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Assessment of Hyoid bone position in different anteroposterior skeletal relationships: A Cross Sectional study

Amna Saeed[a], Faisal Farid[b], Sohrab Shaheed[c], Nasir Mushtaq[d]

Abstract

Introduction: Hyoid bone plays an important role in vital biological functions such as deglutition, breathing and phonation. The relative head and neck position is established by this unique anatomical landmark**.** The purpose of this study was to assess the position of hyoid bone in different anteroposterior jaw relationships (Class-I / Class-II/ Class III) in patients presenting to orthodontics department of Rehman College of dentistry.

Material and Methods: A total of 50 lateral cephalograms of patients were randomly selected from patient's records of department. Measurements were taken on software IC Measure version 1.3. After importing the radiographs, the images were digitized on five points for linear and angular measurements. The main outcome measure was the "hyoid bone position in anteroposterior and vertical dimensions" in 3 skeletal classes. The relationship between the variables was assessed by one- way ANOVA test.

Results: Patients in class II had significantly higher mean distance of L1(H-MP) than patients in class III. Moreover, the mean distance L2(H-PP) in class I and III was greater compared to class II. The mean distance L3(H-C3) was greatest in group III ($P < 0.05$). Males had a larger distance L1 (H-MP), ($P < 0.05$) than females. Angular measurements of hyoid bone were not significant among the three classes.

Conclusions: More posterior position of hyoid bone was found in class II, as shown by the smallest horizontal distance (H-C3). The hyoid bone is positioned more superiorly and posteriorly in females compared to males.

Keywords: Hyoid bone; lateral cephalogram; skeletal pattern

Introduction

Orthodontic treatment planning help us to quantify skeletal , dental and soft tissues relations of dentofacial complex.[1] It has been made easier with cephalometric radiography to assess the proportions of soft palate and pharynx, position of hyoid bone and tongue and cranio-cervical angulations.[2-3] Generally, when considering the cranio-cervical skeleton, the hyoid bone is mostly neglected.[4-5] Nevertheless, the relative head and neck position is established by this unique anatomical landmark.[6] It is a U shaped bone, situated in the anterior part of neck. This bone also gives attachment to some important muscles of the floor of the mouth and tongue which depends on hyoid bone for their functions.[2]

The hyoid bone ensures that the head is in correct position while standing by adjusting the strain of the muscles of occipital condyle.[7] It also plays a crucial role in some important biological functions i.e. deglutition, breathing and phonation.[8]

[a] Corresponding Author. BDS; Resident, Department of orthodontics, Rehman College of Dentistry, Peshawar, Pakistan. Email: amna.saeed@rmi.edu.pk

[b] BDS; Resident, Department of orthodontics, Rehman College of Dentistry, Peshawar, Pakistan.

[C] BDS, FCPS, MOrth RCS, FFD RCSI; Professor, Head Department of Orthodontics, Rehman College of Dentistry, Peshawar, Pakistan.

[d] BDS, FCPS; Professor, Department of Orthodontics, Rehman College of Dentistry, Peshawar, Pakistan.

Few articles have reported relationship of hyoid bone with anteroposterior skeletal pattern. A.Tallgren and B.Solow described that the distance between hyoid and mandible is large due to the large curvature of mandible.[9] On the contrary, Haralabakis et al's findings suggested that there is no direct correlation in distance between hyoid bone and mandibular plane when comparing open bite subjects with controls.[6] However, in a study reported by P.Adamidis, position of hyoid bone was significant between class I and class III skeletal malocclusions, more anterior position of hyoid bone was found in Class III group.[10]

Most of the studies in past on hyoid bone position in various skeletal dentofacial patterns are conducted in different populations and they reported conflicting results. Little data exists in our population till now. Therefore, using same variables for hyoid bone position, this study will provide data in different skeletal malocclusions in our population.

Therefore, the aim of this study was to assess the position of hyoid bone in different antero-posterior skeletal malocclusions and gender difference in hyoid bone position were also evaluated.

Material and Methods

This study was conducted in the Department of Orthodontics at Rehman College of Dentistry. Ethical approval to inspect the data of patients was obtained (EC Ref 2021-02-056). A total of fifty lateral cephalograms for subjects consisting 30 females and 20 males with ages of >18 years, mean age 22 years) were randomly selected from a pool of six hundred radiographs. Inclusion criteria were lateral cephalograms with reasonable clarity and contrast of patients in centric occlusion and Frankfort horizontal plane parallel to natural head posture. Patients with skeletal malocclusion I, II, III were taken for the study. Subjects who had previously gone through orthodontic treatment or patients with trauma to the mandible, orthognathic surgery and craniofacial abnormalities were kept out from the study.

Lateral cephalograms of 50 patients (30 females and 20 males) with average age of 25 years (Range 18-35, SD 5 years) were chosen for this study. Records of patients were categorized in to group I, group II and group III according to their skeletal malocclusions. Group I included 25 skeletal class I patients (14 females, 6 males), group II included 20 skeletal class II patients (13 females 11 males) while group III included 5 skeletal class III patients (3 females, 2 males).

The measurements were directly taken on lateral cephalogram, according to the technique outlined by Mortazavi Set al[7] using software IC Measure 1.3. All the radiographs were imported into software and analyzed. The skeletal anteroposterior relations of the subjects were classified into three groups according to ANB angle. Class I was considered when ANB was between (0.5-4°), Class II, when ANB was (> 4°), and class III when ANB was (< 0.5°).[7]

A total of 5 variables (3 linear and 2 angular) were measured on the lateral cephalograms. The definitions of the different parameters, landmarks and planes of reference taken on lateral cephalogram, are given in Table I and shown in Fig 1.

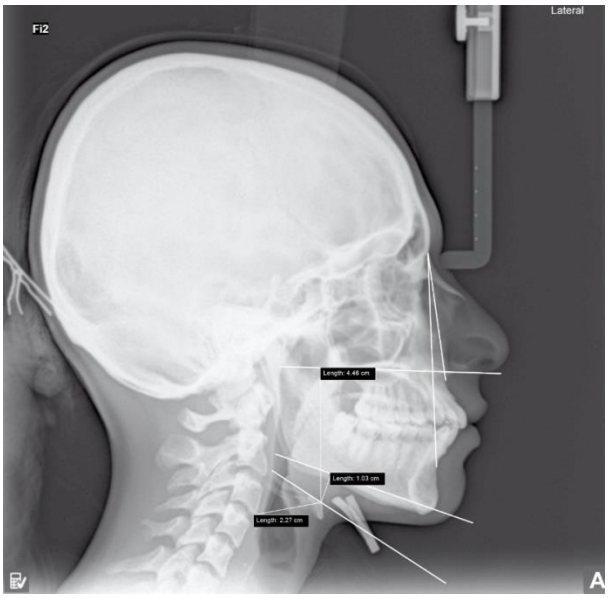

Figure 1: Showing points and reference planes for hyoid bone

Table I: Definitions of hyoid bone variables taken on lateral cephalogram

C3	The point at the most inferior anterior position on the third cervical vertebra
Hyoidale (H)	The most superior, anterior point on the body of the hyoid Bone
Retrognation (RGn)	The most posterior point of the mandibular symphysis
N-A	Line extending between nasion and Point A
N-B	Line extending between nasion and Point B
Palatal plane (PP)	The line from ANS to PNS
Mandibular plane (MP)	The tangent line to the lower border of mandible
Long axis of hyoid bone (LAH)	Parallel line with placement of hyoid bone

Table II: Mean , Standard Deviation and Range for Hyoid bone Parameters.

Variables	Class I			Class II			Class III		
	Means (mm)	Standard Deviation (mm)	Range (mm)	Means (mm)	Standard Deviation (mm)	Range (mm)	Means (mm)	Standard Deviation (mm)	Range (mm)
L1	9.07	3.28	14.0-16.0	10.68	2.93	10.0-11.5	6.18	0.57	1.4-1.7
L2	41.07	4.12	16.0-19.0	37.49	7.39	28.6-32.6	25.70	9.15	22.0-24.0
L3	22.10	3.36	34.3-38.0	15.25	8.19	28.6-30.0	37.03	9.93	25.7-28.3
A1	13.05	8.09	28.9-32.3	14.29	8.06	17.0-19.0	14.29	5.86	25.4-27.6
A2	19.10	15.74	44.5-47.7	18.65	11.67	41.5-43.0	19.55	3.71	10.9-11.9

Table III: Mean differences between different skeletal anteroposterior Hyoid bone Parameters

P-value less than 0.05 (typically ≤ 0.05) is statistically significant.

MS Parameters	Difference Class I to Class II (mm)	P-value	Difference Class I to Class III (mm)	P-value	Difference Class II to Class III (mm)	P-value
L1	-1.57	0.09	2.88	0.09	4.45	0.07*
L2	3.58	0.15	15.36	0.00*	11.79	0.00*
L3	-1.15	0.85	-14.93	0.00*	-13.78	0.00*
A1	-0.53	0.97	-1.27	0.93	-0.73	0.98
A2	0.45	0.10	-0.45	0.99	-0.90	0.98

Table IV: Gender differences in hyoid bone position along with means and SD.

MS Parameters	Males Mean ± SD (mm)	Females Mean ± SD (mm)	Difference	P-value
L1	10.16± 3.1	8.06 ± 3.0	2.1	0.02*
L2	39.95 ± 8.97	33.95 ± 6.81	2.2	0.31
L3	26.48 ± 10.1	24.23 ± 7.93	0.2	0.92
A1	12.56 ± 7.29	11.84 ± 8.10	3.7	0.10
A2	20.08 ± 3.08	13.78 ± 12.89	6.2	0.58

Data were entered and analyzed using software SPSS 20 (IBM Corp, Chicago). One-way ANOVA test was applied to calculate the relationship between variables with a post hoc Tukey's HSD test. Reliability was checked with Pearson's Correlation Co-efficient. A p-value less than 0.05 (typically ≤ 0.05) is statistically significant.

Results

Means and SD for Hyoid bone variables for the three anteroposterior classes are given in Table II. Hyoid bone variables among group I, II and III and their mean differences are given in Table III.

The angle A1, representing (LAH-MP) and angle A2, showing (LAH-PP), did not show significant differences among three AP groups.

All linear measurements i.e. L1(H-MP), L2(H-PP) and L3(H-C3), showed significant differences among each other.

Patients in group II had significantly higher mean distance of L1(H-MP) than patients ingroup III. Moreover, the mean distance L2(H-PP) in group I and III was greater as compared to group II. The mean distance L3 (H-C3) was greatest in group III (P value less than 0.05).

Differences between males and females for the hyoid bone parameters are given in Table IV. Males had a larger distance L1 (H-MP), (P <0.05) than females. All other linear and angular measurements were not significant (P value greater than 0.05).

Discussion

This study was conducted to assess position of hyoid bone in different antero-posterior skeletal malocclusions. The hyoid bone, unlike any other bone, does not consist of any joints with other bones[11] due to which its position is also influenced by changes in body posture and other physiological functions such as breathing and deglutition.[12-13]

Most of the studies done on this subject have shown that the hyoid bone is positioned differently in different skeletal malocclusions. These researches have shown that the hyoid bone changes its position with respect to changes in the position of mandible head posture.[6,10,14]

Additionally, previous literature have established a direct relation between hyoid bone position and airway dimensions, therefore, consideration must be given to this before any orthognathic surgery.[10, 15-16]

More females in our sample may be due to the fact that females are more conscious for their esthetics and seek orthodontic treatment in greater percentage.[17-19] There were more class I and class II patients than class III patients as the prevalence of this malocclusion is low in our population.[20-22]

The outcomes of the current study displayed that L1 (H-MP) was the smallest in group I and greatest in group III. It was also noticed that H-PP was highest in group II and lowest in group I subjects which was statistically significant. Abu Alhaija et al[23] determined that hyoid bone is placed notably nearer to the mandible in class II subjects than class I and III which is in gross contrast to our findings.[7]In our study, H-C3 was the smallest in group II and the greatest ingroup I subjects. This may be due to the fact that position of hyoid bone is more anterior in group 1 subjects. In our investigation, the hyoid bone distance from C3 in group III was greater in group III than group I and II. This finding was in accordance with findings of Abu Alhaija et al[23], who concluded that the distance of hyoid bone with third cervical vertebra was smaller in group II subjects than group I and III skeletal groups. However, Jose et al[8] reported conflicting results to our study in which all the three AP skeletal groups showed there were no significant differences. Tekale also concluded in his study that distance H-C3 was smaller on group II skeletal patients.[14] This is also in agreement with our results where, H point was closer to C3in group II patients.

The angular measurements (A1, A2 and A3) showed no statistical differences between three AP skeletal groups, this finding is coincident with a study done by Chauhan et al. who also found no statistically significant differences in angular measurements between class I and class II patients.[8,24-25]

As for as hyoid bone position in males and females is concerned, except L1, all other measurements in linear and angular dimensions were not statistically significant. In the current investigation, we found that the distance of hyoid bone to the craniofacial structures was smaller in females than males. This may be due to fact that females are physically smaller than males.[15] Lateral cephalograms only demonstrate2D visualization of 3D structures, therefore in long term studies, consideration should be given to CBCT that is a 3D representation and provides accurate images in all the three planes.

In our study, the sample size was small. Sample distribution was not equal among groups, there were more patients in class I and II than class III and there were more females than males. In long term studies larger and well distributed sample size is required to assess the hyoid bone position in different anteroposterior skeletal relationships

Conclusions

1. The hyoid bone is positioned inferior in males compared to females where it is situated more superiorly and posteriorly.
2. The hyoid bone is located differently among three AP skeletal groups. The horizontal distance (H-C3) was smallest

ingroup II subjects than class I and III, showing more posterior position of this bone in Class II.

3. No significant differences in angular measurements, depicting the position of hyoid bone was found among three AP skeletal groups, however significant differences were found in the linear measurements.

Conflict of Interest:
There is no conflict of interest to report.

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