The Saudi Dental Journal (2016) 28, 70–75

King Saud University

The Saudi Dental Journal

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ORIGINAL ARTICLE

Association between anterior alveolar dimensions and vertical facial pattern among Saudi adults

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Received 14 September 2015; accepted 29 September 2015
Available online 10 February 2016

KEYWORDS

Anterior alveolus;
High angle;
Low angle;
Lateral cephalometric radiograph;
Saudi individuals

Abstract *Objective:* To establish the anterior alveolar dimensions among a sample of Saudi subjects with different vertical facial heights.

Materials and methods: Lateral cephalometric radiographs of 63 Saudi subjects (30 males and 33 females) were included in this retrospective study. The sample was divided into high angle (SN-MP $\geqslant 39°$), low angle (SN-MP $\leqslant 28°$) and average angle ($30° <$ SN-MP $< 37°$) groups. The anteroposterior and vertical dimensions of the alveolus surrounding the root apex of upper and lower incisors were calculated.

Results: The anterior alveolar dimensions exhibited significant differences ($p < 0.05$) between the different vertical facial height groups. The males and females demonstrated significant differences ($p < 0.05$) in the anterior alveolar dimensions for the same vertical jaw relationship.

Conclusions: Both gender and the vertical jaw relationship can be factors for different height and thickness of the anterior alveolus. Clinicians must be aware of differences in the anterior alveolar dimensions for safe and sound orthodontic tooth movement.

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1. Introduction

Assessment of the vertical facial pattern is an integral part of any orthodontic case diagnosis. A vertical dimension is commonly a contributing factor in the orthodontic treatment planning decision to extract teeth or consider an orthognathic surgical intervention (Bailey et al., 1999; Sivakumar and Valiathan, 2008). The extraction of teeth due to orthodontic reasons is usually accompanied by the retraction of upper and lower incisors during treatment. The importance of maintaining the position of the upper and lower incisors in the middle of their apical base confinement relates to the enhanced periodontal support around these teeth and overall stability of treatment outcome (Handelman, 1996).

Sound orthodontic tooth movement requires careful monitoring to prevent contact between roots and surrounding bony cortical plates to avoid potential iatrogenic sequelae, such as root resorption and bone loss (Handelman, 1996; Wehrbein et al., 1996). Inevitably, incisor retraction is frequently

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Peer review under responsibility of King Saud University.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.sdentj.2015.09.002
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associated with lingual crown/labial root tipping which has been shown to contribute to root resorption (Horiuchi et al., 1998). In general, when the roots are approximating the lingual or facial bony cortical plates, there is increased apical root resorption (Mirabella and Artun, 1995; Agarwal et al., 2014).

Saudi individuals are reported to have a more convex profile and more proclined incisors than Caucasians (Aldrees, 2011; Hassan, 2011; AlBarakati, 2011). Thus, an orthodontic treatment to enhance a profile and improve upper and lower incisors position through retraction requires careful attention to the biological boundaries represented by the alveolar enhousing of the maxillary and mandibular incisors. The relationship between the anterior alveolar dimensions and various dentofacial characteristics in different populations has been reported (Handelman, 1996; Sergl et al., 1996; Sarikaya et al., 2002; Wonglamsam et al., 2003). The anterior alveolar dimensions in Saudi individuals with a normal Class I jaw relationship and different sagittal maxillomandibular malrelationships have been previously established (Al-Barakati and Alhadlaq, 2007; Alhadlaq, 2010). The aim of the present study was to establish the anterior alveolar dimensions in Saudi subjects with different vertical facial patterns, which was determined by the amount of mandibular divergence.

2. Materials and methods

Lateral cephalometric radiographs of 63 Saudi individuals (30 males and 33 females) were obtained from orthodontic records at King Saud University, Riyadh, Saudi Arabia. All the sample subjects were healthy with no congenital or acquired medical disorder, no previous orthodontic treatment and no history of trauma to the head or neck region. All the subjects were adults with ages ranging between 18 and 36 years old for males and 17 and 42 years old for females. Appropriate ethical approval was obtained from the research center at the College of Dentistry, King Saud University.

Each male and female sample was divided into three groups each: high angle, low angle and average based on the mandibular plane angle (SN-MP) as described in the literature (Handelman, 1996; Rongo et al., 2014). The high angle group included subjects with an SN-MP $\geqslant 39°$. The low angle group included subjects with a SN-MP $\leqslant 28°$. The average group included subjects with a SN-MP ranging from 30° to 37°. The age and SN-MP angle data for all the study groups are presented in Table 1.

All the lateral cephalometric radiographs were traced over an illuminated viewing box in a darkened room using a sharp 3H pencil on an acetate tracing paper. The landmarks identified on each cephalometric tracing were: sella (S), nasion (N), anterior nasal spine (ANS), posterior nasal spine (PNS), upper incisal apex (UIA), lower incisal apex (LIA), gonion (Go), and gnathion (Gn) (Fig. 1). The method of Handelman (Handelman, 1996) was followed for measuring the dimensions of the maxillary and mandibular anterior alveolus (Fig. 2). The following variables were measured on each cephalometric tracing:

- *SN-MP:* the angle formed between a line connecting Go to Gn and a line connecting S to N.
- *Occlusal plane (OC):* a line bisecting the overlapping cusps of the first molars and the incisal overbite.
- *Upper posterior alveolus width (UP):* the distance from the apex of the maxillary central incisor to the limit of the palatal cortex along a line drawn through the apex parallel to the palatal plane (ANS–PNS).
- *Upper anterior alveolus width (UA):* the distance from the apex of the maxillary central incisor to the limit of the labial cortex along a line drawn through the apex parallel to the palatal plane.
- *Upper anterior alveolus height (UH):* the shortest distance between the maxillary central incisor apex and the palatal plane.
- *Lower posterior alveolus width (LP):* the distance from the apex of the mandibular central incisor to the limit of the lingual cortex along a line drawn through the apex parallel to the occlusal plane.
- *Lower anterior alveolus width (LA):* the distance from the apex of the mandibular central incisor to the limit of the labial cortex along a line drawn through the apex parallel to the occlusal plane.
- *Lower anterior alveolus height (LH):* the shortest distance from the apex of mandibular central incisor apex to the lowest point on the mandibular symphysis that is transected by a line parallel to the occlusal plane.

All the measurements were performed manually to the nearest 0.25 mm and 0.25° values. All the linear measurements were corrected for magnification and presented as true values after subtracting the correction factor from each measured value. A magnification correction factor was established by measuring a known value (10 mm) on a ruler fixed near the subject's head during radiographic acquisition. For a reliable assessment, the identification of landmarks and tracing measurements of 10 randomly selected cephalometric radiographs were repeated two weeks later, and a correlation coefficient value between the two repeated measurements was established. An arithmetic mean and standard deviation (SD) for all the variables were calculated. An analysis of variance (ANOVA) followed by Scheffe's test was performed to detect differences between the means of corresponding variables between the dif-

Table 1 Age and SN-MP angle value for different study groups.

	Average ± SD					
	Female Group ($N = 33$)			Male Group ($N = 30$)		
	High angle ($n = 10$)	Low angle ($n = 11$)	Average ($n = 12$)	High angle ($n = 9$)	Low angle ($n = 10$)	Average ($n = 11$)
Age (years)	22.4 ± 3.59	24.3 ± 4.39	19.25 ± 2.15	24.8 ± 3.21	21.6 ± 2.66	23.3 ± 4.74
SN-MP (°)	41.65 ± 1.93	24.45 ± 2.18	34.50 ± 2.08	43.06 ± 2.13	25.75 ± 2.00	33.77 ± 1.92

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