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Optimisation of Teleradiographs Calculation in The Diagnosis of Distal Dentition Taking Into Account the Component of Vertical Jaw Growth

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Abstract

Keywords: distal occlusion, **vertical growth**, horizontal growth, orthodontic treatment.

Introduction

A distal bite is a common anomaly that has a negative impact on the patient's psyche, contributing to impaired speech, mastication and facial aesthetics. According to various researchers, the success of treatment for distal bite is directly related to the condition of its development, including the type of growth of the facial section of the skull. In the diagnosis of dentoalveolar anomalies, special research methods, particularly teleradiography of the head, play a pivotal role. These methods allow for the diagnosis of 'hidden' anomalies, including the size and position of the jaw bones and apical bases in the skull space, as well as the assessment of the facial profile and the type of growth of the facial part of the skull. A cephalometric examination of the head in lateral projection is frequently employed to ascertain the characteristics of the facial structure of the skull and to devise a treatment plan for dental-mandibular-facial anomalies with a distal overbite. It is also employed for differential diagnosis of their varieties. The variety of techniques for analyzing teleradiographs and the large number of anthropometric parameters studied present certain difficulties for orthodontists.

Relevance. Among the various methods of cephalometric analysis of lateral teleradiographs, the objective was to identify the most informative parameters characteristic of distal dentition.

Materials and Methods

A total of 42 patients with distal occlusion, aged between 12 and 18 years, were examined at the Orthodontics Polyclinic of TGSI between 2016 and 2020. A total of 42 patients were included in the study, with 21 tending horizontal and 21 tending to vertical growth patterns.

The study employed anthropometric, photometric and radiographic-cephalometric methods, which were discussed and analyzed.

The diagnosis of patients with distal bite about the jaw growth component was carried out by the Kim method. [5, 6, 8]. The following parameters were employed for analysis:

- Overbite Depth Indicator (ODI);
- Anterio-posterior Dysplasia Indicator (APDI);
- Combination Factor (CF).

The patients were divided into two groups based on the aforementioned criteria.

Group I comprised patients exhibiting vertical growth (21 patients), while Group II consisted of patients displaying horizontal growth (21 patients).

Results and Discussion

A cephalometric analysis of the patients' X-rays was conducted in accordance with the methodology proposed by Kim. [5,13]. The method is suitable for use by novice orthodontists and students.

The APDI parameters (81.47±3.29) exhibited characteristics consistent with those observed in distal occlusion.

When determining ODI parameters by Kim (normal 74.5±6.07) in patients with distal occlusion, in 21 patients this index varied within 71.2±1.04 (skeletal pattern with high angle), which indicates a tendency towards an open bite. In the second group of examined patients, the parameter averaged 77.2±0.4 (skeletal pattern with low angle) and indicated a tendency towards a deep bite.

It is not particularly informative to evaluate the ODI parameter in isolation, as it is interdependent with the APDI parameter. Therefore, it is important to consider its value in comparison with the Combination Factor (CF).

A low CF value indicates a tendency towards vertical growth, while a high CF value indicates a tendency towards horizontal growth.

Table 1. ODI, APDI and CF scores in the survey

Parameters according to Kim method	Normal	Group I	Group II
ODI	74,5± 6,07	71,2± 1,04	77,2± 0,4
APDI	81,4± 3,79	77,5± 1,6	78,3± 0,9
CF	155,9	150,1± 0,8	157,9± 1,6

Figures 1 and 2 illustrate the characteristics of patients from both groups. Figure 1a presents the patient profile prior to treatment. During the diagnostic process, anthropometric, cephalometric (APDI-78.5, ODI-71.8, CF-150.2) and photometric data were analyzed, which served as the basis for assigning the patient to the first group, i.e. to the group of patients with a predisposition to the vertical type of growth, with clockwise rotation of the mandible and enlargement of the lower third of the face. Accordingly, the treatment was aimed at reducing the height of the lower third of the face by the intrusion of the lateral lower teeth. The patient underwent treatment for eight months with a Twin-block appliance to correct the mandibular midline displacement.

The results of the treatment are illustrated in Figure 1b, which depicts the patient's profile following the completion of the treatment. The displacement of the mandible was addressed by stimulating its growth, while the vertical component of jaw growth was controlled to normalize the height of the lower third of the face. The Kim analysis scores at the conclusion of treatment were as follows: APDI 80.7, ODI 73.5, and CF 154.2.

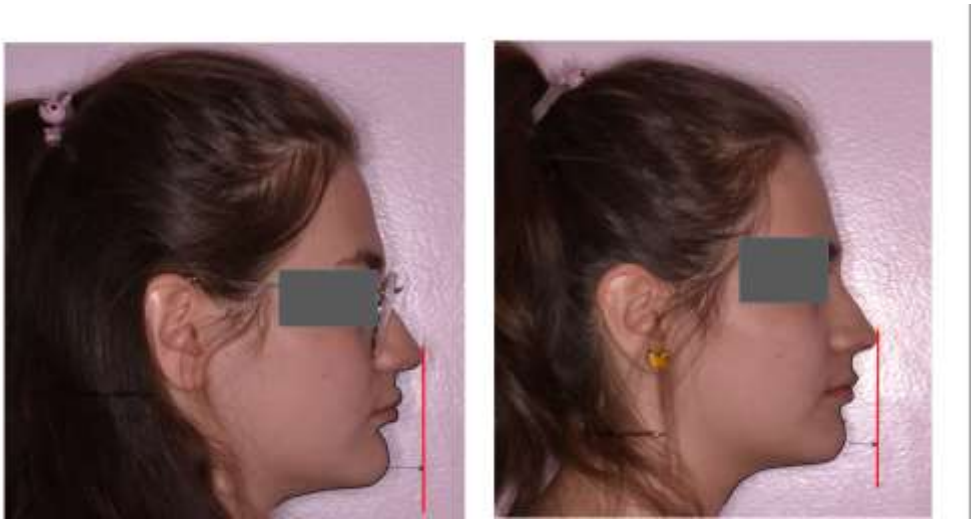
Figure 2 depicts a patient from Group II. This patient exhibited a distal bite and a proclivity towards horizontal growth, accompanied by a low angle and anti-clockwise rotation of the mandible. [9,12,13]. Prior to treatment, the cephalometric data of Kim's analysis were as follows: APDI 78.5, ODI 76.8, CF 155.3. Figure 2a. The selection of treatment tactics was based on an analysis of anthropometric, cephalometric and photometric data. The treatment was carried out using a bite plate for the frontal teeth with bite separation in the area of the masticatory teeth. In parallel, the upper masticatory teeth were intruded and the lower lateral teeth were extruded using a fixed technique. This contributed to the stimulation of the anterior positioning of the mandible and improved the anteroposterior relationship of the jawbones and dentition. Figure 2b illustrates the improvement in scores (APDI 80.2, ODI 75.1, CF 155.3), forward movement of the mandible and normalization of bite height.

1a **1b**

Figure 1. Patient profile from group 1 before and after orthodontic treatment

Figure 1a shows a patient with distal bite (APDI 78.5) and vertical growth type (ODI 71.8) and combination factor (CF 150.2)

(Group I). Figure 1b shows the same patient after treatment with the twin-block appliance, values: (APDI 80.7) (ODI 73.5) (CF 154.2)



2a **2b**

Figure 2. Profile of patient from group 2 before and after orthodontic treatment

Figure 2a shows a patient with distal bite (APDI 78.5) and horizontal growth type (ODI 76.8) and combination factor (CF 155.3)(Group II). Figure 2b shows the same patient after treatment with a non-removable bracket system, after which the following parameters changed: (APDI 80.2) (ODI 75.1) (CF 155.3)

A treatment plan was devised for group I patients based on the cephalometric indices, which involved flattening the occlusal plane, counterclockwise rotation of the occlusal plane by intrusion of the posterior lower masticatory teeth, and maintenance of vertical control in the area of the lateral and frontal teeth. This was done to stimulate growth and forward movement of the mandible.

Group II patients, as indicated by the obtained cephalometric indices, require clockwise rotation of the occlusal plane in order to achieve a sufficient vertical index. Conversely, an increase in the dentoalveolar height results in a displacement of the mandible in the posterior direction, which further compromises the anteroposterior relationship of the tooth rows and jaw bones. Consequently, the control of the vertical and horizontal relationships in the lateral and anterior teeth is successfully achieved by the intrusion of the upper and extrusion of the lower lateral teeth, which contributes to the stimulation

of the anterior positioning of the mandible and improves the antero-posterior relationship of the jawbones and dental rows.

Conclusion

The study of Kim teleradiographs revealed parameters that justified the creation of a diagnostic algorithm and differential approach to the treatment of patients with distal occlusion, taking into account the vertical growth component.

The evaluation of the tendencies of changes in dentoalveolar and soft tissue parameters of the jaw complex in individuals with distal occlusion in the process of growth of the facial skeleton allows for the prediction of the result of treatment for gnathic forms of distal occlusion of dental rows. It has been demonstrated that the horizontal vector of maxillofacial complex growth is a prognostically favorable factor in the treatment outcome of patients with distal ratio of dental arches, whereas the vertical vector is an unfavorable factor.

Given the correlation between vertical and horizontal indices, it is possible to predict the probability of aggravation or the possibility of self-regulation of problems in patients with distal occlusion of dental arches.

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