

Hyoid Bone and Breathing Pattern – Cephalometric Study

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Introduction: Although during a normal breathing the hyoid bone is hardly moving, it is capable to change its position and probably, most importantly, the orientation according to the physiological requirements demanded by pharyngeal obstruction and mouth breathing.

Aim of the study: Determination of the position of the hyoid bone in mouth breathers in comparison with nasal breathers.

Material and method: Seventy children with ages of 8–9 years, with dental-maxillary anomalies took part in the study. After the ORL examination the initial lot has been divided in two groups: mouth and nasal breathers. On the patients' cephalometries, by angular and lineal measurements we have determined the parameters which define the position of the hyoid bone in anterior-posterior and vertical sense.

Results: Although the distance between the hyoid bone and the mandibular basal plane is longer in case of mouth breathers than in nasal breathers (GoGn.H°: 25.12° in comparison with 24.06° and H-hy': 12.37 mm in comparison with 11.65 mm), the results of the statistic tests did not indicate significant differences between the average values of the studied parameters for the two groups.

Conclusions: The measurements indicating the position of the hyoid bone in anterior-posterior sense (C3-H, H-RGn) are not influenced by the breathing pattern, the obtained values being approximately equal in the two studied groups; in case of our patients, on vertical position the hyoid bone having an inferior position in mouth breathers than in nasal breathers.

Keywords: mouth breathing, hyoid bone, cephalometry, hyoid triangle

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Introduction

The importance of the hyoid bone consists in the uniqueness of its anatomic reports. The hyoid is the only bone of the human body which has no bony joints, being related to the pharynx, larynx, mandible and cranium by means of muscles and ligaments.

The contribution brought by the hyoid bone to the maintenance of the breathing equilibrium is much more important than its small dimension. Although during a normal breathing the hyoid bone is hardly moving, it is capable to change its position and probably, most important the orientation according to the physiological requirements demanded by pharyngeal obstruction and mouth breathing [1].

The aim of our study was to determine the position of the hyoid bone in mouth breathers in comparison with nasal breathers.

Material and method

Subjects

The study batch contained a number of 70 patients with ages between 8–9 years who came to the Pediatric Dentistry Clinic from Tîrgu Mureş for an orthodontic treatment. Children who have been previously submitted to ORL surgical interventions (adenoidectomies, tonsillectomies) or who suffered serious breathing disorders, were excluded from the study.

According to the results of the ORL examination, the initial batch was divided in two groups: 24 mouth breathers

and 46 nasal breathers. In case of mouth breathers the ORL examination indicated adenoid hypertrophy, hypertrophy of the palatine tonsils and/or allergic rhinitis.

All 70 patients presented dental-maxillary anomalies of 1st, 2nd and 3rd Angle class. The orthodontic diagnosis was based on the clinical examination, the pattern study and the radiological examination (orthopantomography and cephalometry).

The cephalometric analysis

If we used the cranial surfaces as reference levels in order to determinate the position of the hyoid bone on the cephalometry, little variations of these would be reflected as substantial changes of the hyoid position. The position of the hyoid also varies in case of very soft movements of the head [2].

To avoid these lacks and to obtain conclusive information, Bibby and Preston introduced the analysis of the hyoid position using the "hyoid triangle" which contains localized surfaces between the cervical vertebra and the mandibular symphysis and it does not relate to the cranial surfaces [3].

The same authors established some standard values for the dimensions of the hyoid triangle (Table I).

In the present study we have determined the position of the hyoid bone both relating it to the mandibular basal plane and by the help of "the hyoid triangle" (Figure 1).

Table I. Average values of the hyoid triangle [3]

C3-RGn	67.20 mm, SD 6.6 mm
C3-H	31.76 mm, SD 2.9 mm
H-RGn	36.83 mm, SD 5.8 mm

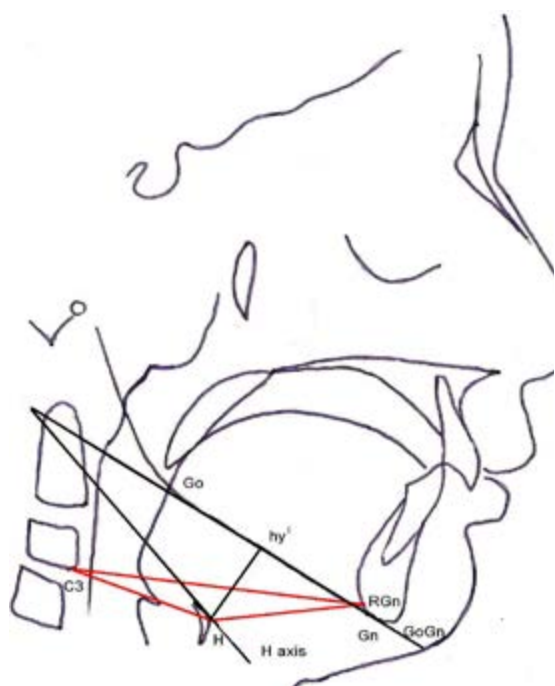


Fig. 1. Landmarks and reference lines used in the present study

The statistical analysis

In order to compare the averages of the two groups, the Student and Mann-Whitney *t* test for odd data have been applied. The significance level has been established for $p < 0.05$.

Results

Tables II and III present the average values and the standard deviations for the measurements, indicating the axial inclination of the hyoid in relationship with the mandible and the vertical position of the hyoid bone. The differences between the averages of the two groups, as shown by the statistical tests are insignificant ($p > 0.05$) (Tables II, III).

The present study analyses the values of the hyoid triangle for each of the 70 participant patients. The obtained

C3 – the most inferior anterior point of the third cervical vertebrae

RGn – retrognathion – the most inferior posterior point on the mandibular symphysis (Bibby and Preston, 1981, Haralabakis *et al.*, 1993)

H – hyoidale – the most superior and anterior point on the body of the hyoid bone (Tallgren and Solow, 1987)

Hy' – hyoid prime – the perpendicular point from H along the mandibular plane (Athanasίου *et al.*, 1991)

Go – gonion – the intersection point of mandibular and ramus planes (Solow and Tallgren, 1976)

Gn – gnathion – the most inferior point on the mandibular symphysis (Bjork, 1947)

H axis – the long axis of the hyoid bone – connects the most anterior point of the hyoid and the most posterior point of the greater horn of the hyoid (Haralabakis *et al.*, 1993)

GoGn – mandibular plane (Bjork, 1947)

GoGn.H° – angular measurement between the long axis of the hyoid bone and the mandibular plane, axial inclination of the hyoid bone (Haralabakis *et al.*, 1993)

H-hy' – linear measurement between H and mandibular plane, vertical position of the hyoid. (Lowe *et al.*, 1986)

C3-RGn – linear measurement between C3 and RGn (Bibby and Preston, 1981)

C3-H – linear measurement between C3 and H, anteroposterior position of hyoid (Bibby and Preston, 1981)

H-RGn – linear measurement between H and RGn, horizontal position of the hyoid (Bibby and Preston, 1981, Haralabakis *et al.*, 1993)

data are presented in Table IV according to the breathing pattern. The analysis of the average values for the two groups (mouth breathers and nasal breathers) does not indicate statistically significant differences ($p > 0.05$).

Discussions

The values of the cephalometry measurements analyzed in this study, related to the position of the hyoid bone do not show significant differences between mouth and nasal breathers. This result obtained by us is in agreement with the results obtained by Subtenly and Sakuda, Bibby and Preston, Bibby, Kumar *et al.*, Kawashima *et al.*, Ferraz *et al.*,

Table II. Comparison between parameters that indicate axial inclination of the hyoid bone for the two groups

GoGn.H°	Mouth breathing patients	Nasal breathing patients
Average value	25.12	24.06
Standard deviation	12.08	11.83
95% CI	20.02–30.22	20.54–27.58
<i>p</i>	ns	

Table III. Comparison between parameters that indicate the vertical position of the hyoid bone for the two groups

H-hy'	Mouth breathing patients	Nasal breathing patients
Average value	12.37	11.65
Standard deviation	6.24	6.33
95% CI	9.73–15.01	9.77–13.53
<i>p</i>	ns	

Table IV. Average value, standard deviation and statistical test results of the measurements of the hyoid triangle for the two groups

C3-RGn (mm)	Mouth breathing patients	Nasal breathing patients
Average value	65.13	69.95
Standard deviation	6.80	6.23
95% CI	63.10–67.15	63.32–68.59
<i>p</i>	ns	
C3-H (mm)	Mouth breathing patients	Nasal breathing patients
Average value	30.58	30.50
Standard deviation	0.46	3.57
95% CI	29.61–31.54	29.43–31.56
<i>p</i>	ns	
H-RGn (mm)	Mouth breathing patients	Nasal breathing patients
Average value	36.70	36.26
Standard deviation	1.25	8.57
95% CI	34.10–39.30	33.71–38.81
<i>p</i>	ns	

who noticed that the hyoid bone has a constant position which is not influenced by the breathing pattern [3–8].

However, authors like Adamidis and Spyropoulos found statistically significant differences between mouth and nasal breathers when they analyzed the position of tongue, mandible and the hyoid bone. Behlfelt et al, Shintan et al, Finkelstein et al found statistically significant differences regarding the vertical position of the hyoid bone in mouth breathers in comparison with nasal breathers, in the sense of an inferior position of the hyoid in mouth breathers [9–12].

In our measurements we noticed that the following average values (lineal and angular) are higher in mouth breathers than in nasal breathers: GoGn.H° and H-hy' (25.12° vs. 24.06° and 12.37 mm vs. 11.65 mm), which indicate the fact that the hyoid bone is in an inferior position in mouth breathers than in nose breathers.

The average values of the distances between the hyoid bone and the C3 vertebra and the RGn point are almost equal in the two groups: C3-H = 30.58 mm in mouth breathers vs. 30.50 mm in nasal breathers; H-RGn = 36.70 mm in mouth breathers vs. 36.26 mm in nasal breathers, only the distance C3.RGn is different, being shorter in mouth breathers than in nasal breathers.

Comparing the average values that we have obtained for the hyoid triangle with the ones of Bibby and Preston (C3-RGn = 67.20 mm, C3-H = 31.76 mm, H-RGn = 36.83 mm) we notice that in case of the distance between the 3rd cervical vertebra and the RGn point the values obtained by us are lower in case of mouth breathers (65.13 mm, SD 6.80) and higher in nasal breathers (69.95 mm, SD 6.95). The average values of the distance between the hyoid bone and the C3 vertebra in mouth breathers are lower than the ones obtained by Bibby and Preston in both groups of study (30.58 mm, SD 0.46, and 30.50 mm, SD 3.57, respectively). The distance between the hyoid bone and RGn is similar as average value with the value obtained by Preston in both groups of study (36.70 mm, SD 1.25, and 36.26 mm, SD 8.57, respectively).

Longitudinal studies dealing with the analysis of airways and hyoid bone proved that both the airways and the position of the hyoid bone suffer modifications during the process of growing and these modifications are different at girls and boys [13,14].

Conclusions

1. In our study the measurements indicating the position of the hyoid bone in anterior-posterior sense (C3-H, H-

RGn) are not influenced by the breathing pattern, the values we have obtained being almost equal in the two studied groups.

2. The measurements we have performed and which had the mandibular basal plane as a reference level (GoGn.H°, H-hy') are higher in mouth breathers than in nasal breathers.
3. On vertical surface the hyoid bone in case of our patients has an inferior position in mouth breathers than in nasal breathers.
4. This position might be interpreted as a postural adaptation of the hyoid bone at the level of the oropharynx in its attempt to maintain constant its anterior-posterior diameter.
5. The subjects of the study have been selected from the patients suffering of dental-maxillary anomalies and therefore the presented results may not be generalized.

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