Development of an Orofacial Esthetic Scale in Prosthodontic Patients

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Purpose: Despite the interest and need to assess orofacial esthetics in prosthodontic patients, few self-reporting instruments are available to measure this construct, and none describe how prosthodontic patients perceive the appearance of their face, mouth, teeth, and dentures. The development of the Orofacial Esthetic Scale (OES) is reported in this article, in particular its conceptual framework, how questionnaire items were generated, and the scale's measurement model. ***Materials and Methods:*** After test conceptualization, the authors solicited esthetic concerns from 17 prosthodontic patients by asking them to evaluate their own photographs. A focus group of 8 dental professionals reduced the initial number of concerns/items and decided on an item response format. Pilot testing in 9 subjects generated the final instrument, the OES. Exploratory factor analysis was performed to investigate OES dimensionality and item analysis to investigate item difficulty and discrimination in 119 subjects. ***Results:*** Prosthodontic patients generated an initial 28 esthetic concerns. These items were reduced to 8 preliminary representative items that were subsequently confirmed during pilot testing. Analysis supported 8 items assessing appearance: face, profile, mouth, tooth alignment, tooth shape, tooth color, gums, and overall impression, measured on an 11-point numeric rating scale (0 = very dissatisfied, 10 = very satisfied). Exploratory factor analysis found only 1 factor and high positive loadings for all items (.73 to .94) on the first factor, supporting the unidimensionality of the OES. ***Conclusions:*** The OES, developed especially for prosthodontic patients, is a brief questionnaire that assesses orofacial esthetic impacts. *Int J Prosthodont 2010;23: 249–256.*

Esthetics has become an increasingly important topic in western society.[1] Improved esthetics is one of the most common reasons for patients to seek prosthodontic treatment, and there are indications that in general dentistry, the focus has shifted from functional restorative dentistry to esthetic dentistry due to a decrease in caries prevalence.[2]

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Dentofacial esthetics is not only important in itself, it is also related to other more general concepts of well-being. Davis et al[3] found that esthetically pleasing tooth restorations were positively correlated with a patient's self-esteem and quality of life. Van der Geld et al[4] found that an attractive smile in particular is important from a psychosocial viewpoint, which supports the general public opinion that dentofacial esthetics are important for personal success.

The assessment of dentofacial esthetics and appearance is challenging because these constructs are neither directly observable nor measurable, and several factors (eg, culture) affect a patient's perceptions. Although a comprehensive interview targeting the individual patient's concerns and expectations is the most appropriate assessment method, this approach is complicated, consumes time, and is difficult to standardize, which poses problems when used in research. One of the most commonly used methodologies to investigate a patient's esthetic perceptions is the ranking of clinical photographs according to esthetic discrepancies.[5–8]

Clinical experience has led to guidelines for anterior dentofacial esthetics that comprise recommendations for visible gingiva and tooth length, proportion, and width,[5,9,10] but Van der Geld et al[4] found that when patients were asked, an esthetically attractive smile depended not only on tooth factors, such as position, size, shape, and color, but also on gingival display and the framing of the lips. For patients, a variety of esthetic aspects are important, and clinical expert opinions are only able to assess how patients perceive their dentofacial esthetics to a certain degree. Considering the disadvantages of expert assessments, patient self-assessment of dentofacial esthetics through use of questionnaires has become a widely used approach. This method has the disadvantage of being less comprehensive than a detailed patient interview, but standardization makes comparison and communication of results feasible, especially for research purposes.

Patients' own assessments of dentofacial esthetics have indeed become an increasingly popular topic. An interesting study by Wolfart et al[11] on prosthodontic patients correlated general well-being with self-assessment of their dental appearance. The authors gathered experts for a consensus meeting and developed a 14-item questionnaire based on Magne and Belser's guidelines for anterior dental esthetics.[9] This questionnaire measures distinct esthetic concerns and psychosocial consequences of esthetic impairment. A recent study by Mehl et al[1] correlated a questionnaire assessing satisfaction with one's own dental appearance (QDA) with the Oral Health Impact Profile (OHIP) and a well-being test (Beltz Test), and found that the OHIP alone did not evaluate dental appearance sufficiently.

Dentofacial esthetics is not only important for prosthodontic patients, it has always been an important treatment outcome in orthodontics as well.[12,13] In both patient populations, esthetics shares a common theme, but the direct malocclusion-related aspects of dentofacial esthetics for orthodontic patients probably differ somewhat from the concerns of restorative patients. Good dentofacial esthetics after orthodontic treatment is assumed to have a beneficial influence on oral health, body image, and appearance-related self-confidence in young adults.[14–16]

Despite the interest and need to assess orofacial appearance and esthetics in restorative patients, no self-reporting instrument with sound psychometric properties has been presented that measures the direct or primary aspects of orofacial esthetics without incorporating the broader issue of a psychosocial impact, which is probably better captured with concepts such as oral health–related quality of life (OHRQoL). This broad concept treats orofacial esthetics conceptually as a component, and while appearance has actually been suggested to be a possible OHRQoL dimension when measured with the OHIP,[17] OHRQoL instruments usually contain only a few indicators for orofacial appearance. For example, only 3 of 49 questions on the OHIP—the most frequently used instrument—address esthetic aspects directly. Wong et al[18] suggested the OHIP-esthetic, but it was developed using subjects undergoing tooth whitening—a patient population that probably does not suffer the full impact of an impaired dentofacial appearance. In fact, Mehl et al[1] showed that the OHIP alone is not sufficient for a profound evaluation of dental appearance; they recommended the development of specific instruments to assess dentofacial appearance.

The aim of this study was to develop an instrument—the Orofacial Esthetic Scale (OES)—that measures self-reported orofacial esthetics in patients with prosthodontic concerns. The development of the OES, in particular its conceptual framework, how questionnaire items were generated, and the scale's measurement model, is reported.

Materials and Methods

Project Overview

The flow diagram in Fig 1 illustrates the study's design.

Test Conceptualization. The research question and a theoretical model to investigate the concept of interest were posed. In addition, the population where the questionnaire was to be applied was defined.

Item Generation and Reduction. An item pool addressing prosthodontic patients' esthetic concerns was created with patients using key informant interviews, photographs of the patients' faces and mouths, and an open-ended questionnaire on perceived esthetics. The basic item pool was discussed and rephrased and the number of items was reduced to eliminate redundancy. This process was reiterated in group discussions until a focus group of professionals reached a consensus. The scale of measurement and the response format of the items was then decided on and followed by pilot testing.

Measurement Model and Item Analysis. The dimensionality of the OES was investigated (factor analysis) to assess whether a single dimension or several exist that need to be measured by dimension scores. An item analysis was then performed investigating item difficulty and discrimination.

Translation. Forward and backward translations and reconciliation per Ohrbach et al[19] and Guillemin et al[20] produced an English version of the instrument (originally developed in Swedish).

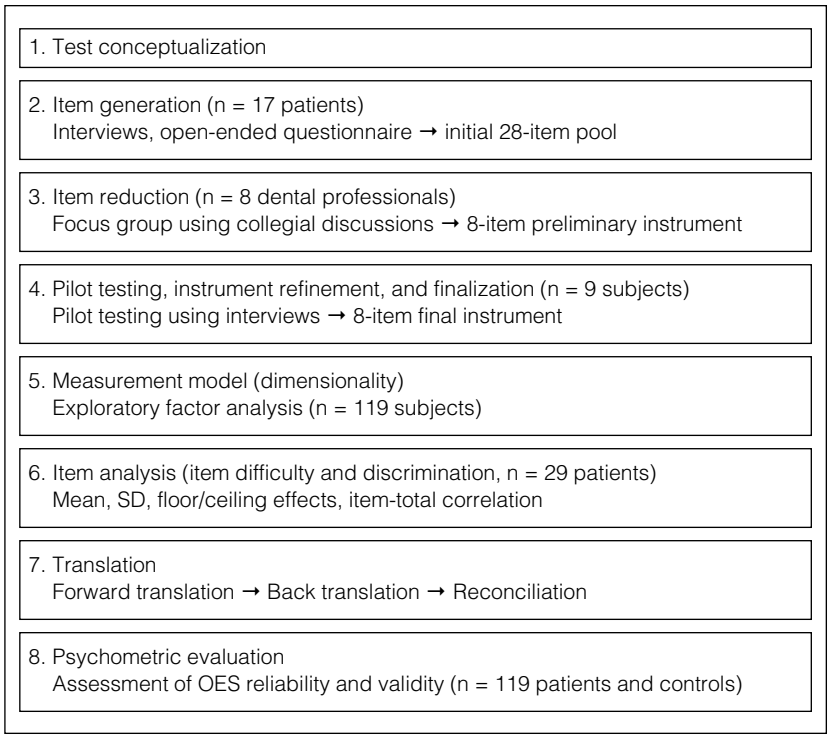

Fig 1 Flow chart of the OES instrument development: Steps 1 to 7 are described in this article and step 8 in a companion article (Larsson et al[34]).

Subjects, Methods, and Data Analysis

Test Conceptualization. The authors wanted to develop a questionnaire, the OES, that assessed the direct impacts of impaired orofacial esthetics. That is, they aimed to assess how patients feel about their personal facial appearance. This methodologic approach is different from assessing the indirect impacts of impaired orofacial esthetics, ie, the broader psychosocial impact of orofacial esthetics. For example, a patient could feel depressed because of his or her facial appearance. The authors could not find any established model of orofacial esthetics, but esthetics in general is characterized as "a set of principles concerned with the nature and appreciation of beauty."[21] Stemming from collegial discussions among dental health care professionals, it was agreed that orofacial esthetics is a concept referring to a particular region of the body consisting of the face, the mouth (including the lips), and the teeth (including the gums). The application of general principles of esthetics to the stomathognathic system served as the conceptual model for this questionnaire's development. The target population for the new instrument was patients with prosthodontic concerns, and the authors assumed that a sample of these patients would be able to generate items that would characterize adequately the orofacial esthetic construct.

Item Generation and Reduction. Three groups of subjects participated in this phase of the study: a sample of patients who generated the initial item pool, dental professionals who condensed and reduced the initial items into a preliminary instrument, and a second group of subjects who pilot-tested this instrument to generate a final questionnaire.

In the first step, 17 consecutive patients (9 women, 8 men; average age: 60.8 years; range: 22 to 82 years) were asked to assist in item generation. Inclusion criteria for patients were referral to a prosthodontic specialist (Centre of Oral Rehabilitation, Linköping, Sweden) and an age of at least 18 years. Exclusion criteria were temporomandibular disorder pain, head and neck tumors, defects after tumor resection, radiotherapy treatment, and communication difficulties.

In the second step, the focus group of dental professionals comprised eight clinicians and researchers: six prosthodontic specialists, one orofacial pain specialist, and one dental surgery assistant. In the third step, the pilot test group comprised nine individuals: four dental surgeons and five lay people.

The Regional Ethics Review Board at Linköping University Hospital approved the study and all patients signed an informed consent form. Participants received no monetary compensation for enrolling in the study.

Item Generation. Subjects were photographed twice—a frontal view of the entire face and a frontal view of the teeth with the lips drawn back—with a digital camera (Canon EOS 30D). The patients were then interviewed; they were allowed to view their photographs during the interview. The interview questions concerned the individuals' thoughts regarding the general

appearance of their face and teeth and about whether something in their face or mouth disturbed them. They were also asked if there was anything they would change or correct if possible. The interviewer noted the answers by hand. The duration of the interviews varied from 25 to 50 minutes, and each interview lasted until no new information emerged.

The patients were also asked to send in their answers to the following open-ended questions within 1 week:

- What factors are important in the appearance of your mouth, your teeth, and your fixed and removable dentures?
- What bothers you most when you think about the appearance of your mouth, your teeth, and your fixed and removable dentures?

Twenty-eight questionnaire items were constructed based on responses given during the key informant interviews, the open-ended questions, and established questionnaires.[11,14,15,22] All items represented broad content validity, but meaning sometimes overlapped and was vague.

Item Reduction. The 28 items generated in step 1 were discussed thoroughly in the focus group, followed by item reduction and rephrasing until a consensus was reached. The purpose was to create a short, clear, easily understood instrument.

The choice of response format for the final items was based on Streiner and Norman's[22] suggestion that attitudes about a construct lie on a continuum. A direct estimation method is straightforward and designed to elicit a quantitative estimate of the magnitude of an attitude from the subject. The authors chose an 11-point numeric rating scale where 0 = very dissatisfied and 10 = very satisfied. Wording was considered vital to allow lay persons to easily understand the questions and be able to quickly fill in the questionnaire. The preliminary version of the self-reporting instrument contained 8 items tailored to perceived orofacial esthetics.

Pilot Testing. After the pretest group filled out the 8-item pilot instrument, participants were interviewed regarding their opinion of the items, response options, and layout to ensure content validity, a comprehensible response format, and a clear layout. The OES was then finalized (Fig 2).

Measurement Model and Item Analysis. One hundred twenty consecutive patients meeting the inclusion and exclusion criteria were divided into four groups that included two patient groups: an esthetically impaired group (esthetic group, n = 30) in which subjects were partially dentate in the canine and incisor regions (41% women, age: 37.5 ± 15.6 years, 1 dropout, leaving n = 29 for analysis) and a functionally disabled group (functional group, n = 30) in which subjects were edentulous or partially dentate in the premolar and molar regions (53% women, age: 59.5 ± 10.5 years). The two healthy control groups were as follows: an esthetic control group (n = 30) in which subjects were age- and gender-matched healthy recall patients with no need of prosthetic treatment (43% female, age: 38.2 ± 15.8 years) and a functional control group (n = 30) in which subjects were also age- and gender-matched healthy recall patients with no need of prosthetic treatment (53% female, age: 59.3 ± 10.4 years).

Data Collection and Analysis. The esthetic and functional patient groups answered the self-administered 8-item questionnaire after a clinical examination at the specialist clinic and the control groups answered it at their homes. A dental surgery assistant answered questions at the clinic or by phone if an item was unclear.

According to Norman and Streiner's recommendations,[23] exploratory factor analysis was used to investigate the dimensionality of the OES. The "eigenvalue greater than 1" rule determined the number of factors.

An item analysis was performed and means and standard deviations were computed to compare items in terms of their ability to characterize subjects along the orofacial esthetic continuum (item *difficulty*). In addition, floor and ceiling effects, such as items with extreme means or near zero variances where no differentiation can take place, were identified. Item *discrimination* was measured using the corrected item-total correlations. This refers to the extent to which a questionnaire item differentiates between subjects with different levels of the trait. This corrected item-total correlation was computed as the correlation between each item and the rest of the scale with the item absent.

Translation. The OES was originally developed in Swedish and was translated into English for international use. The goal of the adaptation process was to achieve equivalence between the original Swedish version and the translated version. Per recommended guidelines,[19] two native English speakers made two independent, forward translations from Swedish to English. Both were aware of the scale as a whole.

After synthesis of the forward translations, the next step was to back-translate from English into the source language. This was done by three individuals who had not seen the original version and were unaware of the scale's purpose. In the reconciliation phase, an expert consensus group comprising four clinicians and researchers—one prosthodontic specialist, one orofacial pain specialist, one orthodontic specialist, and one dental technician—viewed the original and back-translated items and resolved any discrepancies. The entire process was repeated until the expert consensus group was confident that the two versions were semantically and culturally equivalent.[19,20]

Results

Item Generation and Reduction

In the interview analysis, it was obvious that patients were concerned about a variety of facial and dental esthetic problems. Common remarks included: "my chin is too small compared to the rest of the face," "my lip lines are terrible," "do all television personalities bleach their teeth?," "both small and large teeth in a row are disturbing," "large, prominent brown and yellow teeth are the worst," and "natural teeth are often not perfectly aligned."

However, responses in the interviews and to the open-ended questionnaire could be categorized, and 28 initial items reflecting orofacial esthetics emerged:

- Face (3 items): symmetry, profile, the face in general
- Mouth (6 items): smile, lips, lip lines, gums, the mouth in general, hygiene
- Teeth (19 items): natural, alignment, dental arch, symmetry, irregularity, proclination, crowding, space, diastema, missing teeth, tooth replacement, fillings, prostheses, color, discolor, shape, size, tooth attrition, tooth health

In the 8-person expert focus group, item reduction followed a systematic procedure: category by category and item by item. The 28 initial items were reduced to a smaller set of 8 representative items assessing perceived orofacial appearance and dental esthetics. The items of the preliminary OES characterize the face, profile, mouth, tooth alignment, tooth shape, tooth color, gums, and also include an overall impression. After the 9-person pilot group completed the OES, the group participants were interviewed. They reported that the instrument was easy to understand and answer and had a clear layout. No changes of the preliminary version were deemed necessary. The final version is shown in Fig 2.

Dimensionality and Item Analysis

There were no significant differences in age or sex between the patient and control groups. Subjects in the two functional groups were significantly older than in the two esthetic groups ($P < .001$). One patient in the esthetic group was withdrawn because the questionnaire was not completely filled out.

The OES structure was assessed in an exploratory factor analysis; only one factor had an eigenvalue > 1. High positive loadings were found for all items ranging from .73 to .94 on the first factor, which accounted for 73.5% of the variance among scores across all subjects. These findings were interpreted as support for the unidimensionality of the OES.

Orofacial Esthetic Scale
How do you feel about the appearance of your face, your mouth, your teeth, and your tooth replacements (crowns, bridges, and implants)? 0 = very dissatisfied, 10 = very satisfied
1. Your facial appearance 2. Appearance of your facial profile 3. Your mouth's appearance (smile, lips, and visible teeth) 4. Appearance of your rows of teeth 5. Shape/form of your teeth 6. Color of your teeth 7. Your gum's appearance 8. Overall, how do you feel about the appearance of your face, your mouth, and your teeth?

Fig 2 The English version of the OES.

Table 1 presents the item analysis. Means for the items varied between 3.2 (tooth alignment) and 5.6 (profile), and standard deviations were between 2.1 and 2.6 for all items. Ceiling effects were found to be rare but most prominent for the profile and mouth items. Floor effects were also rare and occurred in 3% of subjects on four items.

The corrected item-total correlation measures the correlation between single items (components of the construct) and the summary score (the orofacial esthetic [OE] construct) and ranged from .39 to .81 for the seven items that measured components of OE. The correlation between the two measures of the entire OE construct—the OES summary score and the overall item—was higher (.86) than the correlations between individual OE components and the OES summary score. Therefore, the authors decided to create a 7-item summary score for the OES due to conceptual reasons and the highest item-total correlation.

Discussion

The OES was developed to assess the direct or primary impacts of impaired orofacial esthetics in prosthodontic patients. The OES was developed based on patient opinion with input from dental professionals. Findings support sufficient item difficulty and discrimination, as well as unidimensionality in the target population. In terms of being a burden to the patient and the health care provider, the OES is easy to administer, is usually well accepted by the patient, and scores are easy to interpret. Swedish and English versions are available. The OES can be used as a stand-alone instrument when a detailed assessment of esthetic concerns is desired, or used in combination with broader instruments

Table 1 OES Item Analysis in 29 Esthetically Impaired Prosthodontic Patients

OES item	Mean (SD)	Range	Floor effects % of 0 (worst) scores	Ceiling effects % of 10 (best) scores	Item-total correlation
Face	4.9 (2.3)	0–9	3	0	.64
Profile	5.6 (2.1)	1–10	0	7	.39
Mouth	4.3 (2.4)	0–10	3	3	.75
Tooth alignment	3.2 (2.4)	0–8	3	0	.78
Tooth shape	4.1 (2.3)	1–8	0	0	.81
Tooth color	4.3 (2.4)	1–9	0	0	.54
Gingiva	5.0 (2.5)	1–9	0	0	.62
Overall impression	4.1 (2.6)	0–9	3	0	.86

such as OHRQoL when an analysis of the psychosocial impact related to impaired esthetics (and other perceived oral health problems) is desired.

Approaches to Measurement of Orofacial Esthetics in Prosthodontic Patients

Patients referred to a prosthodontic specialist clinic comprise individuals with needs ranging from purely esthetic concerns to functional rehabilitation because of tooth loss. To create an instrument for this spectrum of needs, an unselected group of referral patients in a specialist clinic was used.

Guidelines for questionnaire development recommend the use of qualitative interviews where subjects describe their experiences. Interview data are then translated into statements and tested for suitability as questionnaire items. This approach has been used predominantly in sociologic research and more recently in medicine and dentistry.[22,24,25]

Different methodologic approaches have been used to develop dental-related questionnaires. The OHIP[26] and the Manchester Orofacial Pain Disability Scale[27] used patient interviews as a basis for their item selection, while the General Oral Health Assessment Index[28] used suggestions from scientific experts. In the current study, interviews were supplemented with open-ended questions to give patients the opportunity to address other aspects of esthetic concern that may not have been discussed during the interview process. Questions from existing questionnaires were also included in the item pool. A further improvement was Streiner and Norman's[22] suggestion of combining interviews and expert opinions during item selection for a new scale.

Orofacial Esthetics—A Unidimensional Construct

The OES was constructed to reflect patients' perceived esthetic values. The authors wanted to measure the direct or primary esthetic impacts. This approach agrees with Marcusson et al's cleft lip and palate study[15] by not mixing esthetic/direct items with psychosocial/indirect items. In contrast, other scales mix esthetics with psychosocial concerns[1,11,18,26]—impacts considered to be indirect or secondary. Four of the 14 items on a questionnaire developed by Wolfart et al address the psychosocial disability that results from esthetic impairment.[11] Questions on these scales use expressions such as "uncomfortable about appearance" and "avoid smiling."[26]

Instead, the authors attempted to create item definitions, such as tooth shape and color, that were devoid of any psychosocial aspects. Using this approach, 7 separate esthetic aspects of the face, teeth, lips, and mouth were identified that formed a unidimensional construct—OE—and these 7 items create the OES summary score. The eighth item is a global assessment of overall impact. The approach to measure direct esthetic impact is in contrast to another instrument that measures dental esthetics and contains 3 specific esthetics-related items and 11 items that address psychosocial issues related to problems with the teeth, mouth, and dentures.[18] Mehl et al[1] also measured esthetic concerns and psychosocial consequences of esthetic impairment.

The assessment of psychosocial consequences and esthetic impairment should be separated. The current findings indicate that assessment of esthetic concerns in prosthodontic patients is needed in more detail than suggested previously by other authors.[1,11,18] Psychosocial consequences of esthetic problems should be measured but using a separate instrument. OHRQoL characterizes the psychosocial consequences of impaired oral health well. The OHIP, one of the most widely used instruments in this area, has a 49-item,[26] a 14-item,[29] and a 5-item[30] version. These versions allow efficient assessment of psychologic discomfort, psychologic and social disability, and handicap related to oral health conditions that is tailored to the purpose and to the available resources in a particular setting.

An important step in OES development was to simplify the terminology as much as possible because an important aspect of a self-reporting instrument is that it is short and easy to understand.[31] To be unambiguous, the authors chose common words used by lay people to describe dental terms, such as gum instead of gingiva and rows of teeth instead of occlusion curve.[32] A semantic problem discussed in the consensus group was the wording for natural teeth and tooth replacements—crowns, fixed dental prostheses, removable partial or total denture, and implant-retained prosthesis. The way patients talk about tooth replacements varies greatly depending on their oral health and experience with dental care.[33] It is crucial to use the constructs that are most easily understood. When patients receive prosthodontic therapy they are often initially well informed, but after some time, they become unaware of the prosthesis they are wearing.

Limitations, Strengths, and Future Research

A limitation of this study seems to be the lack of a special item addressing the lips. Van der Geld et al[4] described the lips as the controlling factor in which portions of the teeth, gingiva, and oral cavity will be seen in an individual's smile. The higher the smile line, the more visible the teeth and gingiva. A higher lip line is associated with youth because lips supposedly sag with age. In the current study, the lip construct did not emerge as a separate item in the interview analysis, but the mouth item included the lips. Therefore, the esthetic concerns addressing the lips are covered in the OES.

A major strength of this study is that the OES was translated into English using accepted guidelines.[19,20] The reproduced English version of the OES may provide the first step for other researchers to cross-culturally adapt the OES.

As the next step in the development of the OES, the authors will investigate the score reliability and validity in a companion paper.[34]

Conclusion

Measuring orofacial esthetics in patients with prosthodontic concerns is challenging in terms of the scope and burden of assessment, as well as the comparability of findings with future assessments of other patients. The OES might provide a standardized assessment method of this construct with minimal burden to the patient and the health care professional. It may serve as a brief characterization of the magnitude and the components of the prosthodontic patient's orofacial esthetic impairment, suitable for use in daily practice as well as in research settings.

Acknowledgments

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Literature Abstract

The relationship between periodontal diagnosis and prognosis and the survival of prosthodontic abutments: A retrospective study

Failure rates have been reported to be as high as 25% for removable partial dentures and 34% for fixed partial dentures. Teeth used as abutments often have a higher rate of tooth loss. A classification system that predicts posttreatment outcomes based on pretreatment conditions could be useful in helping to make treatment decisions. The aim of this study was to examine the relationship between periodontal diagnosis and prognosis and the survival of prosthodontic abutment teeth over time. The study consisted of 70 randomly selected patients with either fixed or removable partial dentures delivered by dental students. Data gathered from dental charts included patient information, periodontal diagnosis and prognosis during the examination, procedure performed, abutment tooth number, year of prosthesis delivery, year of most recent periodontal examination, and year of tooth loss. Overall prognosis for the entire dentition as well as the specific abutment tooth was also recorded. Data were analyzed using chi-square, Kaplan-Meier, and Cox proportional hazards models. Follow-up ranged from 3 to 166 months with a mean of 37.3 months. During the study, 7.1% of abutment teeth were lost. No abutment tooth loss was seen in 88.6% of subjects while 15.7% lost at least one tooth. Caries, tooth fracture, or prosthodontic complications caused 81.2% of losses, and 18.8% of teeth were lost due to periodontal complications. Overall abutment tooth survival was 66% over 13.8 years. Abutment teeth with an initial periodontal prognosis of "good" had a ninefold lower risk of tooth loss compared to teeth with a prognosis of anything other than good. Abutment teeth for removable partial dentures had a 3.05-fold increased risk of tooth loss compared to fixed partial denture abutments. It would seem that a tooth with poor or hopeless prognosis should not be used as a prosthodontic abutment tooth due to its increased risk of failure. However, periodontal prognosis does not always predict tooth loss reliably.

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