Influence of Esthetic Dental and Facial Measurements on the Caucasian Patients' Satisfaction

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ABSTRACT

Purpose: The purpose of the present study was to investigate how some esthetic dental and facial measurements may correlate the variability of patients' ratings of their satisfaction with the maxillary anterior teeth appearance in different gender groups.

Materials and Methods: The following measurements were made on 78 Caucasian subjects: width and length of each maxillary anterior tooth, their distal gingival zenith displacements, the upper lip height, intercommisural width, maximum maxillary central incisal, and gingival display at rest and smile. All the patients rated their satisfaction with the dental appearance on the visual-analogue scale (0 meaning absolute dissatisfaction, whereas 4 indicated complete satisfaction). All the parameters have been analyzed with respect to gender.

Results: The majority of the esthetic dental and facial measurements were larger in men ($p < 0.05$). The great majority of the participants were completely satisfied with their dental appearance (75% of men and 89% of women; $p > 0.05$). In the men, the two factors of maximal maxillary incisal display at rest and intercommisural width at smile paralleled the variability of the patients' satisfaction with dental appearance by 99% ($p > 0.05$). In women, the combination of central incisor width/length ratio, intercommisural width at rest, central incisor gingival zenith displacement, intercommisural width at smile, upper lip height, and maximum maxillary incisal display at rest paralleled the variability of the patients' satisfaction with dental appearance by 99% ($p > 0.05$).

Conclusions: Within the population tested, the results suggest that the use of esthetic dental and facial measurements may serve as an esthetic guideline and should be considered in esthetic anterior oral rehabilitation.

CLINICAL SIGNIFICANCE

The information presented in this article may be useful in helping to create dental restorations with an acceptable esthetic appearance to the patient. Prior to the treatment the dentist should consider not only the size of maxillary anterior teeth but also their gingival architecture and the soft tissue surrounding the teeth.

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INTRODUCTION

Interest in dental esthetics has increased rapidly during the last few decades among both patients and dentists, and the creation of a natural dental appearance has become an important task in all fields of dentistry, especially in prosthodontics and restorative dentistry.[1] Dental appearance, one of the most important aspects of facial attractiveness, encompasses not only tooth color but also the position, shape, and size of teeth, and related aspects, such as gingival morphology and upper lip height, as well as maxillary incisal display and intercommisural width at the rest position and smile.[2–4]

The relative dimensions of teeth seem to be among the most objective dental criteria within the esthetic checklist because they can be easily evaluated. The definition of ideal tooth dimensions, however, remains a difficult task due to individual variations.[5–7] During the treatment planning, it is essential to consider gingival morphology and contour as well as abnormalities in its symmetry and spatial displacement that can significantly affect the harmonious appearance of the natural dentition.[8–10]

Patients' attitudes toward dental appearance are also important and should be acknowledged in dental treatment decisions.[11] Previous studies have indicated associations between patients' dental appearance and quality of life and general well-being.[12–14] Numerous articles have addressed the discrepancy between the patient's and the dentist's perception of dentofacial esthetics, highlighting the importance of the dentist in determining the patient's esthetic expectations prior to beginning treatment.[11,15,16]

The aim of the study was to determine how some esthetic dental (width/length ratios, gingival zenith distal displacements) and facial measurements (upper lip height, maximal maxillary central incisal and gingival display and intercommisural width at the rest position and smile) relate to the variability of patient's ratings of their satisfaction with the existing maxillary anterior teeth appearance.

It was hypothesized that these measurements would demonstrate the variability in satisfaction between the genders and that females would evaluate a greater number of parameters than males.

MATERIALS AND METHODS

The Sample

The study sample consisted of 94 Caucasian volunteer subjects, of whom 32 were males (mean age 23.4 ± 2.5 years old) and 62 were females (mean age 23.0 ± 1.8 years old). The subjects were fifth year dental students who had not previously received formal instruction about esthetic dentistry. All the participants had continuous natural dentitions with natural teeth or fixed restoration on posterior teeth, and with no crowns, porcelain laminate veneers, or composite resin restorations in the anterior maxillary segment.

For the six maxillary anterior teeth, the exclusion criteria were: evidence of gingival hyperplasia, inflammation, altered passive eruption, attachment loss, gingival recession, periodontal surgery, prior visible composite resin restorations on the facial surfaces of the teeth, prior traumatic injury or occlusal wear into the dentin on maxillary anterior teeth, dental malocclusion, or prior orthodontic treatment. During the clinical examination, 13 possible participants were excluded due to the presence of one or more of the criteria listed.

To ensure that the remaining participants (81 of them) did not differ notably from the general population in well-being, the Beltz-Test was used.[17,18] Since the stanine values from 3 to 7 define a normal state of well-being, only participants within this range were accepted for the study. One of the participants revealed a value lower than 3 (euphoric state) and two participants revealed values lower
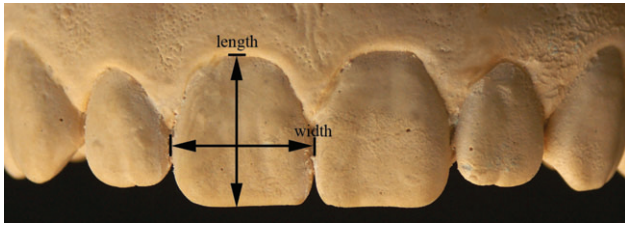
Figure 1. The width and length was measured at the widest mesial-distal portion and longest apical–coronal portion of the tooth.
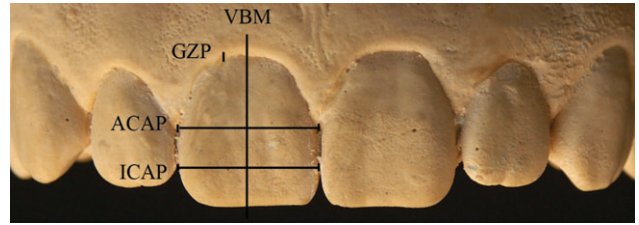

Figure 2. The gingival zenith position (GZP) was measured as the distance of the highest gingival margin position to the vertical bisected midline (VBM), bisecting the midline of the apical (ACAP) and incisal contact area positions of the tooth (ICAP).

than 7 (depressive state), and they were also excluded from the study. Finally, only 78 subjects participated in the study, 32 males and 54 females.

All the participants included in the study gave written informed consent to the survey procedures, which were approved by the Ethical Committee of the School of Dental Medicine.

Dental Measurements

A maxillary impression was made using irreversible hydrocolloid (Alginoplast fast set, Heraeus Kulzer, Hanau, Germany) and poured in hard stone (ISO Type I, Vel-Mix Stone, Kerr Italia S. p. A., Salerno, Italy).

The model was measured using a precise caliper, model: CD-6″ (Mitutoyo Corporation, Kawasaki, Japan) with precision of 0.01 mm. Each parameter was measured three times and the average value was recorded.

The widest mesial–distal portion and the longest apical–coronal portion of the maxillary anterior teeth were measured, and the width/length ratios (WLRs) (%) were calculated (Figure 1).

Gingival zenith displacement on the stone casts was measured as the distance from the most apical point of the gingival marginal scallop to the vertical bisected midline of the maximum crown width. This technique has previously been described (Figure 2).[8]

Facial Measurements

The facial dimensions were measured between different anthropological points directly on the participants, using a precise caliper, model: CD-6″ (Mitutoyo Corporation) with precision of 0.01 mm. The subjects were seated at upright position and asked to look straight. Each parameter was measured three times and the average value was recorded.

The upper lip height, the intercommisural width, maximum maxillary central incisal, and gingival display at the rest position were measured (Figures 3–5).

In smile evaluation, the subjects were asked to give a pleasing very natural smile and the intercommisure width, maximum maxillary central incisal, and gingival displays were measured again (Figures 6 and 7).

Observer Training

Two experienced observers (experienced in dental and facial measurements) measured the parameters on 20 participants. The measurement was repeated after a week interval. No significant difference was noted between the first and the second measurement ($p = 0.89$, paired t-test, $\alpha = 0.05$). The weighted kappa statistics showed satisfactory agreement between the observers ($\kappa = 0.89$; confidence interval CI 0.78–0.93). As the reliability of the measurements and the agreement
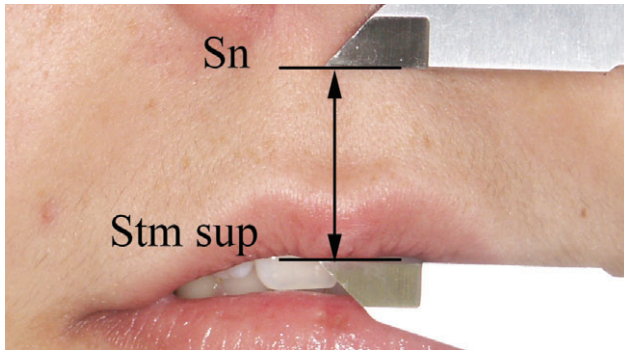
Figure 3. *The upper lip height was measured as the distance from subnazale (Sn) to stomion superius (Stm sup).*

Figure 4. *The intercommisural width at rest was measured as the distance between mouth commisures with lips at the rest position.*
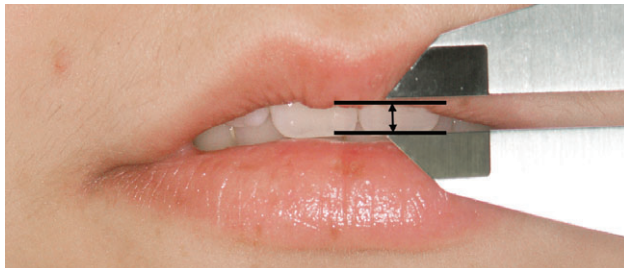

Figure 5. *The maximum maxillary central incisor display at rest was measured as the distance from the lowest line of the upper lip to the incisal edge of the tooth with lips at the rest position.*

Figure 6. *The intercommisural width at smile was measured as the distance between mouth commisures with lips at the smile position.*
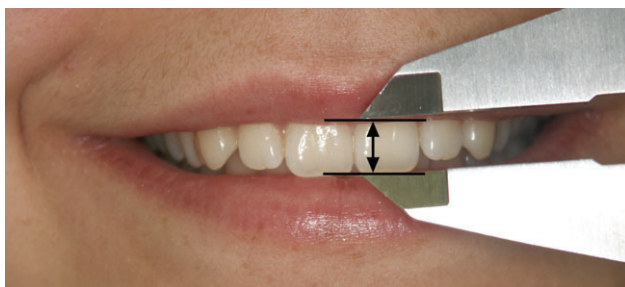

Figure 7. *The maximum maxillary central incisor display at smile was measured as the distance from the lowest line of the upper lip to the incisal edge of the tooth with lips at the smile position.*

were satisfactory, the assessment of the most consistent observer was considered for statistical analysis.

Patients' Evaluation of Satisfaction

This self-evaluation was used to measure the patient's perception of his/her own esthetic dental appearance. The participants judged the appearance of their maxillary anterior teeth on a visual-analogue scale with five categories, 0 meaning absolutely dissatisfied participants, 1 hardly satisfied, 2 satisfied on

average, 3 very satisfied, and 4 completely satisfied with maxillary anterior teeth appearance.

Statistical Analysis

The data were analyzed with a statistical software package (SPSS 10.0; SPSS Inc., Chicago, IL, USA). Paired-samples t-test was used to compare the esthetic dental and facial measurements on both sides of the maxillary dental arch ($p < 0.05$). An independent t-test was used to compare mean measured values between genders ($p < 0.05$). The X^2 test was used to compare the rates of patients' satisfaction with their dental appearance in different gender groups ($p < 0.05$). Multiple regression analyses (forward method) were used to evaluate the relationship of the dental and facial measurements and patients' judgment of their satisfaction with existing dental appearance, separately in men and women.

RESULTS

No statistically significant difference was found between the measurements on both sides of the maxilla ($p > 0.05$), and the mean values for maxillary anterior teeth and their gingival displacements were used in further statistical analyses. None of the participants displayed their gingiva with upper lip at the rest position; therefore, this parameter was excluded from further statistical analysis.

The mean dental and facial measurement values, together with their standard deviations (SD) between different gender groups are shown in Table 1. A comparison of the lateral incisor width/length ratio, all gingival displacements, intercommisural width and maximum maxillary incisal display at the rest, as well as intercommisural width and maximum maxillary incisal gingival display at the smile between genders, was found to be significantly different and higher in men, with the exception of canine gingival zenith displacement being higher in women ($p < 0.05$).

Patients' evaluation of their satisfaction with dental appearance

TABLE 1. DIFFERENCES IN ESTHETIC DENTAL AND FACIAL MEASUREMENTS BETWEEN GENDERS.

	Men Measurement	SD	Women Measurement	SD	t	df	P*
Central incisor width/length ratio (%)	86.19	0.08	86.15	0.11	0.01	76	NS
Lateral incisor width/length ratio (%)	86.36	0.10	78.23	0.10	3.24	76	0.002
Canine width/length ratio (%)	80.27	0.98	82.63	0.49	−1.41	76	NS
Central incisor gingival zenith displacement (mm)	1.17	0.62	0.85	0.54	2.01	76	0.047
Lateral incisor gingival zenith displacement (mm)	0.66	0.46	0.44	0.26	2.54	76	0.013
Canine gingival zenith displacement (mm)	0.10	0.18	0.29	0.27	−3.35	76	0.002
Upper lip height (mm)	14.06	3.41	14.61	2.01	−0.88	76	NS
Intercommisural width at rest (mm)	54.73	2.07	47.32	4.15	8.27	76	0.0001
Maximum maxillary central incisal display at rest (mm)	2.23	1.18	0.76	0.45	2.79	76	0.007
Intercommisural width at smile (mm)	73.07	8.22	64.71	4.73	5.67	76	0.0001
Maximum maxillary central incisal display at smile (mm)	7.14	2.38	6.98	1.91	0.30	76	NS
Maximum maxillary central incisal gingival display at smile (mm)	0.55	0.08	0.20	0.10	−0.87	76	0.05

*Significance set at $p < 0.05$.
NS = non-significant.

TABLE 2. MULTIPLE REGRESSION ANALYSIS (FORWARD METHOD) FOR THE PATIENTS' JUDGEMENT OF THEIR SATISFACTION WITH DENTAL APPEARANCE AS DEPENDENT VARIABLE AND THE ESTHETIC DENTAL AND FACIAL MEASUREMENTS AS INDEPENDENT VARIABLES IN MEN.

Independent variable	R	R²	p	SE
Maximum maxillary incisal display at rest (mm)	0.98	0.96	>0.05	0.08
Intercommisural width at smile (mm)	0.99	0.99	>0.05	0.02

TABLE 3. MULTIPLE REGRESSION ANALYSIS (FORWARD METHOD) FOR THE PATIENTS' JUDGEMENT OF THEIR SATISFACTION WITH DENTAL APPEARANCE AS DEPENDENT VARIABLE AND THE ESTHETIC DENTAL AND FACIAL MEASUREMENTS AS INDEPENDENT VARIABLES IN WOMEN.

Independent variable	R	R²	p	SE
Central incisor width/length ratio (%)	0.57	0.32	>0.05	0.26
Intercommisural width at rest (mm)	0.67	0.45	>0.05	0.24
Central incisor gingival zenith displacement (mm)	0.77	0.60	>0.05	0.21
Intercommisural width at smile (mm)	0.89	0.80	>0.05	0.15
Upper lip height (mm)	0.98	0.97	>0.05	0.05
Maximum maxillary incisal display at rest (mm)	0.99			

revealed that the great majority of the participants were completely satisfied and rated it with the highest score on the visual analogue scale (82% of men and 89% of women). Only 18% of men and 11% of women rated their satisfaction as almost completely satisfied. The difference in patients' satisfaction between different gender groups was found to be not significant ($p > 0.05$).

In the men, using multiple regression analysis (forward method), the combination of only two independent variables—maximum maxillary incisal display at rest and intercommisural width at smile—explained the variability of the patients' satisfaction with dental appearance (dependent variable) by 99% ($p > 0.05$, Table 2).

In women, using the same statistical analysis, the combination of multiple dental and facial independent variables—central incisor width/length ratio, intercommisural width at rest, central incisor gingival zenith displacement, intercommisural width at smile, upper lip height, and maximum maxillary incisal display at rest explained the variability of the patients' satisfaction with dental appearance as the dependent variable by 99% ($p > 0.05$, Table 3).

DISCUSSION

As expected, the results of the study revealed a difference in the sizes of the majority of esthetic dental and facial measurements between men and women ($p < 0.05$). It was also found that the mentioned measurements differentially explained the variability of the patients' satisfaction in both genders, with females using more criteria to explain disapproval of their own smiles than do males.

When it comes to esthetic treatment planning, the discrepancy between the patient's and the dentist's perception of dentofacial esthetics may give rise to problems.[19-21] Therefore, it is important for the dentist to understand the esthetic wishes of the patient before treatment.

Attitudes toward dental appearance have shown rapid changes over the past decades. Differences have been found not only over time but also with respect to gender,[22,23] and this is the major objective of the study.

In order to determine what the patients consider most when they judge their dental appearance, participants were selected with continuous natural dentitions, no

restorations in maxillary anterior region, and absence of gingival inflammation, trauma, or prior orthodontic treatment or obvious esthetic deviation. Since it has been previously reported that the judgment of dental appearance can be influenced by quality of life and general well-being, only those deemed to have a normal state of being were included.[12–14]

The results of our study are in accordance with some previous studies, such as Hasanreisoglu and colleague's, among the Turkish population, who reported that the dimensions of the central incisors and canines varied by gender, with the canines showing the greatest gender variation.[24] Within the Saudi population tested, Abdullah found a significantly higher mean maxillary central incisor width for male subjects.[25] Sterrett and colleagues found significantly greater maxillary anterior teeth width and length measures for males than for females in Caucasians.[7] They also reported that, within male and female Caucasians, the mean width/length ratio of the maxillary three anterior tooth groups was 0.81,[7] and the results of our study are in accordance with it (our range was from 0.78 to 0.86 in three tooth groups).

In order to eliminate the influence of ethnic diversity in this study, only Caucasians were analyzed.

The results of this study also revealed that the gingival zeniths are not universally displaced toward the distal aspects and are tooth dependent. This is in agreement with results previously published by Chu and colleagues,[8] Charruel and colleagues,[9] and Mattos and colleagues.[10] We have also found that the gingival architecture is gender dependent ($p < 0.05$, Table 1), with lower values of the distal zenith displacements in women.

In general, women in our study revealed smaller measurements of gingival displacements, lower lateral incisor width/length ratios, and narrower intercommisural widths at rest and smile as well as smaller maximum maxillary central incisal display at rest and smile ($p < 0.05$, Table 1). The rest of the measured parameters were found to be almost similar to those in men ($p > 0.05$, Table 1). The only measurement found to be higher in women than men was canine width/length ratio ($p > 0.05$, Table 1). As expected, the majority of our participants in both gender groups were satisfied with their dental appearance (82% of men and 89% of women, $p > 0.05$).

The next step of our study was to analyze the influence of the previously measured esthetic dental and facial parameters on the participant's perception of his/her dental appearance in general, and to test the hypothesis about the gender differences in esthetic perception. For that reason we have used multiple regression analysis (forward method) and entered the esthetic dental and facial measurements as independent variables and evaluation of dental appearance as dependent variable, separately for both gender groups.

The results revealed that in men only two facial measurements— maximum maxillary incisal display at rest (by 96%) and inter-commisural width at smile (by 3%)—explained the variability of the patients' satisfaction with dental appearance by 99% ($p > 0.05$, Table 2). This result indicates that the maximum maxillary incisal display at rest in men represents the most strongly correlated factor in their perception of dental appearance.

The results in women revealed that the combination of multiple dental and facial independent variables—central incisor width/length ratio, intercommisural width at rest, central incisor gingival zenith displacement, intercommisural width at smile, upper lip height, and maximum maxillary incisal display at rest explained the variability in the patients' satisfaction with dental appear-

ance as the dependent variable by 99% ($p > 0.05$, Table 3). Comparing these two groups, it is obvious that women have more factors influencing their perception of dental appearance, but what is more important is the distribution of their influence on it. Actually, the majority of the factors explain the variability of the dental appearance by 15 to 20%, with the exception of the first and most strongly correlated factor—central incisor width/length ratio—which explained their dental appearance by around 30% ($p > 0.05$, Table 3). Nevertheless, its influence is much lower than maximum maxillary incisal display at rest in men. Although the central incisor width/length ratio demonstrated the same values in both gender groups (around 86%, $p > 0.05$, Table 1) it seems that this parameter is more important to women than to men. Men in our study demonstrated significantly higher values of maximal maxillary central incisor display at rest position (they were almost 2 mm higher when compared to women, $p < 0.05$, Table 1), and that could explain their significant concern about it.

These results indicate that women consider more parameters during their evaluation of the dental appearance compared to men, from the teeth and gingival appearance to the extent of the smile, tooth, and gingival display, proving our hypothesis to be correct.

Very strong correlation between esthetic dental and facial measurements and patients' evaluation of their dental appearance (explanation of the variability by almost 100% in men and women, respectively) indicates the need for proper selection of variables and inclusion and exclusion criteria during the sample selection, avoiding undesirable influences, such as psychological factors.

The results of this study highlight the importance not only of the size of maxillary anterior teeth but also of their gingival architecture as well as the form of the teeth surrounding soft tissues in patient's self-perception of his/her dental appearance. Any type of dental restoration should be constructed taking into account all of the previously mentioned factors.

CONCLUSIONS

Dental appearance is highly influenced by esthetic dental and facial measurements. Men and women evaluate their dental appearance using different esthetic parameters. Esthetic dental and facial measurements should be used as reference points in conjunction with other subjective and objective esthetic parameters during diagnosis, treatment planning, and the reconstruction of a pleasing smile.

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