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ORIGINAL ARTICLE

Mandibular alveolar bone volume in patients with different vertical facial dimensions

Thamer Alkhadra

Department of Pediatric Dentistry and Orthodontics, College of Dentistry, King Saud University, P.O. Box 60169, Riyadh 11545, Saudi Arabia

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KEYWORDS

Alveolar bone volume;
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Vertical dimension

Abstract *Objective:* To evaluate if there is any difference in alveolar bone surface area in patients with high vertical facial dimension (long face), average vertical facial dimension (average face), and low vertical facial dimension (square short face).

Materials and methods: Forty-five patients who had cone beam computed tomography (CBCT) as part of their orthodontic records were chosen according to their facial vertical dimension. Each group consisted of fifteen patients. Mandibular alveolar bone volume was calculated using Dolphin 3D Imaging software as the total surface area of the symphysis at the level of lower right canine to lower left canine and total surface areas for each patient was considered as total bone volume. Comparison was performed between groups using *t*-test.

Results: Long face type patients showed higher bone volume (total surface area 3220 ± 368 mm^2), average face patients have average bone volume (total surface area 2059 ± 620 mm^2) while square short face patients have the lowest total bone volume (total surface area 1877 ± 112 mm^2). There was a significant difference between long face and square short face groups ($P < 0.005$) however, there was no significant difference between long face and average face groups.

Conclusions: Patients with long face type have higher mandibular alveolar bone volume compared to short facial type patients.

1. Introduction

The craniofacial growth involves major changes in the vertical dimension of the face (Steiner, 1953; Bjork, 1969; Ricketts, 1971; Skieller et al., 1984). These changes vary in different facial types and there are controversies about the etiologic factors involved in determining facial types. It has been reported that genetic predisposition imposes a dominant control in facial vertical growth. Also, it has been documented in the literature that changes in oral function, for example in cases with chronic mouth breathing, can induce an increase in the vertical

E-mail address: thamer@KSU.EDU.SA

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facial dimension (Linder-Aronson, 1970, 1972, 1979; Yamada et al., 1997).

It has been shown that the shape of the mandible differs in different facial types. The differences in mandibular shape and dimensional changes include changes in the cortical bone shape, thickness, and mineralization are different with changes in loading imposed on the mandible by forces applied by the circumoral muscles (Dechow et al., 2000; Bresin, 2001; Kiliaridis et al., 1996; Mavropoulos et al., 2004, 2005; Bresin et al., 1999; van Eijden, 2000; Motoyoshi et al., 2009). It has been reported that cortical bone mineralization varies in different cases with variable vertical facial dimension (Maki et al., 2000, 2001). Previous studies have also postulated that the mandible distorts, bends, and stretches during different oral functions (Korioth and Hannam, 1994; Korioth et al., 1992; Cattaneo et al., 2003, 2005; Usui et al., 2003, 2004). Cortical bone thickness might be responsive to orofacial functions by the muscles attached to the lower jaw (Hylander et al., 1992). Also, the forces imposed on the lower jaw including teeth by the muscles can have direct or indirect effect on the shape of the mandible (Hylander et al., 1987). In addition, previous studies have shown that different facial types have distinct craniofacial morphological characteristics (Swasty et al., 2011). It is not known if different craniofacial shapes are due to specific genetic background or it is more due to environmental influence. Alveolar bone width and surface area is important in orthodontics as it provides the boundaries where teeth can be moved through. The aim of this study was to evaluate if there is any difference in alveolar bone surface area in patients with high, average and short vertical dimensions.

2. Materials and methods

Forty-five adult patients of age 19–32 years old who had CBCT as part of their regular orthodontic treatment due to impacted teeth or other reason that justified obtaining CBCT scans for their comprehensive orthodontic treatment were analyzed. Groups were average vertical facial dimension (average face), high vertical facial dimension (long face), and low vertical facial dimension (square short face) consisting of 15 patients per group (Table 1). Cross sections of the alveolar bone in the anterior part of the mandible spanning between lower left to lower right canines were selected (Fig. 1). Surface area of the alveolar bone around teeth was calculated for three sections around each tooth of the lower front teeth using Dolphin imaging software (Version 11.5, Dolphin Imaging Systems, LLC, Chatsworth, California, USA). Total surface area of the alveolar bone was calculated from cross sections, then the nine sections were pooled and considered as alveolar bone volume. Alveolar bone volume was compared between groups using t-test with alpha set at 0.05 for any significance between the groups.

Table 1 Sample distribution.

Groups	Males	Females	Total
Long face	7	8	15
Average face	8	7	15
Short face	7	8	15
Total	22	23	45

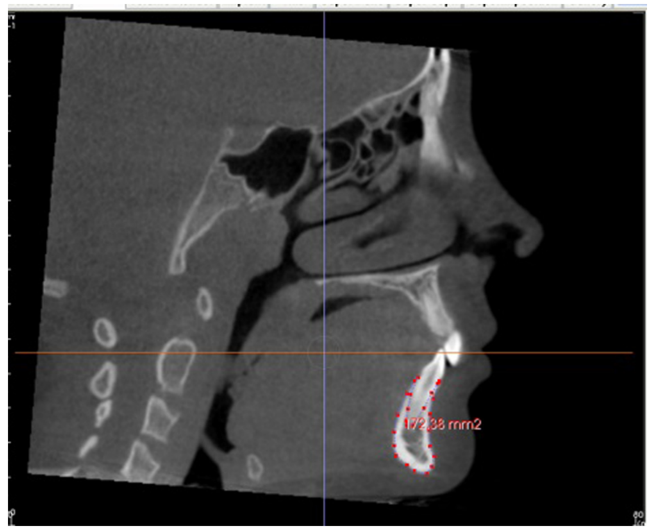

Fig. 1 Measuring alveolar bone surface area from sagittal view using Dolphin Software.

3. Results

Long face group showed the highest mandibular anterior alveolar bone volume compared to average (whose value was in between long and short face groups) and short face groups. There was a statistical significant difference in alveolar bone volume between long and short face groups (P = 0.004) (Fig. 2). However, there was no significant difference between long face group and average face group or between average and short face groups.

4. Discussion

Previous reports have attempted to measure bone morphology from CBCT in patients with different facial types, however,

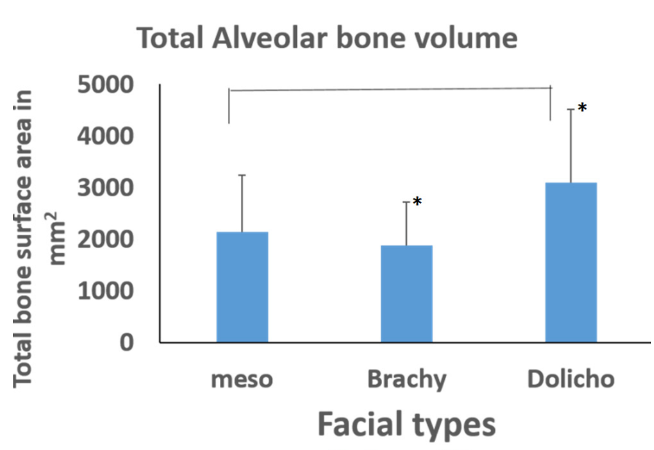

Fig. 2 Graphical representation of comparison of the alveolar bone surface area in cases with different facial vertical dimension.

these reports were limited to cross section of alveolar bone in patients with different facial types (Swasty et al., 2011). It is not known if patients with different vertical dimensions have different mandibular bone volume. It has been established in the literature that the size of the mandible is genetically determined.

The theory of form and function established by Moss inferred that bone morphology and size can be altered by change in orofacial function (Bjork, 1969). Although, there is strong evidence in the literature that some orofacial habits are closely related to some facial types, for example mouth breathing habit has been correlated to increase vertical dimension of the face, also known as dolichol-facial type. There is no information in the literature that measured alveolar bone volume in patients with different vertical dimensions. Hence, it was the aim of this study to evaluate alveolar bone surface area around the teeth or when combined from different cross section may infer or provide information about alveolar bone volume and to evaluate alveolar bone cross sectional area and volume in patients with different facial types. Our results showed that alveolar bone cross sectional area and volume is higher in cases with increased vertical dimension (Dolicho-facial type) compared to those of average or short facial types. Our results are in contradiction with the work of Swasty et al. (2011) who showed that some cross–sectional dimensions of the mandible are smaller in the long face group compared to short or average group. However, this contradiction should be considered with caution as Swasty et al. (2011) used only cross sectional linear measurement and not surface area or total volume. The increased alveolar bone volume in patients with long faces might be attributed to the vertical dentoalveolar compensation when the apical bases are far vertically from each other while teeth are maintaining normal bite. The results of this study needs to be considered in planning dentofacial orthopedic and/or surgical orthodontic treatment for patients with long faces.

5. Conclusion

Patients with long faces have larger alveolar bone volume compared to patients with short faces.

Conflict of interest

The author declare that there are no conflicts of interest.

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