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Original Research

Comparative evaluation of different measurements of hyoid bone in different malocclusion in North Indian population

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***ABSTRACT*:**
Introduction-Position of hyoid bone plays an important role in orthodontics. Its position varies in different growth pattern. Its position is also related in obstructive sleep apnea. However its position varies in different ethnic groups.so,there is need to find a correlation of different landmarks and measurements. **Material and method-**20 patients each of class I, class II and class III were selected based on cephalometric readings. Different landmarks selected to measure the proper location of hyoid bone were selected. **Result-** ANOVA test was applied followed by Tukey HSD**.** The assessment of the horizontal position of the hyoid bone as evident from the ANOVA test results revealed that the hyoid bone was relatively constant. No significant correlation was found among class I ,class II and class III patients regarding the selected parameters. Hyoid ratio in class I, class II and class III was 2.0 ± 0.18, 1.9 ± 0.19 and 2.0 ± 0.20 respectively. C**onclusion-** There is no significant difference in the landmark measurements selected to determine position of hyoid bone among class I, class II and class III patients.
Keyword- hyoid bone, malocclusion, north Indian population.

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INTRODUCTION

Hyoid bone is a U shaped bone that consists of an unpaired body and greater and lesser cornua / horn on each side. It is derived from the second and third pharyngeal arch cartilages. The hyoid bone at rest lies at the level of the third cervical vertebrae. The hyoid has no bony articulations. It plays an active role in achieving a balance between anterior and posterior muscle tension relative to the occipital condyles, which in turn helps to balance the head in an upright posture. The hyoid bone provides an attachment for the supra- and infra-hyoid muscles which form a part of the oropharyngeal complex.[1-3]

Being aware of the position of hyoid in different malocclusion and factors affecting its position can result in better orthodontic treatment without relapse and possible deficient pharyngeal airway space after orthodontic treatment as well as orthognathic surgery. In a study examining the effects of an orthodontic crib on swallowing, Cuozzo and Bowman[4] determined that the distance between the hyoid bone and the mandibular plane increased after the use of the crib. Haralabakis et al[5] found that the

distance between the hyoid bone and the palatal plane is significantly greater among men with open bite than men with normal Class I occlusion. Zhou et al[6] compared the swallowing patterns in adults with normal occlusion and those with skeletal class III malocclusion and determined that the tongue, hyoid bone, and mandible were positioned much lower in skeletal Class III patients than in normal individuals.

MATERIALS AND METHODS

SUBJECT SELECTION CRITERIA:

1. no positive medical history
2. no history of orthodontic treatment
3. no history of trauma
4. no functional shift
5. No congenital missing, cleft or other congenital craniofacial problems

60 subjects following the inclusion criteria were selected and divided into class I, class II ad class III based on following criteria.

1. In Class I, ANB angle must be 0– 4°.
2. In Class II, ANB angle must be > 4°.
3. In Class III, ANB angle must be < 0°.

To determine the errors associated with radiographic measurements, 25 radiographs were selected at random from the control group. The tracings and the measurements of these films were repeated two weeks after the first measurement. A paired 't' test was applied to the first and second measurements and no error associated with radiographic tracings and measurements was found.

Landmarks selected

C3	The point at the most inferior anterior position on the third cervical rtebrae
RGn (retrognathion)	The most inferior posterior point on the mandibular symphysis.
H (hyoidale)	The most superior, anterior point on the body of the hyoid bone.
Hyoid plane	The plane from H along the long axis of the greater horns of the hyoid bone
AA	The most anterior point on the body of the atlas vertebrae seen on the lateral cephalometric radiograph.
PNS (posterior nasal spine)	The tip of the posterior nasal spine seen on the lateral cephalometric radiograph.

Linear and angular measurement:

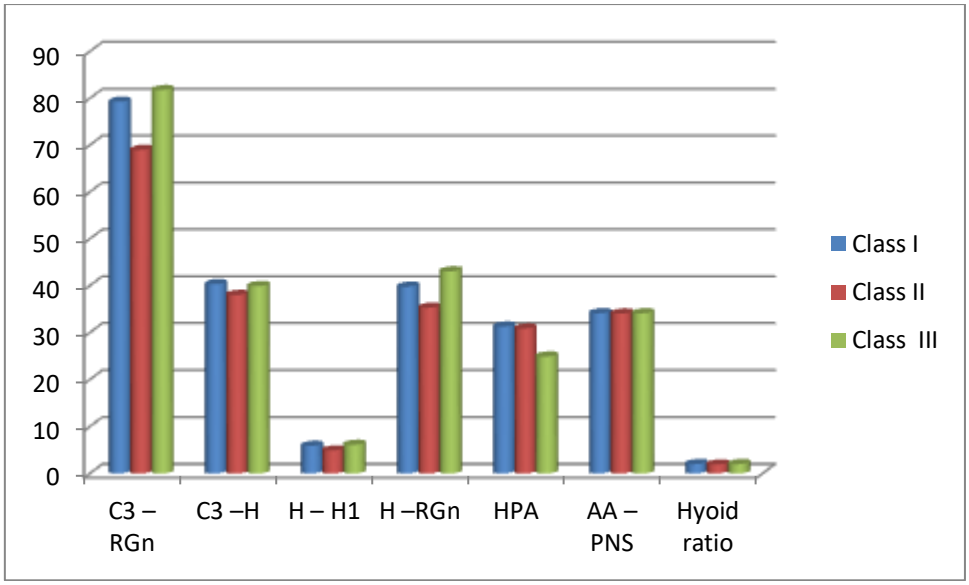
C3 – RgN	Antero -posterior dimension between third cervical vertebra and mandible.
C3 – H	Antero -posterior dimension between C3 and Hyoid.
H-RgN	Antero-posterior dimension between hyoid and mandible.
H-H[1]	Vertical dimension or position of hyoid bone with reference to C3 and RgN plane.
AA-PNS	Linear measurement between anterior body of atlas to posterior nasal spine.
HPA – hyoid plane angle	The most superior posterior angle made by the intersection of the hyoid plane with C3-RGn
Hyoid ratio	Ratio of linear measurement of C3 to RgN and linear measurement of C3 to hyoid

RESULTS

The data were collected and sent for statistical analysis by SPSS software (VERSION 20.0). Descriptive statistics was done for the sample selected and it was concluded that there were no significant differences between the groups. The groups were divided on the basis of ANB into skeletal class I, class II, and class III with the mandible positioned forwardly in class III and backwardly in class II malocclusions. This was verified by the fact that ANB and SNB were significantly different in the three groups.

Table: Comparison of different measurements in Class I, Class II and Class III

	Class I	Class II	Class III
C3 – RGn	79.27 ± 5.87	68.95 ± 1.57	81.75 ± 7.04
C3 –H	40.33 ± 3.33	38.00 ± 3.03	39.90 ± 3.88
H – H[1]	5.87 ± 5.71	4.90 ± 3.19	6.10± 3.32.
H –RGn	39.78 ± 4.94	35.30 ± 3.25	43.05 ± 6.13
HPA	31.28 ± 11.24	30.85 ± 10.86	24.90 ± 10.91
AA – PNS	34.12 ± 3.36	34.05 ± 3.43	34.10 ± 4.15
Hyoid ratio	2.0 ± 0.18.	1.9 ± 0.19	2.0 ± 0.20.



Graph no 1: Comparison of different measurements in Class I , Class II and Class III

One-way ANOVA showing intergroup comparison between different measurements in Class I , Class II and Class III

source	sum of squares SS	degrees of freedom df	mean square MS	F statistic	p-value
treatment	31.8588	2	15.9294	0.0255	0.9749*
error	11,261.6931	18	625.6496		
total	11,293.5519	20			

*p-value>0.05 is insignificant

Tukey HSD results

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inference
Class I vs Class II	0.2826	0.8999947	insignificant
Class I vs Class III	0.0128	0.8999947	insignificant
Class II vs Class III	0.2697	0.8999947	insignificant

The results of the ANOVA test done to compare the horizontal position of the hyoid bone between the three groups concluded that the horizontal position of the hyoid was very stable and the difference between the groups is not statistically significant.

DISCUSSION

It is difficult to precisely determine the position of hyoid bone cephalometrically, as there is high variablity not only from person to person, but also at different time intervals in the same person[7].

Earlier study used cranial structure as reference to find hyoid bone position. In the present study the hyoid triangle analysis was employed planes between the mandibular symphysis and the vertebrae.

The assessment of the horizontal position of the hyoid bone as evident from the ANOVA test results revealed that hyoid bone was relatively constant. No significant correlation was found among class I, class II and class III patients regarding the selected parameters. Hyoid ratio in class I, class II and class III was 2.0 ± 0.18, 1.9 ± 0.19 and 2.0 ± 0.20.

The hyoid bone was found to be less variable in its anteroposterior position and was found to be located almost centrally between the symphysis and the third cervical vertebrae in all the three groups. The hyoid also maintains a very constant relationship to the cervical vertebrae as shown by the C3-H values in the three groups. The antero-posterior position of the hyoid bone is controlled by the relative lengths of the muscles running from the base of the skull, mandible, and tongue to the hyoid bone and maintenance of the patency of the pharyngeal airway space.

Present study was carried out in local population of north India. Hyoid bone position varies in different

skeletal malocclusions which in turn affects growth of mandible due to its connection with hyoid bone via muscular attachments. In high angle class III cases, position of hyoid bone is downward and backward. H-RGn is usually increased in class III cases[8]. In Lebanese population, position of hyoid bone is backward in class II patients which also supports finding of present study and more forwardly placed in class III patients. In class III cases hyoid bone is present in forward position as compared to class I cases[9]. Position of hyoid bone plays an important role in success of orthodontic treatment based on type of mechanics used. Hyoid bone is placed more posterior in skeletal class II patterns and more inferior and anterior in skeletal class I patterns. Earlier study showed hyoid bone is placed more posterior in skeletal class II patterns and more inferior and anterior in skeletal class I patterns.[10]

Traditionally hyoid bone is one of the most overlooked component of the craniofacial skeleton, however importance of hyoid bone in maintaining airway, deglutition and head posture have been adequately documented. The recent emphasis in obstructive sleep apnea and its management has renewed interest in the study of hyoid bone.

The hyoid consists of a horizontal body and paired projections called the lesser horns and greater horns. The hyoid forms a delicate balance between suprahyoid and infrahyoid group of muscles. By these attachments the hyoid bone is connected to and influenced by the tongue, the mandible, the base of the skull , sternum , the scapula , the thyroid cartilage and the pharynx.

Hyoid bone moves forward and slightly upward during protrusion from centric position and it moves downward and backward in maximum opening of the mandible.

Hyoid bone position is determined by the musculature attached to it and not by the occlusion. The position of hyoid in Angle's Class I, Class II and Class III malocclusion is the same and does not vary. As the hyoid descends during growth of the cervical, cranial and mandibular development, its position relation to these areas remains the same. During swallowing hyoid bone moves upward and forward and then downward and back.

In the present study no significant difference is seen in the hyoid bone position with reference to third cervical vertebra in skeletal class I and class II group. Hyoid ratio is similar in different skeletal pattern which implies that in skeletal class II group, hyoid is positioned posteriorly and in skeletal class III group the hyoid is positioned anteriorly.

CONCLUSION

There is no significant difference in the landmarks selected to determine position of hyoid bone among class I, class II and class III patients.

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