Molar dentoalveolar heights’ association with some vertical craniofacial measurements in class I skeletal pattern

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ABSTRACT

Background: Cases with vertical discrepancy have proved to be the most difficult to treat and have the least favorable prognosis. This study was designed to determine the relationship between maxillary and mandibular molar dentoalveolar heights and several vertical skeletal variables; and to start up population standard for the vertical position of the maxillary and mandibular 1st molar, in individuals with skeletal and dental class I.

Materials and method: The sample included 60 digital true lateral cephalometric radiographs (33 females and 27 males) which had been taken in the Orthodontic department in the College of Dentistry, University of Baghdad. They were determined radiographically to have class I skeletal pattern, and clinically to have normal Angle Class I occlusion. Ten skeletal and two dentoalveolar cephalometric measurements were used to assess vertical facial morphology.

Results: Males had a significantly larger molar dentoalveolar height than the females. Both in males and females, maxillary and mandibular dentoalveolar heights were significantly positively correlated with anterior total and lower facial heights and posterior facial height. Ar-Go has higher significant positive correlations in females than males, positive correlations were also found in males between SN-MP angle and molar dentoalveolar heights, and between PP-MP angle and MxMDH only.

Conclusions: Positive relationship between dentoalveolar and craniofacial heights has been confirmed. Population standard for the vertical position of the maxillary and mandibular 1st molar, in individuals with skeletal and dental class I, were verified. The increase in dentoalveolar heights of males show more tendency toward backward rotation of the mandible compared to that of females.

Keywords: molar dentoalveolar heights, vertical dimension, skeletal pattern. (J Bagh Coll Dentistry 2010;22(4):96-101).

INTRODUCTION

In the past, much attention has been given to the diagnosis and treatment of anteroposterior malrelationships of the dental arches. Most of the literature and mechanotherapy which accompanied it were directed primarily at the solution of this problem, as is evidenced by the Angle classification of malocclusion which is only to the horizontal discrepancies of the maxilla and the mandible. However, the cases which have proved most difficult to treat and which have the least favorable prognosis are frequently those in which there is a vertical discrepancy that manifested anteriorly either as a deep overbite or as an open bite (1). Considering both the anteroposterior and vertical dimensions at the same time would lead to a more precise diagnosis from which a more specific treatment could be planned (2).

During facial growth and development, normal occlusion can be attained and maintained despite some variations in facial pattern, primarily as a result of dental compensation (3-7). Therefore a relatively good occlusion with a skeletal discrepancy is not uncommon, and a large variation in the skeletal relationship has been reported even in normal occlusion samples (6, 8).

This confirms that significant anatomical variations exist even within a so-called normal occlusion and to a greater degree in a malocclusion (2).

Extreme vertical facial types (long-face and short-face subjects) are often accompanied by an abnormal vertical development of the posterior dentoalveolar region (1, 5, 9-14).

The amount of vertical growth of the craniofacial complex is probably controlled by both genetic and environmental factors (15, 16). Dentoalveolar regions are considered more prone to environmental influences than to inherited influences (13, 17), and it has also been suggested that during growth, the teeth erupt adapting to the space resulting from the growth pattern of the upper and lower jaws (18). Furthermore, it is a common experience that dentoalveolar heights can be modified, to some extent, by orthodontic treatment (19). In a patient with a deep bite or an open bite coinciding with an extreme vertical lower deficiency or excess, a surgical approach might be considered that requires presurgical dental decompensation. Alternatively, nonsurgical treatment options involve dentoalveolar compensation. The determination of which option is suitable for a patient must be based on the feasibility of dentoalveolar compensation, which in turn will depend on the severity of the skeletal discrepancy. An accurate estimation of the limits.

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of dentoalveolar compensation is therefore a key to successful treatment (20).

The role of dentoalveolar compensation in the development of a normal overbite has been described in samples representing a cross-section of the population with large variations in vertical facial dimensions (21-24). A normal overbite can be attained and maintained as a result of dentoalveolar compensation in connection with variations in skeletal pattern (25). These compensatory variations include dentoalveolar height and proclination or retroclination of the maxillary and mandibular incisors (23-29).

This study was designed to determine the relationship between maxillary and mandibular molar dentoalveolar heights and several vertical skeletal variables; and to start up population standard for the vertical position of the maxillary and mandibular 1st molar, in individuals with skeletal and dental class I.

MATERIALS AND METHODS
Sample
The sample of the present study included 60 digital true lateral cephalometric radiographs (33 females and 27 males) which had been taken in the Orthodontic department in the College of Dentistry, University of Baghdad. All subjects were Iraqi Arabs; their age ranged between 17-25 years; They were not seeking for treatment, determined radiographically to have class I skeletal pattern (ANB: 0° - 4°) (30), and clinically to have normal Angle Class I occlusion, and having complete permanent dentition regardless the third molars. They were clinically healthy with no syndromes, and no evidence of craniofacial anomalies, such as a cleft palate disorders. None had a history of respiratory problems, craniofacial trauma, or history of previous orthodontic, orthopedic or surgical treatment because of possible influences on the vertical development of the dentoalveolar processes or the dimension of the midface structures.

Method
Every lateral cephalometric radiograph was analyzed by AutoCAD (2007) software computer program to calculate angular and linear measurements. Angular measurements were taken directly, while linear measurements were divided by scale for each picture to overcome magnification factor (the ruler of the nasal positioner used to calculate the magnification factor).

The reference points and planes used and the variables measured are shown in Figure 1. In assessing vertical facial morphology, the following skeletal and dentoalveolar variables were used.

**Skeletal variables**
- N-Me (mm): Anterior total facial height, the distance between the N point and the Me point.
- N-ANS (mm): Anterior upper facial height, the distance between the N point and the ANS point.
- ANS-Me (mm): Anterior lower facial height, the distance between the ANS point and the Me point.
- Ar-Go (mm): Ramus length, the distance between the Ar point and the Go point.
- S-Go (mm): Posterior facial height, the distance between the S point and the Go point.
- SN/MP (°): Mandibular plane angle, inclination of mandibular jaw base (MP) to cranial base (SN).
- SN/PP (°): Maxillary plane angle, inclination of maxillary jaw base (PP) to cranial base (SN).
- PP/MP (°): Interjaw base angle, inclination of maxillary jaw base (PP) to mandibular jaw base (MP).
- ArGo/MP (°): The angle between the Ar-Go plane and MP.
- ANB (°): The angle between N-A plane and N-B plane.

**Dentoalveolar variables**
- MxMDH (mm): Maxillary molar dentoalveolar height, the distance between the mesiovestibular cuspid of the upper first molar and the palatal plane along the long axis of the molar.
- MdMDH (mm): Mandibular molar dentoalveolar height, the distance between the mesiovestibular cuspid of the lower first molar and the lower border of the mandible along the long axis of the molar.

Statistical analyses
All the data of the sample were subjected to computerized statistical analysis using SPSS version 15 (2006) computer program. The statistical analysis included:
- **Descriptive statistics: Including;** mean, minimum, maximum, and standard deviation.
- **Independent-samples t-test:** For the comparison of all variables between genders.
- **Person Correlation Coefficient test (r):** To find out the Correlation between the maxillary and mandibular first molar dentoalveolar height and each one of the skeletal variables.

In the statistical evaluation, the following levels of significance were used:
RESULTS

Descriptive statistics for the measured variables are shown in Table 1. Student t-test has shown that the MxMDH, and MdMDH were significantly larger for the male subjects than for the female subjects (Table 2).

In order to determine which variables have an influence on the maxillary and mandibular molar dentoalveolar heights, Person Correlation Coefficient test has been undertaken between the skeletal and dentoalveolar variables (Table 3). In female subjects it was found that MxMDH, and MdMDH were both significantly positively correlated with Ramus length (Ar-Go), Anterior total facial height (AFH), Anterior lower facial height (LFH), and Posterior facial height (PFH).

Table 1: Descriptive statistics for the skeletal and dentoalveolar variables in males and females

<table>
<thead>
<tr>
<th>Variables</th>
<th>Female (n=33)</th>
<th>Male (n=27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ar-Go</td>
<td>Mean 53.7</td>
<td>58.9</td>
</tr>
<tr>
<td>AFH</td>
<td>Mean 38.1</td>
<td>40.1</td>
</tr>
<tr>
<td>UFH</td>
<td>Mean 21.4</td>
<td>22.5</td>
</tr>
<tr>
<td>LFH</td>
<td>Mean 76.8</td>
<td>82.1</td>
</tr>
<tr>
<td>ANB</td>
<td>Mean 2.2</td>
<td>2.4</td>
</tr>
<tr>
<td>SN-MP</td>
<td>Mean 6.4</td>
<td>7.0</td>
</tr>
<tr>
<td>SN-PP</td>
<td>Mean 6.5</td>
<td>7.2</td>
</tr>
<tr>
<td>PP-MP</td>
<td>Mean 1.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Gonial</td>
<td>Mean 5.0</td>
<td>5.5</td>
</tr>
<tr>
<td>MxMDH</td>
<td>Mean 2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>MdMDH</td>
<td>Mean 2.0</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Table 2: Gender differences of dentoalveolar variables by student t-test

<table>
<thead>
<tr>
<th>Dentoalveolar variables</th>
<th>Gender</th>
<th>Mean</th>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>MxMDH</td>
<td>Female</td>
<td>22.29</td>
<td>3.0305</td>
<td>0.4976</td>
<td>5.8</td>
<td>8</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>25.32</td>
<td>3.0305</td>
<td>0.4976</td>
<td>5.8</td>
<td>8</td>
<td>0.000</td>
</tr>
<tr>
<td>MdMDH</td>
<td>Female</td>
<td>30.14</td>
<td>5.0763</td>
<td>0.5928</td>
<td>5.8</td>
<td>8</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>35.22</td>
<td>5.0763</td>
<td>0.5928</td>
<td>5.8</td>
<td>8</td>
<td>0.000</td>
</tr>
</tbody>
</table>

For the male subjects it was shown that MxMDH, and MdMDH were both significantly positively correlated with Ramus length (Ar-Go), Anterior total facial height (AFH), Anterior lower facial height (LFH), Posterior facial height (PFH), and SN-MP; on the
other hand PP-MP has a significant positive correlations only with MxMDH, and Ar-Go has a significant positive correlations only with MdMDH (table 3).

Table 3: Pearson correlation coefficient test between dentoalveolar variables and skeletal measurements

<table>
<thead>
<tr>
<th>Variable</th>
<th>Female(N=33)</th>
<th>Male(N=27)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MxMD H</td>
<td>MxMD H</td>
</tr>
<tr>
<td>Ar-Go</td>
<td>r 0.352*</td>
<td>0.492**</td>
</tr>
<tr>
<td></td>
<td>p 0.045</td>
<td>0.004</td>
</tr>
<tr>
<td>AFH</td>
<td>r 0.633**</td>
<td>0.570**</td>
</tr>
<tr>
<td></td>
<td>p 0</td>
<td>0.001</td>
</tr>
<tr>
<td>UH</td>
<td>r 0.189</td>
<td>0.008</td>
</tr>
<tr>
<td></td>
<td>p 0.293</td>
<td>0.964</td>
</tr>
<tr>
<td>LFH</td>
<td>r 0.616**</td>
<td>0.666**</td>
</tr>
<tr>
<td></td>
<td>p 0</td>
<td>0</td>
</tr>
<tr>
<td>PFH</td>
<td>r 0.510**</td>
<td>0.634**</td>
</tr>
<tr>
<td></td>
<td>p 0.002</td>
<td>0</td>
</tr>
<tr>
<td>SN-MP</td>
<td>r 0.066</td>
<td>-0.043</td>
</tr>
<tr>
<td></td>
<td>p 0.714</td>
<td>0.814</td>
</tr>
<tr>
<td>SN-PP</td>
<td>r -0.206</td>
<td>-0.225</td>
</tr>
<tr>
<td></td>
<td>p 0.25</td>
<td>0.208</td>
</tr>
<tr>
<td>PP-MP</td>
<td>r 0.189</td>
<td>0.112</td>
</tr>
<tr>
<td></td>
<td>p 0.291</td>
<td>0.536</td>
</tr>
<tr>
<td>Gonial</td>
<td>r -0.198</td>
<td>-0.24</td>
</tr>
<tr>
<td></td>
<td>p 0.27</td>
<td>0.179</td>
</tr>
</tbody>
</table>

DISCUSSION

In this study the relationships between maxillary and mandibular molar dentoalveolar heights and several vertical skeletal variables in persons with skeletal and dental class I were investigated.

The mean values for the skeletal variables in the present study were shown to be comparable to those demonstrated by Martina et al (19) in an Italian sample, while the dentoalveolar variables were smaller for the MxMDH, and larger for the MdMDH than those of Martina et al (19). On the other hand it was found that the dentoalveolar variables were almost the same for the female subjects and larger for the male subjects to those demonstrated by Janson et al (22) in Burlington sample for the class I skeletal pattern subjects.

It was found in this study that the MxMDH and MdMDH were significantly larger in males than in females this comes in accordance with Ceylan et al (31) who demonstrated a significant gender differences, and just in parts with Janson (22) who only found a significant difference between males and females for the lower posterior dental height, while the upper posterior dental height didn’t influence significantly by gender. In contrast Martina et al (19) suggested that the amount of both upper and lower molar dentoalveolar heights was not influenced by the sex of the subjects, a potential explanation may be the different statistical approach used in that study which took into account the simultaneous contribution of multiple factors to the individual variation of the molar dentoalveolar heights.

According to Person Correlation Coefficient test (r), anterior total facial height and the anterior lower facial height had a significant positive influence on the amount of molar dentoalveolar heights for male and female subjects, this result supports a positive relationship between dentoalveolar and craniofacial heights (1, 10, 11, 13, 14, 19, 22, 24, 26, 32). As the upper anterior facial height has statistically non significant influence, this suggests that the main difference in total facial height is in the lower anterior facial height.

Ramus length and posterior facial height had a significant positive influence on the amount of molar dentoalveolar heights for male and female subjects except the MxMDH in males where there was no significant relationship with the ramus height; however, there was a positive relationship. This positive relationship can be explained as the increase in ramus vertical height carry the mandible away from maxilla and provide more space for the posterior dentition to erupt.

SN/MP angle showed a significant positive correlation with both upper and lower molar dentoalveolar heights in male subjects. This is a disagreement with Martina et al (19) who had not demonstrated a significant positive correlation of that angle with the molar dentoalveolar heights. This can be explained as different statistical approach had been used in that study. The MxMDH, for males, was positively influenced from the divergency of the jaws (mandibulopalatal plane angle), which is considered one of the most common cephalometric features for definition of vertical facial types. This finding is in accordance with the widespread belief that hyperdivergent facial types have an excessive posterior dentoalveolar (1, 10, 11, 13, 14, 19, 22, 24, 26, 32), and that the hypodivergent facial types have a deficient dentoalveolar development (9, 33). On the contrary decreases in maxillary and mandibular posterior dentoalveolar heights in permanent dentition have been reported by Betzenberger et al (12) in high-angle malocclusions, Martina et al (19) has also reported that the amount of molar dentoalveolar heights for males and females were negatively influenced.
from the divergency of the jaws (mandibulopalatal plane angle).

In spite of the increase in anterior and posterior facial heights together with the increase in dentoalveolar heights, we can find that the positive correlations between Ar-Go and dentoalveolar heights were higher in females than that of males (the positive correlation only with MdMDH), this together with the increase in SN-PP and PP-PP angles in conjunction with the increase in dentoalveolar heights in males reflect a higher tendency toward backward rotation of the mandible with the increase in dentoalveolar heights in males when compared to females. These tendencies may appear more obviously if the same study were done for patient with skeletal discrepancies.

The uniqueness of this study compared to other related studies is that the sample of subjects has normal occlusion and normal skeletal relationship (not referred for orthodontic treatment), so this study may provide normative values for the relationship between molar dentoalveolar heights and craniofacial morphology in individuals without malocclusion.

REFERENCES