LONGITUDINAL STUDY OF THE POSITION OF THE HYOID BONE IN DIFFERENT MALOCCLUSIONS

by

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CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

Little research has been done concerning the position of the hyoid bone. Prior to roentgenography, dissection of the cadaver was the only method to determine the position of this bone. The disadvantage of this method, however, was the inability to study an individual progressively at various times during his life span. In 1931, Broadbent[3] with the Broadbent-Bolton Cephalometer introduced an accurate technique to study the development of an individual head serially by superimposing roentgenographs. The object of this study is to determine if there is any variation in the position of the hyoid bone in Angle's Class II and Class III malocclusion cases as compared with an individual with a normal occlusion.

The hyoid bone is horseshoe shaped and consists of five segments; a body, two greater cornua and two lesser cornua. The relationships of various muscles to the hyoid bone are described in Gray's Anatomy[10] as follows: "The anterior surface gives insertion to the Genio-hyoideus in the greater part of its extent both above and below the transverse ridge; a portion of the origin of the Hyoglosses notches the lateral margin of the Geniohyoideus attachment.

Below the transverse ridge, the Mylohyoideus, Sterno-hyoideus and Omohyoideus are inserted. The posterior surface is smooth, concave, directed backward and downward, and separated from the epiglottis by the hyothyroid membrane and a quantity of loose areolar tissue; a bursa intervenes between it and the hyothyroid membrane. The superior border is rounded, and gives attachment to the hyothyroid membrane and some aponeurotic fibers of the Genioglossus. The inferior border affords insertion medially to the Sternohyoidus and laterally to the Omo-hyoideus and occasionally a portion of the Thyreohyoideus. It also gives attachment to the Levator glandulae thyre-oideae, when this muscle is present."

Caffey[8] states that the hyoid bone can be seen on a latteral roentgenograph at birth. "Ossification of the body and the greater horns of the hyoid bone begins during the fourth and fifth months of prenatal life; these structure may be visible in films at birth."

A thorough review of the literature revealed that the first cephalometric study done on the position of the hyoid bone was done by King[11] who found, "The distance between the hyoid bone and the cervical vertebrae was constant until puberty when the hyoid bone moved forward slightly."

Brodie[6] states, "The position of the tongue likewise influences its effects upon the teeth and alveolar processes.

its normal position finds it almost completely occupying the mouth cavity, including the vault, but occasionally it is positioned no farther superiorly than the occlusal level of the lower arch. In most cases this will be found to be due to variations in those bones of the face from which the tongue is suspended. Thus, in Class III types with the extended mandible and with the hyoid bone at a relatively lower level, the tongue is literally dragged to a lower position."

In 1952 Brodie[7] also stated, "Lack of harmony between the positions of the two arches leads to a superimposing of muscular factors on the skeletal disharmony. This frequently occurs in Class II and Class III cases. Such malrelations necessitate muscular adaptations of various sorts which aggravate the condition."

Therefore, after these muscular adaptations, it is the opinion of the author that a change in the position of the hyoid bone has occurred and this change can be observed on lateral roentgenographs.

CHAPTER II

MATERIAL AND METHOD

All roentgenographs for this study were obtained from the records of the Bolton Fund for the Study of the Development of the Face of the Growing Child, located at Western Reserve University.

A total of 723 cases of children having had Bolton roentgenographs and models taken at ages 6 and 12 were chosen. The Class II and Class III cases, as classified in the records of the Bolton Fund, were listed separately. A study of the models of the remaining cases was made and a random selection was taken to obtain a group with normal occlusion. Each model was evaluated according to 6 categories: degree of overbite, amount of overjet, presence of a crossbite, evidence of habits, missing teeth and finally the presence of any orthodontic treatment. Only cases with a 20 per cent overbite, no overjet, no crossbite, no case history of a habit, no missing teeth and not needing orthodontic treatment were selected. To eliminate poor posture at the time the roentgenographs were taken, only cases with straight cervical vertebrae were used. A check for sibship was made and if found, the cases were eliminated. This same procedure was followed for the Class II and Class III groups.

Bolton celphalometric roentgenographs of 15 children, male, female, untreated orthodontically and with normal occlusion were traced at age 6 and at age 12. Seventeen Class II, Division I and 10 Class III untreated cases were also traced at ages 6 and 12.

The following landmarks were located on the roentgenographs and established on the tracings:

B. Bolton Point - "The highest point in the notch at the posterior end of the condyles on the occipital bone." (Broadbent[4])

F. The intersection of a perpendicular from Frankfort horizontal plane to point Z.

Go. Gonion - "A point on the bony contour of the gonial angle located by bisection of the angle formed by the mandibular base line and the ramal line." (Bjork[2])

H. "The mid-point of the superoinferior dimension of the hyoid bone in a mid-sagittal plane." (King[11])

Na. Nasion - The craniometric point where the mid-sagittal plane intersects the nasofrontal suture.

Or. Orbitale - the lowest point on the left infraorbital margin.

P. The intersection of a perpendicular from Frankfort horizontal plane to point S.

Gn. Gnathion - The lowest most anterior point on the symphysis in the mid-line of the mandible.

R. Bolton Registration Point - A point midway on a perpendicular erected from the Bolton Plane to the center of sella turcica.

S. The center of sella turcica, located by inspection of the profile image of the fossa.

T. The intersection of a perpendicular from Frankfort horizontal plane to the most anterior part of the hyoid bone.

W. The intersection to CV of a line parallel to Frankfort horizontal plane at the most inferior part of the hyoid bone.

X. The intersection of a perpendicular from Frankfort horizontal plane to the most anterior point of the hyoid bone with a parallel to Frankfort horizontal plane at the most inferior point of the hyoid bone.

Y. The intersection on the cervical vertebral plane by a perpendicular from FZ at Z.

Z. The mid-point of the two greater cornua of the hyoid bone.

Bolton Plane. A line joining the Bolton Point and Nasion on the lateral roentgenograph.

CV. "The cervical vertebral plane, represented by a line constructed tangent to the anterior surfaces of the bodies of the second, third and fourth cervical vertebrae." (King[11])

Frankfort horizontal plane. A horizontal plane running through the right and left cephalometric porion and the left orbitale.

Hyoid Plane. A line joining the mid-point of the body of the hyoid bone with the midpoint of the posterior and of the two greater cornua.

Mandibular Plane. Formed by a line joining gonion and gnathion.

Occulsal Plane. A line bisecting the occlusion of the first molars and center incisors.

In the tracing of a case, if any doubt was present as to the position of the hyoid bone, the roentgenograph of the previous and succeeding years was drawn, registered on R point and the average hyoid bone position transferred to the drawing in question.

CHAPTER III

FINDINGS

Measurements of the hyoid bone at ages 6 and 12 in normal occlusion, Class II and Class III malocclusions revealed the following:

The growth in length of the hyoid bone in normal occlusion increased from a mean of 25.5 mm at 6 years of age to a mean of 29.3 mm at 12. This was a growth increase of 3.9 mm (Table 1). The Class II group showed a similar mean increase of 4.3 mm. This was obtained from a mean of 25.7 mm at 6 years of age to a mean of 29.9 mm at 12. The Class III group had the greatest increase of growth in length, increasing from 24.6 mm at 6 years of age to 30.6 mm at 12, a mean increase of 6.0 mm. The mean increase of the normal group was 3.9 mm, a standard deviation of 1.5 mm and a standard error of .38 mm compared to the Class III group which had a mean increase of 6.0 mm, a standard deviation of 2.1 mm and standard error of .67 mm. Comparing the standard errors of both groups yields a Critical Ratio of 2.7. Therefore, the chance occurrence of a deviation as great as or greater is 143.2 to 1. A comparison of the Class II group to the normal group revealed no significant difference.

The angulation of the hyoid bone and the mandibular plane yielded the following:

In the normals, the angle of the Hyoid Plane to the Bolton Plane had a mean of 52.3° at 12. The angle of the mandibular plane to the Bolton Plane registered a similar constance having a 49.1° mean to a 48.2° respectively at ages 6 and 12. This constancy held true for the Class II and the Class III groups, where the Class II group had a 46.9° mean at 6 and a 46.8° mean at 12 for the BHP; and similarly a 49.3° mean to a 48.7° mean at 6 and 12 respectively for the BMP. In the Class III group the BHP at 6 was 47.2° mean compared to a 49.8° mean at 12; and the BMP was a 49.9° mean at 6 remaining constant at 50.0° mean for the 12 year olds.

The vertical position of the hyoid bone was determined by the intersection of the hyoid plane with the cervical vertebrae. Only in the Class III group did the hyoid bone intersect the cervical vertebrae at a different level. This is noted in Figure 2.

The anterior-posterior position of the hyoid bone was compared to sella by two perpendiculars from FH; one to sella (PS) and the second to the most anterior part of the hyoid bone (TX) (Table 2). A mean increase of 1.9 mm in the normal group and a 1.5 mm in the Class III group was obtained. However, the Class II group had only a 0.9 mm increase.

The position of the hyoid bone to the cervical vertebrae was divided into two parts: a measure of the distance that the anterior part of the hyoid bone was forward in relation to the vertebrae along the line WX. A mean increase of 2.6 mm, 2.4 mm and 2.5 mm respectively for the normal, Class II and Class III groups was observed. Also, a line YZ parallel to line WX at the posterior end of the hyoid bone was measured to the tangent CV of the cervical vertebrae. For the normal group, a mean change of -1.2 mm was observed and a mean change of -1.7 mm for the Class II group. (Minus indicates a position closer to the cervical vertebrae at age 12 than at age 6.) The largest change was noted in the Class III group, where a mean change of -3.5 mm was obtained. Comparing the three groups revealed no significant difference.

CHAPTER IV

CONCLUSIONS

A significant difference was found for the growth of the hyoid bone in the Class III group in comparison to the normal group. Even though this proved to be statistically significant, one must be cautious and examine the range (Table 1) of variation of the lengths of the hyoid bone. The extremes of the different groups are similar and considering the standard error, one could very easily place a measurement in any one of the groups.

The anterior-posterior position of the hyoid bone was considered first in relation to sella turcica and second, to a reference line CV representing the cervical vertebrae. In considering the position of the hyoid bone in reference to the skeletal reference point, sella turcica, the Class II mean increase from 6 years to 12 years was smaller than the normals or the Class III group (Table 2). This tended to show a more retrusive position of the hyoid bone in the Class II group. However, the difference was small and statistically the mean of the Class II group at 12 was 14.8 mm, standard deviation 5.2 mm and a standard error of the mean of 1.3 mm; compared to the normal group, which had at 12, a mean of 17.5 mm. standard deviation of 4.1 mm and a standard error of mean 1.1 mm. Comparing the standard errors of both groups yielded a Critical Ratio of 1.59. Therefore, the odds against the occurrence of a deviation as great as or greater is 8.12 to 1. This could occur by chance; thus the means of the two groups are not significantly different.

It is interesting to note that in considering the position of the hyoid bone to the cervical vertebrae, the sum of the mean changes of the anterior end of the hyoid bone (Table 3) and the mean changes of the posterior end of the hyoid bone of all three groups (Table 4) will equal the mean increase in growth of the hyoid bone (Table 1); i.e., normals: 2.6 plus 1.2 equals 3.8. This seems to suggest that growth has accounted for the anterior-posterior change of the hyoid bone in reference to the cervical vertebrae.

The intersection of the hyoid plane to the cervical vertebrae (Figure 2) does support the opinion of Brodie[6] that in Class III types, the hyoid bone is at a relatively lower level.

CHAPTER V

SUMMARY

All material was obtained from the records of The Bolton Fund at Western Reserve University.

A longitudinal study of the position of the hyoid bone in normal occlusions, Angle's Class II and Class III malocclusions was made at ages 6 and 12. Fifteen normal occlusions, 17 Class II and 10 Class III untreated malocclusions were compared by means of lateral roetgenographs.

1. The growth of the hyoid bone from age 6 to 12 was found to be significantly greater in Class III malocclusions as compared to normal occlusions and Class II malocclusions.
2. The hyoid plane in the Class III group intersected the cervical vertebrae at a lower level at age 12 than the normal occlusions and Class II malocclusions.
3. The angulation of the hyoid plane and the mandibular plane was very similar and constant in all three groups with reference to the Bolton plane.

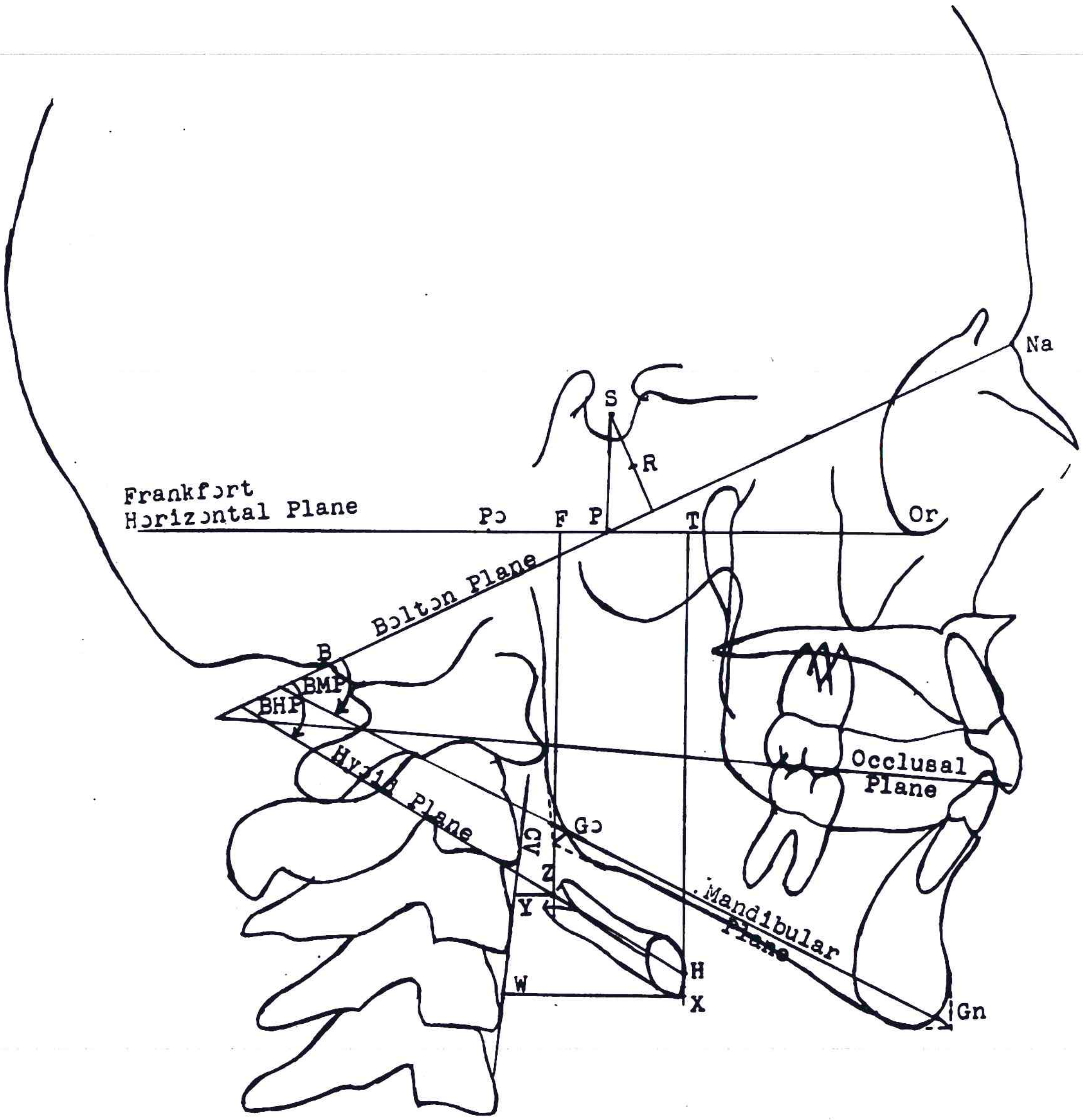

Figure 1. Skeletal landmarks used in study

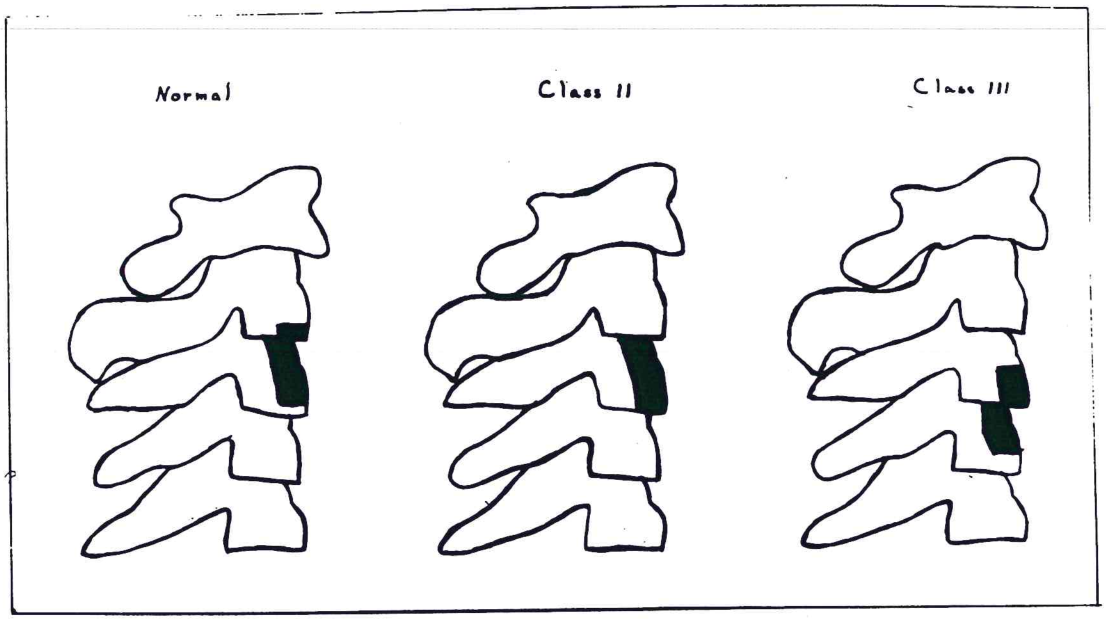

Figure 2. Area of intersection of the hyoid plane to the cervical vertebrae

TABLE 1

GROWTH OF HYOID BONE

	Age	No.	H'Z Mean	Range	Mean Increase from 6 Years to 12 Years	Range	Standard Error
Normal	6	15	25.5	22.7 - 28.6	3.9	2.0 - 5.9	.38
	12	15	29.3	25.0 - 33.0			
Class II	6	17	25.7	22.7 - 29.5	4.3	1.0 - 8.1	.43
	12	17	29.9	25.5 - 35.4			
Class III	6	10	24.6	21.3 - 27.6	6.0	3.2 - 9.9	.67
	12	10	30.6	26.4 - 36.2			

Note: All measurements are in millimeters

TABLE 2

ANTERIOR-POSTERIOR RELATIONSHIP OF HYOID BONE TO SELLA TURCICA

	Age	No.	PT Mean	Range	Mean Increase from 6 Years to 12 Years	Range	Standard Error
Normal	6	15	15.6	8.5 - 25.8	+1.9	-0.3 - +10.5	1.0
	12	15	17.5	9.0 - 26.2			
Class II	6	17	14.0	8.3 - 20.4	+ .9	-5.4 - +8.0	1.0
	12	17	14.8	3.0 - 27.0			
Class III	6	10	16.2	6.0 - 22.5	+1.5	-10.9 - +16.4	2.6
	12	10	17.7	7.3 - 23.8			

Note: All measurements are in millimeters

A plus sign indicates a more anterior position at age 12 than at age 6

A minus sign indicates a more posterior position at age 12 than at age 6

TABLE 3

DISTANCE FROM ANTERIOR END OF HYOID BONE TO TANGENT OF CERVICAL VERTEBRAE

	Age	No.	WX Mean	Mean Change from 6 Years to 12 Years	Range	Standard Error
Normal	6	15	29.1	+2.6	-0.6 - +7.0	0.6
	12	15	31.6			
Class II	6	17	29.5	+2.4	-1.4 - +6.0	0.5
	12	17	31.9			
Class III	6	10	29.0	+2.5	-1.9 - +8.3	1.1
	12	10	31.5			

Note: All measurements are in millimeters

TABLE 4

DISTANCE FROM POSTERIOR END OF HYOID BONE TO TANGENT OF CERVICAL VERTEBRAE

	Age	No.	Y2 Mean	Mean Change from 6 Years to 12 Years	Range	Standard Error
Normal	6	15	6.2	-1.2	-4.7 - +0.7	0.3
	12	15	5.0			
Class II	6	17	5.0	-1.7	-5.4 - + 2.9	0.5
	12	17	3.3			
Class III	6	10	6.7	-3.5	-7.7 - +1.5	-.9
	12	10	3.2			

Note: All measurements are in millimeters

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