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Cephalometric Comparison of Position of the Hyoid Bone in Class I and Class II Patients

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Abstract

Background: According to the close proximity of hyoid bone with dentofacial structures and its muscular attachments, a probable relationship between it and different types of skeletal patterns is suspected.
Objectives: The aim of this study is compare the position of hyoid bone in skeletal class I and class II patients.
Methods: In this study 50 cephalograms were divided into two groups, skeletal class I ($1 \leq ANB \leq 4$) and skeletal class II ($ANB > 4$), with 24 and 26 patients in each group, respectively. Horizontal and vertical position of hyoid bone were evaluated. SPSS software and student t-test were used to analyze the data.
Results: According to the results of our study, there is no statistically significant difference between the hyoid bone position in skeletal class I and skeletal class II patients.
Conclusions: Since the hyoid bone position is similar in skeletal class I and class II patients, the skeletal pattern is not the only determinant of the position of hyoid bone.

Keywords: Cephalometry, Hyoid Bone, Angle Class II Malocclusion, Angle Class I Malocclusion

1. Background

The hyoid bone is a u-shaped (horse shoe shaped) bone, situated on the anterior midline of the neck between symphysis and larynx, suspended from the tip of stylohyoid process of temporal bone by stylohyoid ligaments (1). Unlike the other bones of head and neck, it has no osseous joint and is only distantly articulated to mandible, cranium and pharynx by muscles and ligaments (2). Function of this bone is to maintain equilibrium of respiratory way by serving as anchoring structure for the tongue and also is to keep normal head posture (3-5).

The hyoid bone position could be a good diagnostic guide to malocclusions elicited by destructive oral habits such as atypic deglutition or mouth breathing (6, 7). Changes in the anteroposterior head posture and mandibular inclination can affect the hyoid bone position (3, 8, 9). Treatment with functional appliances that position mandible downward and forward, may also displace the hyoid bone (10-13). Recent orthodontic studies indicate that evaluation of the hyoid bone position may play an important role in assessment of dentofacial structures especially in evaluation of relapse prevention after orthodontic treatment and orthognathic surgeries (14). Furthermore, in several studies, the hyoid bone position and pharyngeal airway space are mentioned in relation. Jose et al, who evaluated this relation in different types of malocclusions, found a positive relationship between lower airway and horizontal distance from the hyoid bone to the retrognathion only in class I skeletal patient with normal growth pattern (15). Guven et al. reported changes in the hyoid bone position and pharyngeal airway space after mandibular body osteoctomy (16). In addition, Parkkinen observed lower hyoid bone position in children with breathing difficulties during sleep. Although several studies reported a positive correlation between the hyoid bone position and mandible (17-19), the other studies concluded that there is no significant correlation between them (7, 20).

2. Objectives

The aim of this study was to evaluate the cephalometric hyoid bone position in patients with skeletal class I and skeletal class II pattern.

3. Methods

Based on sample size in similar studies (21), 24 cephalograms were selected in class I group and 26 cephalograms

for class II group from the archive of dentistry faculty of Hamedan University of medical sciences between "1389-92".

Inclusion criteria was as follows: being Iranian,"neither" adenoidectomy "nor" tonsillectomy history, lack of presence of pharyngeal lesions such as tonsil hypertrophy or tonsilitis, having normal growth pattern (FMA = 22-28) (22), patients in the age group of 9-11 years who didn't attain the age of maturity (in the stage of CS1, CS2 and CS3) (23) and having comfortable nasal breathing. The patients' files were checked for inclusion criteria. Any patient who didn't meet these criteria was excluded. All the cephalograms were taken using the Soredex Digora machine; used in Hamedan dentistry school with standard method in normal head posture and centric occlusion.

Our comparing groups were skeletal class I ($1 \leq$ ANB ≤ 4) and skeletal class II (ANB > 4) malocclusions including 24 and 26 patients, respectively. These two groups were matched regarding the stage of cervical vertebra and sex.

Table 1 shows the frequency of patients in each group.

Horizontal (24) and vertical (25) measurements of the hyoid bone position were conducted according to the previous studies (Figure 1).

All cephalograms were traced manually and 10 cephalograms were randomly selected and traced again after a week to evaluate systematic error.

SPSS 19 software was used for data analysis. Paired t-test was used for estimation of systematic error and independent t-test was used for analysis of difference between two groups' variables. Significance level was considered as $P < 0.05$.

4. Results

Independent t-test, shows no statistically significant difference between two groups of skeletal class I and II malocclusions, considering horizontal dimension measurements. Table 2 illustrates the information related to this evaluation.

Independent t-test, shows no statistically significant difference between two groups of skeletal class I and II malocclusions, considering vertical dimension measurements. Table 3 illustrates the information related to this evaluation. Pearson correlation showed that there was no statistical correlation between ANB and variables.

5. Discussion

The position of the hyoid bone in class I, II and III malocclusions has been evaluated in several studies and various results are achieved (17-22). The position of the hyoid bone is different, not only from an individual to the other one, but also in different time intervals in the same patient (15). Evaluation of the position, shape and function of the hyoid bone seems to be important due to its effect on equilibrium maintenance of surrounding tissues.

In present study, we found no statistically significant difference between class I and II malocclusions, regarding the horizontal and vertical position of hyoid bone. Similar to our study, Carvalho et al. reported no statistically significant difference in the hyoid bone position in class I and II malocclusions and statistically significant difference only was shown with ANS-PNS measurement for the evaluation of vertical position (7). Furthermore, in Jose et al., who evaluated vertical and horizontal position of the hyoid bone in class I, II and III malocclusions using Bibby and Preston analysis (3), no statistically significant difference was found between these three groups (15).

Unlike our study, in the study of Kuroda et al., there was statistically significant difference in hyoid bone position in skeletal class I, II and III patients. The hyoid bone in the class II patients was situated closer to the skull base in comparison with class III patients (17). The controversial results are due to the fact that Kuroda et al. found difference in hyoid position in class II and class III subjects, but in the present study class I and class II subjects are compared.

Adamidis and Spyropoulos evaluated the effect of hypertrophic adenoid tissue on the hyoid bone position in children with mean age of 9 years. The results suggested that more downward inclination of mandible in the mouth breathers as compared to nasal breathers (without hypertrophy of tonsils), can be seen. This study also indicates that the hyoid bone position follows the mandibular posture in the mouth breathing patients and hence, the hyoid bone shows downward inclination, too. The authors said that the reason is indirect effect of craniofacial complex and function of suprahyoid and infrahyoid muscles on the position of hyoid bone (18).

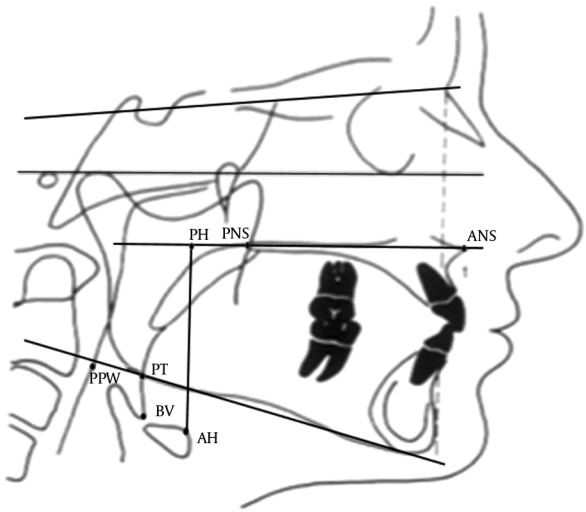
Galvao et al. reported that the hyoid bone is located closer to the rim of mandible in class II patients and is situated farther in class III patients and difference was statistically significant (19). The reason of this finding may be due to investigation of skeletal class II and III patients "not" skeletal class I and II ones.

Haralabakis et al. reported that the distance from the hyoid bone to the palatal plane was found to be statistically greater in the open bite class II group than class I normal patients .They stated that the palatal plane plays a role in the development of skeletal malocclusions, and also the findings strongly suggest that the hyoid bone moves only in close relation with pharynx, cervical spine and mandibular plane in patients with entirely different skeletal pattern. Most of horizontal measurements revealed no

Table 1. Frequency of Males and Females in Each Group

Group	Sex		Total
	Male	Female	
I	8	16	24
II	9	17	26
Total	17	33	50

Figure 1. The Landmarks and Distances Are Shown in the Figure 1



Landmarks: AH, The most anterosuperior point on the body of the hyoid bone; PH, Point of intersection of ANS-PNS and the line perpendicular from anterosuperior point of the body of the hyoid bone to ANS-PNS line; PT, the rearmost point of the tongue contour, formed by a depression which, in radiographic terms, is situated below the mandibular rim, between the 2nd and 3rd cervical vertebra; BV, Posterior point of the base of epiglottis; PPW, Posterior wall of pharynx. Horizontal distances: AH-PPW, Perpendicular line from AH to the posterior wall of pharynx (PPW); BV-PPW, Perpendicular line from BV to PPW; PT-PPW, Perpendicular line from PT to PPW; ANS-PH, Distance between ANS and PH point. Vertical distances: H-SN, Distance from the hyoid bone (the most anterosuperior point of the hyoid bone) perpendicular to SN line along sella turcica; H-FH, Distance from the hyoid bone to the Frankfort plane; H-PP, Distance from the hyoid bone to the palatal plane; H-MP, Distance from the hyoid bone to the mandibular plane.

Table 2. Mean, Standard Deviation and P Value Obtained from Independent t-test for Evaluating Horizontal Position of the Hyoid Bone

Variable	Mean ± SD		P Value
	Class I	Class II	
ANS-PH	59.733 ± 6.0168	58.905 ± 7.8352	0.671
PT-PPW	8.650 ± 3.1763	8.952 ± 3.1061	0.737
BV-PPW	14.817 ± 3.2042	13.905 ± 2.9649	0.308
AH-PPW	26.967 ± 2.4738	25.714 ± 2.2168	0.070

difference in the position of hyoid bone in male and female open bite compared to normal patients (25).

Kollias et al. investigated alterations in craniocervical morphology and the hyoid bone position in different age groups using three series of cephalograms with 10 years interval between each series for each patient (males and females). The mean age of patients was 22 years at the initial evaluation. The results showed that in the males, the descending of the hyoid bone was found to follow a gradual pattern when this bone was related to the sella, Frankfort horizontal plane and the 3rd cervical vertebrae after 20 years and in the female group, statistically significant dif-

Table 3. Mean, Standard Deviation and P-Value Obtained from Independent Test for Evaluating the Variables of Vertical Position of the Hyoid Bone

Variable	Mean ± SD		P Value
	Class I	Class II	
H-SN	87.500 ± 14.6140	85.381 ± 18.1645	0.647
H-FH	72.033 ± 5.3722	71.190 ± 6.0632	0.603
H-PP	51.000 ± 5.2850	51.333 ± 9.1013	0.870
H-MP	11.967 ± 4.9234	10.214 ± 4.5403	0.203

ference was observed only in the horizontal position of the hyoid bone after three series of cephalometric evaluation relative to T0 (26). In the present study all of the patients were in the same age group (9-11 years), therefore it does not seem that the age of patients in two groups would affect the hyoid bone position.

Valenzuela et al. didn't find any statistically significant difference between anteroposterior head posture and the hyoid bone (27). Smith et al. suggested that the hyoid bone position varies with change in the posture from upright to supine due to change in larynx posture and reduction in oropharyngeal airway (28). Since in the present study the cephalograms were taken in natural head position, no difference is expected in the position of hyoid bone due to change in postures.

The results of our study suggest that horizontal and vertical dimensions of the hyoid bone position have no significant difference in skeletal class I and class II patients. Some studies suggest that compensating function of surrounding muscles and soft tissues might result in similarity of the hyoid bone position in different skeletal groups (29).

5.1. Conclusion

Hyoid bone position is not significantly different in skeletal class I and class II patients.Some compensational mechanisms in surrounding structures of dentofacial complex may be responsible for maintaining the position of hyoid bone, despite the difference in the position of maxilla and mandible in skeletal class I and class II subjects.

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