the Journal of CONTEMPORARY DENTAL PRACTICE at www.thejcdp.com
Volume 5 Number 1 February 15, 2004 Winter Issue

The Visible Portion of Anterior Teeth at Rest

Khalid A. Al Wazzan, BDS, MS

Abstract

The visibility of anterior tooth surfaces with lips at rest or during function is an important factor in determining prosthodontic outcome. There is a lack of sufficient information published on this subject. The aim of this study was to investigate the degree of visibility of maxillary and mandibular anterior teeth surfaces when the lips are at rest. Four hundred seventy three adults were examined. All the subjects had maxillary and mandibular anterior teeth present with no caries, restorations, severe attrition, mobility, extrusion, or obvious deformities. The portions of anterior teeth that were visible were measured vertically using a Boley gauge from the border of the lip to the incisal edge for the incisors and to the cusp tip for the canines. The measurement was taken at the midpoint of the tooth when the lips and lower jaw were at the rest position. The length of the upper lip was measured from the base of the columella to the tip of the philtrum at the midline of the face. Males showed more of the maxillary lateral, canine, and mandibular anterior teeth than females. With increasing age, the amount of maxillary anterior teeth that was visible at rest decreased. The subjects with shorter upper lips displayed more maxillary central incisor structure than those with longer upper lips. Racial differences were not found. The amount of visible portions of anterior teeth is determined by muscle positions that vary from person to another. It provides an excellent starting point for vertical positioning anterior teeth that can be modified as necessary in any clinical situation. The findings of this study should help the dentist in providing aesthetic prosthodontic treatment that involves replacement of anterior teeth. A useful guideline for positioning anterior teeth is suggested.

Keywords: Esthetic, tooth visibility, tooth exposure, teeth arrangement

Citation: Al Wazzan KA. The Visible Portion of Anterior Teeth at Rest. J Contemp Dent Pract 2004 February;(5)1:053-062.

Introduction

The presence of maxillary anterior teeth plays an important role in facial aesthetics. Any prosthetic treatment, removable or fixed, that involves their replacement is considered to be rather critical. The amount of visible anterior teeth, with lip at rest or during function, is an important esthetic factor in determining the outcome of fixed and removable prosthodontic care, implant dentistry, operative dentistry, anterior esthetic procedures, and orthognathic surgery.

The displayed amount of anterior teeth is determined by muscle position[1] that varies from one person to another. With lips in function, it is expected 69% of Caucasian Americans from 20 to 30 years of age reveal 75% to 100% of the maxillary anterior teeth and the proximal gingivae while smiling.[2] Owens et al.[3] evaluated the display of gingival tissue during maximum smile of six racial groups: African American, Caucasian, Chinese, Hispanic, Japanese, and Korean. They found female subjects tended to display significantly more gingival tissue than males in four of the six races, and African Americans displayed significantly more gingival tissue than any other race. Peck et al.[4] suggested a "gummy smile" is rarer among males.

With the lips at rest, females display more maxillary central incisors than males.[5,6] Racial differences in the amount of displayed maxillary central incisors were also expected; with the white Americans showing more tooth surface than the blacks.[5,6] It has also been reported the display of maxillary central incisors decreases with age and is concurrently accompanied by a gradual increase in the display of mandibular central incisors.[6] In addition, individuals with shorter upper lips display more maxillary central incisor surface than people with longer upper lips, and those with longer upper lip show more mandibular central incisors.[6]

Vig and Brundo found the mean vertical dimension of visible maxillary central incisors in men with the lips at rest was 1.91 mm, while in women it was 3.40 mm.[6] For the mandibular central incisors, such means were 1.23 and 0.49 mm, respectively. Connor and Moshiri in cephalometric tracings of 100 subjects reported the mean visible dimensions of maxillary central incisors were 1.82±2.80 mm for white males and 4.09±2.27 mm for white females.[5] For black subjects, these dimensions were 1.52±1.70 mm and 2.61±1.51 mm, respectively.

Some authors feel most clinicians pay meticulous attention to detail when providing fixed prosthodontic care, operative dentistry, implant dentistry, and anterior esthetic procedures. At the same time, many of them frequently fail to pay similar attention to detail when providing removable prosthodontic treatment.[7]

For complete denture patients, the maxillary occlusion rim is contoured and adjusted to establish the proposed positions of the maxillary anterior teeth. Several guidelines were suggested to establish the lip length-incisal edge relationship and, accordingly, the visible amount of anterior teeth.[8,9] One of the accepted guidelines was the vertical length of the maxillary occlusion rim in the anterior region extends approximately 2 mm below the relaxed lip.[8] Also, the visible amount of anterior teeth can be one of the helpful guidelines for determining the appropriate vertical dimension of occlusion.[10]

There are no published studies on the desired visibility of lateral incisors and canines. The purpose of this investigation was to determine the degree of visibility of maxillary and mandibular anterior teeth when the lips are at rest.

Material and Methods

Four hundred seventy three adult subjects [213 (45%) males and 260 (55%) females] were randomly selected from the dental clinic of the College of Dentistry, King Saud University and a primary health care center, Riyadh, Saudi Arabia. The ages of the subjects ranged from 20 to 60 years. The subjects were classified as of predominantly Arab extraction, African black, and East Asian. All the subjects had maxillary and mandibular anterior teeth present without

caries, restorations, appreciable attrition, mobility, extrusion, or obvious deformities. Subjects with a history of congenital anomalies, lips trauma, facial surgery, or orthodontic treatment were excluded.

Measurements were made by using a Boley gauge (Buffalo Dental Manufacturing Co., Brooklyn, NY) to the nearest tenth of a millimeter. External edges of the Boley gauge beaks were grounded to facilitate proper fitting to the lip. The internal measuring edges of the beaks remained unaltered (Figure1).

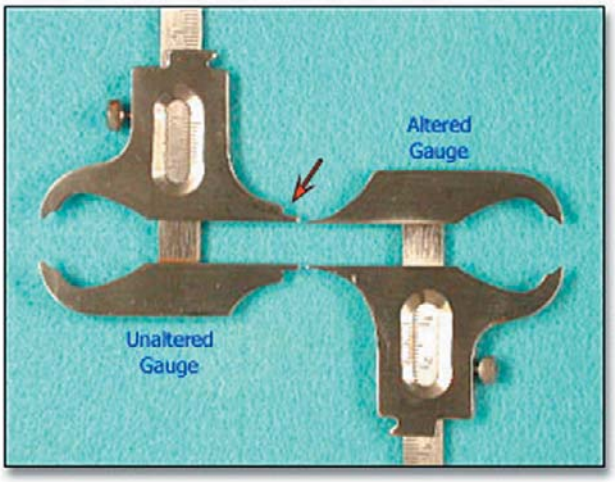


Figure 1. Modification of the Boley gauge.

The portions of anterior teeth that were visible were measured vertically from the lip to the incisal edge for the incisors, and to the cusp tip, for the canines, at the midpoint of the tooth when the lips and lower jaw were at the rest position (Figure 2). The measurement was considered to be zero if the tooth could not be seen regardless of how short it was. Three measurements per tooth were made and the mean was calculated. The length of the upper lip was measured from the base of the columella to the tip of the philtrum at the mid-line of the face (Figure 3). All recorded data were statistically analyzed by t-test and ANOVA.

Results

The most significant differences in the visible amounts of teeth with lips at rest were between the sexes. The males displayed more of the maxillary lateral, canine, and mandibular anterior teeth than the females ($p < 0.01$). On the other hand, females showed more of the maxillary central incisor than males with average visible

Figure 2. Measuring the visible portion of maxillary central incisor.

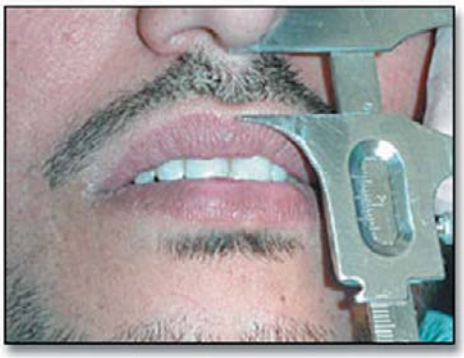


Figure 3. Measuring the length of upper lip.

amounts of 2.91±1.89 mm and 2.66±1.50 mm, respectively. However, the latter deference was not statistically significant (Table 1).

There was a very slight difference in the means of the visible amounts of teeth between the races, with East Asian individuals showing the greatest and African blacks showing the least amounts (Table 2).

Table 3 shows the difference in the visible amount of teeth between the age groups. With increasing age, the amount of maxillary anterior teeth that was visible at rest decreased and the opposite was true for the mandibular anterior teeth. Among the anterior teeth, the amount of visible maxillary central incisors was most significantly affected by aging.

Subjects with shorter upper lips displayed more maxillary anterior incisor structure than subjects with longer upper lips. The amount of visible maxillary canines, in particular, was affected greatly by the length of the upper lip (Table 4).

Table 1. Mean amounts of visible tooth surface by gender (mm).

Sex	n	Maxillary central incisor	Maxillary lateral incisor	Maxillary canine	Mandibular central incisor	Mandibular lateral incisor	Mandibular canine
Male	213	2.66±1.50	1.89±1.35	0.89±1.05	1.14±1.20	1.05±1.12	0.91±1.16
Female	260	2.91±1.89	1.35±1.41	0.29±0.73	0.78±1.25	0.74±1.18	0.60±1.12
t		-1.57	4.22	7.31	3.17	2.91	2.95
P value		NS	<0.0001	<0.00001	=0.0016	=0.0038	=0.0033

± = standard deviation
NS= not significant

Table 2. Mean amounts of visible tooth surface by race (mm).

Race	n	Maxillary central incisor	Maxillary lateral incisor	Maxillary canine	Mandibular central incisor	Mandibular lateral incisor	Mandibular canine
EA	60	2.88±1.75	1.68±1.47	0.61±0.94	1.18±1.45	1.01±1.34	0.75±1.27
SA	385	2.78±1.75	1.56±1.42	0.51±0.92	0.92±1.23	0.90±1.16	0.75±1.14
BA	28	2.40±1.76	1.32±1.27	0.39±0.70	0.60±0.91	0.61±0.90	0.59±1.02
f		0.75	0.62	0.60	2.21	1.12	0.25
P value		NS	NS	NS	NS	NS	NS

± = standard deviation
NS= not significant

Table 3. Mean amounts of visible tooth surface by age (mm).

Age	n	Maxillary central incisor	Maxillary lateral incisor	Maxillary canine	Mandibular central incisor	Mandibular lateral incisor	Mandibular canine
20-25	184	3.13±1.74	1.67±1.50	0.55± 1.00	0.75±1.07	0.71±1.01	0.65±1.04
26-35	170	2.80±1.70	1.63±1.40	0.54± 0.84	0.92±1.36	0.95±1.28	0.78±1.24
36-45	87	2.42±1.67	1.47±1.29	0.51± 0.90	1.04±1.38	1.00±1.26	0.81±1.22
46-55	25	1.85±1.68	1.08±1.15	0.50± 0.99	1.20±1.10	1.12±1.00	0.89±0.93
56-60	7	0.93±1.37	0.57±0.94	0.29± 0.76	1.34±1.23	1.32±1.49	1.07±1.42
f		6.83	2.07	0.16	1.54	1.87	0.66
P value		0.0004	NS	NS	NS	NS	NS

± = standard deviation
NS= not significant

Table 4. Mean amounts of visible tooth surface by upper lip length (mm).

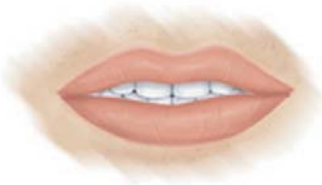
Upper lip length	n	Maxillary central incisor	Maxillary lateral incisor	Maxillary canine	Mandibular central incisor	Mandibular lateral incisor	Mandibular canine
10-15	298	2.82±1.78	1.51±1.46	0.45±0.89	0.95±1.31	0.88±1.23	0.75±1.20
16-20	124	2.69±1.52	1.47±1.27	0.79±0.99	1.05±1.15	1.02±1.11	0.81±1.13
21-25	8	2.04±1.52	1.44±1.49	1.00±1.24	1.16±1.02	1.15±1.09	1.03±1.17
f		1.00	0.04	6.82	0.36	0.75	0.31
P value		NS	NS	0.0004	NS	NS	NS

± = standard deviation
NS= not significant

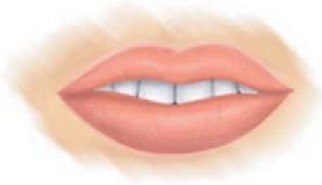
Discussion

The amount of the visible portion of the anterior teeth has been generally overlooked by restorative dentists as an element of esthetic assessment. It is a muscle-determined position that varies from one person to another, and this study revealed the variability of this factor.[1]

The mean visible amount of maxillary incisors in males was 2.66±1.50 mm and in females was 2.91±1.89 mm. In Vig and Brundo[6], the measurements were 1.91 mm and 3.40 mm, respectively; while Connor and Moshiri[5] reported the visible amount of maxillary central incisor to be 1.82±2.80 mm for white males and 4.09±2.27 mm for white females. For the black subjects, such amounts were 1.52±1.70 mm and 2.61±1.51 mm, respectively. The variations may to some extent be explained by differences in measuring techniques and ethnic differences between the populations studied.



Typical male characteristics.



Typical female characteristics.

It was found in the present study females exposed more of the maxillary central incisor than males; contrary to other studies[5,6] this difference was not statistically significant. However, the males significantly displayed more from the maxillary lateral, canine, and mandibular anterior teeth than the females (Table I). A similar result was found by Vig and Brundo in regard to mandibular central incisors.[6] The dentogenic concepts described by Frush and Fisher[11] use the patient's gender, personality, and age in selecting and arranging anterior teeth. They have described the typical male and female dental characteristics. The present study indicated showing more of the maxillary lateral, canine, and mandibular anterior teeth when the lips are at rest is associated with males and it can be considered as a masculine feature, while prominent maxillary central incisors are associated with the females and it can be considered as a feminine feature.

Data presented in Table 2 showed a very slight difference in the means of visible amounts of teeth between the races that supports the findings of Vig and Brundo.[6] Connor and Moshiri[5] reported a significant difference between the white females and black females; however, the male subjects were nearly the same. Results of this study showed the visible amounts of teeth when the lips are at rest increase from African blacks to Arabs and Asians for the maxillary anterior teeth and decreases for the mandibular anterior teeth from Asians to Arabs and African blacks.

With the increasing age, the amount of maxillary central incisor exposed when the lips are at rest decreased from 3.13 mm at age 20 to 0.93 mm at age 60. The opposite occurs for the mandibular incisors, with approximately 0.75 mm showing at age 20 and 1.34 mm at age 60 (Table 3). It is clear from this study that as time and gravity wins out, the tissues surrounding the mouth sag. The

visible length of maxillary anterior teeth diminishes and the amount of mandibular anterior teeth that is visible increases. A similar finding was reported by Vig and Brundo.[6] Facial muscle exercises might help in preventing muscle sagging.[1]

For complete denture patients, a guideline was suggested to adjust the vertical length of the maxillary occlusion rim in the anterior region by extending it approximately 2 mm below the relaxed lip to establish the lip length-incisal edge relationship and accordingly the visible amount of the anterior teeth. The author believes this guideline is still acceptable since it fulfills the requirements of rejuvenation for old patients. This approach is possible especially when it does not conflict with either functional problems or esthetic factors.[1] Conversely, reduction in the amount of maxillary anterior teeth visibility contributes to the early perception of aging of individuals in their 40s.[1] Another point of view is treating all patients using the same therapeutic values regardless of age differences is not acceptable since it contributes greatly to the obvious "denture look."[6]

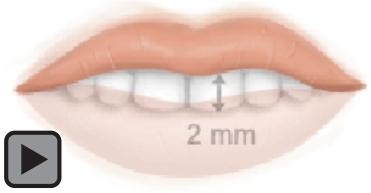


Table 4 shows people with short upper lips display the maximum maxillary anterior teeth surface, while people with long upper lips display more mandibular anterior teeth. This is in agreement with Vig and Brundo.[6] However, except for the maxillary canine, the differences between age groups was not statistically significant.

The visible amount of mandibular incisor teeth has been largely neglected in considering esthetics of prostheses. In complete dentures the incisal edges of mandibular incisors are established by positioning the central incisor 0.5 mm vertical overlap with the maxillary central and a 1 to 2 mm horizontal overlap.[9] These guidelines do not necessarily lead to the appropriate amount of visible tooth structure that is compatible with the patient's age or upper lip length.

The results showed the maxillary central incisor never, and maxillary laterals occasionally, have standard deviations greater than the means. On the other hand, the canines always have larger standard deviations than the means. This indicates the maxillary central incisor is superior reference than the rest of the anterior teeth in regards to the amount of visible tooth surface. The rest of the anterior teeth showed more variation than the maxillary central incisor.

The results of this study showed the maxillary central incisor is the most prominent tooth in the mouth; accordingly, extra care should be taken when selecting its size, form, and positioning.

Anterior tooth selection and arrangement for removable dentures usually depends on the clinician's experience. The arrangement of the anterior teeth should be individualized to the patient's esthetic needs while considering patient's age and sex. The artificial teeth should look like they belong in the patient's mouth. Donovan et al.[7] stated, "Complete dentures offer the clinician the ultimate in freedom in providing patient-accepted esthetics. Given the almost infinite variety of tooth molds, sizes, shades, and arrangements available today, the clinician is limited only by his or her imagination and artistic talent." The Vig and Brundo[6] study as well as the present study have suggested guidelines for the arrangement of anterior teeth should be based upon the amount of tooth exposure when the lips are at rest. Although these guidelines are not absolute, they do provide helpful hints for enhancing the esthetic appearance of the dentures.

In order to create a pleasing esthetic result, the degree of tooth visibility should not be considered separately from other esthetic determinants for the degree of visibility of tooth structure must be in harmony with contours, size, incisal edges, occlusal plane, lip line, smile line, and the location of the midline. The vertical positioning of maxillary anterior teeth cannot be established by the visible amount of tooth alone, because they also play an important role in both anterior guidance and phonetics.

One of the most helpful guidelines in determining the appropriate vertical dimension of occlusion is the visible amount of tooth of the anterior teeth. Halperin et al.[10] stated, "It is critical to evaluate the amount and location of tooth display while the patient rests, speaks, and smiles. The more increased the vertical dimension, the more display of the maxillary and mandibular teeth, because teeth are moved to occupy more of the interocclusal space. The opposite is also true." This general guideline will be more accurate if the patient's age, sex, race, and upper lip length are considered as variables that may affect the visible amount of tooth at rest.

Conclusion

On the basis of the results of this study it is suggested the degree of visibility of anterior teeth is determined by muscle positions that vary from one person to another. These results provide practical guidelines for vertical positioning of the anterior teeth that can be modified as necessary in a given clinical situation.

References

1. Rufenacht CR. Fundamentals of esthetic. Chicago, IL: Quintessence Publ. Co. Inc. 1990. P. 73.
2. Tjan AH, Miller GD, The JG. Some esthetic factors in a smile. J Prosthet Dent. 1984 Jan;51(1):24-8.
3. Owens EG, Goodacre CJ, Loh PL, et. al. A multicenter interracial study of facial appearance. Part 2: A comparison of intraoral parameters. Int J Prosthodont. 2002 May-Jun;15(3):283-8.
4. Peck S, Peck L, Kataja M. The gingival smile line. Angle Orthod. 1992 Summer;62(2):91-100; discussion 101-2.
5. Connor AM, Moshiri F. Orthognathic surgery norms for American black patients. Am J Orthod. 1985 Feb;87(2):119-34.
6. Vig RG, Brundo GC. The kinetics of anterior tooth display. J Prosthet Dent. 1978 May;39(5):502-4.
7. Donovan TE, Derbabian K, Kaneko L, et. al. R. Esthetic considerations in removable prosthodontics. J Esthet Restor Dent. 2001;13(4):241-53.
8. Heartwell CM Jr, Rahn AO. Syllabus of complete denture. 4th ed. Philadelphia, Pennsylvania: Lea & Febiger 1986. p. 257.
9. Zarp GA, Bolender CL, Carlsson GE. Boucher's prosthodontic treatment for edentulous patients. 11th ed. St. Louis, Missouri: Mosby 1997. p. 191. 244
10. Halpering AR, Graser GN, Rogoff GS, et. al. EJ. Mastering the art of complete denture. Chicago, IL: Quintessence Publ. Co. Inc. 1988. P. 135.
11. Frush JP, Fisher RD. How dentogenic restorations interpret the sex factor. J Prosthet Dent 1956; 6: 160-72

About the Author

Khalid A. Al Wazzan, BDS, MS

Dr. Al Wazzan is an Associate Professor in the Department of Prosthetic Dental Sciences at the King Saud University College of Dentistry in Riyadh. The Kingdom of Saudi Arabia. He is a member of the Saudi Dental Society Board of Directors.

e-mail: alwazzan@ksu.edu.sa