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CEPHALOMETRIC CHARACTERISTICS OF OPEN-BITE CASES WITH DEGENERATIVE JOINT DISEASE(DJD) OF TMJ*

Tae-Woo Kim, D.D.S., M.S.D., Ph.D.

The purpose of this study is to investigate the cephalometric characteristics of the open-bite patients with DJD of TMJ. The DJD open-bite cases were compared with normal samples and Class II open-bite cases with normal TMJ respectively. Twenty three open-bite patients with bilateral DJD of TMJ(13.9~35.3 years old, Group I) were selected from the Department of Orthodontics, SNUDH. Group II consisted of thirteen Class II open-bite cases(13.2~27.4 years old) with no TMD signs/symtoms and good condylar shapes. Group III samples were the forty eight healthy dental students who have Class I molar relationships with no history of orthodontic treatment, good facial balance and no TMD symptoms(20.0~26.8 years old). First, sixty measurements in the lateral cephalometric radiographs and analysis of variance($p<0.05$, Scheffe) were used to compare these three groups. The seven measurements showed significant difference($P<0.05$) between Group I and Group II. After analysis of variance, six of them were used for the discriminant analysis(Wilks' stepwise analysis) and the discrminant function for Group I/Group II was obtained. The results and conclusions were as follows : In most of the measurments, Group I and Group II showed the same skeletal and dental characteristics. But seven of the sixty measurements(FH-PP angle, SNB, FH-ArGo angle, articulare angle, gonial angle, upper gonial angle and Ar-Go length) were significantly different($p<0.05$) between Group I and Group II. These differences 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. The resulting discriminant function was : $D = -0.120X_1 + 0.066X_2 + 0.144X_3 - 0.058X_4 + 2.000$, where X_1=ArGo length(mm), X_2=SArGo angle(degree), X_3=FH-PP angle(degree), X_4=Gonial angle(degree). Mean of the group centroids was -0.555 and percent of the "grouped" cases correctly classified was 88.89%.

Key Words : Degenerative joint disease, Temporomandibular joint, Open-bite, Class II, Discriminant analysis

Most of DJD patients referred to Department of Orthodontics at Seoul National University Dental Hospital(SNUDH) showed Class II open-bite skeletal and dental morphology, about which the author discussed in the previous paper[1]. DJD patients' occlusions were very unstable and in some cases the overbite increased again after correction of open-bite with orthodontic and/or orthognathic surgery. This strong relapse tendency drived me to search various methods for screening DJD of TMJ. From this study, it is suggested that lateral cephalograms and their analysis may be one of the supplemental aids for differential diagnosis of Class II skeletal open-bite cases and for detecting the quiescent DJD of TMJ.

DJD is a degenerative joint disorder of synovial joints, often associated with minor inflammatory changes. It has been thought that the peak onset of DJD is around the age of 50 years and it is therefore a disorder of middle age and beyond, in contrast to rheumatoid arthritis which presents somewhat earlier[3]. But recent studies and case reports suggested that TMJ degenerations are not uncommon in children and adolescents[3,5]. It means that there are some possibilities

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for orthodontists to meet DJD patients in their clinics.

Loberg showed DJD open-bite cases which were treated with a combined orthodontic/surgical approach[2]. Rönning et. al. and Yoshimura analyzed the facial skeletal pattern of juvenile arthritis[4,6]. Mandible was affected in size and position, but maxilla and cranial base was normal. My previous study showed that open-bite patients with TMJ DJD have some characteristics of Class II open-bite skeletal pattern[1]. And in this study, open-bite DJD cases were collected and compared cephalometrically with Class II open-bite group without TMD.

Purposes of this study are (1) to investigate the cephalometric characteristics of the open-bite patients with bilateral DJD of TMJ, (2) to compare it with those Class II open-bite cases with normal TMJ, and (3) to get the discriminant function for screening DJD open-bite pateients from Class II open-bite patients.

SAMPLES AND METHODS

Twenty three open-bite patients with bilateral DJD of TMJ(13.9~35.3 years old, Group I) were selected from the patients who visited Department of Orthodontics at SNUDH. Group II consisted of thirteen Class II open-bite cases(13.2~27.4 years old) without TMD signs/symtoms and good condylar shapes. Group III samples consisted of the forty eight healthy dental students who have Class I molar relationships without history of orthodontic treatment, good facial balance and no TMD symptoms(20.0~26.8 years old). First, sixty measurements in the lateral cephalometric radiographs and analysis of variance($p<0.05$, Scheffe) were used to compare these three groups. After analysis of variance, discriminant analysis was done to get the canonical discrminant function for Group I/Group II and to assess the anatomical differences between them. The seven measurements showed significant difference($P<0.05$) between two groups and six of them were used for the discriminant analysis(Wilks' stepwise analysis).

Group I ; Twenty three open-bite patients with DJD of TMJ ; 13.9~35.3 years old

Group II ; Thirteen Class II open-bite cases with no TMD symtoms and good condylar shapes ; 13.2~27.4 years old

Group III ; Forty eight healthy dental students who have Class I molar relationships, no history of orthodontic treatment, good facial balance and no TMD symptoms ; 20.0~26.8 years old

Table 1. Samples and Groups

	I		II		III	
	Male	Female	Male	Female	Male	Female
Number	4	19	3	10	25	23
Mean(SD)	20.94(5.45)		19.62(4.49)		23.70(1.58)	
Range	13.92~35.33		13.17~27.42		20.00~26.82	

Cephalometric Landmarks.

1. S(Sella Turcica) ; The midpoint of sella turcica, determined by inspection.
2. Na(Nasion) ; The intersection of the internasal suture with the nasofrontal suture in the midsagittal plane.
3. Or(Orbitale) ; The lowest point on the lower margin of the bony orbit.
4. Po(Porion) ; The midpoint of the upper margin of the bony external auditory meatus.
5. Ar(Articulare) ; The intersection between the external contour of the cranial base and the dorsal contour of the condylar head or neck.
6. Go(Gonion) ; The point which on the jaw angle is the most inferiorly, posteriorly, and outwardly directed.
7. Me(Menton) ; The lower most point on the symphysial shadow as seen in norma lateralis.
8. Gn(Gnathion) ; The point of symphysis located by bisection of the angle formed by the intersection of the mandibular base line and the facial line(N-Pog).
9. Pog(Pogonion) ; The most prominent or most anterior point of the bony chin deterinmed by inspection and seen from norma lateralis.
10. PNS(Posterior Nasal Spine) ; The tip of the posteior spine of the palatine bone in the hard palate.
11. ANS(Anterior Nasal Spine) ; The tip of the anterior nasal spine seen on the X-ray film from norma lataralis.
12. A(Subspinale) ; The deepest midline point on the premaxilla between the anterior nasal spine and prosthion(Downs).
13. B(Supramentale) ; The most posterior point in the concavity between infradentale and pogonion(Downs).
14. Im ; The middle point of the incisal overlap.

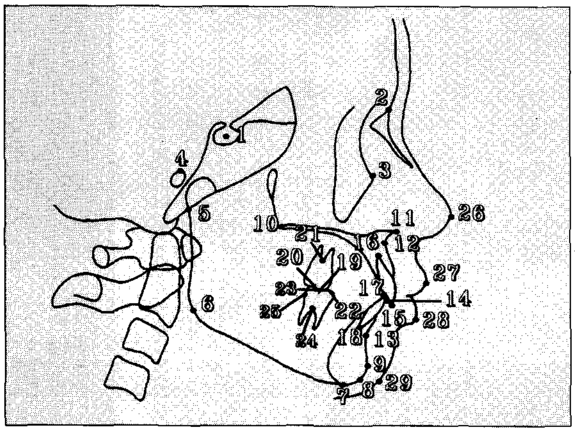

Fig. 1. Cephalometric landmarks.

15. UIE ; Upper Incisal Edge ; The incisal edge of the upper central incisor.
16. UIA ; Upper Incisal Apex ; The apex of the upper central incisor.
17. LIE ; Lower Incisor Edge ; The incisal edge of the lower central incisor.
18. LIA ; Lower Incisal Apex ; The apex of the lower central incisor.
19. U6B ; The mesiobuccal cusp tip of the upper first molar.
20. U6C ; The central groove of the upper first molar.
21. U6F ; The furcation area of the upper first molar.
22. L6B ; The mesiobuccal cusp tip of the lower first molar.
23. L6C ; The central groove of the lower first molar.
24. L6F ; The furcation area of the lower first molar.
25. U6D ; The distal surface of the upper first molar.
26. E ; Most anterior point on the end of the nose(Ricketts).
27. UL ; Most anterior point of the upper lip.
28. LL ; Most anterior point of the lower lip.
29. D ; Most anterior point on the soft tissue chin(Ricketts).

<u>*Linear, Angular Measurements and Ratios*</u>

1. Cranial Base
   1) SN ; Anterior cranial base length.
   2) SAr ; Posterior cranial base length.
   3) NSAr ; Saddle angle.
2. The Relation of Maxilla and Mandible to Cranial Base
   4) SN-PP ; The angle between SN plane and palatal plane.
   5) FH-PP ; The angle between FH plane and palatal plane.
   6) SN-GoMe
   7) SN-GoGn
   8) FMA ; Frankfort horizontal plane angle.
   9) FH-ArGo ; The angle between the FH plane and the ArGo plane.
   10) SArGo ; Articulare angle.
3. The Relation of Maxilla, Mandible and Occlusal plane
   11) PMA ; The angle between the palatal plane and the mandibular plane.
   12) SN-OP ; The angle between the SN plane and the occlusal plane.
   13) PP-MXOP ; The angle between the palatal plane and the maxillary occlusal plane.
   14) PP-MNOP ; The angle between the palatal plane and the mandibular occlusal plane.
   15) FH-MXOP ; The angle between the FH plane and the maxillary occlusal plane.
   16) FH-MNOP ; The angle between the FH plane and the mandibular occlusal plane.
4. The Size and Form of Mandible
   17) Gonial A ; Gonial angle.
   18) UGA ; Upper gonial angle.
   19) LGA ; Lower gonial angle.
   20) Ar-Go ; Ramus height.
   21) Go-Me ; Mandibular body length.
5. Vertical Heights
   22) AFH ; Anterior facial height(N-Me).
   23) PFH ; Posterior facial height(S-Go).
   24) PFH/AFH ; Facial height ratio(S-Go/N-Me).
   25) UAFH ; Upper anterior facial height(N-ANS).
   26) LAFH ; Lower anterior facial height(ANS-Me).
   27) UPFH ; Upper posterior facial height(S-PNS).
   28) LPFH ; Lower posterior facial height(PNS-Go).
   29) UAFH/AFH
   30) LAFH/AFH
   31) UAFH/LAFH
   32) UPFH/PFH
   33) LPFH/PFH
   34) UPFH/LPFH
6. Anteroposterior Relationship of Maxilla and Mandible
   35) SNA
   36) SNB
   37) ANB
   38) Angle of Convexity ; N-A-Pog(Downs)
7. Maxillary and Mandibular Incisor Position
   39) U1 to SN(degree)
   40) U1 to FH(degree)
   41) U1 to PP(degree)
   42) U1 to PP(distance)
   43) IMPA ; Mandibular incisor plane angle.

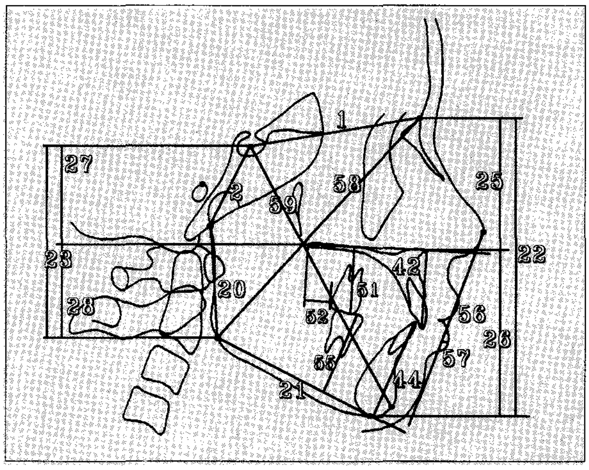

Fig. 2. Linear measurements.

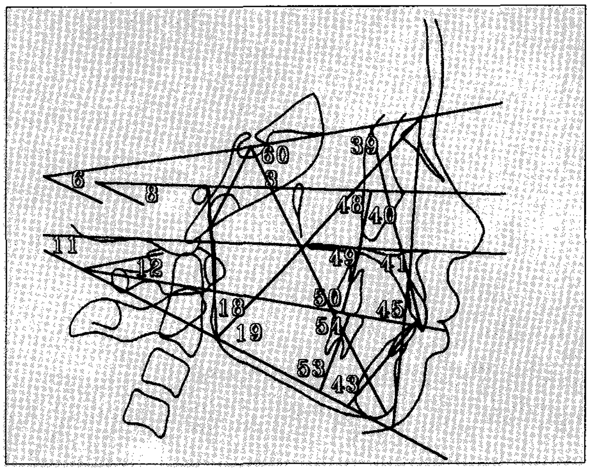

Fig. 3. Angular measurements.

44) L1 to MP(distance)
45) IIA ; Interincisal angle.
46) Overbite
47) Overjet

8. Maxillary and Mandibular First Molar Position
48) U6 to FH(degree)
49) U6 to PP(degree)
50) U6 to OP(degree)
51) U6 to PP(distance)
52) U6 to PNS(distance)
53) L6 to MP(degree)
54) L6 to OP(degree)
55) L6 to MP(distance)

9. Soft Tissue
56) Esth U ; Distance from upper lip to the facial esthetic line(Riketts).
57) Esth L ; Distance from lower lip to the facial esthetic line(Riketts).

10. Others
58) NGo ; Facial depth(distance).
59) SGn ; Facial length on Y-axis(distance).
60) NSGn ; Y-axis angle.

RESULTS

1. Comparing the Groups by analysis of variance

Means and standard deviations are listed in Table 2 to 11. Results of analysis of variance($P<0.05$) are recorded in the final two columns. Means with the same letters are not significantly different at the 0.050 level. Seven variables FH-PP, FH-ArGo, SArGo, SNB, Gonial, UGA and Ar-Go in Gothic bold letters showed significant difference between Group I and Group II.

Table 2. Cranial Base

Variables	Group	Mean	SD	F Ratio	Scheffe grouping*
	I	67.7	3.2		A
SN	II	68.7	3.7	6.7+	A,B
	III	71.0	3.9		B
	I	32.4	3.5		A
SAr	II	35.5	3.0	25.9+	A
	III	39.7	4.6		B
	I	120.7	8.2		A
Saddle Angle	II	126.2	7.3	3.1	A
	III	124.2	6.0		A

* Means with the same letter are not significantly different at the 0.050 level.
+ P<0.05

Table 3. Angular Measurements of Cranio-Maxillo-Mandibular Relationships

Variables	Group	Mean	SD	F Ratio	Scheffe grouping*
SN-PP	I	10.5	3.9		A
	II	9.2	2.2	1.1	A
	III	9.3	3.4		A
FH-PP	I	2.1	3.8		A
	II	-0.6	2.3	4.8+	B
	III	-0.1	2.9		B
SN-GoMe	I	48.0	6.9		A
	II	47.5	5.4	57.2+	A
	III	33.1	6.2		B
FMA	I	39.0	5.2		A
	II	36.3	4.6	35.9+	A
	III	26.7	6.9		B
FH-ArGo	I	93.4	6.7		A
	II	87.4	3.2	38.9+	B
	III	82.4	4.3		C
SArGo	I	161.0	9.5		A
	II	151.0	6.6	29.2+	B
	III	146.6	6.5		B

* Means with the same letter are not significantly different at the 0.050 level.
+ P<0.05

Table 4. Angular Measurements of Palato-Occluso-Mandibular Relationships

Variables	Group	Mean	SD	F Ratio	Scheffe grouping*
PMA	I	38.7	6.3		A
	II	37.9	5.6	52.6+	A
	III	25.1	5.8		B
SN-OP	I	23.2	4.7		A
	II	21.9	5.3	22.2+	A
	III	15.0	5.5		B
PP-MxOP	I	11.5	5.7		A
	II	10.3	4.4	4.0+	A,B
	III	8.2	4.3		B
PP-MnOP	I	15.9	5.0		A
	II	14.6	6.2	33.7+	A
	III	6.4	4.7		B
FH-MxOP	I	13.2	5.5		A
	II	9.8	3.9	6.5+	A,B
	III	8.4	5.4		B
FH-MnOP	I	17.2	5.2		A
	II	14.1	4.9	28.2+	A
	III	7.1	5.8		B

* Means with the same letter are not significantly different at the 0.050 level.
+ P<0.05

Table 5. Measurements for the Size and Form of Mandible

Variables	Group	Mean	SD	F Ratio	Scheffe grouping*
Gonial A	I	125.5	5.4		A
	II	129.5	4.7	5.5+	B
	III	123.9	5.5		A
UGA	I	40.7	4.4		A
	II	43.7	3.2	15.8+	B
	III	46.0	3.4		C
LGA	I	84.5	4.9		A
	II	85.7	4.5	23.2+	A
	III	78.0	4.6		B
Ar-Go	I	41.5	5.8		A
	II	47.4	3.7	34.6+	B
	III	53.7	6.3		C
Go-Me	I	72.2	5.0		A
	II	70.9	4.4	19.7+	A
	III	78.3	4.7		B

* Means with the same letter are not significantly different at the 0.050 level.
+ P<0.05

Table 6. Vertical Height (I)

Variables	Group	Mean	SD	F Ratio	Scheffe grouping*
AFH	I	129.5	7.4		A
	II	134.2	5.1	4.4+	A,B
	III	134.7	7.3		B
PFH	I	73.7	6.9		A
	II	79.6	4.8	36.2+	A
	III	89.2	8.1		B
PFH/AFH	I	57.0	4.4		A
	II	59.5	2.9	27.5+	A
	III	66.7	6.4		B
UAFH	I	57.0	3.4		A
	II	56.3	5.0	4.1	A
	III	59.5	4.5		A
LAFH	I	74.4	5.7		A
	II	77.8	6.7	1.5	A
	III	75.5	5.7		A
UPFH	I	43.9	4.7		A
	II	45.9	3.3	2.9	A
	III	47.6	6.9		A
LPFH	I	30.4	6.5		A
	II	33.7	4.5	18.4+	A
	III	42.1	9.2		B
UAFH/AFH	I	44.3	3.0		A
	II	42.0	3.8	3.0	A
	III	44.1	2.6		A

Table 6. Vertical Height (II)

LAFH/AFH	I	57.4	3.0		A
	II	58.0	3.8	3.1	A
	III	56.0	2.6		A
UAFH/LAFH	I	76.3	8.3		A
	II	73.1	9.6	3.4	A
	III	79.3	7.5		A
UPFH/PFH	I	59.8	6.2		A
	II	57.8	4.1	9.3+	A,B
	III	53.0	7.3		B
LPFH/PFH	I	40.1	5.3		A
	II	42.1	4.3	8.5+	A,B
	III	46.7	7.5		B
UPFH/LPFH	I	150.7	36.4		A
	II	138.9	23.3	6.2+	A,B
	III	120.0	37.3		B

* Means with the same letter are not significantly different at the 0.050 level.
+ P<0.05

Table 7. SNA, SNB, ANB and Angle of Convexity

Variables	Group	Mean	SD	F Ratio	Scheffe grouping*
SNA	I	78.8	3.3		A
	II	81.6	5.9	4.3+	A,B
	III	81.6	3.6		B
SNB	I	73.1	3.5		A
	II	77.2	5.7	16.5+	B
	III	79.5	4.3		B
ANB	I	5.7	2.7		A
	II	4.4	1.8	24.7+	A
	III	2.1	1.8		B
Angle of Convexity	I	11.9	6.9		A
	II	8.3	4.7	24.2+	A
	III	3.0	4.3		B

* Means with the same letter are not significantly different at the 0.050 level.
+ P<0.05

2. Discriminant Analysis

Discriminant analysis was done for Groups I and II. Variables used are FH-PP, FH-ArGo, SArGo, SNB, Gonial, Ar-Go.

Discriminant analysis was done by Wilks' method (stepwise) and S-ArGo, ArGo, FHPP, Gonial angle were included one by one. FH-ArGo was not used for discriminant function, because F level or tolerance or VIN was insufficient for further computation. After stepwise discriminant analysis, finally discriminant function is obtained as follows :

$$D = -0.120X_1 + 0.066X_2 + 0.144X_3 - 0.058X_4 + 2.000$$

Where X1 ; ArGo length(mm)
X2 ; SArGo angle(degree)
X3 ; FH-PP angle(degree)
X4 ; Gonial angle(degree)

Group centroid means of Group I and II were 0.722

Table 8. Maxillary and Mandibular Incisor Position

Variables	Group	Mean	SD	F Ratio	Scheffe grouping*
U1 to SN (degree)	I	109.1	7.2		A,B
	II	113.0	5.9	3.6+	A
	III	107.3	7.0		B
U1 to FH (degree)	I	115.5	9.1		A
	II	120.2	5.8	1.9	A
	III	116.4	6.4		A
U1 to PP (degree)	I	117.0	9.2		A
	II	119.6	6.5	1.5	A
	III	115.0	9.2		A
U1 to PP (distance)	I	32.4	3.1		A
	II	32.9	2.4	0.4	A
	III	32.1	2.7		A
IMPA	I	93.2	5.7		A
	II	91.2	5.7	0.5	A
	III	92.7	5.9		A
L1 to MP (distance)	I	45.7	3.8		A
	II	47.0	3.1	0.7	A
	III	46.0	3.4		A
Interincisal Angle	I	111.6	10.6		A
	II	112.6	9.4	27.2+	A
	III	125.3	6.4		B
Overbite	I	-3.2	3.0		A
	II	-2.4	1.2	80.4+	A
	III	2.0	1.0		B
Overjet	I	6.5	2.8		A
	II	6.5	3.1	26.4+	A
	III	3.3	0.9		B

* Means with the same letter are not significantly different at the 0.050 level.
+ P<0.05

Table 9. Maxillary and Mandibular First Molar Position

Varibles	Group	Mean	SD	F Ratio	Scheffe grouping*
U6 to FH (degree)	I	75.7	6.7		A
	II	76.2	5.8	10.9+	A
	III	82.1	5.8		B
U6 to PP (degree)	I	76.6	7.3		A
	II	75.5	6.1	8.3+	A
	III	81.6	5.4		B
U6 to OP (degree)	I	88.7	6.1		A
	II	92.0	6.0	1.6	A
	III	90.6	5.1		A
U6 to PP (distance)	I	25.0	2.3		A
	II	26.8	2.9	3.7+	A,B
	III	27.0	3.3		B
U6 to PNS (distance)	I	15.0	4.1		A
	II	13.9	5.4	0.4	A
	III	14.4	3.0		A
L6 to MP (degree)	I	80.7	6.7		A
	II	78.9	3.9	0.8	A
	III	79.1	4.8		A
L6 to OP (degree)	I	75.2	7.4		A
	II	77.7	6.3	16.3+	A
	III	83.2	4.7		B
L6 to MP (distance)	I	36.1	4.1		A
	II	36.9	2.4	0.3	A
	III	36.3	3.5		A

* Means with the same letter are not significantly different at the 0.050 level.
\+ $P<0.05$

Table 12. Pooled Within-Groups Correlation Matrix

	FH-PP A.	FH-ArGo	S-ArGo	Ar-Go	SNB	Gonial A.
FH-PP A.	1.000					
FH-ArGo	-.011	1.000				
SArGo	-.116	.434	1.000			
Ar-Go	.022	-.264	.009	1.000		
SNB	-.086	-.174	-.044	.225	1.000	
Gonial A.	-.035	-.251	-.249	-.110	.123	1.000

Table 10. Soft Tissue

Variables	Group	Mean	SD	F Ratio	Scheffe grouping*
Esthetic Upper	I	2.9	2.6		A
	II	2.0	1.7	33.9+	A
	III	-1.1	1.8		B
Esthetic Lower	I	5.2	3.3		A
	II	4.5	2.3	31.8+	A
	III	0.8	1.8		B

* Means with the same letter are not significantly different at the 0.050 level.
\+ $P<0.05$

Table 11. Facial Depth, Facial length and Y-axis Angle

Variables	Group	Mean	SD	F Ratio	Scheffe grouping*
Facial Depth	I	116.7	7.6		A
	II	122.1	4.7	18.4+	A
	III	127.9	7.9		B
Facial Length	I	126.1	7.1		A
	II	131.6	6.4	21.1+	A
	III	137.9	7.6		B
Y-axis Angle	I	78.0	4.0		A
	II	78.5	4.0	39.9+	A
	III	70.4	3.9		B

* Means with the same letter are not significantly different at the 0.050 level.
\+ $P<0.05$

and -1.277. Mean of group centroids is calculated by the following function and it was -0.555. Percent of "grouped" cases correctly classified is 88.89%(Table 14).

$$\text{Mean of Group Centroids} = \frac{n_2C_1 + n_1C_2}{n_1 + n_2} = \frac{23\times(-1.277)+13\times(0.722)}{13+23} = -0.555$$

Table 13. Test of Equality of Group Covariance Matrices using Box's M

Box's M	Approximate F	Degrees of freedom	Significance
20.269	1.7312	10, 2893.2	.0683>0.05

Table 14. Classification Results

Actual Group	No. of Cases	Predicted Group Membership	
		I	II
Group I	23	20 87.0%	3 13.0%
Group II	13	1 7.7%	12 92.3%

Percent of "grouped" cases correctly classified: 88.89%

DISCUSSION

The term 'osteoarthritis' or 'osteoarthrosis' has been used together, but in this study, the author chose the term 'degenerative joint disease' which draws attention to the degenerative changes and not to the any inflammatory component that accompanies the degenerative process. Because pateients with malocclusion visit orthodontists after any inflammatory signs and symptoms have subsided or without knowing any pathologic changes of their TMJs, it is more reasonable for orthodontists to emphasize the degenerative changes than inflammatory process.

Schellas grouped facial skeleton changes due to TMJ degeneration into two groups : compensated and uncompensated(Fig. 4)[5]. DJD may progress rapidly, leading to condylar degeneration, loss of vertical dimension and an uncompensated open-bite malocclusion[5]. From the author's experiences, it seems that if DJD happens at young age, the facial skeleton change is usually uncompensated. In other words, the younger the patients are, the more the uncompensated types occur. As orthodontists, we often see only this type of DJD, because most of orthodontic patients are ages less than 30. So, in this study, only uncompensated bilateral open-bite DJD patients are selected for GROUP I.

DJD patients were diagnosed by clinical examination, orthopantomogram, TMJ radiograms, computerized tomograms, magnetic resonance imaginging and/or bone scan. In history taking, DJD open-bite patients usually complain that opening of the bite became more severe recently. This fact can be corroborated by clinical findings such as the attrition of the anterior teeth which gave an evidence of mastication. If the past facial photographs of patients are availble, it would be helpful to know whether open-bite happened recently or it existed long ago. Bone scan also can be used to evaluate the state of bone lesion, active or inactive. The patients who had history of splint therapy were not included, because that kind of therpy could give an influence to the occlusion.

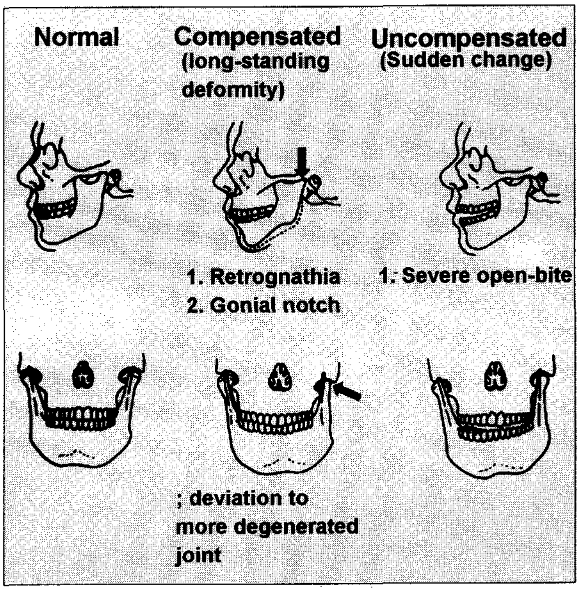

Fig. 4. Facial Skeleton remodelling and occlusion changes due to TMJ degeneration ; modified from the drawings of Schellhas KP, et.al., Am J Orthod Dentofac Orthop 1993 : 104:51-59.

Rönning et al reported that in juvenile chronic arthritis the growth of the mandible is affected in a predictable pattern ; reduction in overall dimension is seen, with reduced posterior facial height and a characteristic posterior growth rotation with gonial bony apposition and marked ante-gonial notching, along with compensatory over-eruption of the mandibular incisors[4]. In this study GROUP I showed the similar results when compared with GROUP III. In Group I, SN-GoMe, FH-ArGo, SArGo and PMA increased significantly, which means posterior rotation of mandible. Ar-Go and Go-Me were smaller. Especially Ar-Go was even smaller when compared with GROUP II. This finding is related with the reduced posterior facial height(small PFH and LPFH). But the gonial bony deposition and marked antegonial notching, which are the features of compensated type, were not seen in most of DJD cases (GROUP I). In summary, cephalometric characteristics may be explained by the fact that in DJD cases the mandible is rotated backward due to the shortening of the ramus height following the degenerative destruction of condylar head and its surrounding structures. These changes also make DJD facial skeleton pattern very similar to that of Class II open-bite with normal TMJs(GROUP II).

Because the author found in the previous study[1] that bilateral DJD open-bite cases showed similarities to Class II open-bite cases with normal TMJ, clinically and radiographically, we decided to compare Group I with Group II and to try to find any cephalometric differences between them. Many DJD patients had no pain and DJD was not active. In such cases, it is possible for us to fail in detecting DJD in their TMJs during diagnosis procedures. Moreover, in my experience, some of DJD patients showed strong relapse tendency after orthodontic and/or surgical treatment than any other Class II open-bite cases with normal TMJ. Therefore, when we found open-bite cases with Class II pattern, the differential diagnosis is so important, we use many diagnostic laboratory assistance such as magnetic resonance imaging, computerized tomographs, TMJ radiographs andbone scan. They are of great help, but there are some problems to use them routinely for financial and/or ethical reasons. At that point, cephalometrics can be used as one of the supplemental aids for screening the quiescent DJD of TMJ. This study proves that original anatomic pattern of DJD open-bite patients was different from that of Class II open-bite patients in FH-PP, FH-ArGo, SArGo, SNB, Gonial, UGA and Ar-Go. By using six variables a discriminant analysis was done. This analysis with Wilks' method(stepwise) provided a discriminant function : $D = -0.120X_1 + 0.066X_2 + 0.144X_3 - 0.058X_4 + 2.000$, where X1 is ArGo length(mm), X2 is SArGo angle(degree), X3 is FH-PP angle(degree) and X4 is Gonial angle(degree). And the canonical discrminant function(fueled by ArGo length, SArGo angle, FH-PP angle and Gonial angle) then can be used to assign standardized discriminant scores to each of Class II open-bite cases. Based on these scores, the patients will be divided into two different groups with 88.89% confidence. Two examples from the GROUP I and II are shown in Fig. 5 and 6. If the score obtained from the discriminant function is higher than -0.555, the sample has the probabilities of DJD(Fig. 5) with 88.89% confidence. And on the contrary if the score is lower than -0.555, it would have normal TMJs(Fig. 6).

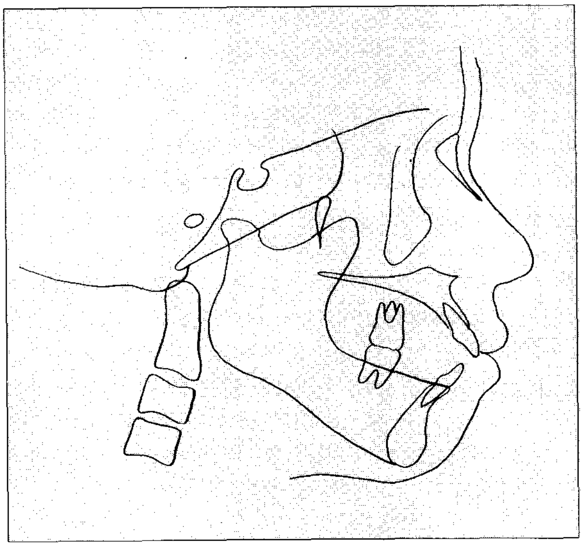

Fig. 5. One sample from Group I (open-bite patients with DJD of TMJ). Y.B.K., 36.5Y/Female

$D = -0.120 \times 38.5 + 0.066 \times 170.5 + 0.144 \times 1.0 - 0.058 \times 120.0 + 2.000$
$= 1.017 > -0.555$

In our department, percentage of Class II cases is low, which may be resulted from anthropological reason and different viewpoint for esthetics. Even Class II open-bite cases are not so many. Afterward if we could collect more Class II open-bite samples, the percentage of confidence would be higher than 88.89%. And nowadays, the number of adult patients are increasing continuously, and many of them are expected to have DJD of TMJ. As a result, the author believes that a cephalometric study of the compensated type will be useful to orthodontic diagnosis and patient selection.

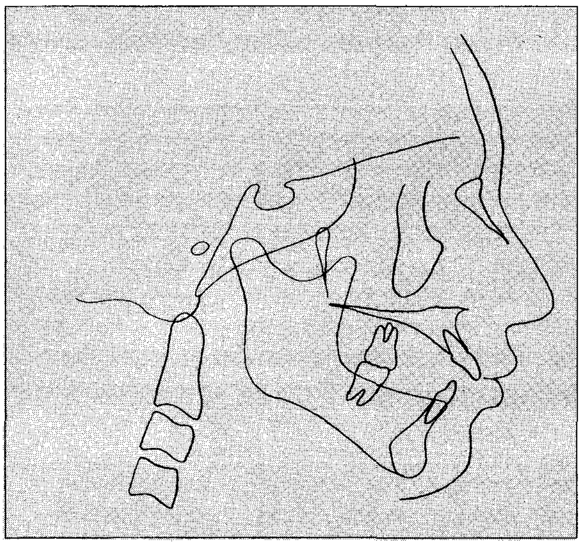

Fig. 6. One sample from Group II (Class II open-bite cases with no TMD symptoms and good condylar shapes). Y.J.S., 21.1Y/Female

$$D = -0.120 \times 49.0 + 0.066 \times 147.5 - 1.5 \times 0.144 - 0.058 \times 134.5 + 2.000 = -2.962 < -0.555$$

CONCLUSION AND CLINICAL IMPLICATIONS

1. Comparing the three groups

In most of the measurments, Group I and Group II showed the same skeletal and dental characteristics. But seven of the sixty measurements(FH-PP angle, SNB, FH-ArGo angle, articulare angle, gonial angle, upper gonial angle and Ar-Go length) were significantly different($p<0.05$, analysis of variance) when comparing GROUP I and GROUP II. These differences may be explained by the fact that in DJD cases the mandible rotated backward due to the shortening of the ramus height following the degenerative destruction of condylar head and its surrounding structures.

2. Discriminant analysis

The six measurements(FH-PP angle, SNB, FH-ArGo angle, articulare angle, gonial angle and Ar-Go length) were used for discriminant analysis(Wilks' stepwise). The resulting discriminant function fueled by Ar-Go length, articulare angle, FH-PP angle and gonial angle was used to assign discriminant scores to each of the 46 subjects(GROUP I and III). This function discriminated correctly 88.89% of these samples. This study showed that lateral cephalograms may be used as a supplemental aid for screening Class II skeletal open-bite cases and for detecting the quiescent DJD of TMJ.

Author Address

Tae-Woo Kim, D.D.S., M.S.D., Ph.D.
Department of Orthodontics, College of Dentistry, Seoul National University.
Yeounkun-Dong 28, Chongno-ku, Seoul, 110-749, Korea
Tel) 82-2-760-3817, 82-2-760-2678
Fax) 82-2-740-8735(Push start button just after ringing) 82-2-760-3817
***Dr. Tae-Woo Kim** is a full-time lecturer at the Seoul National University, College of Dentistry, Department of Orthodontics, Seoul, Korea.*

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KOREA. J. ORTHOD. 1995 ; 25 : 665-674