

Esthetic evaluation of incisor inclination in smiling profiles with respect to mandibular position

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Introduction: The smile is a key facial expression, and a careful assessment of the facial profile in smiling is an essential part of a complete orthodontic diagnosis. The aim of this study was to determine the preferred maxillary incisor inclination in the smile profile with regard to different mandibular positions. **Methods:** A smiling profile photograph of a man with normal facial profile features was altered digitally to obtain 3 different mandibular sagittal positions in 4-mm decrements or increments from -4 to $+4$ mm. In each mandibular position, the inclination of the maxillary incisors was changed from -10° to $+10^\circ$ in 5° increments. A total of 234 raters (72 senior dental students, 24 orthodontists, 21 maxillofacial surgeons, 25 prosthodontists, and 92 laypeople) were asked to score each photograph using a Likert-type rating scale. Mann-Whitney, Kruskal-Wallis, and intraclass correlation coefficient tests were used to analyze the data. **Results:** In retruded and protruded mandibles, normal incisor inclination and the most retroclined incisors were selected as the most and the least attractive images, respectively, by almost all groups. With an orthognathic mandible, the image with the most retroclined incisors was selected as the least attractive, but the raters were not unanimous regarding the most attractive image. The intraclass correlation coefficient was 0.82 (high level of agreement). Also, the sex of the raters had no effect on the rating of the photographs. **Conclusions:** It is crucial to establish a normal incisor inclination, especially in patients with a mandibular deficiency or excess. An excessive maxillary incisor lingual inclination should be avoided regardless of the mandibular position. (*Am J Orthod Dentofacial Orthop* 2015;148:387-95)

Improving facial esthetics has gained more popularity with the advent of the soft tissue paradigm and is a main goal in the treatment of orthodontic patients.¹ The mouth is an important feature in facial attractiveness,²⁻⁵ and a facial smiling profile assessment is an integral part of a complete orthodontic diagnosis.⁶ Kerns et al⁷ reported that from an esthetic viewpoint, the

profile and frontal views of the same smile were not rated similarly; the former was rated higher than the latter. Buccolingual inclination of the maxillary incisors also plays a major role in profile smile attractiveness.^{6,8}

To improve the prediction of the most proper position of the maxillary incisors, several profilometric studies have been conducted.^{6,9,10} Schlosser et al⁹ compared the preferences of orthodontists and laypeople with regard to the buccolingual position of the maxillary incisors in smiling profiles. This study showed a higher level of acceptance with maxillary incisor protrusion than with retrusion in both panels and therefore suggested either not to retract a normally protrusive maxillary dentition or to advance rather than retract the maxillary anterior teeth. In another study by Ghaleb et al,¹⁰ 3 groups including dentists, orthodontists, and laypeople scored the attractiveness of smiling profiles based on maxillary incisor inclinations. The results showed that a 5° protrusion of the maxillary incisors from the normal inclination had the highest rate of appeal among the raters. A statistically significant difference was found among different groups regardless of the sex of the raters of the preferred profile photographs.

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Cao et al⁶ reported that the smiling profile with a 5° lingual incisor inclination was the most favorable among their panels (orthodontists and undergraduate students), whereas the profiles with 15° of labial inclination received the lowest scores.

Although previous studies of profile esthetics have mainly focused on the position or the inclination of the maxillary incisors in profile views with normal mandibular position, to our knowledge, no studies have yet evaluated the esthetic effects of maxillary incisor inclination with regard to different mandibular positions in smiling profiles.^{6,9,10} Moreover, the mandibular position is a characteristic of the patient's inherent underlying skeletal pattern and is difficult to alter during orthodontic treatment. Therefore, it may be important for clinicians to take into account the balance between the incisor inclination and the mandibular sagittal position. This information might assist orthodontists in considering mandibular position in treatment planning for choosing the appropriate inclination for the maxillary incisors.

The objectives of this study were to determine the preferred maxillary incisor inclination in the smile profile of a male subject with regard to different mandibular positions and to elucidate whether the raters' profession and sex played a role in the assessment of the preferred maxillary incisor inclination.

MATERIAL AND METHODS

A finished orthodontic patient (age, 23 years) was chosen from the patients treated at the orthodontics clinic of Shiraz University of Medical Sciences. Informed consent was obtained from the patient for participating in this study. He was chosen based on the following clinical and lateral cephalometric criteria: (1) Class I canine and molar relationships with adequate overjet and overbite, (2) well-positioned maxillary incisors according to cephalometric standards, (3) normal facial convexity angle and vertical height ratio as described by Legan and Burstone,¹¹ (4) normal soft tissue cephalometric analysis (Ricketts' E-line¹² and Merrifield's z-angle¹³), and (5) facial angle and H-angle as described by Holdaway¹⁴ and nasolabial angle and maxillary lip angle as described by Arnett and Bergman¹⁵ within the normal range.

A right lateral profile photograph with the patient in natural head position with a blue background at a distance of 1.5 m from the camera and a speed of 1/125 was taken with a digital camera (c-2000; Olympus America, Melville, NY) under standard conditions. To standardize the photograph, the subject was asked to sit down. By using the ear positioners of the cephalostat,

both the Frankfort plane and the pupillary plane were parallel to the ground.

The first image was taken with a neutral facial expression. The second image was taken with the subject in a posed smile, and a small 100-mm ruler was fixed above his head on the facial sagittal plane.

This 100-mm fixed ruler was used as a guide for computer-aided alterations to quantify hard and soft tissue alterations. The ruler and ear positioners of the cephalostat were later removed digitally to give the subject a normal appearance. The use of image alterations of 1 subject has been shown to be successful in studying variations in dental appearance.^{10,16}

The smiling photograph was altered using a commercially available image editing software program (Adobe Photoshop CS, version 8.0; Adobe Systems, San Jose, Calif). During the first alteration step, only 1 parameter was changed: the anteroposterior position of the mandible. The mandibular prominence of the subject's facial profile was altered in 4-mm decrements and increments from -4 to +4 mm in to represent retrusion and protrusion of the mandible, respectively. By changing the position of the mandible in the horizontal plane relative to the true vertical line that crosses the glabella (defined as the most prominent anterior point in the midsagittal plane of the forehead¹⁷), 3 profiles were created (retruded, normal, and protruded). To focus on the sagittal aspect of the facial profile, the vertical height of the constructed face was kept constant.

In the next step, each profile group was further divided into 5 subgroups. The maxillary incisor inclination of each image was changed from -10° to +10° relative to the norm values of the subject in 5° decrements and increments to represent retroclined and proclined incisors. To simulate the changes of incisor inclination, the crowns of the central and lateral incisors were separately cut in the Adobe Photoshop program.¹⁰ Each tooth was considered as an individual object with the center of rotation at the incisal edge. The central incisor was superimposed from the tracing of the lateral cephalograms, and the center of rotation was placed at the incisal edge of the tooth. To maintain the symmetry, the center of rotation of the lateral incisor was set at the midpoint of the mesiodistal width. To maintain the vertical positions of the maxillary incisors, horizontal lines were drawn tangent to the incisal edges of the teeth, and vertical tangents were drawn medial to the maxillary canines as the distal limit for sagittal repositioning of the lateral incisor.¹⁰

Each simulation was made in 5° decrements and increments, and 2 modifications were produced to represent retroclined incisors and 2 to represent proclined incisors. Artistic editing was used when necessary to

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