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Cephalometric Evaluation of Dentofacial Features of Class III Malocclusion in Adults of Mashhad, Iran

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Abstract

Background and aims. Class III malocclusions are considered as one of the most complex orthodontic problems to diagnose and treat. Numerous studies have been conducted to determine the morphologic characteristics of craniofacial complex in patients with this malocclusion. The aim of this study was to determine the dentofacial characteristics of Class III malocclusion in Mashhadian adults.

Materials and Methods. This cross-sectional descriptive study consisted of 114 cephalograms including 57 individuals with Class III malocclusion (28 males and 29 females with mean age of 19.28 years) as the case group, and 57 adults with uncrowded Class I occlusion (28 males and 29 females with mean age of 17.2 years) as the control group. Cephalometric evaluation was performed by measuring nine angular and nine linear measurements and the dentofacial characteristics of two groups were compared by Student's *t*-test.

Results. SNA angle, the distance from A point to Nasion perpendicular and the maxillary effective length was significantly lower in Class III group, while SNB and SN-Pog angles were significantly higher compared to control group. Mandibular effective length did not differ in two groups. Maxillary incisor protrusion and mandibular incisor retrusion in Class III subjects was also observed. From the vertical aspect, only mandibular plane angle showed an increase in Class III group ($P < 0.05$).

Conclusion. Maxillary deficiency, mandibular prognathism, maxillary incisors protrusion and mandibular incisors retrusion are present in individuals with Class III malocclusion, but mandibular effective length does not differ significantly from Class I patients.

Key words: **Cephalometry, class III malocclusion, dentofacial.**

Introduction

According to Angle's Classification, Class III malocclusion is defined in cases that mandibular first molar is positioned mesially relative to the first molar of maxilla.[1] Class III malocclusions are considered as one of the most complex and difficult orthodontic problems to diagnose and treat. Numerous studies have been conducted to determine the morphologic characteristics of craniofacial complex in patients with Class III malocclusion.[2-8] These studies have shown that the term "Class III malocclusion" is not a single diagnostic entity but can result from various combinations of skeletal and

dentoalveolar components. In these studies, the cephalometric evaluation indicated that in most cases maxillary retrusion existed,[2-7] while the mandible showed prognathism.[2-6] Only Moukaeh[8] has reported a normal mandibular position in Class III patients.

Many studies revealed that in patients with dental Class III relationship, skeletal Class III relationship is present as well.[3,4,7] From the dentoalveolar aspect, several studies showed protrusion of the maxillary incisors,[2,3,8] and retrusion of mandibular incisors,[2,3,5,7] except for the findings of Mouakeh's, in which the retrusion of maxillary incisors is mentioned.[8]

In the assessment of vertical components in Class III patients, Ellis & McNamara,[2] Guyer et al[3] and Ishii et al[7] reported an increase in the lower facial height while the findings of Kao et al[6] and Mouakeh[8] showed the decrease of lower facial height in individuals with Class III malocclusion.

The determination of essence and the prevalence of the special components of the Class III malocclusion have special importance as facial beauty is affected most by this malocclusion compared to other discrepancies. The majority of researchers agree with dentoalveolar pattern of this abnormality: the Class III relationship of molars, more anterior position of mandibular teeth and the decrease of overjet or negative overjet. However, the agreement on the possible pathogonomonic skeletal pattern for this malocclusion is still a matter of controversy.

The purpose of this study was to describe the skeletal and dental cephalometric characteristics of Class III malocclusions selected from study models on the base of dental relationships and comparing them to individuals with uncrowded Class I occlusion.

Materials and Methods

Ethical approval for the study was obtained from the Medical Ethics Committee of Mashhad University of Medical Sciences.

This was a cross-sectional descriptive study performed on 114 lateral cephalograms in two groups. In the first group 57 lateral cephalograms of Class III patients including 28 males and 29 females with mean age of 19.28 years ranging from 16 to 30 years were selected. These cephalograms were selected from more than 6000 files of the patients referred to the Department of Orthodontics, Mashhad Dental School between 1993 and 2003. Selection criteria included Class III molar and canine relationship (more than one cusp) in both sides, presence of negative overjet, age of 16 or older, no previous history of orthodontic treatment, and no cleft lip or palate or other craniofacial syndromes. The second group consisted of 57 cephalograms of young individuals with normal Class I occlusions including 28 males and 29 females with mean age of 17.2 years ranging from 16 to 20 years which were obtained from the study of Jalaly & Ramezanzadeh[9] in 1995 serving as control group. The cephalograms of the first and second group were prepared using Asahi (Asahi, Japan) and Planmeca (Planmeca, Finland) radiography machines, respectively. On the basis of Rabani & Sahafian's study[10] the magnification of these radiography machines were proved to have no significant difference.

All of the cephalograms were traced on special "Asetate" tracing papers (18 × 24 cm) (Dentaurum) by one operator. The measurements were performed manually with 0.5 mm accuracy for linear parameters and 0.5 degree for angular ones. Eighteen cephalometric parameters for the evaluation of the skeletal and dental structures were measured. To facilitate cephalometric analysis these parameters were divided into one vertical and five horizontal groups (Table 1). All of these parameters are based on Steiner,[11] Down[11] and McNamara[12] analysis. Mean, minimum, maximum, range, and standard deviation for male and female subjects in the first and second groups were calculated separately for all parameters.

Statistical analysis was performed using SPSS software and Student's *t*-test to compare two groups. For evaluation of method error, 20 lateral cephalograms including 10 cephalograms from the first and 10 cephalograms from the second group were selected randomly and traced again by the same examiner after several weeks. The Dalberg formula and reliability were used for calculating method error.[13,14]

Table 1. Cephalometric measurements used in the present study

Group	Parameter
Maxillary skeletal position	1. SNA (angle) 2. Point A to nasion (Na) perpendicular (mm)
Mandibular skeletal position	1. Pogonion (Pog) to nasion perpendicular (mm) 2. SNB (angle) 3. SN-Pog (angle) 4. Facial angle
Relationship between mandible and maxilla	1. Effective mandibular length: condilion (Co) to gnathion (Gn) (mm) 2. Effective midface length: condilion to point A (mm) 3. The difference between mandibular and maxillary effective lengths 4. ANB (angle)
Mandibular dentoalveolar position	1. L_1 to mandibular plane (angle) 2. L_1 to point B (mm)
Maxillary dentoalveolar position	1. U_1 to NA (mm) 2. U_1 to point A (mm) 3. U_1 to NA (angle)
Vertical components	1. Lower facial height (mm) 2. Mandibular plane angle 3. Facial axis angle

Results

Statistical tests showed a reliability ranging from 0.62 to a maximum of 0.96 for all 18 parameters in both groups. Therefore, differences between the first and second tracings were not significant.

In all of these cephalograms, eighteen parameters (9 linear and 9 angular) were measured and compared (Table 2). In both control and case groups, maxillary and mandibular effective lengths and lower facial height were less in females than in males and this difference was statistically significant ($P \leq 0.05$).

The anteroposterior position of maxilla relative to the cranial base – indicated by the SNA angle and point A to nasion perpendicular – was significantly retrusive in the Class III group ($P \leq 0.05$).

All four measurements used to determine the anteroposterior position of the mandible showed mandibular prognathism relative to the cranial base in Class III group; however, this difference was only significant for SNB and SN-Pog angles ($P \leq 0.05$) and not for the other two measurements. The ANB angle and differences between maxillary and mandibular lengths showed Class III skeletal relationship in Class III group ($P \leq 0.05$).

The angle of L_1 to mandibular plane was significantly smaller in Class III group ($P \leq 0.05$). Although the distance of L_1 to point B was less in the first group, this finding was not statistically significant. Therefore, the patients with Class III malocclusion compared to uncrowded Class I cases showed more upright and retrusive position of the mandibular incisors.

All three measurements used to evaluate maxillary dentoalveolar position showed protrusion of upper incisors in Class III patients ($P \leq 0.05$).

Mandibular plane angle was significantly higher in Class III group ($P \leq 0.05$), whereas lower facial height and facial axis angle were not significantly different in two groups.

Table 2. The comparison of the statistical results of cephalometric parameters between control and case groups

Statistical parameters / Cephalometric parameters	Case n = 57		Control n = 57		P
	Mean	SD	Mean	SD	
SNA	77.64	4.33	82.35	3.57	0.000 *
Point A to Na perpendicular (mm)	−8.75	5.97	−2.33	3.85	0.000 *
Pog to Na perpendicular (mm)	−5.96	9.67	−7.35	6.64	0.375
SNB	83.03	3.31	79.77	3.33	0.000 *
SN-Pog	83.52	3.54	80.96	3.58	0.000 *
Facial angle	88.50	4.29	87.89	3.56	0.408
Mandibular length (mm)	128.42	8.43	126.35	7.14	0.160
Maxillary length (mm)	85.15	5.92	94.70	5.63	0.000 *
Maxillary-mandibular Difference	43.26	7.75	31.64	4.98	0.000 *
ANB	−5.40	3.49	2.57	2.04	0.000 *
L_1 to mandibular plane (angle)	86.26	8.75	97.66	5.46	0.000 *
L_1 to point B (mm)	7.07	3.20	7.91	2.76	0.136
U_1 to NA (mm)	10.50	3.61	6.84	2.02	0.000 *
U_1 to point A (mm)	7.50	2.86	6.05	1.87	0.002 *
U_1 to NA (angle)	31.08	6.15	24.49	4.36	0.000 *
Lower facial height (mm)	73.03	6.92	72.42	5.92	0.612
Mandibular plane angle	32.15	6.89	27.24	5.15	0.000 *
Facial axis angle	92.26	4.21	92.22	4.58	0.966

n: Number of cases
* Significant ($P \leq 0.05$)

Discussion

In this study, 114 lateral cephalograms including 57 cephalograms of patients with Class III malocclusion as case group and 57 cephalograms of uncrowded Class I occlusion as control group were compared.

It is believed that individuals with Class III malocclusion may have combinations of dentoalveolar and skeletal components. Diagnosis and consideration of the various components is essential in treating the underlying cause of the discrepancy appropriately.[15]

In this study, two parameters were used to evaluate the maxillary skeletal position. Measuring SNA angle and the distance of point A to nasion perpendicular showed maxillary deficiency in the majority of Class III cases (Table 2). These results are similar to those of the previous studies.[2-8]

All four parameters used to evaluate mandibular skeletal position revealed mandibular prognathism in Class III group, but this difference was only significant for SNB and SN-Pog angles ($P \leq 0.05$) and not for facial angle and the distance from Pogonion to nasion perpendicular (Table 2). These results corroborate other studies.[2-6] Mouakeh[8] did not find significant difference between mandibular skeletal position in Class I and Class III cases. In the latter study, the patients were 5-12 years old in whom the growth of lower

jaw may have not been completed, whereas in our study, samples aged 16-30 years had passed maximum mandibular growth.

We used one angular and three linear parameters to compare skeletal position of two jaws relative to each other. Maxillary effective length in Class III group was significantly shorter than control group ($P \leq 0.05$), and mandibular effective length in this group was slightly longer than control group, but this difference was not statistically significant. This finding indicates that mandibular position rather than mandibular length is the main cause of mandibular prognathism in our cases. The difference between maxillary and mandibular lengths as well as ANB angle indicated the Class III skeletal relationship in case group ($P \leq 0.05$) (Table 2). These findings are similar to the results of Guyer et al,[3] Toms,[4] Rak,[5] Ishii et al[7] and Mouakeh.[8]

From two parameters used to evaluate the mandibular dentoalveolar position, the angle between lower incisor and mandibular plane (IMPA) showed retrusion of lower incisors in Class III group compared to control group ($P \leq 0.05$) (Table 2). Previous researches have also reported the lower incisors retrusion.[2,3,5,6] On the other hand, maxillary dentoalveolar position showed protrusion of upper incisors, which is in accordance with the results of other reports,[2,3,7] but in disagreement with one study that showed upper incisors retrusion.[8] This may be due to the low age of study samples in whom dental compensations had not occurred yet.

Lower facial height and facial axis angle in Class III group were greater than control subjects, but had no statistical difference, whereas mandibular plane angle in case group was significantly greater than control group ($P \leq 0.05$) (Table 2).

The results of Ellis,[2] Guyer,[3] and Ishii[7] showed the increase of the lower facial height and the results of Kao[6] and Mouakeh[8] showed the decrease of the lower facial height in Class III patients.

An interesting finding in the present study was the great prevalence of maxillary skeletal retrusion. In the late 1970s, Delaire and coworkers in France showed that forward positioning of the maxilla could be achieved with reverse headgear, if treatment is begun at an early age.[1] The best current data suggest that successful forward repositioning of the maxilla can be accomplished before age 8, but after that orthodontic tooth movement usually prevails skeletal change.[16,17]

Conclusion

From the results of the present study, it is concluded that Class III patients in comparison with Class I individuals show:

1- Maxillary deficiency
2- Mandibular prognathism
3- Maxillary incisor protrusion
4- Mandibular incisor retrusion
5- No difference in mandibular effective length
6- No difference in facial height

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