DENTAL-ALVEOLAR COMPENSATORY PHENOMENA OF MALOCCLUSION CLASS II ANGLE.
LATERAL CEPHALOMETRIC STUDY
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Abstract: The purpose of our study was to identify the dental-alveolar phenomena making up for skeletal imbalances due to malocclusion Class II, using the lateral cephalometry method. The research was carried out on 52 patients (29 girls and 23 boys), aged between 7 and 18 years, chosen from 113 cases clinically diagnosed with malocclusion Class II Angle. The lateral cephalometric images were processed using the ORTHALIS software, whereas the cephalometric measurements were conducted by means of the Tweed and Steiner method. The databases and statistical analyses were carried out using the SPSS 16.0 software for Windows and descriptive statistics means. The results obtained reveal 5 skeletal patterns of Class II. The dental-alveolar compensation phenomena occurring in the Class II skeletal patterns associated with the skeletal growing patterns identified in the study group took a wide variety of dental-alveolar forms. The wide variety of clinical manifestations and expressions at the skeletal and dental-alveolar levels fully supports the opinion according to which malocclusions Class II Angle are far from being a mere clinical entity, but rather a complex cranio-dental-maxillo-facial syndrome.

Key words: malocclusion Class II, lateral cephalometric, dental-alveolar process, dental occlusion.

INTRODUCTION
Our research (1 and 2) reveals the correlations between the shape of the face and the dental arch. Therefore, dolichocephalic persons have a long narrow face, and their dental arch is narrower and oblong, whereas brachycephalic persons have a shorter and wider face, and their dental arch is wider. There are several works focusing on the relation between the cranio-facial structures and the size of the dental arch in malocclusion subjects (3 and 4). According to their results, in malocclusion Class II division 1, the maxillary dental arch is narrower in dolicocephalic skulls and wider in brachycephalic ones, whereas the size and shape of the mandible arch is similar in all three face types (mesocephalic, brachycephalic, dolicocephalic).

Other authors (5, 6 and 7) examined the characteristics of the dental arch by comparison with malocclusion Class II divisions 1 and 2 in subjects that had not had any orthodontic treatments. According to Moorrees’ findings, the inter-canine widths on both the maxillary and the mandible are bigger than in the control patients, in malocclusion Class II division 2, and smaller in malocclusion Class II division 1, whereas the studies of Buschang et al. (6), Wallow et al.(7), Peck et al.(8) reveal a smaller than the average inter-canine width.
Literature is still controversial regarding the characteristics of the dental-alveolar arch in subjects diagnosed with malocclusion Class II Angle divisions 1 and 2, as compared to subjects not suffering from any malocclusions. The characteristics of the dental arch in malocclusion Class II as compared to the dental arch of children not suffering from malocclusions reveal virtually statistically insignificant differences (9, 10 and 11). Notwithstanding the above, Staley (12) finds bigger inter-molar and inter-canine widths in normally grown children as compared to those suffering from malocclusion Class II Angle.

Dental occlusion is the result of the relations between the bone, muscle and teeth components. The dental arch often reacts, in order to make up for the skeletal imbalances, and, last but not least, intra-arch harmony influences dental occlusion.

The wide variety of clinical manifestations of malocclusion Class II Angle accounts for the researchers’ and clinicians’ high interest in identifying any dental arch modifications in Angle divisions 1 and 2, as well as any distinctions between them.

Therefore, the purpose of our study was to identify the dental-alveolar phenomena making up for skeletal imbalances due to malocclusion Class II, using the lateral cephalometry method.

MATERIAL AND METHOD

Patients and data collection

The research was carried out on 52 patients (29 girls and 23 boys), aged between 7 and 18 years, who came for orthodontic treatment in the Department Orthodontics of the "Sf. Spiridon" Emergency University Hospital and in a private orthodontic practice in Iasi, Romania.

The cases were chosen from 113 cases clinically diagnosed with malocclusion Class II Angle. The patient selection criterion was the cephalometric confirmation of the diagnosis of malocclusion Class II skeletal. Of the 52 patients with a cephalometric diagnosis of malocclusion Class II skeletal, 30 were clinically diagnosed with dental malocclusion Class II Angle division 1, 16 were clinically diagnosed with dental malocclusion Class II Angle division 2, whereas the remaining 6 were clinically diagnosed with dental malocclusion Class I Angle.

Evaluation of images

The lateral cephalometries were performed using a STRATO-X 11.8% magnification coefficient orthopantomograph, and they were processed by two examiners, using the ORALIS software. The Tweed and Steiner method was employed for cephalometric measurements.

Statistical analysis

The database and statistical analyses were carried out using the SPSS 16.0 software for Windows and descriptive statistics.

RESULTS

Measurements of the angles between the maxillary bases and skull base (Steiner’s method) led to the identification of Class II skeletal patterns, according to which, mandibular retrognathism occurred in 50.0% of the cases, maxillary
prognathism, in 9.6% of the cases, and maxilllary prognathism associated with mandibular retrognathism, in 19.2% of the cases, whereas bimaxilllary retrognathism and bimaxillary prognathism had a 13.5% and 7.7% occurrence rate, respectively.

The skeletal growing patterns in the study group were determined according to the measurements of the Tweed triangle and revealed occurrence rates of 42.3%, 36.5% and 21.2% for the normodivergent, hyperdivergent and hypodivergent facial patterns, respectively.

Table I shows the association between the skeletal growing patterns and the Class II skeletal patterns discovered in the study group.

Table I. ASSOCIATION BETWEEN THE SKELETAL GROWING PATTERNS AND THE CLASS II SKELETAL PATTERNS

<table>
<thead>
<tr>
<th></th>
<th>Normodivergent</th>
<th>Hyperdivergent</th>
<th>Hypodivergent</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandibular retrognathism</td>
<td>13</td>
<td>7</td>
<td>6</td>
<td>50.0</td>
</tr>
<tr>
<td>Maxillary prognathism</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>9.6</td>
</tr>
<tr>
<td>Maxillary prognathism with mandibular retrognathism</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>19.2</td>
</tr>
<tr>
<td>Bimaxillary retrognathism</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>13.5</td>
</tr>
<tr>
<td>Bimaxillary prognathism</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>7.7</td>
</tr>
<tr>
<td>percentage</td>
<td>42.3</td>
<td>36.5</td>
<td>21.2</td>
<td>100.0</td>
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</table>

The dental-alveolar compensation phenomena were identified by measuring the dental angles and distances against the planes of reference, as provided by the Steiner and Tweed method. The dental-alveolar compensation phenomena occurring in the Class II skeletal patterns associated with the skeletal growing patterns identified in the study group took a wide variety of dental-alveolar forms. Here are the highest occurrence rates of these forms: upper pro-dental-alveolar associated with lower retro-dental-alveolar – 21.2%; upper normal-dental-alveolar associated with lower retro-dental-alveolar – 19.2%; bi-retro-dental-alveolar – 17.3%; upper pro-dental-alveolar associated with lower normal-dental-alveolar – 17.3%; bi-pro-dental-alveolar – 13.5% (table II). The other forms of dental-alveolar compensation had low occurrence rates.
Table II. FORMS OF DENTAL-ALVEOLAR COMPENSATION OF CLASS II SKELETAL PATTERNS

<table>
<thead>
<tr>
<th>Skeletal patterns</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>%</th>
</tr>
</thead>
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<td>mandibular retrognathism</td>
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<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>2</td>
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<tr>
<td></td>
<td>hyperdivergent</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>hypodivergent</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>maxillary prognathism</td>
<td>normodivergent</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
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<tr>
<td></td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>hypodivergent</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>maxillary prognathism with mandibular retrognathism</td>
<td>normodivergent</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>1</td>
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<tr>
<td></td>
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<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>hypodivergent</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>bimaxillary retrognathism</td>
<td>normodivergent</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>hyperdivergent</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>hypodivergent</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>normodivergent</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td></td>
<td>hyperdivergent</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>hypodivergent</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>procent</td>
<td>13.5</td>
<td>21.2</td>
<td>3.8</td>
<td>17.3</td>
<td>7.7</td>
<td>19.2</td>
<td>17.3</td>
<td>100</td>
</tr>
</tbody>
</table>

A – bi-pro-dento-alveolie
B – pro-dento-alveolie superioară cu retro-dento-alveolie inferioară
C – normo-dento-alveolie
D – bi-retro-dento-alveolie
E – retro-dento-alveolie superioară cu pro-dento-alveolie inferioară
F – normo-dento-alveolie superioară cu retro-dento-alveolie inferioară
G – pro-dento-alveolie superioară cu normo-dento-alveolie inferioară

DISCUSSIONS

The analysis of the data on the skeletal patterns of the subjects in the study group, which we gathered in our study, reveals that mandibular retrognathism has the highest occurrence rate. This finding is in agreement with Hotz’s (19) prediction, according to which malocclusion Class II due to mandibular retrognathism caused by environmental factors (nutrition) will become a common human characteristic in the future, in the absence of the normal phenomenon of dental attrition. Riolo (20) and Isik (21) too identified a normally positioned maxillary and retrognathic mandible in malocclusion Class II, as shown by us in our study group. The maxillary has a normal position, whereas the mandible is retrognathic in malocclusion Class II
Angle division 1, which was also stated in other works. According to Craig (22), patients suffering from malocclusion Class II Angle division 1 have a shorter mandible body, while their first permanent molars are in a more distal position. Maj et al. (23) conclude that mandibular retrognathia is not necessarily a growth disorder, but rather a consequence of the way in which the bones are assembled, more precisely of the mandibular plane angle.

Based on the data gathered, we may state that mandibular retrognathia occurrences are mainly due to an inherited mandibular retrognathia pattern, revealed by us in a family, to a larger skull base angle, which we found in some of the malocclusion Class II Angle division 1 patients, as well as to the absence of dental attrition. Brezniak (24) also found a normally positioned maxillary in malocclusion Class II Angle division 2, followed by upper jaw retrusion.

Despite the fact that literature often ranks maxillary retrognathism second, after normal maxillary position, in the group we studied maxillary prognathism ranked second, with an occurrence rate of 28.84%; anterior positioning of the upper jaw was also specified in other researches conducted by authors such as Rothstein and Rosenbloom. In some cases, maxillary prognathism was accompanied by a normally developed mandible. A normally developed mandible, present in malocclusions Class II Angle, was also mentioned in Demish’s and Peck’s works. These authors found a normally developed mandible in malocclusions Class II Angle division 2, which was also pointed out by us, in some of the malocclusions Class II Angle division 2 patients. In opposition with Demish et al.’s data, Pancherz measured a smaller SNB angle in malocclusion Class II Angle divisions 2 and 1. If a comparison between the two divisions is drawn, the SNB angle is smaller in malocclusion Class II Angle division 2, than in malocclusion Class II Angle division 1. We also found occurrences when maxillary prognathism was accompanied by mandibular retrognathia, a skeletal pattern with a divergent evolution, in which facial convexity increases, severely influencing the patient’s features.

Maxillary retrognathism occurs less frequently than maxillary prognathism, i.e. in 13.5% of the cases (almost half of the maxillary prognathism occurrences). According to our results, the specificity of this pattern consists of the fact that maxillary retrognathism was also accompanied by mandibular retrognathism, thus creating a sort of “balanced imbalance”, or a convergent evolution towards retrognathism, which disturbs facial esthetics in the sense of a straight profile, which is however more easily accepted by the patient and more easily tolerated by the people around him, as compared to a divergent evolution of the inter-maxillary relations. Maxillary retrognathism was revealed by Harris and Pancherz in malocclusions Class II Angle.

According to our data, this skeletal pattern occurs to a lesser extent in the study group, i.e. 7.7%. It is only natural for such a bone structure to be less common in the populations from Center and Eastern Europe, generally characterized by
mandibular retrognathia. And when this pattern does occur, it may be considered a result of the population mix processes, which are common nowadays.

As for vertical development, our data show a hopeful reality, namely that almost half of the study group is characterized by normal divergence in malocclusion Class II. However, more than a third are hyperdivergent, whereas less than a third are hypodivergent. A malocclusion Class II analysis reveals significant distinctions between the two divisions: whereas half of the investigated subjects with malocclusion Class II Angle division 1 enjoy normal divergence, in malocclusion Class II Angle division 2 normal divergence is identified only in 1/3 of the subjects. Both hyperdivergence and hypodivergence amount to about 1/3, the latter being however slightly higher in malocclusion Class II Angle division 2. Other literature works (8 and 11) also pointed out this last finding, namely that hypodivergence is slightly higher in malocclusion Class II Angle division 2 than in malocclusion Class Angle II division 1.

We revealed anterior mandibular rotation especially in malocclusion Class II Angle division 2 cases, which was also supported in Bjork’s (13) and Karlsen’s (14) works.

Compensatory dental-alveolar phenomena enjoyed a wide range of manifestations in each skeletal pattern. This compensation phenomenon is related to the skeletal imbalance and to the inter-maxillary bone relations, designed to achieve dental occlusion.

The dental-alveolar compensatory reaction is dependent on and also works in direct connection with the surrounding muscles and temporo-mandibular joint. This phenomenology accounts for the diversity of the clinical manifestations of the dental-alveolar pattern that ranges from normal bimaxillary and bi-pro-dental-alveolar dentition, to diverging combinations such as retro-dental-alveolar and pro-dental-alveolar, pro-dental-alveolar and retro-dental-alveolar, normal-dental-alveolar and retro-dental-alveolar dentitions. It is necessary to understand the importance of soft parts analyzed in their relation to the skeletal and dental-alveolar pattern, as pointed out by Nanda (15 and 17), and to be careful in our analysis, since, as the abovementioned author stated: “one cannot suppose that, if the bone structures and teeth have normal morphologies and accurate inter-relations, the soft tissues structures will automatically take a normal position”.

Therefore, when setting a diagnosis and defining our therapeutic goals, we should not generalize the values of the cephalometric and biometric dental-alveolar indicators. It is important to infer and than identify cranio-maxillo-dental-facial harmony and balance.

The wide variety of clinical manifestations, with several particular aspects that are specific to our population, makes us support Graber’s (1), Moyers’ (16), Peck’s (8), McNamara’s and Boboc’s (18) opinions, according to whom, malocclusion Class II is just an umbrella term. In addition to being a clinical entity, it is also a polymorphous syndrome requiring thorough analyses for the
identification of all the elements specific to each clinical case at the bone, teeth, dental-alveolar and muscular levels, which basically individualize each patient.

**CONCLUSIONS**

The results of our study underline the considerable variability of the skeletal and dental-alveolar patterns in malocclusions Class II, which requires the full examination of these cases by X-ray investigations. Cephalometric data set the diagnosis and quantify the imbalances of each clinical case, thus guiding the orthodontic therapy strategy.

The wide variety of clinical manifestations and expressions at the skeletal and dental-alveolar levels fully supports the opinion according to which malocclusions Class II Angle are far from being a mere clinical entity, but rather a complex cranio-dental-maxillo-facial syndrome.

**REFERENCES**