Comparison of pharyngeal airway dimensions and sagittal position of the upper and lower jaw in class III patients

This article describes a study whose objectives were the development of a 3D pharyngeal airway analysis method using CBCT in class III patients and the comparison of airway parameters to the sagittal position of the upper and lower jaw.

Anteroposterior disharmony in the skeletal Class III condition can be a result of mandibular excess, maxillary deficiency or both. This skeletal disharmony can affect pharyngeal airway dimensions. This issue is receiving increasing attention because of a possible connection of pharyngeal airway space (PAS) dimensions and obstructive sleep apnea (OSA) syndrome [1].

Many studies have used lateral cephalometric radiographs to evaluate the PAS. However, the validity of such lateral cephalometric radiographs for pharyngeal airway evaluation is limited because they provide two-dimensional images of complex three-dimensional anatomic structures [2].

Cone-beam computed tomography (CBCT), provides the possibility of evaluating the airway using a noninvasive, rapid, low radiation dose scan [3]. With this technique, it is possible to measure the volume and dimensions of the airway by establishing various cross-sectional planes [4].

MATERIAL AND METHODS

Scans were obtained from 10 Class III patients using SOREDEX SCANORA 3Dx CBCT system. The following instrument parameters were used: 90kV, 10mA, 18-second scan time, and 24x16.5cm field of view.

Digital image files were exported in a Digital Imaging and Communications in Medicine (DICOM) format and imported into InVivo Dental software (Anatomage, San Jose, CA, USA). The pharyngeal airway of each patient was isolated and studied at three levels:

1. the posterior nasal spine (PNS)
2. the most inferior point of the soft palate, and
3. the top of the epiglottis.

The volume of all three parts between sections was measured [Figure 1] and the cross-sectional area at each of these levels [Figure 2].

The level and area of maximum constriction were determined. All measurements were compared with SNA, SNB and ANB angles that are measured in the InVivo Dental 3D analysis.

The Pearson correlation test was used to compare correlation between airway dimensions and sagittal position of the upper and lower jaw. P<0.05 was considered as statistically significant.

RESULTS

The mean pharynx volume was 23.98cc (13.0cc to 34.2cc) and the mean ANB angle -3.38° (-8.0° to 0.5°). Positive correlations were found between SNA and volume to PNS point (Volume 1), SNB and volume between most inferior point of soft palate and top of epiglottis (Volume 3). However only statistically significant (p<0.05) positive correlation was found between ANB angle and the volume between the PNS point and most inferior point of soft palate (Volume 2). No correlation was found between the cross-section area and anteroposterior jaw position [Table 1].

DISCUSSION

3D analysis provides accurate data and is now considered an essential tool for the precise assessment of craniofacial morphology [5,6]. Several 3D techniques have been developed to compensate for the drawbacks of 2D measurements [7,8]. Criteria for

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FIGURE 1. Measurement of pharyngeal airway volume:
A. Top Left: Volume of whole pharynx;
B. Top Right Volume 1;
C. Bottom left Volume 2;
D. Bottom right Volume 3.
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3D analyses are essential not only to ensure the accuracy of treatment planning, but also to evaluate anatomical structures [9,10,11,12].

3D evaluation of the connection between the jaw position and the size of the airway provides an opportunity for the estimation of the effects of orthognathic treatment on pharyngeal airway [13,14,15,16].

However, there is no similar research that compares sagittal position of the upper and lower jaw with 3D dimensions of PAS. Based on the results of this study, it can be concluded that current methodology provides an excellent opportunity for the estimation of the effects of orthognathic surgery on PAS. There is correlation between big skeletal class III anteroposterior discrepancy between the upper and lower jaw and decreasing in volume of middle third of the pharyngeal airway.

REFERENCES


FIGURE 2.
Cross-sectional area measurements of these planes:
A, Top Left: posterior nasal spine area;
B, Top Right Soft palate plane area;
C, Above Left. Epiglottis plane area.

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TABLE 1. 3D measurements, 2D measurements and angles.