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Guidelines for Maxillary Incisal Edge Position—A Pilot Study: The Key Is the Canine

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Abstract

Purpose: The purpose of this pilot study was to evaluate the relationship between the vertical position of the maxillary central incisal edge and the maxillary canine relative to the maxillary lip line in repose of dentate patients. This may be beneficial for clinicians in establishing guidelines for the rehabilitation of edentulous patients.

Materials and Methods: One hundred and four Caucasian dentate patients (59 men and 45 women) between the ages of 30 and 59 years were evaluated. A millimeter ruler was used to measure the maxillary right central incisor edge and the maxillary right canine tip to the maxillary lip in repose. Data were collected in reference to sex and age.

Results: For the female group, average central incisor exposure in relation to the relaxed maxillary lip line was 3.8 mm, and the range of exposure was –1 to +8 mm. In the 30- to 39-year olds (17 patients), the average was 4.1 mm with a range of 0 to 8 mm. The average in the 40- to 49-year-old group (16 patients) was 2.8 mm with a range of –1 to +6 mm. In 50- to 59-year olds (12 patients), the average was 1.8 mm with a range of –1 to +5 mm. In the male group, the average central incisor exposure was 2.5 mm, and the range was –3 to +7 mm. The average for the 30- to 39-year-old group (20 patients) was 3.2 mm with a range of 0 to 7 mm. For the 40- to 49-year group (18 patients), the average was 2.4 mm and for 50 to 61 years (21 patients), it was 1.4 mm with a range of –3 to +5 mm in both latter age groups. The canine position for the female group average exposure was 0 mm, with a range of –2 to +2 mm. For the 30- to 39-year old group, average exposure was 1 mm with a range of –1 to +2 mm. The 40- to 49-year-old group exposed an average of 0.4 mm with a range of –1 to +2 mm. For the 50- to 59-year old group, canine exposure was –0.5 mm with a range of –2 to +1 mm. The male average canine exposure was –0.5 mm, and the range was –3 to +2 mm. For the 30- to 39-year old group, the average was 0.9 mm with a range of –1 to +2 mm. The 40- to 49-year-old group exposed an average of 0.2 mm, with a range of –1 to +2 mm. For the 50- to 59-year old group, average was –0.9 mm with a range of –2 to +1 mm.

Conclusions: There was a large range of maxillary central incisal exposure in relation to the maxillary lip line. The average dimension of central incisor exposure represented less than 30% of the subjects in the study and could not be used predictably to assess incisal edge position. The range of canine exposure was narrower. The average dimensions of canine exposure to the lip were within 1 mm for both men and women in all age groups. Further studies are needed to confirm these preliminary results. The average dimensions for the different sex and age groups related to canine exposure represented a greater proportion of the subjects. Therefore, it is suggested that the average canine exposure dimension can be used clinically to assess anterior incisor edge position when restoring edentulous patients.

The ideal goal for a restorative dentist is to return a patient to normal contour, comfort, function, esthetics, speech, and health of the stomatognathic system. The anterior teeth play an important role in esthetics, phonetics, and incision of food. When restoring or replacing these teeth, esthetics is often a primary focus.

When a patient is missing all of the maxillary anterior dentition, the restorative dentist should attempt to position the teeth

in a fashion similar to the arrangement of ideal dentate patients of similar age, gender, race, and facial structures.[1] Phonetics and/or the vertical position of the maxillary central incisors with the lip in repose may be evaluated with this goal in mind.

Various authors have used phonetic guidelines to establish the vertical maxillary incisal edge position in the fabrication of maxillary dentures.[2–4] For example, Payne used phonetics to determine the position of the maxillary anterior teeth using the sounds "S," "Z," and "C."[3] He reported that if the vertical positions of the teeth were too low, the teeth would "click" together. Boucher observed that the vertical positions of the maxillary anterior teeth were determined by phonetics, especially with labiodental sounds.[1] He noted that the maxillary central and lateral incisors touched the lower lip during pronunciation of the letters "F" and "V." He also noted that when the maxillary lip was at rest, the incisal edges of the maxillary teeth were usually visible.

Several authors have reported that the vertical positions of the central incisors were primarily determined by their relationship with the lip in repose (say "emma" and relax) regardless of age or sex.[7-10] As a general rule, these authors observed that the occlusal aspect of maxillary occlusal rims (maxillary central incisors) should extend approximately 1 to 2 mm below the lip in repose. Speech ("F" sounds) was then used to modify this vertical position. A survey of the maxillary lip in repose relative to the maxillary central incisor position of dentate patients was performed by Vig and Brundo.[11] They evaluated the maxillary central incisor position of dentate patients related to sex, race, lip length, and age. The average amount of central incisor exposure with the lip in repose was 1.91 mm for men and 3.4 mm for women. Relative to race, Caucasians averaged 2.43 mm, blacks 1.57 mm, and Asians 1.86 mm. People with a short upper lip (10 to 15 mm) exposed 3.92 mm, whereas people with 31 to 35 mm length lips exposed an average of 0.25 mm. Relative to age, averages were 3.31 mm for patients less than 29 years, 1.58 mm for 30 to 39 years, 0.95 mm for 40 to 49 years, 0.46 mm for 50 to 59 years, and 0.04 mm for above 60 years of age.[11]

The measurements of Vig and Brundo for central incisor exposure were averages, and did not report the number of patients, the method of evaluation, or the range of incisal edge exposure in dentate patients. When an average dimension is used to determine maxillary central incisor position without consideration of the extent of the range, the average may be inaccurate.

Frush and Fisher stated that the "smiling line" helped determine the vertical position of the maxillary teeth in complete dentures.[12] They observed that the central incisors were longer than the other maxillary teeth, and the curvature of the maxillary teeth followed the curve of the upper border of the lower lip during smiling. Using their guidelines, the locations of the maxillary anterior teeth were suggested to just barely reach the lower lip during smiling.

Misch stated that the vertical position of the maxillary anterior teeth and the lip in repose should be determined by the maxillary canine position, rather than the central incisal position.[13] He noted the range of exposure of the central incisors was greater than the range of exposure of canines. Many authors have noted that maxillary central incisors' incisal edges were longer than the cusp tips of the canines compared in the horizontal plane.[1,4,7-10] Therefore, once the vertical position of the canine tips have been identified, the central incisal position can be established; however, no range or average dimension of the maxillary anterior teeth exposure was reported by Misch, relative to the lip in repose.

The purpose of this study was to evaluate the position of the incisal edges of maxillary central incisors and maxillary canines in relationship to the maxillary lip in repose in Caucasian dentate patients.

Materials and methods

Fifty-nine male and 45 female (30 to 59 years) Caucasian adults were enrolled from a private practice. All 104 subjects had at least first molar occlusions. Patients were excluded if they had a history of plastic surgery to the lips or orthodontics used to modify the anterior incisal edge positions. Also excluded from this study were any subjects with moderate to severe wear of the maxillary anterior teeth.

Measurements were made by the same examiner with the patients seated upright in a chair with their heads unsupported. Each patient was asked to say "emma" and relax his/her face and lower jaw. A millimeter ruler was used to measure and record the vertical distance (in mm increments) from the most inferior position of the maxillary vermillion border of the lip in repose to the maxillary right central incisor edge (Fig 1). A similar procedure was used to measure the position of the maxillary right canine tip to the maxillary lip in repose position (Fig 2). There was no accounting for incisal tooth wear, orthodontic skeletal position, or lip length. The data from these adults were separated by age and sex. Age brackets used for the study consisted of three groups: 30 to 39, 40 to 49, and 50 to 59 years old.

Results

In the female group, the overall average central incisor exposure was 3.8 mm, and the overall range of exposure was –1 to

Figure 1 The vertical exposure of the maxillary central incisal edge in relationship to the lip in repose was measured in 104 patients (59 men and 45 women). This 32-year-old female patient exposes 5 mm of the central incisor in the midline.

Figure 2 The vertical position of the maxillary canine in relationship to the lip in repose was also measured in these same 104 patients. This 32-year-old female patient exposes –1 mm of canine with the lip in repose.

Figure 4 This 30-year-old female patient had a central incisor exposure of 6 mm, and her canine exposure was 1 mm.

+8 mm (Fig 3). In the 30- to 39-year-old group (17 patients), the average was 4.1 mm with a range of 0 to 8 mm (Fig 4). The average central incisor tooth exposure in the 40- to 49-year-old group (16 patients) was 2.8 mm with a range of –1 to +6 mm. In the 50- to 59-year-old group (12 patients), the average was 1.8 mm with a range of –1 to +5 mm.

In the male group, the overall average central incisor exposure with the lip in repose was 2.5 mm and the range was –3 to +7 mm (Fig 5). In the male 30- to 39-year-old group (20 patients), the average was 3.2 mm with a range of 0 to 7 mm. In the 40 to 49-year-old group (18 patients), average was 2.4 mm and in the 50 to 59-year-old group (21 patients), the average was 1.4 mm with a range of –3 to +5 mm in both latter age groups.

In the same 104 dentate patients, the right maxillary canine incisal edge exposure with the lip at rest was measured. The overall female average exposure was 0 mm; the range was –2 to +2 mm (Fig 6). For the 30- to 39-year old, average exposure was 1 mm; range was –1 to +2 mm (Fig 4). For the 40- to 49-year-old group average exposure was 0.4 mm; range was –1 to +2 mm. For the 50- to 59-year old, average exposure was –0.5 mm; range was –2 to +1 mm.

The male average position of the canine in relation to the lip in repose was –0.5 mm: range was –3 to +2 mm (Fig 7). The 30- to 39-year-old subjects' average was 0.9 mm; range was –1 to +2 mm. The 40- to 49-year-old group exposed an average of 0.2 mm canine incisal edge; range was –1 to +2 mm. For the 50- to 59-year old average exposure of the canine was –0.9 mm; range was –2 to +1 mm. The average values for canine exposure were within 1 mm for both male and female subjects.

Discussion

The determination of the vertical position of the maxillary anterior teeth is an important criterion in patients missing these teeth. One of the goals in prosthetics is to replace these teeth in positions similar to dentate patients of the same gender, age, race, and facial structures. Hence, a clinical study of the

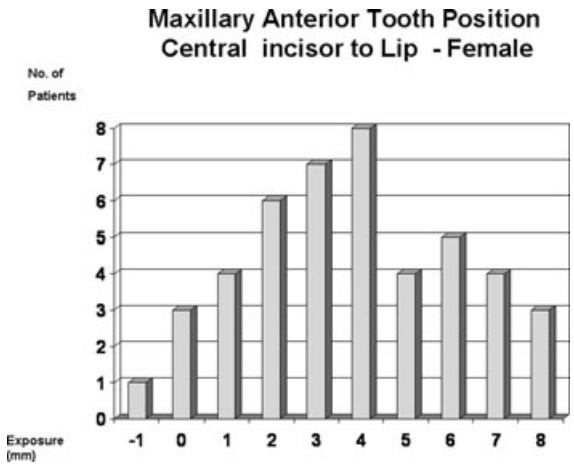

Figure 3 The maxillary central incisor tooth position in relationship to the maxillary anterior lip in repose was evaluated in 45 women between the ages of 30 and 59 years. Less than 20% of the female population was similar to the average.

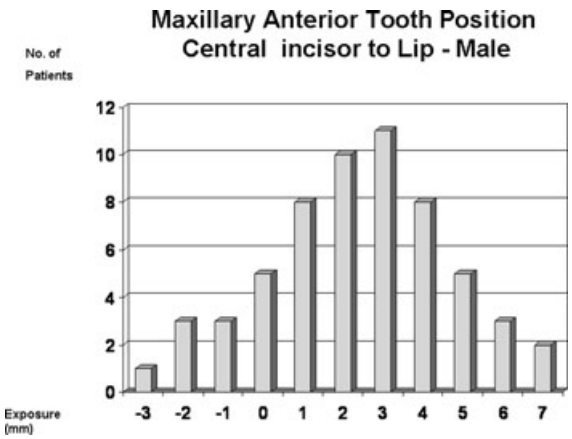

Figure 5 The maxillary central incisor tooth position in relationship to the maxillary anterior lip in repose was evaluated in 59 men between the ages of 30 and 59 years. Sixty-five percent of the subjects were not similar to the average.

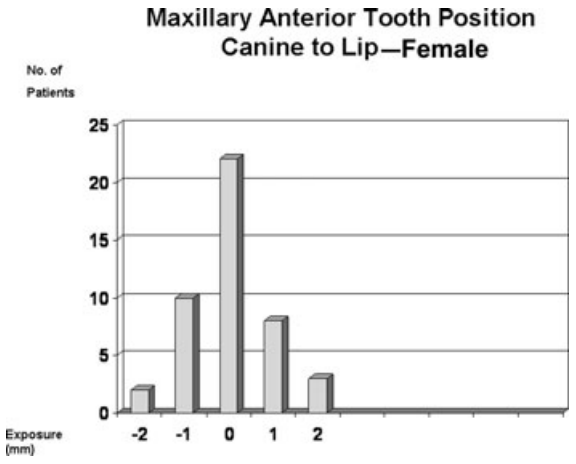

Figure 6 The maxillary canine lip exposure was evaluated in relation to the maxillary lip in repose in the same female group as in Figure 3. Almost 50% represented the average, and only five subjects were more than 1 mm from the average.

averages and ranges of these elements in dentate patients was needed to record these values.

The amount of maxillary central teeth exposure with the lip in repose is a highly variable position and is dependent on many factors. One central incisor to lip in repose average position is not specific enough to use in edentulous patients of various ages. In fact, because the range in this study was so large and the sample size so small, only 20% of the patients under 40 years exhibited an average exposure.

The use of averages with a narrower range (3 to 4 mm in the canine position) may be more predictable than using averages with a wider range (6 to 8 mm in the central incisor position). As reported in this study, the canine tip position was usually –1 to +1 mm longer than the maxillary lip in repose at the ages of 30 to 59 years. In this report, it was also observed that the canine position varied less with age or sex, compared to central incisor positions. In other words, the canine position in relation to the maxillary lip at 35 years is more similar to its position at 55 years of age than the central incisor positions at these ages. Therefore, this study suggests that, for Caucasians between the ages of 30 and 59 years, the canine tip has a more consistent position to the resting maxillary lip position than the maxillary central incisor edge. Exposure of maxillary incisors was 1 to 2 mm longer than the canines in reference to a horizontal plane. Therefore, the vertical position of the maxillary central incisal edge may be positioned after the canine tip position is determined.

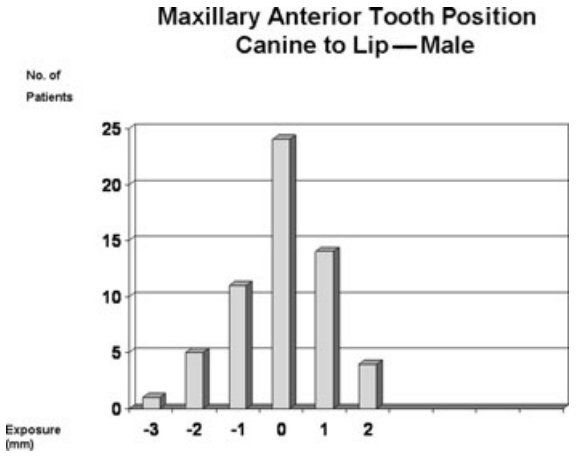

Figure 7 The maxillary canine exposure was evaluated in relation to the maxillary lip in repose in the same male group as in Figure 5. Sixty of the subjects were similar to the average, and only 10 subjects were more than 1 mm from the average.

A potential flaw in the design of this study was measuring the amount of tooth display with a handheld ruler, because the examiner might distort the lip/tooth relationship. The limitations of the study include the number of patients in each age group, the clinical method to evaluate the canine lip/tooth position, and the fact that only one investigator made the measurements. It should be noted that when the canine was above the lip in repose, it was necessary to slightly distort it to make the measurement. As a result, photographs or other passive measurements would not allow assessment of the tooth position. This report also limited its evaluation to subjects with little to no wear of the anterior teeth. The limited sample size and method to assess the canine versus the central tooth position suggests further studies are necessary before a broad generalization of the results.

The consequences of incorrectly positioning the maxillary central incisors in relation to the maxillary lip line include both obvious esthetic consequences and other more subtle problems, including improper plane of occlusion, occlusal vertical dimension, occlusal scheme during mandibular excursions, and moment forces placed on anterior teeth, dentures and/or implants. For example, when the central incisor exposure is insufficient (too apical), the canine may also be apically positioned. This may result in an incorrect position of the maxillary teeth. The anterior point of the plane of occlusion for an edentulous patient is determined by the incisal edge position, whether it is parallel to Camper's Plane or one-half the length of the retromolar pad.[4,5] A consequence of improper central incisor edge position may be that the entire vertical position of the maxillary occlusal plane may be affected.

Conclusion

For patients in this pilot study, the range of exposure of maxillary central incisors was wide, and the use of an average dimension as a guide may not be accurate in clinical practice.

This study also found that the relationship in the exposure of the cusp tips of maxillary canines to the maxillary lip in repose position exhibited a narrow range. The average dimensions for maxillary canines relative to age and sex were closer to the extremes of the range. In this patient population, the canine position relative to the maxillary lip appeared to be a more predictable determinant for establishing the vertical position of the maxillary anterior teeth. In this study, the maxillary canine position to lip in repose had an average dimension within 1 mm

of the upper lip, regardless of sex or age. Hence, it is suggested that this relationship may be used as one of the determinants of anterior tooth position in edentulous, Caucasian patients. Additional studies are mandated to further verify this clinical observation.

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