Hyoid bone position in relation to facial growth pattern in class III malocclusion

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Abstract

Aim: Hyoid and its attached muscles involved in three basic functions: deglutition, phonation, respiration and control of pharyngeal spaces. The aim of this study was to evaluate hyoid bone position in relation to facial growth pattern in class III malocclusion.

Material and Methods: This was a retrospective descriptive analytical study, performed on lateral cephalograms of fifty patients with class III malocclusion with prognathic profile. Cephalograms were classified to three facial growth pattern groups so each group comprised of minimum 15 samples. T-test and ANOVA were used to compare the difference of mean value of growth pattern groups. $P< 0.05$ was considered as the level of significance.

Results: The difference between means of ANB angle (0.78 degree) were significant ($P=0.027$) in three facial growth pattern groups. The indices determining the growth pattern were significantly different in three facial growth pattern groups ($P<0.001$). The findings showed a significant difference in H-RGN between three facial growth pattern groups and also showed no significant difference in H-Pal P, H-SN, H-Mand P, H-C3 between three growth pattern groups.

Conclusion: The anteroposterior position of hyoid bone related to cervical column was not affected by facial growth pattern. But its antroposterior position related to mandible was affected by facial growth pattern. There were significant differences between hyoid bone position in three facial growth patterns. Vertical position of hyoid bone was not affected by facial growth pattern.

Keyword: Hyoid, Growth Pattern, Class III Malocclusion

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Hyoid bone, in contrast to other cranio-cervical bones, has no articulation and is attached by muscles and ligaments to mandible, cranium and pharynx. Hyoid position during growth and development is important. Higher position of this bone in human in relation to other mammalians controls exact tongue movements during speech and swallowing more precisely.[1]

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Changes in hyoid bone position have some influences on positions of related apparatus, so vertical changes of this bone alter position of mandible and its horizontal changes alter cervical column inclination.[2]

Hyoid bone is also affected by mandibular position.[3,4] The question is that: can facial growth pattern affect Hyoid bone or can hyoid position rotate mandible and produce long or short faces? Haralabakis et al. compared hyoid bone position in 39 long face patients with 43 class I malocclusion patients and concluded that hyoid bone distance to palatal plan was significantly longer in long face group than normal group but horizontal position of this bone in open bite patients was the same as normal occlusion patients.[5]

Erdine et al. evaluated hyoid bone position in 75 patients in three facial growth patterns (25 patients in each growth pattern) and concluded

that only distance of hyoid bone to Pog in normal growth pattern was different significantly from hypodivergent facial growth pattern and hyoid bone had more superior - posterior position in hyperdivergent group.[6] Pea et al. compared hyoid bone position of three facial growth patterns in 163 patients of 30-67 year old (mean 45.9 year old) but there was no significant relationship between position of hyoid bone and facial growth pattern except for H-RGN which was different significantly in three groups. They found a negative and weak correlation between H-RGN and FMA, such the hyoid bone distance to mandibular symphis increased when FMA decreased. [7]

Aim of this study was to evaluate hyoid bone position in class III malocclusion patients with different facial growth pattern.

Materials and Methods

This study was a cross-sectional retrospective descriptive analytical study. Lateral cephalometric radiographs of 50 patients with class III malocclusion (ANB ≤1, wits ≤0) were chosen and evaluated. Minimum age was 14 for females and 16 for males. Sharpness of hyoid bone in radiographs and prognatic profile were considered in selecting radiographs. Cephalometric radiographs divided to three facial growth pattern consideing FMA, GoGn-SN angle and Jarabak index. (Table 1)

Table 1: Cephalometric measurements to determine facial growth pattern.

Measurements	Horizontal	Vertical	Normal
Go Gn-SN	30 or <	34° or >	32
FMA	23 or <	27 or >	25
Jaraback index	65% or >	62%or <	62-65%

There were 18 patients in normal, 16 patients in horizontal and 16 patients in vertical growth pattern groups. Then cephalometric landmarks of hyoid bone were evaluated. All radiographs were prepared in one clinic by X-ray apparatus 2002- PM (EC model) and Kodak film with a standard manner (teeth in occlusion, lips in rest and patient in natural head position). Cephalometric radiographs traced based on these landmark and measurements (Fig 1):

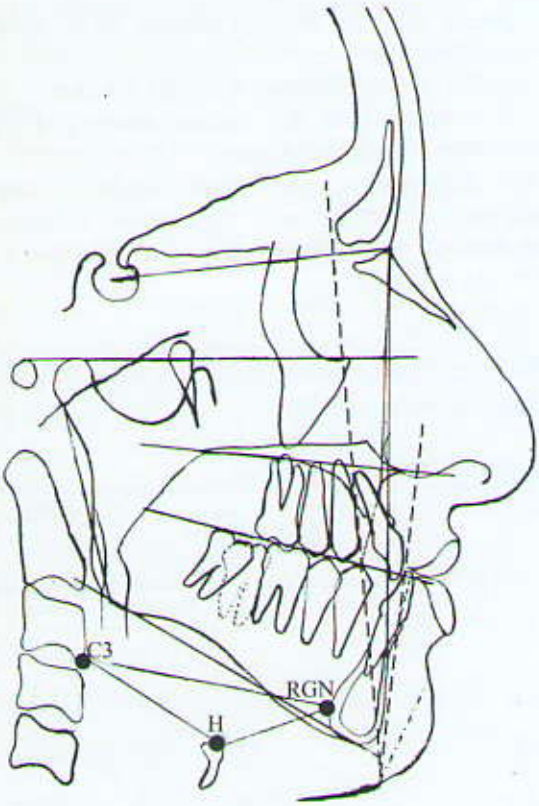

Fig 1: Tracing of a patient.

* Landmarks for determining hyoid bone position. [8,9]

C3: Most anterior- inferior point on body of 3rd cervical vertebra.

H (Hyoid): Most anterior- superior point on body of hyoid bone.

RGN (Retrognation): Most posterior point on posterior border of mandibular symphysis.

* Lines for determining hyoid bone position:8, 9

C3- RGN: The shortest distance of C3 from RGN points.
H-C3-RGN: perpendicular distance of H point to direct line between C3 and RGN points which displays vertical position of hyoid bone.
C3-H: The shortest distance of C3 from H point which refers to horizontal position of hyoid bone.
H-SN: The shortest distance between H point and SN plan.
H-RGN: The shortest distance of H and RGN points which displays horizontal position of hyoid bone.
H- palatal plan: the shortest distance of H point from palatal plan.
H-S: The shortest distance of H and S points.
H- Mandibular plan: the shortest distance of H point from mandibular plan.
After dataaathering, they were numbered and analyzed by SPSS and differences between variables of three groups were analyzed by t-Test and ANOVA.

Results

Based on Table 2, means of wits' appraisal in horizontal growth pattern (HGP) vertical growth pattern (VGP) and normal growth pattern (NGP) groups were -5.87mm, -7.62mm, -6.94mm respectively and -6.82mm in total. Their differences were not statistically significant (P=0.559).
Mean of ANB angle in HGP, VGP and NGP groups were -1.50, 0.68, -1.44 respectively and 0.78 in total. The differences were statistically significant in three groups (p=0.05)
Differences between means of variables which determine facial growth pattern such as FMA, GoGn- SN angle and Jaraback's index (Table 2) in three groups were statistically significant (P<0.001).

Table 2: Mean and standard deviation of variables to determine anteroposterior malocclusion and facial growth pattern.

Variables	Vertical			Normal			Horizontal			P.value
	Mean	SD	Number	Mean	SD	Number	Mean	SD	Number	
ANB	0.68	2.72	16	-1.44	2.68	18	-1.50	2.16	16	0.050
Wits	-7.62	5.73	16	-6.94	3.52	18	-5.87	4.41	16	0.559
FMA	32.76	4.10	16	26.47	3.50	18	21.56	3.07	16	0.000
GoGn-SN	41.62	3.66	16	34.88	1.87	18	29	3.68	16	0.000
Jarabak index	59.13	1.99	16	63.02	2.00	18	68.87	2.55	16	0.000

Means of variables which determine hyoid bone position presented in Table 3 and Table 4. Based on Table 3 differences between means of H-RGN in three groups were statistically significant (P=0.019) and based on Table 4 difference of H-RGN mean in NGP compare to VGP was statistically significant (P=0.016) but this difference between NGP and HGP (P=0.714) and also between HGP and VGP (P=0.296) was not.

Differences of H-C3, C3-RGN and H-palatal plan and H-SN and H-Manibular plan were not statistically significant between three groups. P values were 0.883, 0.218, 0.876, 0.492, 0.557 and 0.148 respectively (Table 3) and also were not statistically significant in comparing any two groups (Table 4).

Table 3: Mean and standard deviation of measurement to determine hyoid bone position and p.value to compare three facial growth patterns.

Variables	Vertical			Normal			Horizontal			P.value
	Mean	SD	Number	Mean	SD	Number	Mean	SD	Number	
H-RGN	39.12	6.29	16	45.77	6.79	18	43.06	6.71	16	0.019
H-C3	36.93	4.04	16	37.77	4.39	18	37.00	5.13	16	0.833
C3-RGN	5.31	4.17	16	7.50	5.06	18	5.12	3.66	16	0.218
H-Pal.P	65.25	7.34	16	63.77	9.42	18	64.37	7.94	16	0.876
H-SN	110.68	10.87	16	108.30	11.32	18	108.00	5.4	16	0.492
H-S	109.75	10.71	16	105.79	11.69	18	107.94	8.91	16	0.557
H-Mand.P	14.75	3.85	16	17.17	7.92	18	13.12	4.91	16	0.148

Table 4: P value to compare any of the two groups

Measurement Variable	H-RGN	H-C3	C3-RGN	H-PP	H-SN	H-S	H-MP
NGP & VGP	0.016*	1	0.457	1	0.719	0.849	0.726
NGP & HGP	0.714	1	0.363	1	1	1	0.761
HGP & VGP	0.296	1	1	1	1	1	1

Discussion and Conclusion

Position of hyoid bone is different in skeletal class I, class II, class III malocclusions. [10, 11] Hyoid bone moves down after birth which continues to pubertal growth spurt and become stable after that. [12,13] In this study, mean age was 16.98 and age ranges were 14-20 years in females and 16-25 years in males. Samples were in the same growth period and hyoid bone was in a constant position.

Wits and ANB were used to determine malocclusion of the samples, mean of Wits' appraisal was -6.8mm in total and -5.8, -7.62, -6.9mm in HGP, VGP, and NGP respectively. Mean of ANB was 0.78 in total and -1.5, -0.68, -1.44 in HGP, VGP and NGP respectively. Differences of this angle means were statistically significant in three groups (P=0.05).

To determine facial growth pattern FMA, GoGn-SN angle and Jarbak index were used. Means of this measurements were statistically significant in three groups (P<0.001).

Hyoid bone position was evaluated antero-posteriorly and vertically in this study:

Antero-posterior position of hyoid bone:

To evaluate ant- post position of hyoid, H-C3 and H-RGN were used. Mean of H-C3 was not different statistically in three facial growth patterns. But mean of H-RGn in VGP was less than HGP and NGP and their differences were statistically significant (P=0.019). In comparing two groups, significant differences existed between VGP and NGP but not between HGP and NGP.

Haralabakis et al [5] evaluated cephalometric radiographs of patients with open bite and normal occlusion and concluded antero-posterior position of hyoid was not statistically different in two groups. Their result is different form our results. Erdin et al [6] evaluated hyoid bone position in three facial growth patterns and found statistical significant differences in distance of hyoid bone from pog between NGP and HGP which is different from our results.

Pae et al [7] evaluated hyoid bone position in three facial growth patterns but only mean of H-RGN was statistically different in three facial growth patterns which is the same as our results.

Vertical position of hyoid bone:

To evaluate vertical position of hyoid bone variables such as H-SN, H-S, H-PP, H-MP were used. Results showed that mean of each variable in VGP was more than NGP and HGP, but the differences were not statistically significant.

Erdin et al [6] evaluated distance of hyoid bone from SN, PP, OCP, FHP in three facial growth patterns but did not find any statistically significant differences between three groups which is similar toour results.

Pae et al [7] evaluated hyoid bone position in 163 adult patients but found no statistically significant differences in three facial growth patterns which is the same as our results.

Haralabakis et al [5] found that hyoid bone distance from PP is significantly more in open bite long face patients than normal occlusion.

Vertical hyoid bone position was the same in three facial growth patterns in Pae and Erdin studies but was different in Haralabakis study. Inour and there were no statistically significant differences between three facial growth patterns in antero- posterior and vertical position of hyoid bone. This which may be consequence of constant relation of hyoid bone to vertebral column and not considering the type of class III malocclusion (Mandibular- prognatism or maxillary deficiency).

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