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ORIGINAL ARTICLE

Patients' and dentists' perception of dental appearance

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Abstract The purpose of this study was to compare the patients' and dentists' perception of dental appearance. Based on internationally accepted guidelines about dental esthetics, a questionnaire was developed to measure "dental appearance" (QDA). Eleven items defined a QDA sum score (0="absolutely satisfied", 44="absolutely dissatisfied"). The QDA was completed by 16 patients (eight women, eight men, mean age 63±9 years) before and after a complete oral rehabilitation. Forty-two dentists evaluated the esthetics before and after rehabilitation on a visual analog scale (VAS, 0="absolutely unesthetic", 100="absolutely esthetic"). The patients' quoting showed a significant esthetic improvement (QDA sum score) from 22 before treatment to 3.5 after treatment ($P \leq 0.001$). Although most of the dentists judged an improvement in most of the patients dental appearances, no significant correlation could be found between patients' and dentists' judgment regarding dental appearance ($r = -0.13$–0.53, $P > 0.05$). When evaluating the influence of age, gender, and experience on rating dental appearance, no significant differences ($P > 0.05$) could be found.

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Introduction

A combination of public media [1], new materials, and techniques have fueled an esthetical cultural revolution [2], which is now leaving the dentists to address the esthetic expectations of today's patients. Traditionally, dentistry has focused on biomedical and mechano-technical approaches to patients' dental health care [3]. Since emphasis on enhancing personal appearance is demonstrated in patients' increased demand for esthetic procedures [2] and positive effects on a patients self-esteem and quality of life were identified [4], a variety of different influential factors have been evaluated [5–11]. In order to achieve excellent esthetic results, several authors have presented guidelines regarding tooth proportions and golden standard values [5–11]. In general, objective and quantifiable measurements are considered as conventional indicators of esthetic success or failure [5–11]. In summary, a harmoniously balanced smile, judged from a professional perspective, is assumed to arise as a result of the ideal interaction of dental and gingival beauty criteria [12, 13].

However, dental appearance is additionally influenced and measured by more abstract, psychological factors such as ideal body image, self-image, and personal motivation [3, 14]. Moreover, gender-related differences play a significant role in esthetic dentistry, since women and men seem to have different approaches and needs for enhancing their dental appearance [12, 15, 16]. As a result, it seems to be difficult to address individual needs with specific guidelines or a systematic approach that will lead to consistent results [17–19]. A successful therapy largely depends on good

interaction between the clinician and patient, especially in situations of complex restorations [5–8, 20]. However, in several studies, significant differences between patients' and dentists' esthetic perception and degree of esthetic treatment need were evaluated [21–23]. In general, dentists seem to rate a greater need for esthetic treatment than patients [23, 24]. To the knowledge of the authors, little is known about self- and professional assessment before and after complete oral rehabilitations. To avoid misunderstandings in the daily practice when accomplishing complex treatments, it would be of interest for the clinician to know to what extent the professional and the patients' assessment of dental appearance agree. It is of further interest to seek an answer to the question whether there are any differences related to experience, age, or gender, when professionals rate dental appearance.

The purpose of this study was to compare self- and professional perception of complex oral rehabilitations, including the anterior teeth of the maxilla and to evaluate experience-, age-, and gender-related differences in professional judgment.

Materials and methods

Participants

Sixteen (eight men, eight women) patients were randomly selected from the students' patient pool. The mean age of the patients was 63±9 years; they were unpaid volunteers. The patients had been treated in a student course in the Department of Prosthodontics, Propaedeutics and Dental Materials, Christian-Albrechts University, Kiel between April 2003 and April 2004 and received either a fixed or removable restoration. All treatments were performed in the Clinical Prosthetic Course II. The students were supervised by faculty members and the responsible assistant medical director or the head of department. The restorations were fabricated in commercial dental laboratories or in the department's dental laboratory.

The dental appearance was assessed professionally before and after oral rehabilitation by 42 dentists (30 men, 12 women), who were participants of a postgraduate advanced training program dealing with dental esthetics. The mean age of the dentists was 37.5±8.5 years with a mean professional experience of 11.3±7 years.

Study procedures

Within the 4 months of the student course, each patient received a complete oral rehabilitation (for example, see Fig. 1) performed by one undergraduate student. The treatment included an oral hygiene instruction and motivation, a provisional phase which lasted nearly 2 months, a prosthetic treatment and a final recall session, 4 weeks after finishing the rehabilitation. The treatment was permanently supervised by three assistant professors, who were calibrated with lectures and an esthetic curriculum. Before insertion of the completed fixed or removable restorations, they were supervised again by the responsible assistant medical director or the head of the department, with a working experience in the area of esthetic dentistry of 5 or 15 years, respectively [10, 12, 14].

The oral rehabilitation was performed either with fixed dental prostheses (n=7), removable dental prostheses (n=7),

Fig. 1 Examples of photographs of a patients situation used in this study before oral rehabilitation during strong smiling (P_smile, (**a**, **b**)) and anterior teeth without lips (P_teeth, (**c**, **d**))

or full dentures in the maxilla (n=2). For all patients, the natural compromised dentition and/or existing restorations were replaced, and all restorations encompassed the anterior teeth of the maxilla. None of the patients was edentulous prior to being restored.

The patients were asked to answer two questionnaires in the following order: a well-being test [25] and a questionnaire asking for "Satisfaction with one's own dental appearance" (QDA) [14, 26]. Both questionnaires were completed before therapy and 4 weeks after oral rehabilitation.

Treatment documentation/photographs

Two standardized digital photographs were taken from each patient before and after oral rehabilitation (EOS D10, Canon, Japan, Fig. 1). The photographs were taken perpendicularly to the axes of each patient's upper anterior teeth. They consisted of (1) lips and teeth during strong smiling (P_smile, Fig. 1a, b) and (2) anterior teeth until the first premolar without lips (P_teeth, Fig. 1c, d). All photographs were taken with a standardized magnification of 1:1.8.

Questionnaires

Well-being test

To ensure that the patients did not differ notably from the general population in well-being, a long-established and highly reliable test was used, which contains 28 items (Befindlichkeitsbogen, Beltz Test, Germany) [25, 27]. In consideration of age and gender of the patients, the results were transformed to standardized so-called stanine values. These stanine values ranged from 2 to 9. Values from 3 to 7 define a normal state of well-being, whereas values lower than 3 define a euphoric state, and values higher than 7 indicate a depressive state. Only patients with normal well-being were accepted for the study.

New questionnaire "Satisfaction with one's own dental appearance" (QDA)

Based on the guidelines regarding anterior esthetics developed by Magne and Belser [7], a questionnaire with 11 items was developed, and its reliability and validity were tested [12, 14, 26]. This questionnaire is shown in Table 1.

A Likert scale with five categories of choice per item was used. For the following analyses, the items asked in a positive way (Q1, Q2, Q3, Q5) were transformed (value_transform=value×(−1)+4). For the QDA sum score, all items were added and could be at most 44, meaning absolutely dissatisfied patients, whereas 0 indicated completely satisfied patients.

Table 1 Questionnaire "Satisfaction with the own dental appearance" (QDA)

Number	Question[a]
Q1	I am content with the appearance of my teeth.
Q2	I am content with the size (length and width) of my teeth.
Q3	I am content with the color of my teeth.
Q4	I don't like the position of my teeth.
Q5	I am content with the appearance of my gums.
Q6	I don't like the form of my teeth, they are e.g., too angular, too round...
Q7	I am dissatisfied if my teeth are recognized as artificial.
Q8	I am dissatisfied with the black hole disease between my teeth.
Q9	I tend to hide my teeth.
Q10	I wish I had other teeth.
Q11	Because of my teeth, I feel rather old.

[a] Questions were asked in German and translated for this table

Dentist evaluation

Dental appearance was assessed professionally before and after oral rehabilitation by 42 dentists. The dentists were participants of a postgraduate advanced training program in dental esthetics. In two digital projector presentations, P_smile and P_teeth were shown. The first presentation evaluated P_smile, whereas the second presentation evaluated P_teeth. The presentations were performed on two consecutive days and no information about the planned second survey was given during the first survey. The dentists had 7 s time to judge each photograph and were not allowed to confer with each other. The dentists judged the photographs according to the esthetic appearance on a visual analog scale (VAS). The VAS had a length of 100 mm and the endpoints "absolutely unesthetic" and "absolutely esthetic". Test–retest reliability was evaluated using eight photographs of P_teeth shown during the P_smile presentation and vice versa. For the following analyses, these results were transformed to numbers from 0 ("absolutely unesthetic") to 100 ("absolutely esthetic").

Statistical analysis

The data was statistically analyzed using "SPSS for Windows" (Version 11.5, SPSS Inc., USA) at a level of significance of $P \leq 0.05$. The data was not distributed normally, and therefore, non-parametric tests were used. The Wilcoxon rank sum test was used to compare the data before and after oral rehabilitation and to evaluate age-, gender-, and experience-related differences. To calculate the test–retest reliability of P_smile and P_teeth and to assess the correlation between the QDA and the professional assessment, the Spearman rank correlation coefficient was used.

Results

All of the 16 participants (100%) showed a normal well-being (mean age 63±9 years, range 45–72, eight females, eight males) and were included in the study.

The data of the QDA sum score and the professional assessment are shown in Table 2.

The median values of the QDA sum score of 22 (before oral rehabilitation) and 3.5 (after) show a significant improvement of the esthetic ranking ($P \leq 0.001$). The median VAS value was 24 for P_smile and P_teeth before rehabilitation. After rehabilitation, the median VAS value improved to 61 for P_smile and 60 for P_teeth. Both P_smile and P_teeth were significantly different before and after rehabilitation ($P \leq 0.0001$). When evaluating the influence of age, gender, and experience of the dentists, the group was divided in two different subgroups for each parameter. However, no significant differences between the subgroups concerning the variables P_teeth and P_smile before and after treatment for each subgroup could be found ($P > 0.05$; Table 2).

Additionally, a statistical analysis to evaluate differences in the judgment of the pictures of P_smile and P_teeth itself was conducted. A significant correlation between P_smile and P_teeth could be found when pooling all professional participants' judgments ($r = 0.6$, $P \leq 0.0001$).

Again, the influence of age, gender, and experience was analyzed. The consistency of the professional evaluation of P_smile and P_teeth showed significant correlations for the subgroups ($r = 0.43$–0.85, $P \leq 0.05$; Table 3). Merely, the evaluation of P_smile/P_teeth before the treatment judged by female professionals and dentists aged less than 37 years was not found to correlate significantly ($r = 0.3$–0.42, $P > 0.05$; Table 3). Additionally, no significant correlation could be found when dentists with an experience more than 11 years judged P_smile and P_teeth after complete rehabilitation ($r = 0.25$, $P = 0.34$; Table 3).

Table 2 Questionnaire Dental Appearance sum score (QDA, $n = 16$) and dentists evaluation of the esthetical outcome judging photographs during strong smiling (P_smile) or photographs of the anterior front without lips (P_teeth)

		Before treatment median[a]	Percentiles (25th, 75th)	After treatment median[a]	Percentiles (25th, 75th)	Median of differences	Percentiles (25th, 75th)	*P* comparisons before/after	
Patients evaluation (QDA)									
QDA sum score[b]		22	9; 28	3.5	0; 7	14	7; 23	0.001	
Dentists evaluation (VAS)[c]									
P_teeth	42	24	19; 29	60	52; 65	34	24; 42	0.0001	
P_smile		24	18; 30	61	57; 66	35	26; 45	0.0001	
Dentist evaluation subgroups									
Experience								*P* (comparisons between the subgroups' judgment of P_teeth and P_smile before and after treatment)	
P_teeth	17 (≥11 years)	24	20, 30	61	52, 63	34	23; 40	P teeth before	P teeth after
P_smile		21	15, 28	61	52, 63	38	33; 45	$P = 0.76$	$P = 0.62$
P_teeth	25 (<11 years)	26	18, 29	55	52, 66	30	24; 43	P smile before	P smile after
P_smile		27	22, 32	58	53, 67	30	28; 41	$P = 0.06$	$P = 0.55$
Age									
P_teeth	22 (≥37 years)	24	20, 31	61	55, 64	34	22; 46	P teeth before	P teeth after
P_smile		25	15, 29	61	59, 66	38	30; 45	$P = 0.17$	$P = 0.3$
P_teeth	20 (<37 years)	23	18, 27	55	49, 67	34	22; 40	P smile before	P smile after
P_smile		24	20, 32	61	51, 66	32	25; 43	$P = 0.3$	$P = 0.5$
Gender									
P_teeth	30 (male)	25	20, 29	60	53, 68	26	24; 40	P teeth before	P teeth after
P_smile		25	20, 28	61	57, 66	30	27; 35	$P = 0.94$	$P = 0.5$
P_teeth	12 (female)	23	14, 29	55	46, 71	31	20; 47	P smile before	P smile after
P_smile		22	17, 33	61	49, 69	39	26; 44	$P = 0.27$	$P = 0.7$

Additionally, the age-, gender- and experience-related evaluation is shown

[a] All values are significantly different between before and after oral rehabilitation ($P < 0.05$, Wilcoxon rank sum test)

[b] Data is shown on a Likert scale with five categories of choice per item. The codes for these categories ranged from 0 for "not at all" to 4 for "very much"

[c] Data is shown on a visual analog scale (0–100; 0="absolutely unesthetic", 100="absolutely esthetic")

Table 3 Gender-, age-, and experience-related correlations of the professional assessment of photographs during strong smiling (P_smile) or photographs of the anterior front without lips (P_teeth) after and before oral rehabilitation

	Gender (n=12 female, n=30 male)		Age (n=22<37years, n=20≥37years)		Experience (n=25≤11years, n=17>11years)		All partcipants
	r, P male	r, P female	r, P≥37years	r, P<37years	r, P≥11years	r, P<11years	r, P
Correlations between P_smile and P_teeth for the evaluation of the consistency of the professional assessment							
P_smile before /P_Teeth before	0.76, 0.0001[a]	0.3, 0.3	0.85, 0.0001[a]	0.42, 0.07	0.9, 0.0001[a]	0.47, 0.02[a]	0.6, 0.0001[a]
P_smile after/P_Teeth after	0.61, 0.0001[a]	0.74, 0.006[a]	0.43, 0.04[a]	0.74, 0.0001[a]	0.25, 0.34	0.77, 0.0001[a]	0.64, 0.0001[a]
P_smile before /P_smile after	0.14, 0.46	0.56, 0.9	0.28, 0.2	−0.026, 0.9	0.48, 0.049	−0.09, 0.6	0.12, 0.5
P_teeth before /P_teeth after	−0.01, 0.95	0.2, 0.56	0.17, 0.43	0.057, 0..8	−0.01, 0.9	−0.01, 0,9	−0.052, 0.7
Correlations between the professional judgement of P_smile and P_teeth and the patients self-assessment (QDA)							
P_smile before/QDA before	0.29, 0.27	0.15, 0.65	0.22, 0.4	0.53, 0.1	0.17, 0.5	0.2, 0.5	0.16, 0.5
P_teeth before/QDA before	0.3, 0.25	0.12, 0.7	0.22, 0.4	0.52, 0.04	−0.13, 0.6	0.2, 0.45	0.31, 0.24
P_smile after/QDA after	0.11, 0.7	0.42, 0.2	0.26, 0.36	0.39, 0.12	0.4, 0.13	0.32, 0.22	−0.08, 0.77
P_teeth after/QDA after	0.27, 0.3	0.26, 0.4	0.2, 0.4	0.2, 0.47	0.4, 0.11	0.21, 0.44	0.17, 0.5

Additionally, the correlations between the questionnaire for dental esthetic sum score (QDA) and the professional assessment are shown

[a] All values show significant correlations for P_smile and P_teeth (P<0.05, Spearman rank correlation coefficient)

Further, the correlations of the professional assessment of P_smile and P_teeth and the subjective assessment of the patients themselves (QDA sum score) were assessed (Table 3). Although most of the dentists judged an improvement in most of the participants' dental appearances and also the patients themselves judged an improvement within the QDA, no significant correlation could be found between the professional evaluation and the patients assessment independent from age, gender, or experience (r=−0.13–0.53, P>0.05).

Reliability of the professional assessment was tested with a test–retest procedure. For the evaluation and re-evaluation of P_smile (r=0.36–0.515, P<0.05) and P_teeth (r=0.35–0.67, P<0.05), a significant correlation was revealed.

Discussion

In this study, the prosthodontic treatment of the patients was performed by different students in the Clinical Prosthetic Course II. Each patient was treated by a different student, which raises the question of the reproducibility of the esthetic outcome of the restorations. This limitation was tried to be minimized by permanently supervising the students by three assistant professors, who were calibrated with lectures and an esthetic curriculum. To assure a high quality of the oral rehabilitation, the restorations were supervised again by the responsible assistant medical director or the head of department, both with a working experience in the area of esthetic dentistry of 5 or 15 years, respectively [10, 12, 14].

When focusing on the test–retest reliability of P_teeth and P_smile, a relatively low correlation was found. A possible explanation might be the fact that reliability was only tested on 25% of the patients and that the VAS offers 100 possible markings, whereas, e.g., a Likert scale has only five options, which narrows the possible choices. Therefore, a low correlation can be explained with the use of the VAS as the measuring tool. Regardless of these explanations, the degree of reliability shown might be seen as a limitation of this study.

The initial pictures (P_teeth and P_smile) and the self-assessment (QDA and Beltz test) of the patients' dental appearance have been collected in the first dental appointment. As a result of the procedure, the pictures for the professional assessment before treatment start to exhibit discolorations, plaque, and calculus (see Fig. 1). In the process of the dental treatment, patients received a professional oral hygiene cleaning, a periodontal treatment where necessary, and instructions for a daily oral hygiene regime.

This resulted in missing debris in the pictures after completion of the dental treatment. This factor might have influenced the naturally “plaque-sensitive” dentists in their judgement additionally negatively (before treatment) or positively (after treatment), despite having no actual influence on the esthetical outcome of the restoration. This esthetical relevant co-factor should have been avoided on the initial pictures and is therefore a limitation of this study, since it could have influenced the esthetical perception of the professional experts.

Interestingly, patients and dentists assessed an improvement regarding esthetics, but the judgment of the esthetic appearance of the oral rehabilitation between dentists and

patients did not correlate. A possible explanation for this phenomenon might be that some oral rehabilitations had to be made with compromises, and the patient considered this fact in his or her judgment. As a result, the patient judged his or her denture more “mercifully” than an expert not involved in the treatment. The patient “wanted” to be satisfied with the result of the oral rehabilitation, which was influenced by his or her wishes (e.g., choice of color, tooth shape, etc.). Furthermore, most of the patients were conscious of the anatomic limitations of their own condition. In contrast, dentists, especially those who want to improve their esthetic competence participating in a postgraduate advanced training program dealing with dental esthetics, might have had very high requirements and therefore might have judged the esthetic outcome more critically.

In this context, it is worth mentioning that in general, patients in a student course seem to have high esthetical requirements, but may not expect absolute perfection. However, during the treatment, the main target of the students was to meet the patient's overall dental demand without increasing or decreasing the patient's esthetical education or expectations. This could further elucidate why the subjective patient's judgment may not correlate with the expectation of a highly demanding professional. Further support of this explanation can be found in the literature, where the esthetical result of a dental restoration seems to be more important to the treating dentist itself, and is in general, perceived in a more differentiated way [10, 15].

Additionally, due to the fact that the dentists only had a limited impression of the patients because only the lower third of the patients' face was shown to them, they were not influenced by any co-factors—unlike the patients.

Observing esthetic wishes in daily practice shows that dissatisfying esthetic perception in most patients tends to be based on a more general judgment of their esthetic appearance. Very seldom, a patient analyzes precisely the factors contributing to their esthetic appearance. In contrast to that, dentists are able to evaluate factors for an unesthetic smile and are the experts knowing to which extend an improving treatment is possible. The consequently following differences in esthetic judgment between patients and dentists is in agreement with several other studies [17, 21, 22].

Additionally, complex concepts like esthetic perception, ideal body image, and self-image are affected by emotional and personality factors that develop during the life cycle [3]. This leads to different esthetic perception of dental appearance and inhomogeneous results within the patient group itself. Economic status and education level [28], as well as gender, age, and relation to the assessed person play an important role [29]. To exemplarily show the complexity of patients' perception, a study reported that girls were more critical of their tooth color than were boys; however, parents and dentists were more critical of boys' tooth color than of girls. Younger patients were more critical than older patients; parents of younger subjects were less critical than those of older subjects [29]. However, not only the patients' assessments seem to be inhomogeneous, literature reports differences within the dental profession and specializations itself [24, 30, 31].

In contrast to the literature in the present study, no significant difference within the professional assessment could be found when evaluating the influence of age, gender, or experience, which implies that these factors seem not to influence a professional judgment of dental appearance. These findings have to be considered with care, since the number of participating patients and dentists is relatively small for this statistical analysis. Due to this fact, a comparison of the subgroups has been conducted instead of a correlation analysis, which reduces the statistical power. However, within these limitations, the results indicate consistency within the dental profession itself.

In summary, patients and professional perception (within the different dental specializations) of dental appearance seem to differ. Since esthetics have become an important issue in modern society and the number of elective esthetic procedures increases [3], it seems important to have a good communication between patient and dentist [5–8, 20] with incorporating individual customer and professional differences when planning the treatment and try to visualize treatment results before finalization [10, 32]. A possible approach to let the patient see a simulation of a possible result before the actual treatment start could be wax-ups and mock-ups [7, 8] or digital imaging [33].

Conclusions

Under the limitations of this study, the following conclusions can be drawn:

1. Dentists and patients judged a significant improvement, which range largely depended on the severity of the esthetical status the patients showed before treatment in contrast to the final esthetical result of the restoration.
2. However, the judgment of esthetic appearance seems to conflict when patients evaluate their own restorations and the same restorations are rated by independent professionals. It can be concluded that the patients are satisfied with dental esthetics when they meet their personal demands. In contrast, independent professionals do not consider this personal influence and instead judge according to higher-ranking esthetical guidelines, which could be achievable theoretically, but might fail the wishes and willingness of the patient.
3. No difference could be found when professionals were asked to judge the esthetic appearance on pictures smiling or pictures with retracted lips.

Conflict of interest declaration The authors declare that they have no conflict of interest.

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