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Characteristics of Skeletodental Pattern in High Angle Cases

Sang-Cheol Kim[1] and Kyung-Wha Kang[b], Kyung Whan Lee[3]

The patient with an anterior open bite has one of the most difficult orthodontic problem to correct. Previous studies have yielded different conclusions as to exactly where the morphologic problems associated with vertical dysplasia- high angle cases are located.

In order to identify the cephalometric features of high angle cases and highlight the measurements that characterize high angle cases, 109 pretreatment cephalograms, 35 high angle, 37 average angle, and 37 low angle cases, were analyzed and compared statistically.

As the mandibular plane was steeper, the anterior facial height, especially lower anterior facial height, became greater, and the posterior facial height became smaller. All the dentoalveolar vertical dimensions, especially in upper, increased. And all the skeletal angular measurements increased. Especially Lower gonial angle had most positive correlation to mandibular plane angle. Upper incisor was lingually inclined, and lower incisor was labially inclined in high angle cases.

Key Words : high angle case, cephalometric analysis

The patient with an anterior open bite has one of the most difficult orthodontic problem to correct.[1] Anterior open bite is a developmental abnormality caused by a combination of dental and skeletal factors. These patients exhibit a typical appearance with a long ovoid face and increased lower facial third proportion.[2-4] The alar base is often narrow and the lips are incompetent with increased upper incisor exposure. In profile, the nose is usually prominent but with mild paranasal depression. The lower lip may be everted or attempting to achieve lip competence by straining the mentalis muscle. The chin is commonly reduced with a high mandibular plane angle.

These classical facial features may alternatively be classified as long-face syndrome with open bite.[5] Because the disproportionately long lower face is often accompanied by an open bite, this has also been labeled "skeletal open bite." This terminology has led to confusion in the literature since samples of persons suspected of having vertical problems have been chosen on the basis of overbite or open bite,[6,7] or mandibular plane angle.[8] Not all long-faced patients have open bite and not all open bite patients are long faced.[5] Not surprisingly, these studies have yielded different conclusions as to exactly where the morphologic problems associated with vertical dysplasia- high angle cases are located.

Many authors attempted to categorize the skeletal characteristics of high angle cases by cephalometric methods.[9-16] In contrast to the well-known soft tissue features, the skeletal features varied between studies

1) Professor, Department of Orthodontics, College of Dentistry, Wonkwang University

2) Postgraduate student, Department of Orthodontics, College of Dentistry, Wonkwang University

3) Postgraduate student, Department of Orthodontics, college of Dentistry, Wonkwang University

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Table 1. SN-GoGn angle for subdivision of subjects

Groups	Males (n=45)	Females (n=64)
High angle	≥ 35.76 °	≥ 38.46 °
Average angle	35.75 °~ 24.83 °	38.45 °~ 28.15 °
Low angle	< 24.82 °	≤ 28.14 °

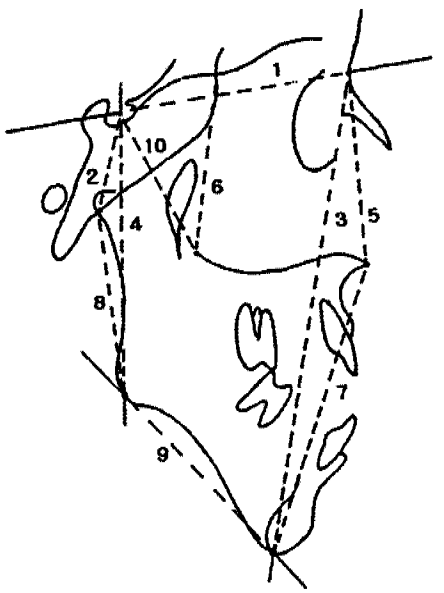

Fig. 1. Linear measurements of skeletal pattern.

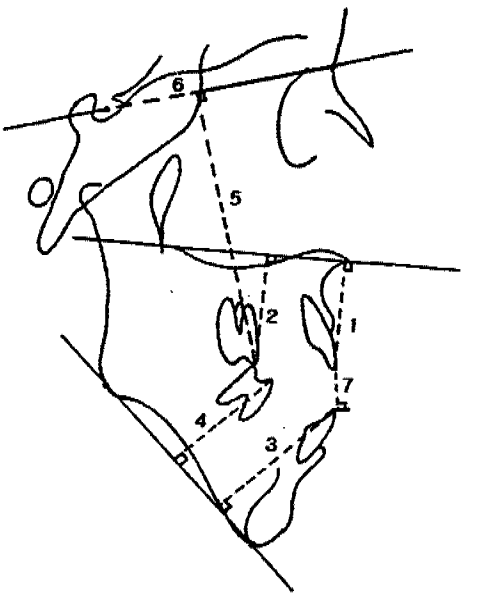

Fig. 2. Linear measurements of dentoalveolar pattern.

and were sometimes contradictory.

The aim of this study is to identify the cephalometric features of high angle cases and highlight the measurements that characterize high angle cases.

MATERIALS AND METHODS

The subjects in this study were chosen from skeletal Class III patients who presented to the Department of Orthodontics, College of Dentistry, Wonkwang University. It was comprised of 109 subjects, 45 males and 64 females, with an age range of 17 to 38 years (22 years in mean) in males, 17 to 37 years (22 years in mean) in females.

The subjects were divided into three vertical types according to SN-GoGn angle. High angle group was supposed to have over 1 S.D. greater SN-GoGn than the Korean mean (30.29±5.47 in male, 33.30±5.16 in female), whereas low angle group had under 1 S.D. smaller than the Korean mean (Table 1). The subjects were subdivided into 35 high angle, 37 average angle, and 37 low angle cases.

The pretreatment cephalometric radiographs of subjects in this study were traced manually. In total, 21 skeletal and 11 dentoalveolar features were measured. Angular and linear measurements were calculated the nearest 0.01 degree, 0.01 mm, respectively. To minimize the error of the method, the measurements were taken twice. The measurements adopted in this study are illustrated in Fig. 1 to 4, and defined in Tables 2 to 5.

Intergroup mean differences for each measurement were assessed, by analysis of variance, between the

Table 2. Linear measurements of skeletal pattern.

Name	No. Code	Definition
Anterior cranial base	1. S-N	The distance between sella and nasion
Posterior cranial base	2. S-AR	The distance between sella and articulare
Anterior facial height	3. AFH	The distance between nasion and menton
Posterior facial height	4. PFH	The distance between sella and gonion
Upper anterior facial height	5. UAFH	The distance between nasion and anterior nasal spine
Upper posterior facial height	6. UPFH	The distance between ethmoidal registration point and posterior nasal spine
Lower anterior facial height	7. LAFH	The distance between anterior nasal spine and menton
Lower posterior facial height	8. LPFH	The distance between articulare and gonion
Mandibular body length	9. GO-ME	The distance between gonion and menton
Sella to posterior nasal spine	10. S-PNS	The distance between sella and posterior nasal spine

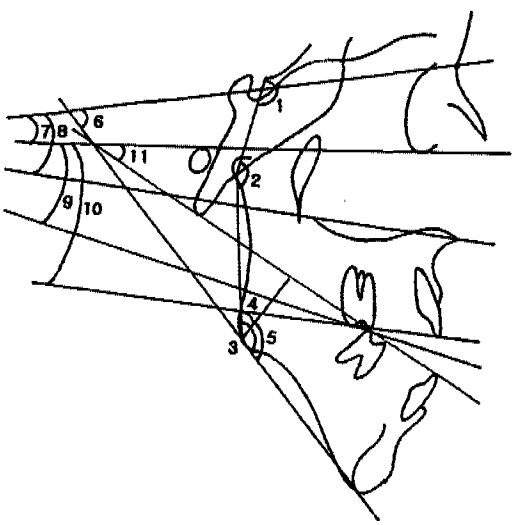

Fig. 3. Angular measurements of skeletal pattern.

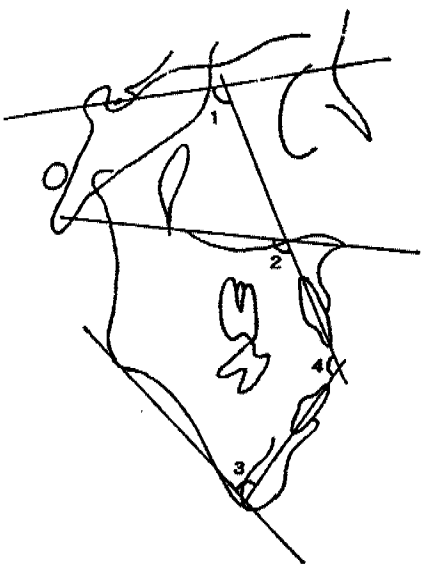

Fig. 4. Angular measurements of dentoalveolar pattern.

three groups of high, average, and low angle. It was followed by Duncan's Multiple Range comparisons between groups.

Sexual dimorphism was investigated by Students' *t* test in three groups respectively.

Pearson correlation coefficients were calculated to assess the relative correlation of the other measurements to the SN-GoGn angle.

RESULTS

Comparison of each measurement between three groups(Table 6)

Three skeletal linear measurements, the anterior facial height and the lower anterior facial height, were significantly greater in that order of high angle,

Table 3. Linear measurements of dentoalveolar pattern.

Name	*No. Code*	*Definition*
Upper anterior dental height	1. UADH	Perpendicular distance between upper central incisal edge and the palatal plane
Upper posterior dental height	2. UPDH	Perpendicular distance between mesiobuccal cusp tip of maxillary first molar to the palatal plane
Lower anterior dental height	3. LADH	Perpendicular distance between lower central incisal edge and the mandibular plane
Lower posterior dental height	4. LPDH	Perpendicular distance between the mesiobuccal cusp tip of mandibular first molar to the mandibular plane
Upper first molar to sella in vertical plane	5. U6 SV	Distance between the mesiobuccal cusp tip of maxillary first molar to sella along a line perpendicular to SN
Upper first molar to sella in horizontal plane	6. U6-SH	Distance between the mesiobuccal cusp tip of maxillary first molar to sella along a line parallel to SN
Overbite	7. OB	Distance between the tip of the lower central incisor to the upper central incisal edge along a line perpendicular to Frankfort horizontal

average angle, and low angle group. A skeletal linear measurements, the upper anterior facial height, was significantly greater in both high angle and average angle group than in low angle group. Posterior facial height and lower posterior facial height were smallest in high angle group.

Two dentoalveolar linear measurements, the upper anterior dental height and the upper posterior dental height were significantly greater in that order of high angle, average angle, and low angle group. Two dentoalveolar linear measurements, the lower anterior dental height and the upper first molar to sella in vertical plane, were significantly greater in both high angle and average angle group than in low angle group. Overbite greatest in low group.

Five skeletal angular measurements, the gonial angle, the lower gonial angle, the mandibular plane angle, the Frankfurt horizontal to functional occlusal angle, and the Frankfurt horizontal to mandibular occlusal angle, were significantly greater in that order of high angle, average angle, and low angle group. Two skeletal angular measurements, the anterior cranial base to Frankfurt horizontal angle and to palatal angle, were significantly greater in high angle group than in both average and low angle group. The Frankfurt horizontal to maxillary occlusal angle was significantly greater in both high angle and average angle group than in low angle group.

Two dentoalveolar angular measurements, the upper incisor to cranial base angle and the upper incisor to palatal plane angle, were significantly smallest in high angle group. But, the lower incisor to mandibular plane angle was smallest in low angle group.

Correlation of the other measurements to Sn-GoGn angle(Table 7)

Those which had positive correlation to Sn-GoGn angle were as follows: three skeletal linear measurements-the anterior facial height, the upper anterior facial height, and the lower anterior facial height, four dentoalveolar linear measurements-the upper anterior dental height, the upper posterior dental height, the lower anterior dental height and the upper first molar to sella in vertical plane, seven skeletal angular measurements- the gonial angle, the lower gonial angle, the anterior cranial base to Frankfurt horizontal angle, the anterior cranial base to palatal angle, the Frankfurt horizontal to functional occlusal angle, the Frankfurt horizontal to maxillary occlusal angle, and the Frankfurt horizontal to mandibular occlusal angle, and

Table 4. Angular measurements of skeletal pattern.

No. code	*Definition*
1. N S-AR	The angle between the nasion-sella line and the sella-articulare line
2. S AR GO	The angle between the sella-articulare line and the articulare gonion line
3. GOA	The angle formed by the mandibular plane and a tangent to the posterior border of ramus through articulare
4. UGOA	The angle between the tangent to the posterior border of ramus through articulare and the line joining nasion and gonion
5. LGOA	The angle between the mandibular plane and the line joining nasion and gonion
6. SN-GOGN	The angle between the sella-nasion line and the gonion-gnathion line
7. SN FH	The angle between the sella-nasion line and the Frankfort horizontal line
8. SN-PP	The angle between the sella-nasion line and the palatal plane
9. FH-FOP	The angle between the Frankfort horizontal line and the functional occlusal plane
10. FH-MX OP	The angle between the Frankfort horizontal line and the maxillary occlusal plane
11. FH-MN OP	The angle between the Frankfort horizontal line and the mandibular occlusal plane

Table 5. Angular measurements of dentoalveolar pattern.

No. code	*Definition*
1. U1-SN	The angle between the sella-nasion line and the long axis of the upper incisor
2. U1-PP	The angle between the palatal plane and the long axis of the upper incisor
3. L1 MP	The angle between the mandibular plane and the long axis of the lower incisor
4. I-I	The angle between the long axis of upper and lower incisors

a dentoalveolar angular measurement- the lower incisor to mandibular plane angle.

Those which had negative correlation to Sn-GoGn angle were as follows: two skeletal linear measurements- the posterior facial height, and the lower posterior facial height, two dentoalveolar linear measurements- the upper first molar to sella in horizontal plane and overbite, two dentoalveolar angular measurements- the upper incisor to cranial base angle and palatal plane angle.

Sexual dimorphism(Table 7-10)

Nine skeletal linear measurements, the anterior cranial base, the posterior cranial base, the anterior facial height, the posterior facial height, the upper anterior facial height, and the upper posterior facial height, the lower posterior facial height, the mandibular body length, and the sella to posterior nasal spine, were significantly greater in the male subjects in each group.

Three dentoalveolar linear measurements, the lower anterior dental height, the lower posterior dental height, and the upper first molar to sella in vertical plane, were significantly greater in the male subjects in each group. Upper posterior dental height was significantly greater, whereas the overbite was significantly smaller, in the male subjects of high angle group. The overbite was significantly greater in the male subjects of average

Table 6. Differences of skeletodental measurements between groups

Variables	High group(H) Mean	Average group(A) Mean	Low group(L) Mean	F value	Duncan grouping
Linear measurements (mm)					
Skeletal					
AFH	138.33	132.93	123.20	38.21 ***	H>A>L
PFH	83.30	86.86	89.12	7.26 **	H<AL
UAFH	59.67	58.72	56.29	6.80 **	HA>L
LAFH	79.60	75.03	67.03	53.85 ***	H>A>L
LPFH	50.24	53.52	56.23	15.58 ***	H<A<L
Dento-alveolar					
UADH	32.14	30.18	27.56	29.72 ***	H>A>L
UPDH	27.52	26.45	24.42	17.62 ***	H>A>L
LADH	46.20	46.56	42.64	14.26 ***	HA>L
LPDH	37.56	38.10	36.39	2.87	
U6-SV	80.74	79.85	76.34	7.79 ***	HA>L
U6-SH	28.85	34.78	36.15	18.30 ***	H<AL
OB	-0.95	0.85	2.41	22.98 ***	H<A<L
Angular measurements (°)					
Skeletal					
GOA	130.90	126.11	117.71	59.66 ***	H>A>L
LGOA	83.79	78.44	70.39	138.62 ***	H>A>L
SN GOGN	40.97	32.55	22.13	357.94 ***	H>A>L
SN-FH	8.28	6.66	6.17	6.70 **	H>AL
SN PP	11.02	9.40	7.98	8.85 ***	H>AL
FH-FOP	13.90	10.83	7.06	33.58 ***	H>A>L
FH-MX OP	11.38	9.54	7.81	6.37 **	HA>L, H>AL
FH-MN OP	12.41	7.52	4.10	55.77 ***	H>A>L
Dento-alveolar					
U1-SN	106.42	112.35	113.78	10.37 ***	H<AL
U1-PP	116.96	121.18	120.78	4.19 *	H<AL
L1-MP	46.00	46.26	42.47	13.18 ***	HA>L

(* : p<0.05, ** : p<0.01, *** : p<0.001)

angle group. The upper first molar to sella in horizontal plane was significantly greater in the male subjects of low angle group.

A skeletal angular measurements, the Frankfurt horizontal to maxillary occlusal angle, was significantly smaller in the male subjects of high angle group. Two skeletal angular measurements, the mandibular plane angle, and the anterior cranial base to Frankfurt horizontal angle, were significantly smaller in the male subjects of low angle group.

A dentoalveolar angular measurement, the lower incisor to mandibular plane angle, was significantly greater in the male subjects of all groups.

Table 7. Correlations of the other measurements to SN-GoGn angle

Variables	Correlation coefficients
Linear measurements	
Skeletal	
AFH	0.61 ***
PFH	-0.43 ***
UAFH	0.26 **
LAFH	0.71 ***
LPFH	-0.50 ***
Dento-alveolar	
UADH	0.66 ***
UPDH	0.51 ***
LADH	0.36 ***
U6-SV	0.29 **
U6 SH	-0.52 ***
OB	0.53 ***
Angular measurements	
Skeletal	
GOA	0.77 ***
LGOA	0.89 ***
SN-FH	0.34 ***
SN-PP	0.36 ***
FH-FOP	0.68 ***
FH-MX OP	0.35 ***
FH-MN OP	0.73 ***
Dento-alveolar	
U1-SN	-0.39 ***
U1-PP	-0.25 ***
L1-MP	0.35 ***

(** : p<0.01, *** : p<0.001)

Table 8. Sexual dimorphism in high angle group

Variables	Female (n=17) Mean ± S.D.	Male (n=18) Mean ± S.D.	t value
Linear Measurements (mm)			
Skeletal			
S-N	67.33 ± 2.49	67.67 ± 3.33	-2.36 *
S-AR	34.34 ± 3.85	39.37 ± 4.20	-3.70 ***
AFH	130.75 ± 5.31	145.48 ± 3.48	-9.65 ***
PFH	77.71 ± 5.00	88.58 ± 3.89	-7.16 ***
UAFH	56.15 ± 2.47	63.00 ± 3.07	-7.29 ***
UPFH	51.25 ± 3.08	56.27 ± 2.37	5.40 ***
LAFH	75.71 ± 3.89	83.28 ± 3.92	-5.73 ***
LPFH	47.15 ± 4.70	53.16 ± 4.79	-3.75 ***
GO-ME	76.26 ± 3.12	84.40 ± 5.66	-5.30 ***
S-PNS	46.31 ± 2.57	52.72 ± 2.22	-7.87 ***
Dento-alveolar			
UPDH	25.96 ± 2.53	28.99 ± 2.22	-3.75 ***
LADH	44.58 ± 2.72	47.72 ± 3.99	2.73 *
LPDH	36.08 ± 2.78	38.95 ± 3.23	-3.75 **
U6-SV	75.67 ± 3.76	85.93 ± 1.86	-9.73 ***
U6-SH	27.86 ± 3.97	29.77 ± 5.91	-1.13
OB	0.07 ± 1.75	1.91 ± 2.62	2.64 *
Angular measurement (°)			
Skeletal			
SN-GOGN	40.94 ± 2.78	41.01 ± 4.47	-0.06
SN-FH	8.30 ± 2.35	8.26 ± 2.45	0.05
FH-MX OP	13.14 ± 3.41	9.73 ± 5.60	2.19 *
Dento-alveolar			
L1-MP	44.46 ± 2.86	47.45 ± 4.20	-2.47 *

(* : p<0.05, ** : p<0.01, *** : p<0.001)

DISCUSSION

Although many authors attempted to categorize the skeletal characteristics of high angle cases, these studies have yielded different conclusions as to exactly where the morphologic problems associated with vertical dysplasia.[9-16] Especially skeletal and dental features were not differentiated in selection of subjects. Vertical skeletal pattern, rather than dental parameters as like open bite, should be basis of grouping of subjects.

On the basis of Korean norms of Sn-GoGn, the

Table 9. Sexual dimorphism in average angle group

Variables	Female (n=21) Mean ± S.D.	Male (n=16) Mean ± S.D.	t value
Linear Measurements (mm)			
Skeletal			
S-N	68.30 ± 2.84	71.79 ± 3.84	-2.98 **
S-AR	36.30 ± 2.98	38.96 ± 3.00	-2.69 *
AFH	128.87 ± 5.24	138.25 ± 6.50	-4.72 ***
PFH	82.88 ± 4.02	92.10 ± 5.11	-5.95 ***
UAFH	56.20 ± 3.06	62.02 ± 2.78	-6.04 ***
UPFH	51.55 ± 3.77	56.04 ± 4.25	3.34 **
LAFH	73.68 ± 3.78	76.80 ± 6.00	-6.04 ***
LPFH	50.25 ± 4.29	57.81 ± 3.88	-3.87 ***
GO-ME	78.23 ± 4.38	82.84 ± 3.27	-3.67 ***
S-PNS	47.81 ± 2.98	52.83 ± 3.87	-4.31 ***
Dento-alveolar			
UPDH	26.25 ± 2.00	26.71 ± 2.25	-0.65
LADH	44.91 ± 2.64	48.74 ± 3.79	3.46 **
LPDH	36.61 ± 2.12	40.07 ± 3.44	-3.51 **
U6-SV	77.20 ± 3.83	83.33 ± 4.42	-4.42 ***
U6-SH	33.56 ± 4.14	36.39 ± 6.09	-1.60
OB	0.16 ± 2.16	1.75 ± 2.12	-2.23 *
Angular measurement (°)			
Skeletal			
SN GOGN	33.85 ± 1.30	30.86 ± 1.66	5.94 ***
SN-FH	7.42 ± 2.25	5.66 ± 2.19	2.39 *
FH-MX OP	8.63 ± 4.01	10.73 ± 3.95	-1.59
Dento-alveolar			
L1-MP	44.52 ± 2.58	48.55 ± 3.86	3.61 **

(* : p<0.05, ** : p<0.01, *** : p<0.001)

Table 10. Sexual dimorphism in low angle group

Variables	Females (n=26) Mean ± S.D.	Males (n=11) Mean ± S.D.	t value
Linear Measurements (mm)			
Skeletal			
S-N	68.28 ± 3.27	71.38 ± 2.55	-3.14 **
S-AR	36.46 ± 3.37	40.07 ± 4.11	-2.57 *
AFH	120.82 ± 4.86	128.82 ± 5.32	-4.29 ***
PFH	86.47 ± 4.12	95.36 ± 5.31	-4.95 ***
UAFH	54.62 ± 1.94	60.23 ± 3.24	-5.36 ***
UPFH	50.95 ± 2.52	55.51 ± 2.99	-4.44 ***
LAFH	66.05 ± 5.49	69.35 ± 3.54	-2.18 *
LPFH	54.54 ± 3.74	60.20 ± 5.17	-2.99 **
GO-ME	78.88 ± 3.48	82.52 ± 4.83	-2.26 *
S-PNS	47.52 ± 2.33	52.58 ± 3.37	-4.54 ***
Dento-alveolar			
UPDH	24.24 ± 1.84	24.84 ± 1.67	-2.64
LADH	41.72 ± 2.60	44.83 ± 2.70	-3.24 **
LPDH	35.66 ± 2.63	38.13 ± 2.59	-0.98 *
U6-SV	74.52 ± 3.01	80.63 ± 3.31	-5.27 ***
U6-SH	34.72 ± 5.14	39.52 ± 6.59	-2.18 *
OB	2.31 ± 1.55	2.64 ± 1.57	-0.60
Angular measurement (°)			
Skeletal			
SN-GOGN	22.62 ± 3.05	20.98 ± 2.80	1.59
SN-FH	6.58 ± 2.93	5.22 ± 2.54	1.42
FH-MX OP	7.73 ± 3.96	8.00 ± 3.06	-0.22
Dento-alveolar			
L1 MP	41.60 ± 2.62	44.55 ± 2.67	-3.09 **

(* : p<0.05, ** : p<0.01, *** : p<0.001)

subjects of this study were subdivided into three groups- high, average, and low angle group. Grouping like this would be an acceptable one in considering the vertical skeletal dysplasia.

Most of skeletal linear measurements were significantly larger in high angle group. Especially the correlation of lower gonial angle to Sn-GoGn angle was significantly high. These findings generally coincided with most reports.[17 24] Although small posterior facial height in this study, Ellis et al. found no significant

difference in posterior facial height between groups.[25]

All the dentoalveolar vertical dimensions were greater in high angle group. Especially upper anterior dental height was strongly correlated to Sn GoGn angle. These findings were partially in coincidence with the study of Janson et al.[26] which showed that the dentoalveolar heights are significantly different between faces with excessive, normal, and short lower anterior facial height and the upper teeth presented a higher correlation to the UAFH/LAFH ratio than the lower teeth.

Most of skeletal angular measurements were significantly larger in high angle group. The lower gonial angle had especially significant correlation to Sn-GoGn angle. These are consistent with the findings of Kim and Sohn,[14] Lee and Yang,[15] Bae and Ryu,[16] Sassouni and Nanda,[18] and Hapak,[20] indicating a downward growth of mandible as a key factor in the formation of high angle.

In regard to the incisal inclination of the maxillary and mandibular teeth, the lower incisors were inclined more labially, whereas the upper incisors were inclined more lingually. This findings were contradictory to Tsang's study.[22]

From this study, many measurements showed the differences between male and female subjects. Sexually dimorphic measurements were nearly skeletal linear ones. This was consistent with the findings of Cooke and Wei[27] who noted that angular measurements were similar between sexes, whereas several linear measurements had greater readings in male subjects. The significance of differences was tended to be great in high angle group. This suggests that sexual dimorphism may be exaggerated by dentofacial deformities. All dentoalveolar height were greater in male subjects, which coincided with the study of Janson et al.[26]

CONCLUSION

In order to identify the cephalometric features of high angle cases and highlight the measurements that characterize high angle cases, 109 pretreatment cephalograms, 35 high angle, 37 average angle, and 37 low angle cases, were analyzed and compared statistically. The results were as follows:

1. As the mandibular plane was steeper, the anterior facial height, especially lower anterior facial height, became greater, and the posterior facial height became smaller.
2. As the mandibular plane was steeper, all the dentoalveolar vertical dimensions, especially in upper, increased.
3. As the mandibular plane was steeper, all the skeletal angular measurements increased. Especially Lower gonial angle had most positive correlation to mandibular plane angle.
4. As the mandibular plane was steeper, upper incisor was lingually inclined, and lower incisor was labially inclined.

REFERENCES

1. Jones OG. A cephalometric study of 32 North American black patients with anterior open bite. Am J Orthod Dentofac Orthop 1989;95:289-96.
2. Bell WH. Correction of skeletal type of anterior open-bite. J Oral Surg 1971;29:706-14.
3. Epker BN, Fish LC. Surgical-orthodontic correction of open-bite deformity. Am J Orthod 1977;71:278-99.
4. Proffit WR, Bell WH. Surgical correction of dentofacial deformities. Philadelphia: WB Saunders; 1980. pp 1062-3.
5. Schendel SA, Eisenfeld J, Bell WH. The long-face syndrome: vertical maxillary excess. Am J Orthod 1976;70: 398-408.
6. Richardson A. Skeletal factors in anterior open-bite and deep over-bite. Am J Orthod 1969;56: 114-27.
7. Nahoum H. Vertical proportions: a guide for prognosis and treatment in anterior open bite. Am J Orthod 1977;72: 128-46.
8. Isaacson JR, Isaacson RJ, Spiedel TM, Waring RW. Extreme variation in vertical facial growth and associated variation in skeletal and dental relationships. Angle Orthod 1971;41:219-229.
9. Jarabak JR. Open bite skeletal morphology. Fortschr Kieferorthop 1983;44:122-33.
10. Cangialosi TJ. Skeletal morphologic features of anterior open-bite. Am J Orthod 1984;85:28-36.
11. Ellis E, McNamara JA. Components of adult class III open bite malocclusion. Am J Orthod 1984;42: 277-90.
12. Nanda SK. Patterns of vertical growth in the face. Am J

Orthod Dentofac Orthop 1988;93:103 16.
13. Denison TF, Kokich VG, Shapiro PA. Stability of maxillary surgery in open bite versus non open bite malocclusion. Angle Orthod 1989;59:5 10.
14. Kim YW, Sohn BH. A cephalometric study of dentofacial morphology in relation with facial growth pattern. Kor J Orthod 1985;15:239 247.
15. Lee TJ, Yang WS. A study on the correlationship between overbite depth and skeletal factors of craniofacial complex. Kor J Orthod 1985;15:279-289.
16. Bae KW, Ryu YK. A cephalometric study on the vertical and anteroposterior dysplasia of the craniofacial skeleton. Kor J Orthod 1988;18:175-188.
17. Subtelny JD, Sakuda M. Open-bite: diagnosis and treatment. Am J Orthod 1964;50:337-56.
18. Sassouni V, Nanda S. Analysis of dentofacial vertical proportions. Am J Orthod 1964;50:801-23.
19. Lopez-Gavito G, Little RM, Joondeph DR. Anterior open bite malocclusion: longitudinal 10-year post-retention evaluation of orthodontically treated patients. Am J Orthod 1985;87:175 86.
20. Hapak FM. Cephalometric appraisal of the open-bite case. Angle Orthod 1964;34:65-72.
21. Frost DE, Fonseca RJ, Turvery TA, Hall DJ. Cephalometric diagnosis and surgical orthodontic correction of apertognathia. Am J Orthod 1980;78:657-69.
22. Tsang WM, Cheung LK, Samman N. Cephalometric characteristics of anterior bite in a southern Chinese population. Am J Orthod Dentofac Orthop 1998;113:165-72.
23. Nahoum HI, Horowitz SL, Benedicto EA. Varieties of anterior open-bite. Am J Orthod 1972;61:486-92.
24. Enunlu N. Palatal and mandibular plane variations in open-bite cases with varying aetiology. Trans Eur Orthod Soc 1974;165-71.
25. Ellis E, McNamara JA, Lawrence TM. Components of adult Class II open bite malocclusion. J Oral maxillofac Surg 1985;43:92 105.
26. Janson GRP, Metaxas A, Woodside DG. Variation in maxillary and mandibular molar and incisor vertical dimension in 12-year-old subjects with excess, normal, and short lower anterior face height. Am J Orthod Dentofac Orthop 1994;106:409-18.
27. Cookc MS, Wei SHY. Cephalometric standards for the southern Chinese. Eur J Orthod 1988;10:264-72.

국문초록

수직적으로 긴 안모의 두부방사선계측학적 특징

원광대학교 치과대학 교정학교실

김 상 철·강 경 화·이 경 환

전치부 개교를 동반하는 수직적으로 긴 안모는 임상교정에서 치료하기 어려운 증례중 하나이다. 이런 증례의 특징을 찾기 위한 많은 시도가 있었으나 골격 및 치성 요소에 대한 개별 파악이 이루어지지 않음으로써 일관된 설명 없이 혼돈 만 초래하게 되었을 뿐이다. .

수직적으로 긴 안모의 두부방사선계측학적 특징을 확인하기 위하여 Sn-GoGn 각에 따라 구분된 109개의 치료 전 두부방사선사진 (35 수직군, 37 평균군, 37 수평군)을 분석하여 비교한 결과 다음과 같은 결과를 발견하였다.

수직적으로 긴 안모일수록 전안모고경, 특히 하전안모고경이 증가하며 후안모고경은 짧아지고, 모든 치조골, 특히 상악에서의 두께가 깊어진다. 또한 모든 골격적 각계측항목이 커지는데 특히 lower gonial angle의 상관성이 컸다. 한편 상악 전치는 점점 설측경사되었고 하악 전치는 순측경사되는 경향을 보였다.

주요 단어 : 수직적으로 긴 안모, 두부방사선계측