sciendo

DOI: 10.2478/aoj-2010-0005

Display of the incisors as functions of age and gender

Andrea Fonseca Jardim da Motta,* Margareth Maria Gomes de Souza,* Ana Maria Bolognese,* Clarice Júlia Guerra† and José Nelson Mucha†

Department of Orthodontics, School of Dentistry, Federal University of Rio de Janeiro* and the Department of Clinical Dentistry, School of Dentistry, Fluminense Federal University,† Rio de Janeiro, Brazil

Background: Older subjects usually show less of their upper incisors and more of their lower incisors than younger subjects.
Objectives: To determine how much of the upper and lower central incisor crowns are visible in Brazilian subjects with their lips at rest.
Methods: The subjects were 240 white Brazilian subjects divided into four age groups: Group 1, 12 to 15 years of age; Group 2, 20 to 30 years of age; Group 3, 31 to 50 years of age and Group 4, 51 years of age and older. Each group contained 30 males and 30 females. The vertical display of the incisors was measured in millimetres from the midpoints of the incisal edges of the upper and lower central incisors to the borders of the upper and lower lips.
Results: In females, the mean upper central incisor display reduced from 4.45 mm in Group 1 to 1.32 mm in Group 4, and in males it reduced from 3.35 mm in Group 1 to 0.57 mm in Group 4. Less of the lower central incisor crowns were displayed in Group 1 females (Mean: 0.47 mm) than in Group 4 females (Mean: 2.22 mm), and in Group 1 males (Mean: 0.61 mm) than in Group 4 males (Mean: 3.05 mm). Brazilian women showed significantly more of their upper incisor crowns than Brazilian men in Groups 1, 2 and 4, whereas Brazilian men showed significantly more of their lower central incisors than Brazilian women in Group 4.
Conclusions: With the lips at rest, older Brazilians display less of their upper central incisors and more of their lower central incisors than young Brazilians. Women show more of their upper incisors than men, while men display more of their lower central incisors than women.
(Aust Orthod J 2010; 26: 27–32)

Received for publication: June 2009
Accepted: November 2009

Andrea Fonseca Jardim da Motta: afjmotta@gmail.com
Margareth Maria Gomes de Souza: margasouzaster@gmail.com
Ana Maria Bolognese: anabolognes@yahoo.com.br
Clarice Júlia Guerra: neycurvo@yahoo.com.br
José Nelson Mucha: nelsonmucha@w

Introduction

Facial appearance is an important factor in many cultures and the mouth and teeth in particular are major factors determining our perceptions of emotion and facial attractiveness.[1–3] In orthodontics, we generally evaluate dentofacial attractiveness from a lateral view rather than in a full or three-quarter view of the face.[4–8] The latter two views are widely used by the media to illustrate and identify faces while the profile view is generally reserved for postage stamps, coins and orthodontic publications. It could be argued that an assessment of facial aesthetics should begin by viewing the patient from the front, at rest, during conversation and smiling.[8] The extent to which the anterior teeth are displayed when the lips are at rest and during activities, such as smiling, may influence our perception of facial attractiveness and should be part of the initial orthodontic assessment.[3,7]

Various authors have described a gradual reduction in the display of the upper central incisors and an increase in lower incisor display with increasing age.[9–12] The display of lower incisors in individuals 60 years or older was reported to be similar to the display of upper incisors in subjects less than 30 years of age.[9] Furthermore, women tend to show more of their upper anterior teeth and less of their lower

© Australian Society of Orthodontists Inc. 2010

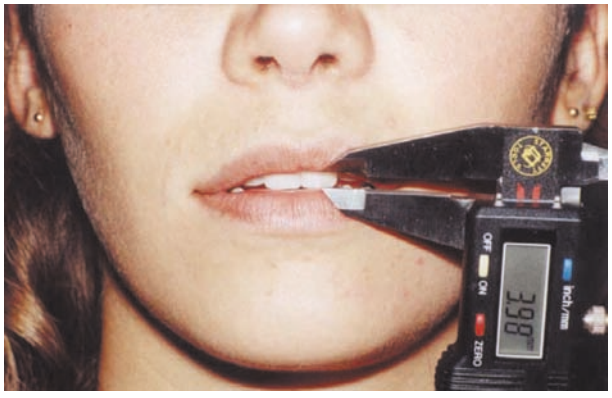


Figure 1. Measurement of upper central incisor display.

anterior teeth than men.[9,11–13] However, Peck et al. found no significant gender differences in the relationships between the upper lip and the teeth with the lips at rest.[10]

Although various authors have suggested guidelines for the arrangement of the anterior teeth, no author has reported the extent to which the anterior teeth are visible in the frontal view in a mixed population, when the lips are relaxed.[9,10,12,15] We aim to determine how much of the upper and lower central incisor crowns are visible in the white Brazilian subjects with their lips at rest, and to determine if age and gender influence the findings.

Materials and methods

The subjects in this cross-sectional study were 120 male and 120 female white Brazilians between 12 and 72 years of age. The subjects were divided into the following age groups: 12 to 15 years of age (Group 1); 20 to 30 years of age (Group 2); 31 to 50 years of age (Group 3); 51 years of age and older (Group 4). Each group consisted of 30 males and 30 females randomly selected from three sources. The subjects in Group 1 were selected from students attending a city high school and the subjects in Group 2 were selected from dental students attending the Federal University of Rio de Janeiro. Group 3 and 4 subjects were selected from patients attending two private dental clinics. The subjects in all groups were randomly selected from those that met the inclusion criteria using the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA).

At the time of examination all subjects lived in Rio de Janeiro. According to the latest National Survey of Households, conducted by the Brazilian Institute of Geography and Statistics (IBGE), white Brazilians make up 53.6 per cent of the metropolitan population. The remainder are: Pardos, a mixture of Whites, Blacks and Indigenous groups with complexions varying from light to dark (33.6 per cent); black Brazilians (12.3 per cent); Asian and/or Indigenous Brazilians (0.5 per cent).

Only white Brazilians with orthognathic profiles, no facial disharmony, normal occlusion or Angle Class I malocclusion who would not benefit from any form of orthodontic treatment were included. Subjects with a history of facial surgery, anterior dental trauma, restored upper or lower incisors or previous orthodontic treatment were excluded.

Measurements of incisor display were obtained with the lips at rest and mandibular posture unstrained.[10,16] The following procedure was used: subjects were asked to stand in front of the examiner in a natural upright posture with Frankfort plane parallel to the floor.[16] They were then instructed to wet their lips with their tongues, open their mouths gently, swallow and articulate the word 'Emma'.[17] Each subject's posture was checked twice to ensure that the lips were at rest and the teeth slightly apart.[8]

The amounts of upper and lower central incisor crowns displayed were then measured with a dial caliper from the midpoints of the incisal edges of both upper central incisors to the lower border of the upper lip and from the midpoints of both lower central incisors to the upper border of the lower lip (Figure 1).[9,12] When measurements of the right and left central incisors differed, the mean of both incisors was used, and when an incisor could not be seen the measurement was considered to be zero.

The entire procedure was performed by a single examiner and the error of the method was established by repeating the measurements in 60 subjects, one week apart. In order to verify the intra-examiner systematic error, Student's paired *t*-tests were applied and the random error was calculated using Dahlberg's formula.[18] The results of the error analysis indicated that the method was reliable because the differences were not statistically significant and Dahlberg's formula revealed that the errors ranged from 0.22 to 0.31 mm.

The Kruskal-Wallis non-parametric test was performed to assess differences between the age groups

Table I. Upper and lower central incisor display with the lips at rest.

Group	Central incisors	Gender	Mean (mm)	SD (mm)	Median	Minimum	Maximum
Group 1 (12–15 years)	Upper	Female	4.45	1.19	4.62	2.49	6.39
		Male	3.35	1.14	3.35	1.09	5.57
	Lower	Female	0.47	0.42	0.50	0.00	1.06
		Male	0.61	0.57	0.66	0.00	1.72
Group 2 (20–30 years)	Upper	Female	3.57	1.28	3.64	0.69	5.97
		Male	2.24	1.34	1.89	0.18	5.21
	Lower	Female	0.60	0.66	0.50	0.00	2.66
		Male	0.97	1.08	0.58	0.00	4.39
Group 3 (31–50 years)	Upper	Female	2.25	0.87	2.49	0.52	4.32
		Male	1.73	1.28	1.53	0.00	4.36
	Lower	Female	1.75	1.16	1.56	0.00	4.58
		Male	1.82	0.93	1.52	0.52	4.01
Group 4 (≥ 51 years)	Upper	Female	1.32	1.18	1.24	0.00	3.55
		Male	0.57	0.53	0.60	0.00	1.94
	Lower	Female	2.22	1.20	2.24	0.00	4.22
		Male	3.05	1.45	3.12	0.95	5.30

and genders, and when a significant difference was found the Mann-Whitney U test was used. Probabilities < 0.05 were considered to be statistically significant.

Results

The results indicate that the display of the upper incisors declined with age in both genders, and that male Brazilians showed less of their upper incisors than female Brazilians (Table I). In both genders there was a gradual increase in lower incisor display with age.

In the youngest female subjects (Group 1) 4.45 ± 1.19 mm of the upper incisor crowns were visible below the upper lip and in the youngest male subjects 3.35 ± 1.14 mm of the upper incisor crowns were visible. The lengths of the upper central incisors crowns visible below the upper lips in the females fell steadily with increasing age from 3.37 ± 1.28 mm (Group 2), to 2.25 ± 0.87 mm (Group 3) to 1.32 ± 1.18 mm (Group 4). The lengths of the upper incisors crowns visible below the upper lips in the males fell at a similar rate from 3.35 ± 1.14 mm in Group 1 to 0.57 ± 0.53 mm in Group 4 (Figure 2).

In the female subjects, the lengths of lower central incisors displayed at rest increased from a mean of 0.47 mm in Group 1, to 0.60 mm in Group 2, 1.75 mm in Group 3 and 2.22 mm in Group 4. The increase was greater in the male subjects than in the female subjects: 0.61 mm in Group 1, 0.97 mm in Group 2, 1.82 mm in Group 3 and 3.05 mm in Group 4 (Figure 3).

Table II gives gender comparisons of the upper and lower incisor display for the different age groups. In all age groups, the female subjects displayed more of the upper central incisors than the male subjects, and the males showed more of their lower incisor crowns than the female subjects. The male – female differences for upper incisor display reached statistical significance in Groups 1, 2 and 4 and for lower incisor display in Group 4 (Table II).

Comparisons of incisor display in the various groups and for both genders are given in Table III. In the female subjects, the decrease in upper incisor display was significant when all groups were compared with each other, but there were no significant differences in lower incisor display in Groups 1 and 2, and Groups 3 and 4. In males, the display of upper incisors fell significantly in all groups, except between Groups 2 and 3. The age-related increase in the display of lower incisors in the men was not significant when comparing Groups 1 and 2, but it was significant for the other groups.

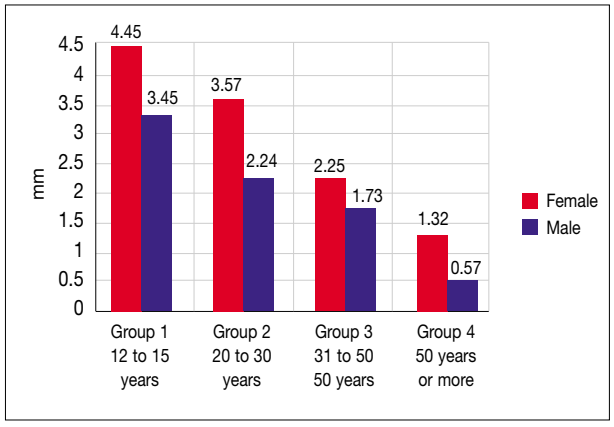


Figure 2. Mean values (mm) for the display of upper incisors, by age and gender.

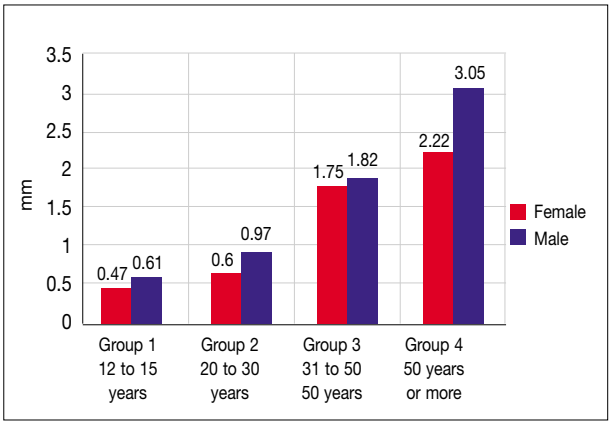


Figure 3. Mean values (mm) for the display of lower incisors, by age and gender.

Table II. Gender comparisons of upper and lower incisor display.

Group	Central incisors	Median (mm) Females	Males	U*	p
Group 1	Upper	4.62	3.35	235.0	**< 0.01**
(12–15 years)	Lower	0.50	0.66	363.5	> 0.05
Group 2	Upper	3.64	1.89	205.0	**< 0.01**
20–30 years)	Lower	0.50	0.58	372.5	> 0.05
Group 3	Upper	2.49	1.53	334.0	> 0.05
(31–50 years)	Lower	1.56	1.52	426.0	> 0.05
Group 4	Upper	1.24	0.60	282.5	**< 0.05**
(≥ 51 years)	Lower	2.24	3.12	312.5	**< 0.05**

* Mann-Whitney U test, significant values in bold

Discussion

We measured the upper and lower incisor crowns visible below and above the margins of the lips in white Brazilians living in Rio de Janeiro. When the lips were at rest, we found the upper incisor display reduced with age and the lower incisor display increased in women and men. As a rule, the women showed more of their upper incisors than the men, while the men displayed more of their lower incisors than the women. These findings may have important implications for orthodontic treatment planning, which tends to ignore long-term changes in the incisor – lip relationships.

One aspect that must be considered is that the sample selected for this study may not be representative of all white Brazilians since the research was held in the city of Rio de Janeiro and Brazil is a large country with five geographical regions and several large cities. As can be seen from the data provided by the IBGE (the agency responsible for statistical, geographic, cartographic, geodetic and environmental information in Brazil) the country's population is diverse, comprising many races and ethnic groups. So it is possible that white Brazilians from Southern Brazil may differ from white Brazilians in the North of the country. However, the results obtained in this study confirm what others have reported on upper and lower incisor display.

The display of the anterior teeth is relevant not only for dental aesthetics, but also for facial attractiveness. The shape, alignment, position and display of the upper central incisors determine a pleasant smile and should be considered when planning orthodontic treatment.[20] One of the challenges an orthodontist or restorative dentist may face is to determine the extent to which damaged upper incisors should be displayed. In such situations, the relationship between the upper lip and the displayed portion of the anterior teeth at rest is an important consideration.[5–8,10,12,21]

We selected subjects with a normal or Angle's Class I malocclusion. Subjects with the latter condition had slightly misaligned teeth, but it was not severe enough to require orthodontic treatment. Although the subjects we selected may not be representative of the patients seeking orthodontic treatment, our average values can be used as reference points or guidelines for incisor display, particularly for smile aesthetics in the long-term.

Table III. Age comparisons of upper and lower central incisor display.

	Females			Males		
	Group 2	Group 3	Group 4	Group 2	Group 3	Group 4
Upper central incisors						
Group 1	238.0 **(<0.05)**	56.5 **(<0.01)**	33.5 **(<0.01)**	224.0 **(<0.01)**	159.5 **(<0.01)**	8.5 **(<0.01)**
Group 2	-	183.0 **(<0.01)**	91.0 **(<0.01)**	-	355.0 (>0.05)	83.5 **(<0.01)**
Group 3	-	-	249.0 **(<0.01)**	-	-	205.0 **(<0.01)**
Lower central incisors						
Group 1	427.5 (>0.05)	117.0 **(<0.01)**	98.5 **(<0.01)**	378.5 (>0.05)	129.0 **(<0.01)**	56.0 **(<0.01)**
Group 2	-	159.5 **(<0.01)**	124.5 **(<0.01)**	-	222.0 **(<0.01)**	117.5 **(<0.01)**
Group 3	-	-	334.5 (>0.05)	-	-	228.0 **(<0.01)**

Mann-Whitney U test, *p* values in brackets, significant values in bold

Some authors consider that the smile is the main aesthetic factor in an orthodontic diagnosis.[12–24] Useful information can be obtained by observing a patient during normal conversation, but care should be exercised when observing the upper lip as it moves from the rest position to a full smile as the final position can be highly variable.[8] The positions of the incisal edges of the upper incisors relative to the relaxed lips are often used in orthodontic treatment planning as a vertical reference point. The determination of the 'relaxed lips position' is reproducible, but not easily obtained for all patients or on some occasions.[21]

Our findings on the age changes in the display of the upper and lower incisors and, in particular, the reduced display of the upper anterior teeth and increased display of lower anterior teeth with age, agree with previous studies.[9–12] These results confirm previous reports that young people display more of their upper incisors than older people.[5,14] These changes were not determined by changes in the positions of the teeth, but rather by age-related changes in the facial tissues and the effect of gravity on the lips.[25] Elongation of the lips continues throughout life and exceeds the age-related increase in lower anterior face height.[19] The positions of the lips also depend on factors such as lip length, lip type and muscle tonus, but we did not assess these factors.

Age-related changes in incisor display can be underestimated if the sample includes subjects from a narrow age band.[10] We used subjects between 12 and 72 years, but only the gender comparisons between Groups 1, 2 and 4 were statistically different. It is important that incisor display is appropriate for the age of the patient. The prosthodontic literature typically recommends that artificial teeth are set up so that 2 mm of the central incisor crowns are visible when the lips are at rest, but patients who want a more youthful appearance will often ask for more of their incisor crowns to be visible.[14] When the display of the anterior teeth is considered insufficient (e.g. excessive tooth wear) the patient's age can be used as a reference to determine the average length of incisors visible at rest. In orthodontic treatment planning the mean values can be used to establish the amount of intrusion to be performed in the upper and/or lower arches. Over-intrusion of the upper incisors in young patients may result in aesthetically compromised smiles later in life.[8,26] Some authors have recommended that the lower incisors rather than the upper incisors should be intruded to preserve smile aesthetics as the patient ages.[8,22,23]

Routine use of incisal edge – lip border measurements taken with the lips at rest should be an important part of a diagnosis and subsequent treatment planning, not only in orthodontics but also in other fields of dentistry. We have provided data on the appropriate positions of the incisors to optimise dentofacial aesthetics in a wide age range of patients. Additional studies are needed, however, to determine how a smile may change with age.

Conclusions

1. With increasing age, both genders show less of their upper incisors and more of their lower incisors.

2. Females display more of their upper incisors than males and males display more of their lower incisors than females.

Corresponding author

Dr Andrea Fonseca Jardim da Motta
Ave. Engenheiro Martins Romeu n.41, apt.803
Ingá, Niterói, RJ
Brazil CEP 24210-400
Email: afjmotta@gmail.com

References

1. Kershaw S, Newton JT, Williams DM. The influence of tooth colour on the perceptions of personal characteristics among female dental patients: comparisons of unmodified, decayed and 'whitened' teeth. Br Dent J 2008;204:pE9.
2. Eli I, Bar-Tal Y, Kostovetzki I. At first glance: social meanings of dental appearance. J Public Health Dent 2001;61: 150–4.
3. Mack MR. Perspective of facial esthetics in dental treatment planning. J Prosthet Dent 1996;75:169–76.
4. Hulsey CM. An esthetic evaluation of lip-teeth relationships present in the smile. Am J Orthod 1970;57:132–44.
5. Miller CJ. The smile line as a guide to anterior esthetics. Dent Clin North Am 1989;33:157–64.
6. Mackley RJ. 'Animated' orthodontic treatment planning. J Clin Orthod 1993;27:361–5.
7. Sarver DM, Ackerman JL. Orthodontics about face: The re-emergence of the aesthetic paradigm. Am J Orthod Dentofacial Orthop 2000;117:575–6.
8. Zachrisson BU. Esthetic factors involved in anterior tooth display and the smile: vertical dimension. J Clin Orthod 1998;32:432–45.
9. Vig RG, Brundo GC. The kinetics of anterior tooth display. J Prosthet Dent 1978;39:502–4.
10. Peck S, Peck L, Kataja M. Some vertical lineaments of lip position. Am J Orthod Dentofacial Orthop 1992;101: 519–24.
11. Dickens ST, Sarver DM, Proffit WR. Changes in frontal soft tissue dimensions of the lower face by age and gender. World J Orthod 2002;3:312–20.
12. Al Wazzan KA. The visible portion of anterior teeth at rest. J Contemp Dent Pract 2004;5:53–62.
13. Arnett GW, Bergman RT. Facial keys to orthodontic diagnosis and treatment planning. Part II. Am J Orthod Dentofacial Orthop 1993;103:395–411.
14. McLaren EA, Rifkin R. Macroesthetics: facial and dentofacial analysis. J Calif Dent Assoc 2002;30:839–46.
15. Misch CE. Guidelines for maxillary incisal edge position-a pilot study: the key is the canine. J Prosthodont 2008;17: 130–4.
16. Burstone CJ. Lip posture and its significance in treatment planning. Am J Orthod 1967;53:262–84.
17. Zachrisson BU. Facial esthetics: guide to tooth positioning and maxillary incisor display. World J Orthod 2007;8: 308–14.
18. Houston WJ. The analysis of errors in orthodontic measurements. Am J Orthod 1983;83:382–90.
19. Vig PS, Cohen AM. Vertical growth of the lips: a serial cephalometric study. Am J Orthod 1979;75:405–15.
20. Spear FM, Kokich VG, Mathews DP. Interdisciplinary management of anterior dental esthetics. J Am Dent Assoc 2006; 137:160–9.
21. Burstone CJ. Charles J. Burstone, DDS, MS. Part 1. Facial esthetics. Interview by Ravindra Nanda. J Clin Orthod 2007;41:79–87.
22. Sarver DM. The importance of incisor positioning in the esthetic smile: the smile arc. Am J Orthod Dentofacial Orthop 2001;120:98–111.
23. Sarver DM, Ackerman MB. Dynamic smile visualization and quantification: Part 1. Evolution of the concept and dynamic records for smile capture. Am J Orthod Dentofacial Orthop 2003;124:4–12.
24. Lindauer SJ, Lewis SM, Shroff B. Overbite Correction and Smile Aesthetics. Semin Orthod 2005;11:62–6.
25. Fudalej P. Long-term changes of the upper lip position relative to the incisal edge. Am J Orthod Dentofacial Orthop 2008;133:204–9.
26. Ackerman MB, Ackerman JL. Smile analysis and design in the digital era. J Clin Orthod 2002;36:221–36.