치의학석사 학위논문

Hyoid bone position of severe Class II anterior open bite patients with degenerative joint disease

퇴행성 턱관절질환을 가진
중등도 이상의 골격성 II급
개방교합 환자의 설골 위치

2013 년 2 월

서울대학교 치의학 대학원
치의학과
고 명 백

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Abstract

Hyoid bone position of severe Class II anterior open bite patients with degenerative joint disease

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Introduction: Previous studies have reported close relationship of the hyoid bone and the adjacent structures. The aim of this study is to analyze vertical, horizontal and angular position of the hyoid bone in female adults with severe Class II and to find out relationships between hyoid bone position and anterior open bite with degenerative joint disease.

Methods: Forty women who had been diagnosed with skeletal Class II (ANB angle > 3°) were evaluated. The samples divided into two groups. Group 1 consisted of 20 subjects (age; 24.72±7.48) without open bite and no degenerative joint disease. They had normal disk position from TMJ MRIs and showed no anterior open bite (overbite > 0 mm) from cephalograms. Group 2 consisted of 20 subjects (age; 25.65±7.14) with severe anterior open bite (> 2.8 mm) and degenerative joint disease. DJD was diagnosed from MRIs or radiographies by an experienced radiologist. Lateral cephalograms of each subject were traced and digitized. Independent t-test was used to compare the hyoid bone position between two groups.

Results: Subjects with open bite and degenerative joint disease showed no statistically significant differences in vertical, horizontal and angular position of hyoid bone compared with group with normal overbite and no degenerative joint disease.

목 차

Ⅰ. Introduction

Hyoid bone position is a reflection of the relative tensions of the muscles, ligaments, and fasciae attached to it. It plays an important role in maintaining airway patency. Previous studies have reported close relationship of the hyoid bone and its adjacent structures.[1-3]

Opdebeeck et al. (1978) examined 27 patients with short face syndrome and 9 patients with long face syndrome. The LFS group was characterized by a clockwise rotation of the mandible "in concert" with the hyoid, tongue, pharynx, and cervical spine. The mandible of the SFS group rotated similarly, but in an opposite counterclockwise direction. They found that the hyoid bone moved with the mandible, the tongue, the pharynx, and the cervical spine in both groups, and they stated that the reason behind this seemed to be the need to maintain patency of the upper airway.[4]

Tallgren and Solow (1987) examined hyoid bone position in three groups of Finnish women aged 20-29, 30-49, and 50-81. The mean vertical distances of the hyoid bone to the upper face, the mandible and the cervical column were significantly greater in the two older age groups.[5]

Adamidis (1992) investigated the hyoid bone position of two groups of patients exhibiting Class I and Class III malocclusions. He found a statistically significant difference in the position and inclination of the hyoid bone between the two groups. Class III patients showed a more anterior position of the hyoid bone and the bone showed a reverse inclination.[6]

Haralabakis (1993) studied the position of the hyoid bone in 36 anterior open bite (at least 2mm) patients and 43 individuals with normal occlusion. He found that there was no difference in the hyoid bone position of the open bite group

compared to that of the normal group.[2]

Grant (1959) studied the position of the hyoid bone in Class I, II, and III malocclusion. He concluded that the hyoid bone position is constant in the three types of malocclusion.[7]

Andersen (1963) examined the vertical position of the hyoid bone in 34 patients with anterior open bite and 40 individuals with normal occlusion. No sex differentiation was made for both groups and the age of the subjects ranged from 15 years 9 months to 60 years. The vertical position of the hyoid was determined by relating the greater horns of the hyoid to the body of the third cervical vertebra. He found that there was no statistically significant difference among the two groups.[8]

Subtelny and Sakuda (1964) also studied the position of the hyoid bone in 25 open bite patients and 30 individuals with normal occlusion. No sex differentiation was made for both groups and the subjects were over 12 years of age. They measured its vertical position relative to the palate and its horizontal position relative to the lingual aspect of the mandibular symphysis. No differences were found between the two groups.[9]

Previous papers, as such, have already studied the difference in position of the hyoid bone according to the dentofacial morphology. However, there were studies that could not find statistically significant difference in the hyoid bone position.

Some considered antero-posterior skeletal factor as an influence on hyoid bone position, but vertical factors such as open bite are not controlled.[2, 8, 9] On the other hand, some researchers studied the position of the hyoid bone in open bite patients and normal occlusion, but antero-posterior factor was not controlled.[7] These sample selection method might influence the results.

The aim of this study was to examine the hyoid bone position in patients with

anterior open bite and degenerative joint disease against the individuals with normal overbite and no degenerative joint disease.

Ⅱ. Material and methods

The sample consisted of 40 women over the age of 18 (Table I) who had been diagnosed with skeletal Class II malocclusion (ANB angle > 3°). Men were not included to avoid skewing the measurements with gender-related size differences. No subject had undergone previous orthodontic treatment or had previously been diagnosed with juvenile rheumatoid arthritis. Each subject had a primary complaint of a malocclusion, and routine lateral cephalograms were taken for the orthodontic records.

The sample was divided into two groups. Group 1 consisted of 20 subjects with normal overbite and no degenerative joint disease. They had normal disk position, which was confirmed with TMJ MRIs. Group 2 consisted of 20 subjects with severe anterior open bite (> 2.8 mm) and degenerative joint disease. DJD was diagnosed from MRIs or radiographies by an experienced radiologist.

One investigator traced all cephalograms. Lateral cephalometric radiographs were traced on acetate tracing film. The tracings were digitized by using a digitizer interfaced with a desktop computer. Fifteen landmarks (Fig 1) were digitized on each radiograph, from which 15 variables (Fig 2 and 3) were calculated.

The axial inclination of the hyoid bone was determined by measuring H_{axis}–MP (Fig 2), the angle formed between the long axis of the hyoid and the mandibular plane. The long axis of the hyoid was determined from the line through hyoidale (H, the most superior and anterior point of the body of the hyoid bone) and the most posterior point of the greater horn of the hyoid.

The horizontal position of the hyoid was determined by measuring H to S_{per} (Fig 3), the distance of hyoidale from perpendicular line to Frankfort Horizontal

plane through sella. The vertical position of the hyoid bone was determined by measuring the distance of hyoidale to sella-nasion (H to SN), to Frankfort horizontal (H to FH), to palatal plane (H to PP) and to mandibular plane (H to MP).

For the convenience of the analysis, these variables were subdivided into 2 categories : skeletodental measurements and hyoid bone position. The positions of the landmarks are shown in Figure 1, and their measurements are shown in Figure 2 and 3.

The differences were tested by using independent t-test. A difference with a P value less than .05 was considered significant.

To test the magnitude of measurement error in this study, the lateral cephalograms of 10 randomly selected patients were measured again. By using Dahlberg's formula, the errors ranged from 0.25 to 0.97 mm for the linear measurements and from 0.28° to 1.23° for the angular measurements.

Ⅲ. Results

Table II shows the descriptive statistics of the measurements that exhibited differences between the two groups. It also shows the significance of these differences. Regarding the skeletodental relationship, Group 1 had smaller SNB and larger overjet than Group 2. These results indicate that subjects with degenerative joint disease had a skeletal Class II pattern with a retrognathic mandible. FMA, SN to mandibular plane angle, maxillomandibular plane angle and gonial angle were larger in the subjects in Group 2 than those in Group 1. This indicates that the subjects in Group 2 had steeper mandibular planes.

The hyoid bone position showed no statistically significant differences between the two groups. The presence of high standard deviation showed that there were great variations in hyoid bone position.

Ⅳ. Discussion

It has generally been assumed that changes in hyoid bone position are directly related to tongue adaptations. Kondo (2007) observed hyoid bone and tongue position in open bite patients with mouth breathing. She described that in these patients the hyoid bone was located in a low position and the tongue was not in contact with the palate before the treatment. Also she mentioned that after establishing nasal respiration, the hyoid bone moved superiorly and the tongue came into contact with the palate.[10] In this case, there seems to be a relationship between hyoid bone position and tongue posture. And special regard is paid to the fact that hyoid bone is inferiorly positioned in open bite patients.

Meanwhile Proffit (1978) pointed out in his review article that 'long face syndrome' is characterized by a low position of the mandible relative to the maxilla and low tongue posture. And this posture could lead to constriction of the maxillary dental arch because of the removal of resting pressure of the tongue due to the low tongue posture, and perhaps to anterior open bite because of differential eruption of the teeth anteriorly and posteriorly.[11] According to his mention, it could be postulated that hyoid bone position in open bite patients may be lower than in normal individuals due to the low tongue posture.

Generally, mouth breathing has been considered to be associated with open bite. Besides the etiologic factors listed above, Kim (1978) mentioned in his study that degenerative joint disease is related to the skeletal Class II open bite.[12] And other studies examined the relationship between degenerative joint disease and dentofacial morphology in women with anterior open bite. They found that facial morphology with TMJ ID is related to the skeletal Class II open bite tendency.[13, 14]

However the position of the hyoid bone in Class II open bite caused by degenerative joint disease has not been studied.

Andersen (1963)[8] and Sakuda(1964)[9] studied the position of the hyoid bone in open bite patients and normal occlusion. These studies showed no difference in hyoid bone position between the two groups. But in these studies, antero-posterior factor was not controlled. We thought these sample selection methods might influence the results.

There are several studies which handled antero-posterior factors. Adamidis (1992) investigated the hyoid bone position of two groups of patients exhibiting Class I and Class III malocclusions. He found that Class III patients showed a more anterior position of the hyoid bone and also a reverse inclination.[6] On the other hand, Grant (1959) studied the position of the hyoid bone in Class I, II, and III malocclusion. He concluded that the hyoid bone position is constant in the three types of malocclusion.[7] However, both studies considered antero-posterior skeletal factor as an influence on hyoid bone position, but vertical factors such as open bite were not controlled.

The purpose of this study was to compare the hyoid bone position of women with severe Class II anterior open bite and degenerative joint disease against women with Class II normal overbite and no degenerative joint disease. In this study, we limited samples to Class II patients, so only the vertical factor was considered.

Group 2 had larger FMA, gonial angle, SN to mandibular plane angle, maxillomandibular plane angle and smaller SNB angle than those of Group 1. It indicates a clockwise rotation of the mandible which leads to anterior open bite. This is consistent with the previous studies, which have been performed on patients with TMJ symptoms with open bite. Kim[12, 15], Ahn et al.[16] reported a backward rotation and retruded position of the mandible in patients with DJD. These changes were more severe as DJD progressed to disk displacement without reduction. The differences between two groups may be explained by the fact that

in DJD cases the mandible rotated backward due to the shortening of the ramus following the degenerative destruction of condylar head and its surrounding structures.

All of the measurements that were used to determine the horizontal, vertical and angular position of the hyoid bone showed no statistically significant difference between the two groups.

These results indicate that distances of the hyoid bone to the head and to the mandibular plane are not influenced by anterior open bite with degenerative joint disease.

Particularly, the measurements H to MP, H to S_{per}, H_{axis}-MP in both groups showed quite high standard deviations. This may be due to the variety of hyoid bone position. Graber[17], King[18] and Stepovich[19] stated that slight variations in head position in the cephalostat, the postural position of the spine, and the state of function all affect the position of the hyoid bone. They concluded that the hyoid bone has a highly variable position, not only from person to person but also from minute to minute in the same person.

However, we must remain cautious before generalizing this conclusion about hyoid bone position. We had difficulties in selecting subjects who had severe open bite (> 2.8 mm) with degenerative joint disease. And there were not much TMJ MRIs data associated with Class II normal disk position. For this reason, we could not find enough sample size for generalization.

We collected open bite samples with degenerative joint disease as an experimental group. But not all of them showed lower tongue posture. Further study about open bite subjects who have mouth breathing with normal TMJ and open bite patients who have degenerative joint disease without mouth breathing might be useful in clarifying the relationship of the hyoid bone position and tongue posture.

Ⅴ. Conclusion

Subjects with open bite and degenerative joint disease showed no statistically significant differences in vertical, horizontal and angular position of hyoid bone compared to subjects with normal overbite and no degenerative joint disease. This suggests that the hyoid bone has a highly variable position.

Table I. Comparison of means and age ranges of subjects with normal overbite and no degenerative joint disease(group 1), and subjects with severe anterior open bite and degenerative joint disease(group 2)

	Group 1 N = 20	Group 2 N = 20	Total N = 40
Age(year)	24.7 ± 7.5	25.6 ± 7.1	25.2 ± 7.2
Range	18.1 - 50.9	18.8 - 41.8	18.1 - 50.9

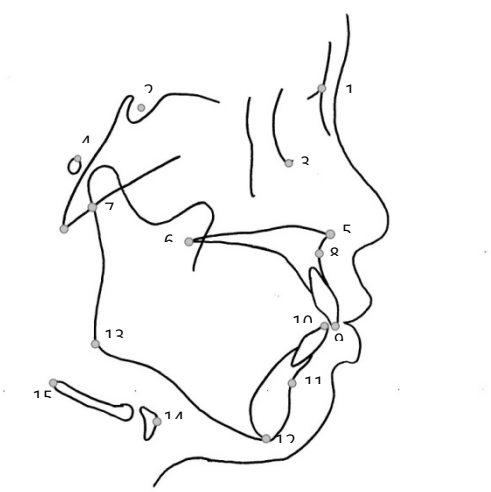

Fig 1. Landmarks used in the study: 1, Nasion; 2, Sella; 3, Orbitale; 4, Porion; 5, Anterior nasal spine; 6, Posterior nasal spine; 7, Articulare; 8, Point A; 9, Incisal end of maxillary incisor; 10, Incisal end of mandibular incisor; 11, Point B; 12, Menton; 13, Gonion; 14, Hyoidale; 15, The most posterior point of the greater horn of the hyoid.

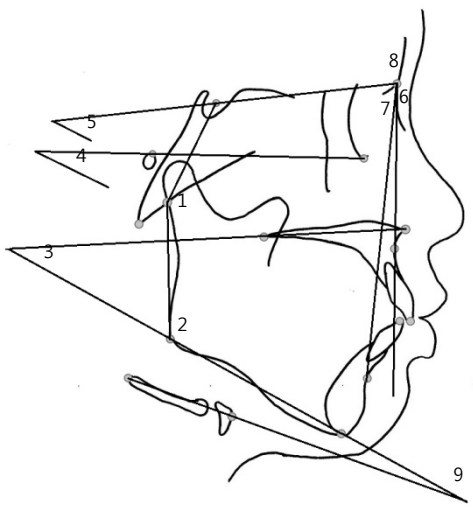

Fig 2. Angular measurements used in the study: 1, Articular angle (S-Ar-Go); 2, Gonial angle (Ar-Go-Me); 3, Maxillomandibular plane angle; 4, FH to mandibular plane angle; 5, SN to mandibular plane angle; 6, SNA angle; 7, SNB angle; 8, ANB angle; 9, H_{axis}-MP angle.

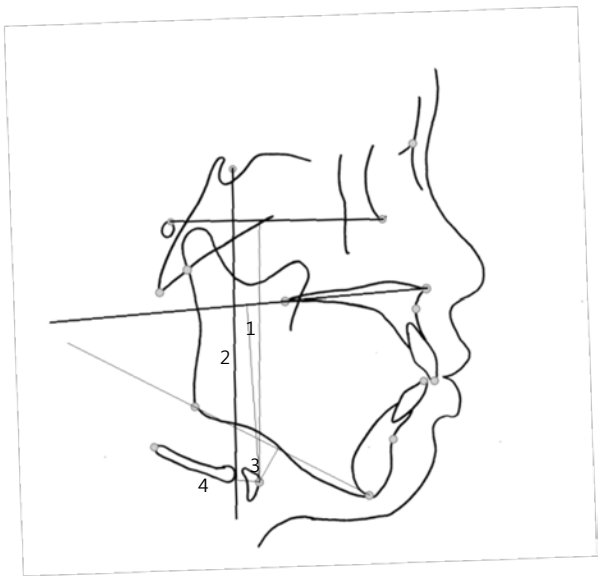

Fig 3. Linear measurements used in the study: 1, H to FH; 2, H to PP; 3, H to MP; 4, H to S_{per}.

Table II. Test of significance of difference between means of subjects with normal overbite and no degenerative joint disease(group 1), and those with severe anterior open bite and degenerative joint disease(group 2)

Variables	Group 1 (n=20)	Group 2 (n=20)	Significance
Skeletodental measurements			
Gonial angle (°)	119.5 ± 6.9	123.6 ± 3.8	*
Articular angle (°)	155.0 ± 7.6	158.7 ± 7.0	NS
SNA angle (°)	80.5 ± 2.4	79.1 ± 2.9	NS
SNB angle (°)	76.1 ± 3.6	73.6 ± 2.8	**
ANB angle (°)	5.4 ± 1.9	5.5 ± 2.0	NS
FMA (°)	28.4 ± 5.9	35.9 ± 5.6	**
SN to mandibular plane angle (°)	38.4 ± 5.3	46.3 ± 4.9	**
Maxillomandibular plane angle (°)	27.8 ± 5.4	36.1 ± 4.6	**
Overbite (mm)	1.37 ± 1.7	-4.07 ± 1.3	**
Overjet (mm)	3.20 ± 1.6	5.53 ± 2.1	**
Hyoid bone position			
Hyoidale to FH plane (mm)	88.0 ± 4.6	90.1 ± 6.2	NS
Hyoidale to palatal plane (mm)	60.6 ± 4.5	61.7 ± 5.3	NS
Hyoidale to mandibular plane (mm)	8.5 ± 6.1	10.6 ± 4.6	NS
Hyoidale to S_{per} (mm)	12.4 ± 6.6	9.0 ± 6.0	NS
H_{axis} ∠ mandibular plane (°)	14.5 ± 10.0	18.3 ± 10.5	NS

NS, Not significant; *P < .05, **P < .01.

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국문초록

목적: 골격성 II급 환자에서 퇴행성 턱관절질환을 가진 중등도 이상 개방교합군과 정상 턱관절 및 정상피개교합군을 나누어, 설골의 수평적, 수직적 위치, 도는 각도의 차이를 비교하였다.

방법: 표본은 골격성 II급 부정교합 (ANB > 3) 으로 진단받은 40명의 성인 여성을 대상으로 하였고 퇴행성 턱관절질환 및 개방교합이 관찰되는지의 여부에 따라 두 집단으로 나누었다. Group 1은 정상 턱관절 및 정상 피개교합인 골격성 II 집단으로 (n = 20, age = 24.72 ± 7.48) 자기공명 영상에서 관절원반의 변위가 나타나지 않고 측모두부계측방사선 사진으로 측정한 overbite가 0 mm 이상이다. Group 2는 퇴행성 턱관절질환을 동반한 심한 개방교합이 있는 골격성 II급 환자로서 (n = 20, age = 25.65 ± 7.14) 측모두부계측방사선사진
으로 측정한 overbite가 - 2.5 mm 이하이다. 측모두부계측방사선 사진을 계측하여 주위 구조물에 대한 설골의 위치 관계를 측정하였으며, 이로부터 얻어진 데이터를 비교하기 위해 독립 표본 T-검정이 사용되었다.

결과: 퇴행성 턱관절질환을 가진 중등도 이상의 골격성 II급 개방교합 환자와 정상 턱관절 및 정상피개교합인 골격성 II급 환자 사이에 설골의 수직적, 수평적 위치나 각도의 유의할 만한 차이는 발견되지 않았다.