Original Article

International Journal of Dental and Health Sciences
Volume 01,Issue 05

POSITION OF HYOID BONE AND ITS RELATIONSHIP WITH VERTICAL FACIAL DIMENSIONS

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ABSTRACT:

OBJECTIVE: To test the hypothesis that there is no difference in the position of hyoid bone in subjects with different vertical facial dimentions.

MATERIAL AND METHOD: Seventy Pakistani adult male and female subjects in the age range of 15 to 25 years were selected for this study. Based on the vertical growth pattern of the face, subjects were divided into Group I (n = 20 subjects in whom Frankfort mandibular plane angle [FMA] measured 20 to 25 degrees), Group II (n = 20; subjects in whom FMA angle measured 15 > degrees), and Group III (n = 30; subjects in whom FMA angle measured > 30 degrees). Lateral cephalograms(as part of routine investigation) with the mandible in rest position were traced and analyzed manually for evaluation of hyoid bone position.

RESULTS: The anteroposterior position of the hyoid bone was significantly forward in subjects with short face syndrome compared with normal subjects and subjects with long face syndrome.

The vertical position of the hyoid bone was comparable among subjects with different vertical jaw dysplasias. The axial inclination of the hyoid bone was more oblique in subjects with long face syndrome than in those with short face syndrome .

Key words: hyoid bone,vertical jaw dysplasias.

INTRODUCTION:

The hyoid is a single bone located symmetrically in the midline below the mandible, at the centre of the neck. Due to its attachments, it is tied to the base of the skull, to the mandible, to the tongue, to the larynx, and to the scapular belt, the hyoid bone is closely related to a complex tendino-muscular complex. From this important position, the hyoid bone participates in all functional and nutritional activities of the head and neck complex. Greatly involved in the physiology of the pharyngeal column, it plays an important role in the process of ontogenic development being remarkably stable. The position of the tongue effects the position of hyoid bone thus effecting the pharyngeal airway [1-2]. Narrowing of the pharyngeal air space might be a cause in obstructive sleep apnea [3].the precise relationship between hyoid bone and vertical growth pattern in not known as yet. Opdebeeck and associates considered long face and short face individuals and

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compared the position of hyoid pone and noted its movement with respect to mandible, tonge, pharynx , and cervical spine [4].

Erdinc AM, Dincer B, Sabah ME also evaluated the position of hyoid bone with regard to vertical face heights. Ashok Kumar Jena, Ritu Duggal conducted similar study on Indian population. Thus, the position of pharyngeal passage can be indicated by the position of hyoid bone and tongue. So it is of importance to determine the relationship of hyoid bone position with different vertical jaw bone dysplasias.[1]

MATERIAL AND METHODS:

Subjects of this study were selected from patients who attented daily opd, Department of Orthodontics, Dr Ishrat ul ebad institute of oral health sciences, Dow university. A total of 70 Pakistani adult male and female patients in the age range of 15 to 25 years were selected . The type of molar relationship and the sagittal jaw relationship were not considered when subjects were selected for the study. History of orthodontic treatment, anomalies of cervical vertebra, anterior or posteriocross bite, mouth breathing , tongue thrusting were given as exclusion criteria.All the subjects were divided into three groups on the basis of Frankfurt mandibular plane angle,(FMA).Group 1 included 20 subjects whose FMA angle measured 20 to 25 degrees, group 2 included 20 subjects whose FMA angle measured < 15 degrees, and group 3 included 30 subjects whose FMA angle measured > 30 degrees.

After subjects had been selected for the study, they were advised lateral cephalogram (as part of routine orthodontic investigation) that was used for evaluation of hyoid bone position. subjects were guided to stand still with the mandible in relaxed position to ensure that no strain or change in head posture occurred, during exposure of final cephalograms. The head was fixed in the cephalostat. Subjects were especially advised not to swallow during exposure of the radiograph. Similar exposure paramiters and same cephalostat was used for the exposure of all the radiographs.

Some cephalometric landmarks and reference planes were used to evaluate hyopid bone position, fig 1 .2

For evaluation of vertical and the anterioposterior positions of the hyoid bone Sella perpendicular (Sper) and PTR perpendicular (PTRper) planes were used as vertical reference planes, and the C3C horizontal (C3Chor) plane was used as the horizontal reference plane, respecively. The perpendicular distances from H-point to PTRper plane (H-PTRper distance) and from H-point to Sper plane (H-Sper distance) were used to evaluate the anteroposterior position of hyoid bone, whereas the perpendicular distances from Hpoint to C3Chor plane (H-C3Chor distance) and from G-point to C3Chor plane (G-C3Chor distance) were used to evaluate the vertical position of the hyoid bone. The angle between H-axis and PTRper plane (Haxis-PTRper angle) and the angle between hyoid axis and C3C horizontal plane (Haxis-C3Chor angle) were considered as angular parameters for evaluating the axial inclination of hyoid bone. All linear and angular parameters are shown in Figure 2. All cephalograms were traced and analyzed manually by the first investigator. All parameters were measured thrice, and the mean was considered for statistical analysis.

STATISTICAL METHOD:

Statistical Package for the Social Sciences (SPSS) software, 16 was used to analyse data. Data were subjected to descriptive analysis for mean, range, and standard deviation of all variables. One-way ANOVA was used for analysis of variance, and a post hoc test (Bonferroni) was used for multiple comparisons. $P < .01$ was considered the level of statistical significance.

RESULTS:

The anteroposterior position of the hyoid bone was evaluated from the H-PTRper distance and the H-Sper distance. When the position of the H-point was anterior to the PTRper and Sper planes, values for the perpendicular distances were considered as positive; values were considered as negative when the the position of the H-point was posterior to the reference planes.

The mean of all the parameters amongst the three groups of subjects were statistically highly significant ($P < .01$).The anterioposterior position of hyoid bone was significantly different among subjects with different vertical jaw dysplasias. mean H-PTRper distance of group 1 and 2 is significant when compared with group three, mean H-sper distance is signicant for all the groups in intergroup comparison.

The vertical position of the hyoid bone was determined from H-C_3Chor and G-C_3Chor distances. When the positions of the H-point and the G-point were superior to the C_3C horizontal plane, values for the HC $_3$Chor and G-C_3Chor distances were considered as positive; when the positions of the H-point and the G point were inferior to the C3C horizontal plane, values for the H-C3Chor and G-C3Chor distance were considered as negative. The mean H-C_3Chor and G-C_3Chor distance was least in group three. the intergroup comparison shoes significant difference in all the three groups. Thus the present study proves that the vertical nature of the subject effects the position of hyoid bone.

The axial inclination of the hyoid bone was determined from the Haxis-PTRper angle and the Haxis- C_3Chor angle. With clockwise axial inclination of the hyoid bone, the values for these angles were considered as positive; the values for these angles were considered as negative when anticlockwise axial inclination of the hyoid bone was evident.

The mean Haxis- PTRper angle and Haxis-C3Chor angle among subjectsin the three groups were high and were statistically significant (P <0.01), Haxis- PTRper angle and Haxis-C_3Chor angle mean values were significant when group 1 was compared with 2 and 2 was compared with 3,while it was not significant otherwise. Thus the present study showed that the axial inclination of the hyoid bone was different in subjects with different vertical growth patterns of the face.

DISCUSSION:

The position of the hyoid bone was most anterior in the subjects with a long face, the hyoid bone follow rotation of chin. When the mandible was rotated in an upward and forward direction,the suprahyoid muscles pulled the hyoid bone to move into a more anterior position, and when the mandible was rotated in a downward and backward direction, the hyoid bone tended to move posteriorly. Haralabakis, Toutountzakis, and Yiagtzis also found no difference in anteroposterior position of the hyoid bone in adult individuals with anterior open bite compared with individuals with normal bite when its position was evaluated from near reference structures like the cervical spine, pharynx, and mandibular plane. Unlike a previous study by Opdebeeck [4] et al,the present study showed significant difference in the dimentions of hyoid bone with regard to vertical dysplasia . The vertical position of the hyoid bone in subjects with short face syndrome was slightly upward compared with that in subjects with long face syndrome and those with normal anterior face height. This could be the result of pull from the suprahyoid muscles, which occurred as the mandible was rotated in an upward and forward direction. In subjects with long face mandible is rotated downwards and backwards, causing slightly downward positioning of the hyoid bone. In subjects with enlarged tonsils, a more caudal position of hyoid bone was observed. The axial inclination of the hyoid bone was evaluated in relation to both vertical (PTRper) and horizontal (C3C horizontal) reference planes. In subjects with short face syndrome, the axial position of the hyoid bone was more horizontal, whereas in those with long face syndrome, the axial position of the hyoid bone was more oblique. Opdebeeck et al [4] observed rotation of the mandible in concert with rotation of the hyoid bone. According to Opdebeeck et al [4] a significantly large SN:hyoid plane angle was found in subjects with a high FMA with no significant difference between mandibular plane and hyoid plane angle. Thus the hyoid bone was involved in overall rotational movement of the movable parts of the craniofacial complex The more oblique axial position of the hyoid bone in subjects with high FMA and the more horizontal position of the hyoid bone in subjects with low FMA could be due to differences in tongue position. In subjects with counterclockwise rotation of the mandible, tongue position was posterior and superior against the palate, whereas in subjects with moderate clockwise rotation of the mandible, the tongue was positioned anteriorly, with the base of the tongue higher than normal at the level of the incisal edge; in extreme clockwise rotation of the mandible, the tongue was slightly retruded, with a very high tongue root position and with the tongue tip down in the mandible.[4] In subjects with high FMA, the cross section of the lower pharynx was reduced and the hyoid bone was closer to the cervical spine.[5-7]

Encroachment of the vital pharyngeal space induced stretching of the cervical spine and hyperextension of the head. Thus the stretched cervical spine pulled the pharynx and the hyoid bone posteriorly and superiorly, while the tongue was rotated in the same direction, resulting in altered tongue position. Many previous studies reported a close association between inclination of the hyoid bone and mandibular inclination. Thus the present study assumes that the pharyngeal airway passage would be more sufficient in subjects with short face syndrome than in those with long face syndrome. A mandibular setback procedure in subjects with long face syndrome could result in further narrowing of the pharyngeal airway passage and would lead to postsurgical obstructive sleep apnea.

However, further study is required to evaluate the direct association between pharyngeal airway space and different vertical jaw dysplasias.

CONCLUSION:

The position of the hyoid bone in subjects with short face syndrome was more anterior than in subjects with long face syndrome.The vertical position of the hyoid bone was comparable among subjects with different vertical jaw dysplasias.

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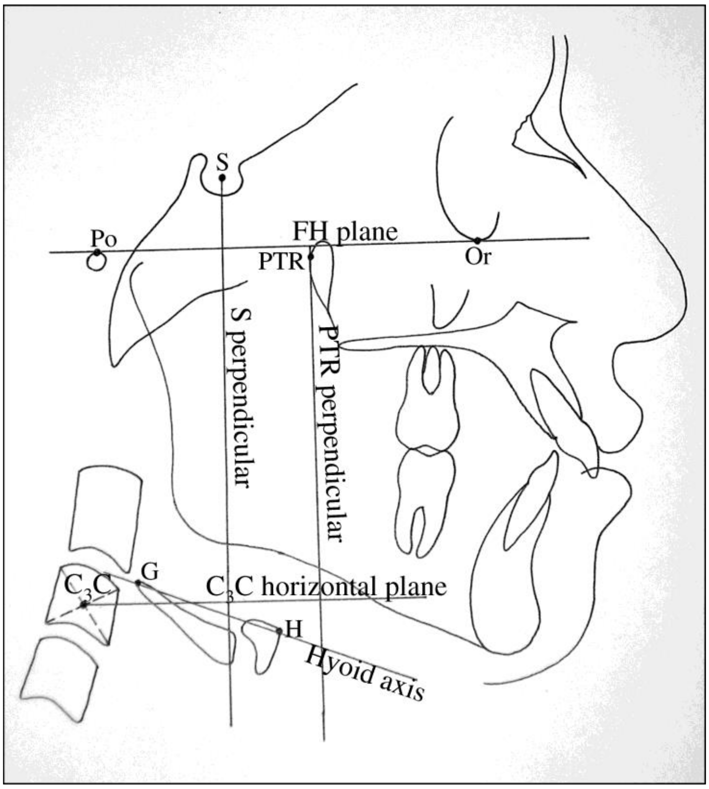
FIGURES:

FIGURE 1:



Sella (S): Geometric center of the pituitary fossa located by visual inspection.
Orbitale (Or): The lowest point on the inferior rim of the orbit.
Porion (Po): The most superiorly positioned point of the external auditory meatus.
Pterygoid vertical reference, (PTR): The most posterior point on the distal radiographic outline of the pterygomaxillary fissure.
Center of third cervical vertebra (C3C): The intersection point of diagonal lines drawn between the anteroinferior and posterosuperior corners and between the anterosuperior and posteroinferior corners of the third cervical vertebra.
Hyoidale (H): The most superior anterior point on the body of the hyoid bone.
G-point (G): The most posterior point of the greater horn of the hyoid bone.
Cephalometric reference planes, used for the evaluation of hyoid bone position.
Frankfort horizontal plane (FH-plane): The horizontal plane that joins Po and Or.
Sella perpendicular (Sper) : The perpendicular line drawn on the FH-plane at S.
PTR perpendicular (PTRper): The perpendicular plane drawn on the FH-plane at PTR.
C3C horizontal (C3Chor): The horizontal plane perpendicular to the Sper at C3C. Hyoid axis (Haxis): The line that connects points H and G.

FIGURE 2:

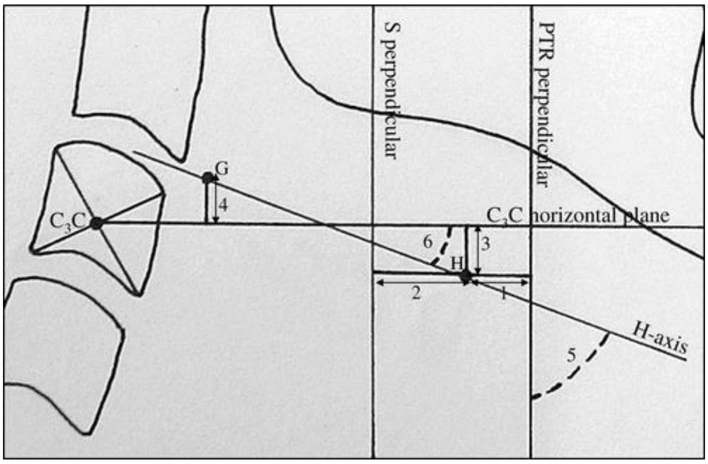


Figure 2. Linear and angular parameters used for the evaluation of hyoid bone position. 1: H-PTRper distance; 2: H-Sper distances; 3: H-C3Chor distance; 4: G-C3Chor distance; 5: Haxis-PTRper angle; and 6: Haxis-C3Chor angle.

TABLES:

PARAMETERS	GROUP 1		GROUP 2		GROUP 3		P VALUE	INTERGROUP COMPARISON		
	MEAN	S.D	MEAN	S.D	MEAN	S.D		1 VS 2	1 VS 3	2 VS 3
H-PTRper distance, mm	-3.14	-1.27	3.49	0.72	-5.58	-0.98	0.00	.863	.000	.000
H-Sper distance, mm	13.35	1.63	20.19	2.09	11.03	2.25	0.00	.000	.001	.000
H-C3Chor distance, mm	-17.72	-0.91	-13.9	-1.52	-15.9	-1.19	0.00	.000s	.000	.000
G-C3Chor distance, mm	-5.54	-0.98	-5.55	-0.65	-2.93	-0.92	0.00	1.00	.000	.000
Haxis-PTRper angle, degrees	67.95	1.48	71.86	2.77	66.74	2.93	0.00	.000	.320	.000
Haxis-C3Chor angle, degrees	20.93	1.69	13.63	2.97	20.46	2.18	0.00	.000	1.00	.000