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X-RAY CEPHALOMETRIC FEATURES OF NASAL AND GNATHIC SECTIONS IN DIFFERENT FACIAL SKELETON GROWTH TYPES

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ABSTRACT

Based on the results obtained through studying head lateral teleroentgenograms of 68 patients (aged 18–25) with a full set of permanent teeth and physiological occlusion, a method was developed, which allows exploring the angular parameters of the nasal (n-cond-sn) and gnathic (sn-cond-gn) face sections. In view of the type of the face gnathic part growth, the patients were divided into three groups: Group 1 (n=27) included patients with a neutral type of face growth and a mandibular angle of 119°–123°.

Group 2 (n=22) were patients featuring a vertical type of the face gnathic part growth with a mandibular angle exceeding 123°. In patients of Group 3 (n=19), the mandibular angle was below 119° along with the horizontal type of the face gnathic part growth. Patients with physiological occlusion were found to have the nasal part angular parameters (n-cond-sn) relatively stable at different types of jaw growth: neutral type, 29.85±0.22°; vertical type, 30.01±0.22°; horizontal type, 29.96±0.29°, respectively. The angular parameters of the face gnathic part (sn-cond-gn) are variable and were identified based on the type of face growth, whereas the dimensional parameters in case of the vertical growth type (33.02±0.26°) exceed similar indices in people who featured the neutral (30.04±0.28°) and horizontal (26.92±0.29°) growth types. The angular parameters obtained for the nasal (n-cond-sn) and gnathic (sn-cond-gn) parts of the face can be employed as stable reference points when assessing the jaw growth types in patients with physiological occlusion, detecting facial features with maxillofacial anomalies and deformities (both congenital and acquired), and serve as a criterion pointing at the effectiveness of prosthetic and orthodontic treatment.

Keywords: X-ray cephalometry, face nasal part, gnathic part of face, facial part of skull, head lateral teleroentgenography, facial skeleton growth types.

INTRODUCTION

The normal variability of morphological features of the human craniofacial region, as well as the structure and the patterns of their development are of reasonable research and applied interest for experts in the area of clinical dentistry, orthodontics, maxillofacial surgery, neurosurgery, and ophthalmology [21,49,54]. The constitutionally meaningful features of the facial section taken as objects for in-depth study within aesthetic dentistry include: the gnathic type of the face (meso-, dolicho-, brachygnathic); the type of the facial skeleton growth (neutral, horizontal, vertical); the masticatory muscles thickness and spatial orientation; the morphological (angle) and morphometric features of the mandible (condylar width, angular width) [4,15,22,28,33,37,39]. Analysis of orthodontic treatment outcomes in patients with maxillary system issues, which is aimed at ensuring proper morphometric, functional and aesthetic balance, is performed in various aspects: the evaluation of the anatomical and functional status of the maxillofacial area, of the occlusion, and of aesthetic effect achieved [5,9,14,16,24,31,41,52,58].

The diagnostic value of identifying the facial skeleton growth type roots in the fact that patients have high demands concerning orthodontic treatment, while paying special attention to aesthetics. High-quality planning and treatment take an orthodontist knowing not only the normal indicators, yet also respective deviations from such values, including variations in view of the facial skeleton growth type [3,6,29,40,59].

The authors prove that the facial skeleton growth type developed in childhood determines the further direction for the growth of the face gnathic part, while horizontal and vertical growth types point at predisposition to developing dental issues [1,18,35,51,53,61].

Subject to research outcomes, clinicians have developed the parameters of the norm, identified the distinctive features of the facial skeleton structure for the orthognathic bite depending on the gender and the age, the morphology of the temporomandibular joint, the dental arches, the occlusal plane, and the teeth position [8,12,38,43,62]. There has been an interconnection detected between the lateral teeth group mesiodistal tilt of the upper and lower jaws in people featuring different types of facial skeleton growth, and for various physiological occlusions [25,27,42,34,50,60].

The orthognathic bite, recognized as a standard norm when investigating the etiopathogenesis of dental issues, is described as dominated by the neutral type of face growth. The orthognathic bite reveals quite wide variability range, where the height and the depth may vary significantly, the general structure of the facial skeleton, though, remaining within the neutral type of growth. In case of the neutral growth type, the height and the depth of the facial skeleton feature approximately similar development [7,11,20,48].

The depth predominance over the height is typical of the horizontal growth type, whereas the height prevailing means that the growth type is vertical. In these cases, we are talking about disturbed proportions in the facial skeleton development in the transverse-longitudinal directions, which affects the majority of the craniofacial structures. In case of the horizontal growth type, for instance, there is anterior rotation of the upper jaw, as well as an increase in the incisors protrusion, and a decrease in the alveolar process height in the posterior part to be observed. The vertical type of growth features a posterior rotation of the upper jaw, an increase in the face total height as well as in the height of the face middle zone, and the lower jaw micrognathia [44,46,55].

Literature contains some data on face nasal parameters deviations from the age norm in people with congenital pathology and in case of genetics-related health issues diseases [2,23,45].

Cephalometric studies that are part of the mandatory diagnostic measures employed to examine patients with dental issues are of specific interest in applied dentistry, since they allow shaping an objective view of the skull parameters and their relationships [10,17,57].

Craniometric and cephalometric studies allow not only identifying the face-soft-tissue-to-bone-structure ratio, but monitoring the effectiveness of orthodontic and surgical treatment, too [19,32,36,56]. Experts have found the facial skull bone structures to have craniological polymorphism, as well as to determine its relief and symmetry in relation to the median sagittal plane, thus working a significant effect on both the facial aesthetics and the face profile harmony [13,26,30,47]. An analysis of respective literature shows that angular measurements characterizing the X-ray cephalometric features of the facial skeleton nasal and gnathic sections in patients with physiological bites are lacking, which explains the reason behind this present study.

Aim of study: to carry out a comparative analysis of the angular parameters of the face nasal and gnathic sections on a lateral teleroentgenograms obtained from young people with physiological occlusions.

MATERIALS AND METHODS

X-ray studies involved 68 young people aged 18–25, with a full set of permanent teeth and physiological types of occlusal relationships. Prior to the research, voluntary informed consents were obtained subject to the Ethical Principles for Medical Research Involving Human Subjects (Nuremberg Code, 1947; World Medical Association Declaration of Helsinki, 1964). The patients were divided into three groups based on the type of face gnathic part growth. Group 1 were 27 persons with a neutral type of facial growth, where the mandibular angle was 119°–123°. The patients belonging to Group 2 (n=22) featured the vertical type of the face gnathic growth and an increase in the mandibular angle (above 123°). In Group 3 (n=19), a horizontal type of growth of the face gnathic part was to be observed along with a decrease in the mandibular angle (under 119°) (Fig.1).

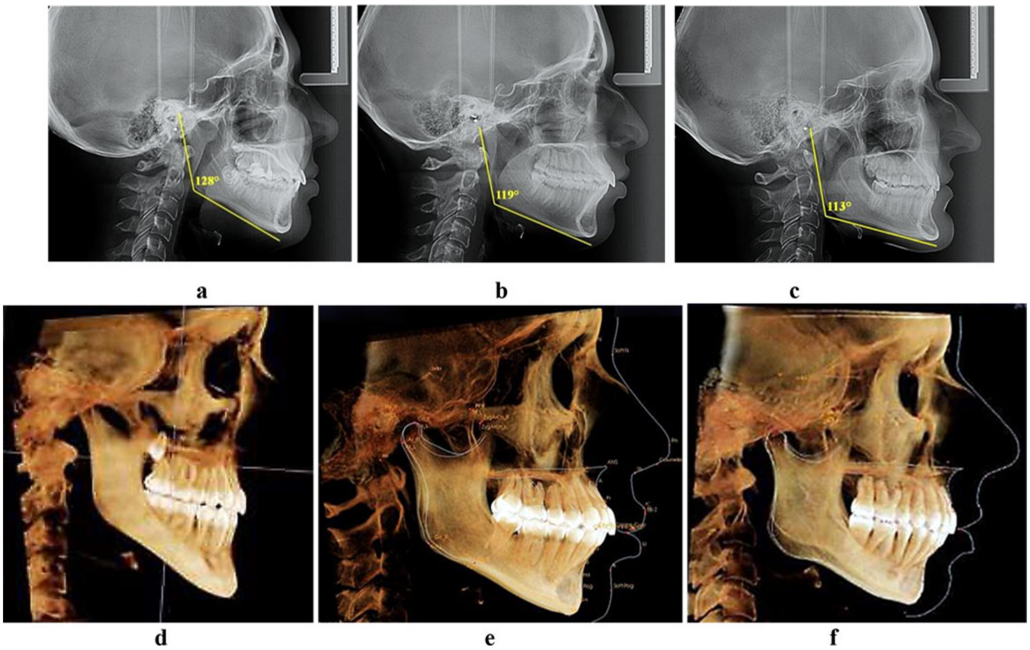

Fig. 1. Teleroentgenograms and computed tomograms, patients with vertical (a, d), neutral (b, e) and horizontal (c, f) type of jaw growth.

On the lateral teleroentgenogram, the main reference point was the top point of the lower jaw articular head, which was marked as the *cond* point (*condylion*). The cutaneous point of *n* (nasion) was placed in the deepest spot between the forehead and the nose. The *sn* (*subnasale*) point was located at the junction spot of the nasal septum and the upper lip. The cutaneous *gn* (*gnation*) point was recognized to be the most prominent point of the chin soft tissues protruding forward and downwards. These points were connected by horizontal lines drawn from the articular point while shaping nasal (*n-cond-sn*) and gnathic (*sn-cond-gn*) angles (Fig. 2).

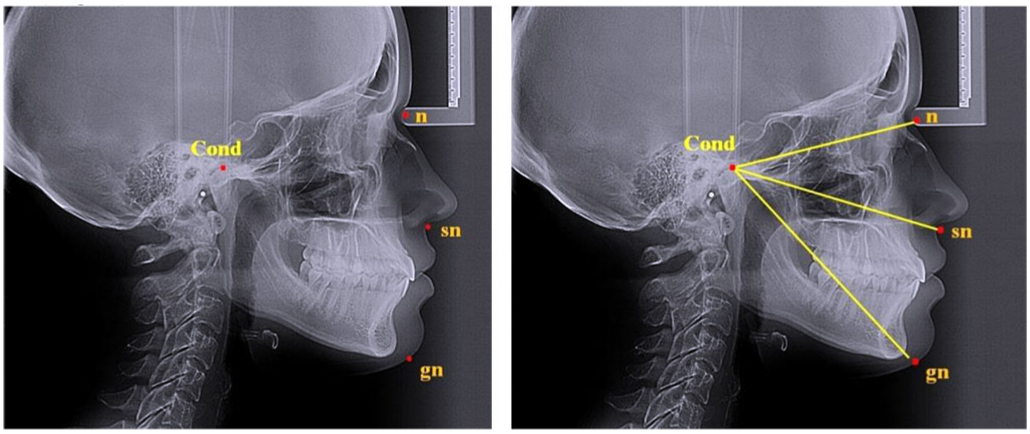

Fig. 2. Major reference points for analyzing nasal and gnathic face parts on teleroentgenograms, lateral projection

The teleroentgenograms were used to match the resulting angles shaped by the said lines.

The statistical data processing was performed using the Microsoft Excel 2013 software and the SPSS Statistics 22.0 software package. The calculated values included the median value (M), the non-sampling error (± m) while taking into account the mean square deviation (δ). The minimal statistically significant difference was set at p<0.05.

RESULTS AND DISCUSSION

In people featuring physiological occlusions, in case of the neutral jaw growth type (Group 1), the mandibular angle was 120.97±0.38 degrees (δ=1.96).

The face nasal angle (n-cond-sn) within the group was an average of 29.85±0.22 degrees (δ=1.15), the gnathic angle (sn-cond-gn) being 30.04±0.28 degrees (δ=1.44).

Given the above, as could be seen from the teleroentgenograms, young people with physiologically occlusive relationships and the neutral type of gnathic growth, the angular parameters of the face gnathic part matched similar parameters of the nasal part, while no statistically significant differences (p<0.05) between the parameters in focus were detected (Fig. 3).

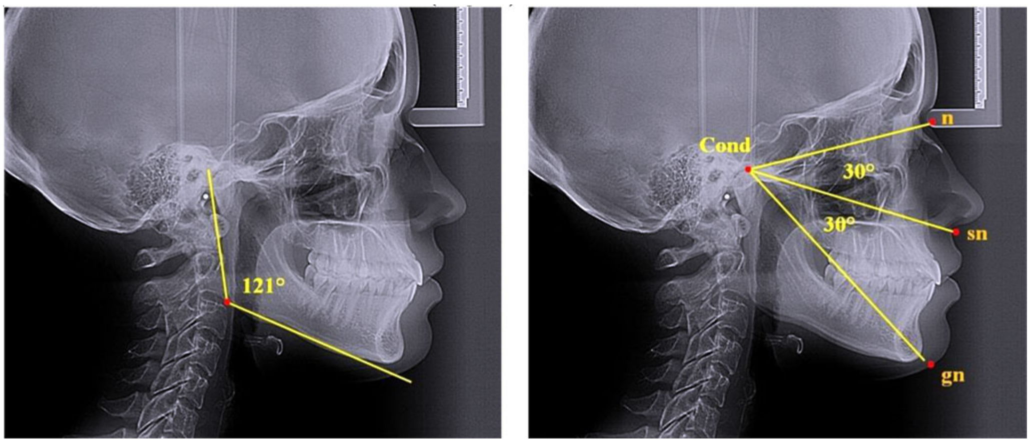

Fig. 3. Angular parameters, nasal and gnathic part of face; teleroentgenograms, lateral projection; neutral type of growth

In patients with physiological occlusions and the vertical jaw growth (Group 2), the mandibular angle was 128.36±0.51 degrees (δ=2.39), which exceeded reliably (p<0.05) the similar parameter in those who featured the neutral type of the gnathic growth of face. An increase in the non-sampling error and in the mean square deviation were indicative of a greater variability in the mandibular angle if compared to the neutral type of growth.

The nasal facial angle (n-cond-sn) in patients with the vertical jaw growth was 30.01±0.22 degrees (δ=1.05). There were no significant differences observed pertaining to this parameter, if compared with the results obtained in Group 1 (p>0.05), which means that the type of the face gnathic part does not have any effect on the indicators related to the nasal part of the face. The gnathic angle value (sn-cond-gn) in patients of Group 2 was significantly above that in patients of Group 1 (p<0.05), making up 33.02±0.26 degrees (δ=1.23). Besides, the angle of the gnathic part exceeded the nasal angle by 3 degrees (Fig. 4).

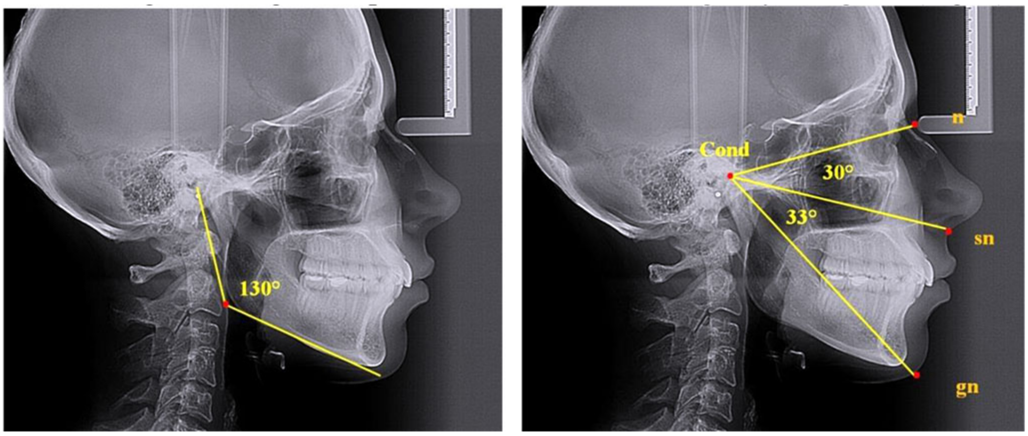

Fig. 4. Angular parameters, nasal and gnathic parts of face; teleroentgenograms in lateral projection, vertical growth type

This means that in case of the vertical growth type of the face gnathic part observed in young people with physiological occlusal relationships, the angular parameters of the gnathic part were significantly above similar parameters of the nasal part ($p>0.05$).

In patients with the physiological types of occlusion and the horizontal jaw growth (Group 3), the mandibular angle was 111.89±0.59 degrees (δ=2.52), which is significantly below ($p<0.05$) that in people with the neutral type of gnathic face growth. An increase in the non-sampling error and in the mean square deviation, just like in Group 2, pointed at a greater variability of the mandibular angle than in case of the neutral type of growth of the face gnathic part. The nasal facial angle (n-cond-sn) in patients with the horizontal jaw growth was 29.96±0.29 degrees (δ=1.23). There were no significant differences detected in this parameter compared with the data obtained from studying Groups 1 and 2 ($p>0.05$), which confirms the idea that the type of the gnathic part has no effect on the face nasal part parameters. The gnathic angle (sn-cond-gn) in patients with the horizontal jaw growth and significantly smaller than in people with the neutral type of the face gnathic growth ($p<0.05$), and was 26.92±0.29 degrees (δ=1.24). Besides, the face gnathic part angle was smaller than the nasal angle by 3 degrees (Fig. 5).

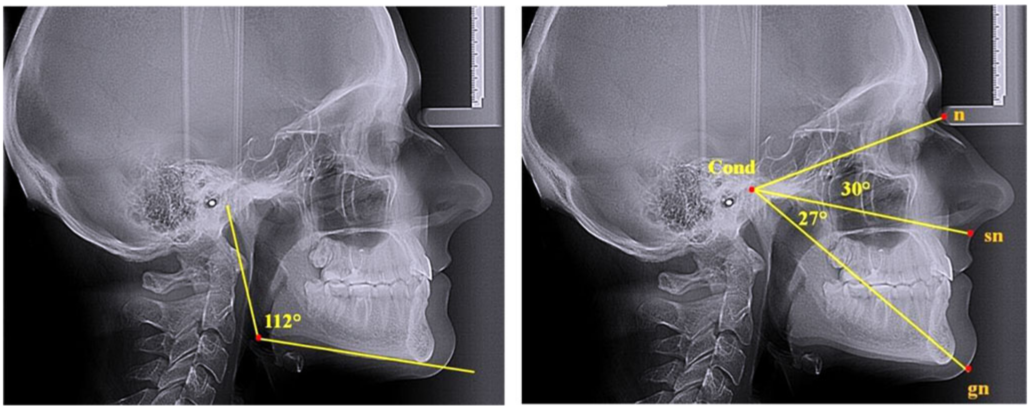

Fig. 5. Angular parameters of nasal and gnathic part of face; teleroentgenograms, lateral projection; horizontal growth type

The obtained angles of the face nasal and gnathic sections can serve as reference points when assessing the jaw growth type in case of physiological occlusion, detecting the facial features bearing maxillofacial anomalies and deformities (either congenital or acquired genesis), as well as be employed as a criterion to evaluate the effectiveness of prosthetic and orthodontic treatment.

CONCLUSIONS

1. The X-ray morphometric measurements of head teleroentgenograms in the lateral projection are reliable and informative when it comes to studying the size and location of the skull facial bones, the main directions of head facial growth, as well as when analyzing the angular parameters of the nasal and gnathic parts of the face.

2. The head facial part types of growth are determined by the basic linear and angular parameters of teleroentgenograms, as well as by the main jaw growth types.
3. Given the regularities pertaining to the skull facial structure, dependencies observed between the morphometric parameters of the dental arches, jaws, facial skeleton bones, as well as the relationship of stable anatomical references of the craniofacial complex with certain planes, there was a method proposed for studying the angular parameters of the face nasal and gnathic parts on head lateral-projection teleroentgenograms.
4. Measuring the angular parameters of the nasal (n-cond-sn) and the gnathic (sn-cond-gn) sectors of the skull facial part on teleroentgenograms (lateral projection of the head), the *condylion* bone point and the soft-tissue (skin) points of *n* (*nasion*), *sn* (*subnasale*), and *gn* (*gnation*) were used as anthropometric references.
5. The proposed method employed to study the facial skeleton using stable anthropometric references shows that patients with physiological occlusion have angular parameters of the face nasal part (*n-cond-sn*) that are relatively stable at various types of jaw growth, making up: the neutral type, 29.85±0.22°; for the vertical type, 30.01±0.22°; for the horizontal type, 29.96±0.29°.
6. The angular parameters of the facial skull gnathic part (*sn-cond-gn*) are variable and are determined by head facial growth, while the dimensional parameters in case of the vertical growth type (33.02±0.26°) go beyond similar values in people with the neutral (30.04±0.28°) and the horizontal (26.92±0.29°) growth types.
7. The angular value of the face nasal part (*n-cond-sn*) can be well used in clinical dentistry for identifying occlusion issues in the vertical plane, both in the nasal and in the gnathic parts of the face.

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