Dento-Alveolar Compensation in Subjects with Mandibular Prognathism

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Summary

Dento-alveolar adaptation in subjects with mandibular prognathism is the reason of clinical findings of almost normal occlusal and dental relationships between maxilla and mandible, despite of sagittal jaw.

The purpose of this study was to obtain: the most significant characteristics of patients with mandibular prognathism; to find which variables quantitatively describe dento-alveolar adaptation and which of the used parameters have the most influence on achieving the normal relationship between the upper and the lower jaw as well to find the correlation between defining cephalometric variables.

A sample of 62 cephalograms of subjects with mandibular prognathism both sexes, average age 18.7 years were analyzed. Cephalograms of eugnathic subjects were served as control. Eight dento-alveolar variables were observed: SNA, SNB, ANB, GIBG, DIBD, IIK, LA and LB, and statistical analysis were performed. As compared to eugnatic patients, all variables were significantly different, except SNA. The most signifficant decrease was found in the variable presenting the inclination of lower incisors in the relation to the mandibular base (DIBD), meaning that patients with mandibular prognathism have more retruded lower incisors which is a result of dento-alveolar adaptation.

Significant correlations were found between variables SNB and ANB, DIBD and LB, and ANB and LB.

Key words: *dento-alveolar adaptation, mandibular prognathism.*

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Introduction

Skeletal Class III pattern (frontal cross bite, genuine skeletal Class III, pseudo Class III, functional Class III) is characterized by specific extra and intra oral symptoms and is present in 3-5% of the normal population, but is more often present in Asia (1).

The etiology of mandibular prognathism is not always clear. Despite genetic predisposition, it could be caused by some endocrine disease or as a part

of Paget's disease. It is transmitted recessively, but in some families it is transmitted as a dominant trait. To determine the correct orthodontic therapy in these patients, the diagnostics should be very thorough and should comprise gnathometric, functional and roentgencephalometric analysis.

The size, length and shape of the mandible are characteristic in Class III patients. Tollaro et al (2) found increased length of the mandibular base in children with Class III skeletal pattern as well as anterior displacement of the whole mandible. Williams and Andersen (3) also found that mandibular prognathism arises partly because of the increased mandibular length, and these findings were confirmed by Guyer et al, and Miyajima et al (4, 5). According to Burdi and Spyropoulos, the prenatal growth of the mandible is very complex, and the abnormal mandibular shape could be in direct relationship with modified morphologic characteristics of the m. masetter (6).

As a result of his investigation Sato found that anterior mandibular displacement because of anterior displacement of glenoidal fosse may be an important etiologic factor in development of Class III malocclusion (7).

Dento-alveolar adaptation which Solow (8) considered an attempt at biologic adaptation of the position of the alveolar process and teeth in all three dimensions, in cases of significant craniofacial discrepancies, is the reason for finding almost normal relationship between dental arches in a patient with mandibular prognathism, despite disturbed sagittal intermaxillar relationship.

The purpose of this study was to determine on the cephalograms of 62 patients with diagnosed mandibular prognathism the most significant characteristics of patients with mandibular prognathism and to find which variables quantitatively describe dento-alveolar adaptation and which of the used parameters influence most achievement of normal relationship between the upper and the lower jaw, as well as determination of correlation between the defined cephalometric variables.

Subjects and methods

A sample of 62 lateral cephalometric radiographs of subjects with mandibular prognathism of both sexes (26 males and 36 females), average age 18.4 year, was analyzed. Cephalograms of 62 eugnathic subjects, obtained from the Department of Orthodontics, School of Dental Medicine University of Zagreb served as the control.

Eight dentoalveolar variables were observed (Figure 1):

1. SNA	(s - n - ss)	The angle of maxillary prognathism;
2. SNB	(s - n - sm)	The angle of mandibular prognathism;
3. ANB	(ss - n - sm)	Sagittal jaw relationship;
4. GIBG	(1 : sp - pm)	Inclination between the upper incisors and the maxillary base;
5. DIBD	(1 : m - go)	Inclination between the lower incisors and the mandibular base;
6. IIK	(1 : 1)	Interincisal angle
7. LA	(1 : n - ss)	Position of the upper incisor in relation to the maxillary apical base (linear value);
8. LB	(1 : n - sm)	Position of the lower incisors in relation to the mandibular base (linear value).

Sample analyses were performed by conventional roentgencephalometric procedure.

Results and discussion

On the results of this investigation basic statistic parameters were determined as well as the correlation analysis between variables. On the basic sample of 62 subjects by using Leavan test no statistical significant difference was determined between the male and female subjects (Table 1). Table 2 shows basic statistical parameters of the subjects of both sexes. Statistical analysis shows that data were distributed according to the normal distribution, and so the Pearson correlation analysis was performed (Table 3).

In the Croatian population (9) the mean value of the maxillary prognathism angle (SNA) is 81°

in eugnathic patients, while in patients with mandibular prognathism we found 81.12° which is not statistically significantly different. The same findings were determined by Chang et al. (10) in the Chinese population, and Hashim and Sarhan (11) in a sample of British children. Karlsen in his investigation found that point A has an almost identical sagittal position in relation to the anterior cranial base during growth and development in patients with skeletal mandibular prognathism and eugnathic patients, and is increased an average of 1.0 mm from 6 to 18 years in both the investigated samples (12).

The mean value of the SNB angle, representing the anteroposterior position of the mandible in relation to the anterior cranial base in this investigation was 83.46 degrees, while in eugnathic, comparative sample this value was 78.5° (9), which is a statistically significant difference. Chang (10) found in the Chinese children a mean value of 77.32° in eugnathic patients, and 80.79° in patients with mandibular prognathism. Hashim and Sarhan (11) in the British population found a value of 77°, and in patients with mandibular prognathism they found increased value of 81.7°.

The mean value of the ANB angle determined in this investigation was -2.33°, whereas in eugnathic patients the mean value was 2.5° (9). According to Hashim (11) the mean value of this angle is 3.7° in eugnathic, and -0.2 in patients with mandibular prognatism. Chang (10) found a value of 4.56° for the ANB angle, but in patients with mandibular prognathism he found a mean value of 0.92°.

The GIBG angle represents the degree of the incisor protrusion in relation to the maxillary base. The mean value was 115.33°, and in eugnathic patients the value is 111.5°. These findings suggest that the protrusion of the upper incisors in relation to the maxillary base is a result of dentoalveolar adaptation which is characteristic for the Class III maxillomandibular relationship.

DIBD angle represents the degree of protrusion or retrusion of the lower incisors in relation to the mandibular base. In relation to eugnathic patients (92°), patients with mandibular prognathism have statistically significant value increase for this angle (83.54°), also as a result of dentoalveolar adaptation. According to Hashim and Sarhan (11) the mean value for this angle in eugnathic patients is 91°, and in patients with skeletal Class III 89.7°. Tweed stated (13) that the position of the lower incisors is crucial for a stable maxillomandibular relationship, and their position in relation to the mandibular base, which should be 90 degrees, is of great importance. According to Downs (14) this value should be 91.4°, according to Brodie 88.3° (15), according to Broadbent 89.5° (16) and Goldsman 89.3° (17).

The interincisal angle strongly affects the appearance of the lower face, so this value is relevant in aesthetic evaluation of the face. In this investigation we found a mean value of 136.31°, and in eugnathic patients the mean value is 131.5° (9). The patients with mandibular prognathism have an increased value of this angle compared to eugnathic patients because of the protrusion of the upper and retrusion of the lower incisors. Other authors also found increased angle in patients with mandibular prognathism. Chang (10) in eugnathic patients found a mean value of 145.75° for this angle an increased value in skeletal Class III patients; 156.52°.

The parameter LA represents the position of the upper incisor in relation to the maxillary apical base. The mean value was 5.74 mm, while the eugnathic patients have decreased value of 4.5 mm. This could be attributed to the dento-alveolar adaptation, a result of anterior position of the upper incisors in relation to the apical base.

The value of the variable LB (3.35 mm) suggests the retrusion of the lower incisors in relation to the mandibular apical base, because the value for the eugnathic patients is 4.5 mm. It is also part of dentoalveolar adaptation.

In circumstances of normal growth and development the correlations between different parts of the body are balanced, so the cephalometric parameters should also be in a balanced correlation. Solow (8) confirmed statistical interrelationship between incisor inclination and interjaw relationships using correlation and factor analysis.

In this investigation statistical significant correlation between variable ANB and GIBG ($r = -0.37$) was found. Correlation with LA ($r = -0.24$) and LB ($r = 0.353$) are of specific interest because they could not be explained as a topographic relationship but as a biological one. The increase of the SNB value,

which results in an increase in the ANB angle leads to increased inclination of the upper incisor at a level of significance of 0.05. Among the changes that appear in the dento-alveolar compensatory mechanism Ishikawa et al emphasizes the strong relationship between the lower incisor inclination and sagittal interjaw relationship. Using correlation analysis the authors found that more the sagittal maxillomandibular relationship have a tendency to be mandibular prognathic, the upper incisors are tipped more labially and the lower incisors more lingually (18). Their results confirmed those of Donovan (19) who stated that inclination of the lower incisors could be greatly influenced by sagittal interbasal relationship and plays an important role in achieving normal interincisal relationship, despite morphological compensatory dento-alveolar changes that arise through soft tissue and occlusal forces (18).

Parameter GIBG show negative correlation with IIK (r = -0.615) and positive correlation with LA (r = 0.632). Parameter DIBD show also negative correlation with IIK (r = -0.492) and positive correlation with LB (r = 0.501). Although with extremely low correlation coefficient (r = -0.255) there is statistically significant correlation between parameters SNB and DIBD. Parameter IIK negatively correlated with LA (r = -0.589) and LB (-0.459).

Similar results were presented by Corelius and Linder-Aronson (20), who found significant positive correlation between variables DIBD and LB (r = 0.63), ANB and LB (r = 0.57) and DIBD and ANB (r = 0.52). An investigation performed by Lündstrom (21) on 25 pairs of twins aged 12-15 and 23-26 years show correlation between the direction of the mandibular growth and inclination of the incisors.

Conclusions

As a result of the investigation we can conclude the following:

- Characteristic craniofacial morphology in patients with mandibular prognathism is determined in comparison with eugnatic patients.
- Mean values and standard deviation of eight variables of patients with mandibular prognathism were determined and served for comparison with eugnatic subjects. Compared to eugnathic subjects we found that significantly different variables are: SNB, ANB, GIBG, DIBD, IIK, LA and LB. Variables SNB, GIBG, IIK and LA increased, and ANB, DIBD and LB increased values which is in harmony with the nature of the malocclusion.
- Statistically significant correlation, although with low correlation coefficient, was found between variables SNB and DIBD (-0.255). ANB statistically significantly correlated with GIBG (-0.370), LA (-0.324) and LB (0.353). Angle DIBD correlated topographically with the angle IIK (-0.492), and with variable LB (0.632).
- Among the variables that mostly influence the development of the normal dento-alveolar relationship the most important are: GIBG, LA, DIBD and LB.