility	Cost (initial)	Cost (hindsight)	Treatment again
Esthetics (initial)	1.00	0.62	0.41	0.37	0.26	0.29	0.43	0.09
Esthetics (current)	0.62	1.00	0.55	0.49	0.32	0.25	0.43	0.15
Mastication	0.41	0.55	1.00	0.51	0.40	0.30	0.47	0.18
Phonetics	0.37	0.49	0.51	1.00	0.38	0.21	0.41	0.19
Cleansibility	0.26	0.32	0.40	0.38	1.00	0.24	0.37	0.11
Cost (initial)	0.29	0.25	0.30	0.21	0.24	1.00	0.46	0.19
Cost (hindsight)	0.43	0.43	0.47	0.41	0.37	0.46	1.00	0.29
Treatment again	0.09	0.15	0.18	0.19	0.11	0.19	0.29	1.00

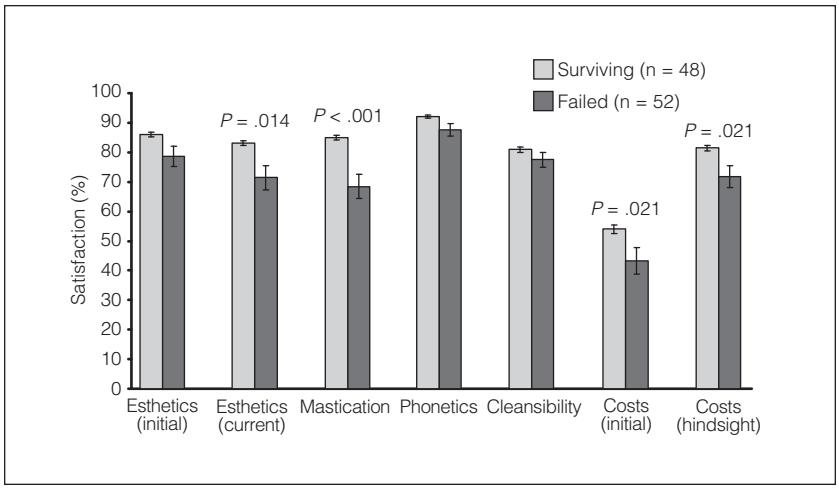

Fig 2 Differences in satisfaction of patients who have and have not experienced at least one failed prosthesis. *P* values denote significant differences.

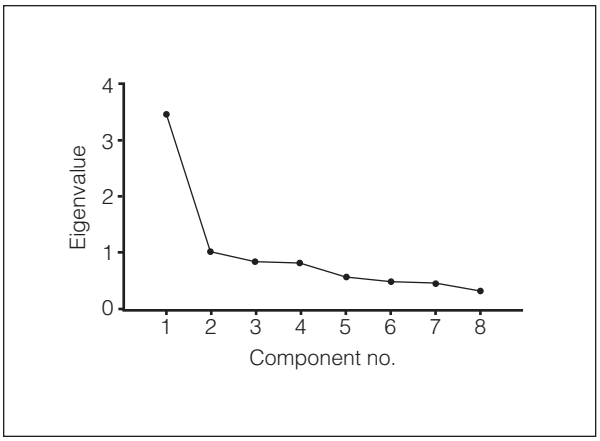

Fig 3 Factor analysis scree plot.

Table 3 Factor Analysis–Rated Component Matrix.

	Communalities	Component	
	Extraction	1	2
Esthetics (initial)	0.57	0.75	0.06
Esthetics (current)	0.69	0.83	0.07
Mastication	0.60	0.74	0.23
Phonetics	0.52	0.70	0.17
Cleansibility	0.35	0.55	0.22
Cost (initial)	0.48	0.28	0.64
Cost (hindsight)	0.63	0.55	0.57
Treatment again	0.66	−0.03	0.81
Eigenvalues		3.46	1.04
% of variance explained (unrotated)		42.23%	56.19%
% of variance explained (varimax rotation)		36.99%	56.19%

(68% ± 4% vs 85% ± 0.8%, $P < .001$), initial costs (43% ± 5% vs 54% ± 1.4%, $P = .021$), and costs in hindsight (72% ± 4% vs 81% ± 0.9%, $P = .021$) (Fig 2). Patients who had experienced a failure were older (mean age: 65 ± 2 years vs 59 ± 0.6 years, $P < .001$) and had their prostheses in situ for a greater period of time (mean time: 11.7 ± 0.7 years vs 7.0 ± 0.3 years, $P < .001$). There were no differences in sex ($P = .57$) or treatment type ($P = .17$) between these groups.

Dimensionality was explored using factor analysis. The Bartlett test for sphericity was significant ($P < .001$), and the Kaiser-Meyer-Olkin (KMO) measure was 0.84. Factor analysis identified two components with Eigenvalues ≥ 1.0, which explained 98.42% (unrotated) and 93.18% (varimax rotation) of the variation (Fig 3, Table 3). Items with scores ≥ 0.5 were considered to contribute to components. Component 1 included satisfaction with esthetics (initial), esthetics (current), mastication, phonetics, and cleansibility. Component 2 included satisfaction with costs (initial), satisfaction with costs (hindsight), and whether patients would undergo the same treatment again. Although satisfaction with costs (hindsight) had scores ≥ 0.5 for both components 1 and 2, its score for component 2 was greater and, thus, was considered part of the second dimension.

Discussion

Prosthodontic treatment success is related to prosthesis survival, as well as its ability to fulfill biologic-related and patient-evaluated objectives. Objective measures can be employed to assess mortality and morbidity but cannot be extrapolated to patient satisfaction with prostheses.

A wide variety of outcome measures have been employed by researchers to assess subjective patient parameters, including tailor-made (ad hoc) scales, VASs, and validated quality of life scales (eg, OHIP).[39] Quality of life scales measure impairment, discomfort, limitation, disability, and handicap; this cannot be directly equated with patient treatment satisfaction.[11,12] A patient who has significant oral impairment and disability is unlikely to be satisfied with their prosthetic treatment; however, the reverse is not necessarily true. For this reason, researchers of patient-evaluated outcomes often employ a satisfaction questionnaire in preference to a quality of life scale[13,15,16,18–21,29,31,40] or they utilize both assessment tools together.[17,35,41] Quality of life scales and patient satisfaction questionnaires are complimentary, and when validated scales are used together, they will effectively provide a global assessment of patient-evaluated outcomes.

To date, however, the satisfaction questionnaires employed by researchers have not been scientifically validated and differ from study to study. They record important patient outcomes, but their results are not directly comparable. It was the aim of the authors to address this major limitation by developing a questionnaire to assess patient satisfaction with FDPs and assess its reliability and validity.

A VAS was selected to record patient responses. In other research settings, this scale has been shown to be valid and reliable, and its versatility and ratio nature were considered ideal for this patient-evaluated satisfaction questionnaire.

Validity and reliability of questionnaire results are complicated by the response rate. The response rate to this questionnaire was generally higher than that of similar studies reported in the literature. It is accepted that in clinical settings, the practicality of continuous sequential enrollment of patients for subsequent assessment of FDPs results in up to 75% of data requiring censoring (and therefore becoming lost) over the timeline of the studies.[42–45] Within questionnaire studies, response rates range from 36%[46] to 100%.[47] Stanford et al[46] reported a 43% response rate, with a 36% useable response rate, for a survey on implant therapy in an ectodermal dysplasia population. Johansson et al[48] reported a 57% response rate from Swedish adult patients when sent a questionnaire about their demographics, health, and quality of life. Yatani et al[49] reported a response rate of 62.3% in a survey of nonattending temporomandibular disorder patients. A single study[47] on knee arthroplasty obtained a 100% response rate but required the services of a private investigator to locate all patients.

Clearly and predictably, not all patients responded to this PSQ. This poses a risk of bias. To explore possible response rate bias within this study, a previous paper assessed demographic- and treatment-related parameters of the patients who did and did not respond to the questionnaire.[50] Responding and nonresponding patients had similar sex distributions, Kaplan-Meier 10-year estimated cumulative survival rates, and received a similar distribution of treatment prostheses. Respondents, however, were older, had their prostheses in situ for a greater length of time, received more prosthetic units, and underwent more treatment episodes than nonrespondents. Knowing the similarities and differences, it was concluded that the results from the questionnaire would be informative and of value.

Questionnaires are commonly developed, and standard validation techniques are used within the dental and medical literature.[7,51–54] To improve the quality, guidelines have been published by the International Epidemiology Association European Questionnaire Group.[25,26] The PSQ development and subsequent validation followed these accepted techniques. In comparison to the PSQ, a recent study invited 120 consecutive patients to participate in the validation of an orofacial esthetic scale.[54] Their response rate, at point of service, was 119. In contrast, this PSQ was postal and included all patients who had received prosthodontic treatment from various socioeconomic backgrounds over a 20-year period. It is argued by the authors that a 50% response rate, particularly given the 20-year timeline and foreseeable changes in patient postal location and capacity to respond, is exceptional.

The broad range of prosthodontic patients and their longitudinal outcomes involved in this questionnaire validation enhance its external validity. Despite possible concerns related to the response rate, it is likely that the same types of patients will respond to the future use of this postal questionnaire as those who responded for this study. The collated demographic information[50] also facilitates the powerful application of this questionnaire. Future researchers can assess their patient population with that used to validate this questionnaire, thus simplifying arguments of the questionnaire's external validity.

Postal and electronic questionnaires have been considered more prone to response rate bias than traditional interview methods. Despite this perception, they are widely employed in epidemiologic research and are associated with several fiscal and opportunity advantages. A 2009 Cochrane systematic review[55] evaluating response to postal questionnaires identified, among other strategies, that questionnaires that were shorter, had fewer questions of a sensitive nature, included stamped return-addressed envelopes, ensured participant confidentiality, provided a personalized cover letter, and re-contacted nonrespondents had increased response rates. Other strategies also associated with improved response rates were monetary incentives, prenotification, and interesting comments on envelopes. This current study was designed in 2005 but incorporated many of the above strategies identified by the 2009 systematic review into the postal questionnaire design.

Assessment and report of patient satisfaction is subjective. It is therefore important that the measure employed is both reliable and valid. An instrument that consistently provides the same answer (and is thus reliable) is useless if that answer is incorrect (and thus not valid).

Reliability refers to the ability of a test/instrument to provide consistent results. Generally, VASs have been shown to provide reliable results when used for both clinical[23] and mailed[24] questionnaires. Specifically, the reliability of this VAS patient satisfaction questionnaire was found to be excellent, with a Cronbach alpha of 0.8 for the full sample and an equal-length Spearman-Brown coefficient of 0.7 for the split-half sample. The coefficients assess consistency and reliability, with 0 indicating no consistency and 1 indicating perfect consistency. When questions investigate similar outcomes, a coefficient greater than or equal to 0.7 indicates good internal reliability.[36] The split-half sample method compared the consistency of items between two hypothetical groups, as if those groups were separate administrations of the same survey. For this assessment, the first four questionnaire items were compared with the last four questionnaire items. A decrease in the coefficient from 0.8 to 0.7 for the split-half analysis was to be expected, since the first four items were included in component 1 of the questionnaire structure and the last four items were included in both components 1 and 2 of the questionnaire structure.

A test-retest reliability method was specifically not used in this study because it was deemed impractical and to have restricted applicability. It was probable that some patients could be unwilling to or unable to answer the questionnaire twice and that previous exposure to the questionnaire during the first round of this method could introduce recall bias undermining the validity of the resultant analysis.

The patient questionnaire was found to record valid measures and, thus, represent the patients' views accurately. The questionnaire's content validity, discriminant construct validity, convergent construct validity, and dimensionality were assessed.

A nominal expert group appraised the content validity. That is, is it sensible to conclude that the questions can assess what they aim to assess? The questionnaire and responses of the pilot test were reviewed, with the recommendations implemented in the analyzed version.

New instruments evolve from theoretical considerations, and construct validity refers to their ability to measure what should theoretically be measured. Construct validity has two dimensions: discriminant and convergent. The discriminant construct validity indicates that the instrument is not related to measures with which it should not be related, while convergent validity indicates that the instrument results are similar to measures with which it should theoretically be related. The discriminant construct validity of the questionnaire content was assessed through the correlation matrix. Redundancy of questions would indicate that the questionnaire lacked discrimination and that more than one question was assessing the same outcome, therefore not adding additional knowledge to the instrument (or clinician). The correlation matrix showed that all values were below 0.8 (range: 0.09 to 0.62) and, thus, no items were redundant, with all contributing further to understanding of the patients' satisfaction. The convergent construct validity was assessed by comparing the satisfaction of patients with an already known outcome (prosthesis failure versus no prosthesis failure). It detected a significantly decreased satisfaction in patients who had experienced a failure compared with their counterparts. This finding was not surprising and had been predicted a priori. This indicated that the results of the questionnaire were likely to be accurate and that the questionnaire was in fact measuring what it was designed to measure: the patients' satisfaction.

The construct of the instrument was further explored with factor analysis. Factor analysis examines the dimensionality and structure of an instrument. In this case, the factor analysis considered whether the instrument explored one or multiple facets associated with patient satisfaction. The results of the Bartlett test and KMO were favorable and indicated the instrument was suitable for further exploration via factor analysis. Specifically, the Bartlett test for

sphericity was significant ($P < .001$), indicating the questionnaire variables were unlikely to be unrelated. The KMO was greater than 0.50 (KMO = 0.84), indicating that the variance within the questionnaire variables may be related to and explained by an underlying structure. Factor analysis was completed and identified two components that explained over 90% of the variation of the results. The first component included items assessing satisfaction with esthetics (initial), esthetics (current), mastication, phonetics, and cleansibility. The second component included items assessing satisfaction with costs (initial), costs (hindsight), and whether patients would undergo the same treatment again.

It was not surprising that a single component comprised variables assessing satisfaction with oral function and that a separate component comprised variables assessing satisfaction with treatment costs. The inclusion of whether patients would undergo the same treatment again in component 2 is extremely informative. Clearly, assessment of whether patients would choose, if required, to undergo the same treatment again is more closely related to satisfaction with costs than to satisfaction with oral functions. The authors will explore this relationship between patient satisfaction and treatment costs in further research.

Understanding why one patient reports high satisfaction and another reports low satisfaction remains elusive. Evidently, perceptions of dissatisfaction are complex and may be related to aspects of dental treatment that have not been traditionally considered relevant in research, such as overall discomfort during the procedure, general inconvenience, rapport with the operator, and other psychosocial factors. Patient-evaluated dentistry should be considered a vital component of evidence-based dentistry.

Use of this patient evaluation questionnaire in further research is justified. The questionnaire was simple to apply, would be easy to use in different research settings, and provided results that were ratio in nature and, thus, directly comparable with similar questionnaire studies. Validation of this questionnaire for use in non-English research and varying population centers and continued development to reflect evolution of patient expectations and changes within the prosthodontics field is recommended.

Conclusion

The Patient Satisfaction Questionnaire developed proved reliable and valid for assessing patient-evaluated outcomes of FDPs. Use of this Patient Satisfaction Questionnaire in further research is justified.

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