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SPECIFIC FEATURES OF X-RAY ANATOMY AND PROFILOMETRY IN PEOPLE WITH DIFFERENT TYPES OF FACIAL SKELETON

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ABSTRACT

This work is a summary of results obtained through clinical, radiological, and photometric studies involving 90 people (aged 18-25) with physiological types of bite. The first stage of the study implied an assessment of the face main anatomical structures location (chin, lips and jaws) relative to the conventionally accepted and proposed lines (planes) of the teleroentgenogram and face profile images. At the second stage, the patients were divided into three groups featuring different types of dental arches – mesotrusive (n=33), protrusive (n=30) and retrusive (n=27), depending on the incisor angle of the antagonizing medial incisors. Almost all patients of Group 1 were observed to have the upper lip touching the nasal line passing through the n (nasion) and the sn (subnasale) points, the lower lip receding backwards and the occlusal relationships falling within the age norm, while the average incisor angle being 135.24±3.09°. In most patients of Group 2, the upper and lower lips were located forward from the nasal line, while the occlusal relationships matched the age norm, and the average incisor angle was 116.24±3.02°. In Group 3, the patients' upper and lower lips were located behind the nasal line, the occlusal relationships corresponding to the age norm and the average incisor angle making up 146.24 ± 3.34°. The obtained data expand the vision of the upper and lower lip facial topography for various dental arches, and are of applied importance when it comes to assessing the aesthetic profile of soft facial tissues, as well as the data in question can serve the criteria to evaluate the rehabilitation effectiveness in patients with dental pathology in view of their individual maxillofacial features.

Keywords: profilometry, X-ray anatomy, face soft-tissue profile, facial aesthetics, facial skull, physiological occlusion, dental arch, mesotrusion, retrusion, protrusion.

INTRODUCTION

Thorough investigation into the normal variability of the human cranial morphology, as well as the structure and patterns of its development, are of reasonable research and pragmatic interest for clinical experts involved in dentistry (surgical, orthopedic, general), orthodontics, maxillofacial surgery, neurosurgery, and ophthalmology [9,16,20,24,31,37,49,66].

The applied value of orthodontics, which is a complex diverse discipline, implies not only correcting

issues affecting the position of teeth, the dental arch shape (size), and the bite, yet also in ensuring the correct growth of the jaws, improving the shape of the facial skull, bringing back to normal the dental function, restoring facial aesthetics, guiding the development of adjacent body organs and systems as a whole [1,12,19,26,40,55,61].

Orthodontic treatment, which includes arriving at morphological, functional and aesthetic optimum through any age stage, is to be implemented employing both conventional methods that have long proven effective in correcting dental issues and deformities at the early stages of their development, and advanced innovative technologies and treatment techniques that allow taking therapeutic and preventive measures in case of obvious anomalies and deformities of the dental apparatus [2,21,29,33,47,51,67].

Dental anomalies and deformations mainly come accompanied by significant morphological, functional and aesthetic issues. There are significant changes in the facial features to be observed as well as distortion affecting the proportions of the face and its parts, which leads to a serious deterioration in facial aesthetics, at the same time working a negative effect on the patient's psycho-emotional and social status [4,13,35,48,54,60,64].

Clinical studies have revealed a reliable effect that orthodontic treatment has on the face soft tissues position. The face soft-tissue profile contour is under a significant influence of the teeth movement degree, of the mandibular joint articular head position, of the pressure that soft tissues have on the dentition, of the adjustment capacity of the dentition system ligament set, as well as other factors [3,8,41,46,57,62].

The issues related to identifying the right proportion determining the harmonious maxillofacial structure are rated among the key tasks in terms of orthodontic diagnostics and treatment planning [7,58].

Constitutionally significant facial features, taken as objects for thorough study within aesthetic dentistry, include: the gnathic face type (meso-, dolicho-, brachygnathic); the head facial part growth (neutral, horizontal, vertical); masticatory muscles thickness and spatial orientation; the mandible morphological (angle) and morphometric features (condyle width, angular width) [6,22,27,36,43,44,50,56].

There is scientific evidence showing that morphological and the craniofacial anatomical features, which are based on skeletal, dental and soft tissue indicators, should rely not on race and ethnicity alone, yet also on factors like age and sex variability, if we talk about normal structure vs. various dental pathologies [45]. The study of the face soft-tissue profile is of value when it comes to a more complete representation of the patient's individual features, the specifics and harmony of the face, the proportion of the face parts, the face profile convexity or concavity degree, as well as in terms of planning the orthodontic treatment tactics to eliminate anomalies related to the dental system evolution [5,30,59].

Experts have offered convincing proof revealing that the position of the front teeth, i.e. protrusion or retrusion, can have an effect on the lips position, even in case of physiological occlusal relationships [10,18,23,28,38].

The currently employed classifications of dental arches use terms defining the arcade (gnathic) type while taking into account index values and dental indicators based on the teeth size or the dental arch length [11,15,17,32,42,53,65].

Systematizing scientific data can help conclude that orthodontic treatment should aim at maintaining facial parameters or contribute to their improvement, while orthodontic correction, if carried out to improve aesthetics and help achieve occlusive and facial balance, points at the modern approach to planning complex dental treatment [14,25,52].

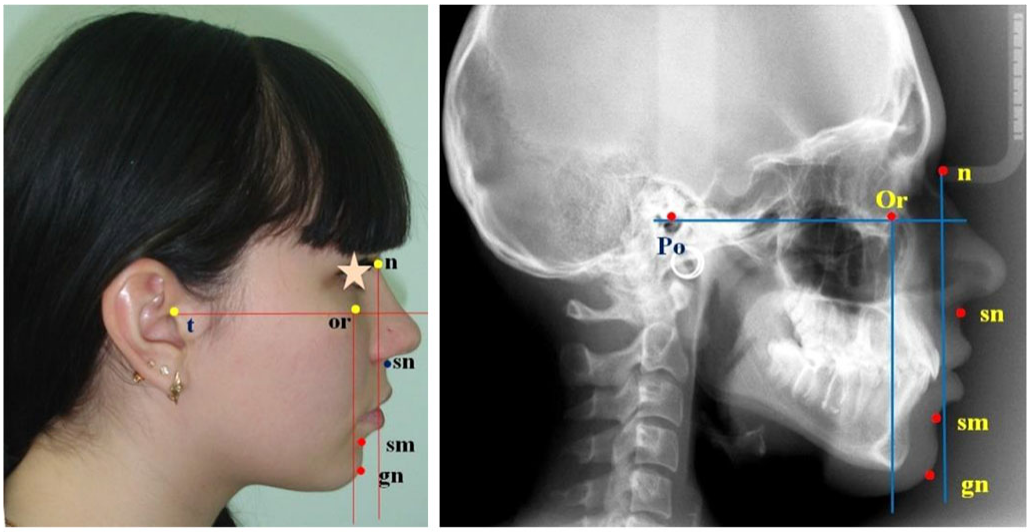
Shaping an understanding of the face soft-tissue parameters and their variability within the physiological norm allows designing a treatment plan aimed both at eliminating dental issues as well as at harmonizing the face of each individual. Despite numerous items published in this field, the issue of determining the interdependence between the frontal teeth trusive position and the lips aesthetic position has not been covered to sufficient extent, which explains the reason behind this study.

Aim of study. To carry out a comparative analysis of various methods to be used for identifying the location of the facial main anatomical structures and to detect the specific features for the lips location in people revealing different trusive types of dental arches with physiological occlusion of permanent teeth.

MATERIALS AND METHODS

The study involved young people aged 18-25, with respective written consent obtained and approved by the local Ethics Committee. Stage 1 of the study involved matching the location of the face main anatomical structures (chin, lips and jaws) in view of the generally accepted and proposed lines (planes)

as reflected in the teleroentgenogram and in the face profile photographs (Fig. 1).

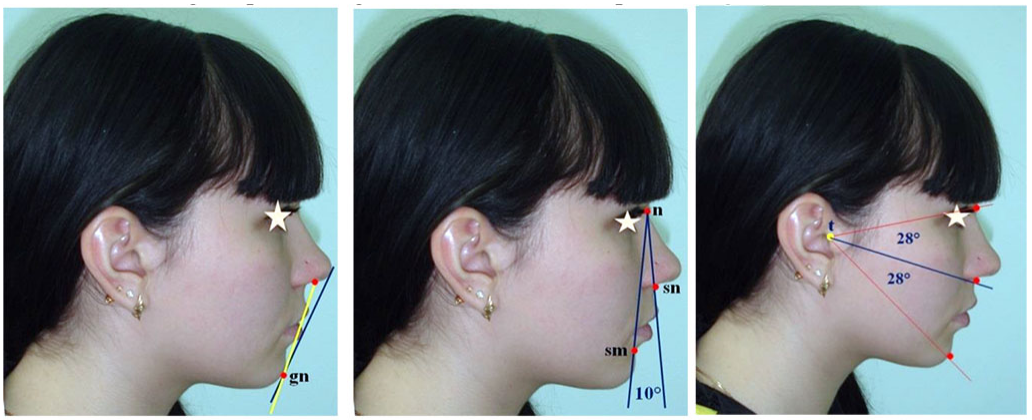


a **b**

Figure 1 – comparative analysis of the main anatomical structures location in relation to the lines, photo (a), teleroentgenogram (b)

There was the Frankfort horizontal drawn, with a nasal and an orbital vertical designed perpendicular to it subject to the guidelines as accepted conventionally in orthodontics.

The profile images were used to analyze the lips position in relation to Rickett's line, which ran connecting the nose tip with the chin, and Steiner's line, which connected the chin and the nasal septum ventral restriction (the middle between the nose tip and the subnasal point). Besides, the upper lip and the lower jaw position was identified along the lines shaped by the nasal-subnasal and nasal-supramental verticals while measuring the profile angle between these mark points (Fig. 2).



a **b** **c**

Figure 2 – comparative analysis of the anatomical structures location in relation to Rickett's and Steiner's aesthetic facial lines (a), nasal verticals (b) and radial facial lines (c)

The radial lines running from the tragion (t) point to the *sn, sm* points were used to identify the proportional balance of the nasal and gnathic parts of the face.

Stage 2 of the study involved 90 patients, and in view of the antagonizing medial incisor angle, which reveals the trusive type of dental arches, the patients were divided into three groups – Group 1 (n=33) were patients with the mesotrusive type of dental arches (inter-incisal angle – 125°-140°); Group 2 (n=30) included patients with the protrusive type of dental arches (inter-incisal angle – below 125°), and Group 3 (n=27) were patients with the retrusive type of dental arches (inter-incisal angle – above 140°) (Fig. 3). All the patients had an optimal incisor overlap, both vertical and horizontal.

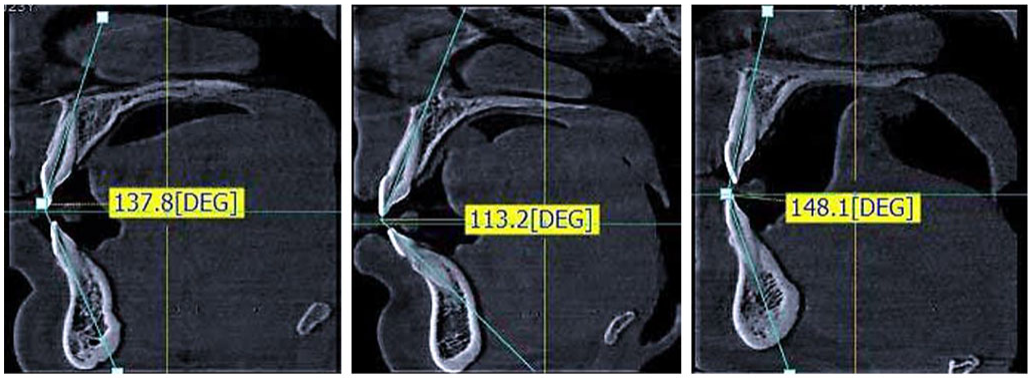


Figure 3 – types of medial incisors location on the CBCT: a – patients of Group 1 (mesotrusive dental arches); b – patients of Group 2 (protrusive dental arches); c - patients of Group 3 (retrusive dental arches).

Also, the trusion of dental arches was identified in view of the gnathic (arcade) and dental indicators to be found in modern classifications. The mesotrusive type was observed in people with meso-arcade normodontia, dolicho-arcade microdontia and brachy-arcade macrodontia dental arches. The protrusive type included dental arches falling within the dolicho-arcade (macro- and normodentia) and meso-arcade macrodontia types. The anterior teeth retrusion was observed in people with brachy-arcade arches with their micro- and normodontia, as well as with meso-arcade microdontia type dental arches [34,39,63].

RESULTS AND DISCUSSION

People with physiological occlusion and mesogenic face type were observed to have the location of the lips, if taken in relation to Rickett's and Steiner's lines, close to normal; the upper lip, though, typically failed to reach Rickett's line and was somewhat protruded in relation to Steiner's line (Fig. 4).

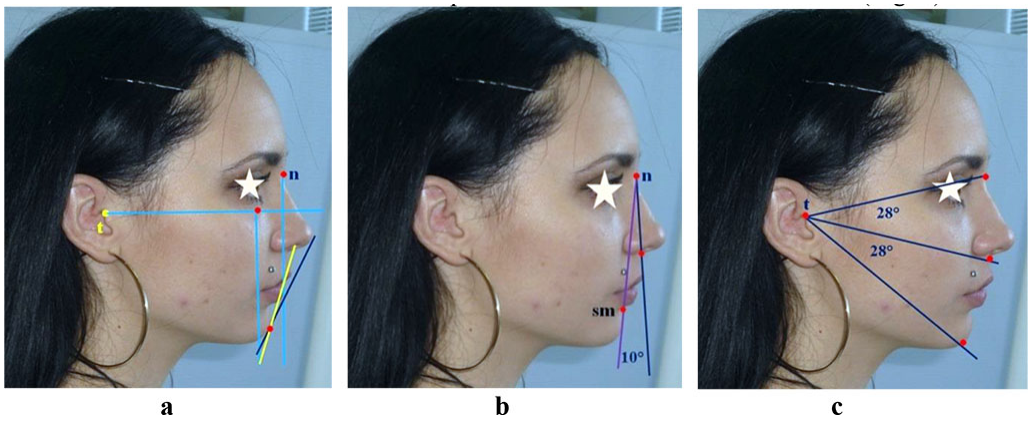
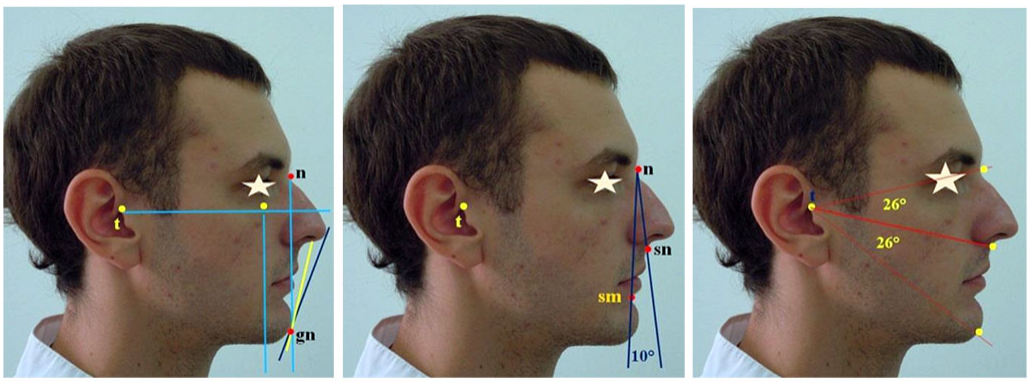


Figure 4 – Specific features of the anatomical structures location in relation to Rickett's and Steiner's aesthetic lines (a), nasal verticals (b) and radial lines (c) in case of the mesogenic face type

When analyzing the position of the upper lip in relation to the initial line, it was noted that the upper lip more often touched the specified landmark. The profile angle, which determines the position of the jaws, and which is shaped by the nasal and the nasal-supramental vertical lines was within the normal range – about 10 degrees. The radial lines separating the nasal and gnathic parts of the face matched the normal values constituting an average of 28.43+0.62 degrees.

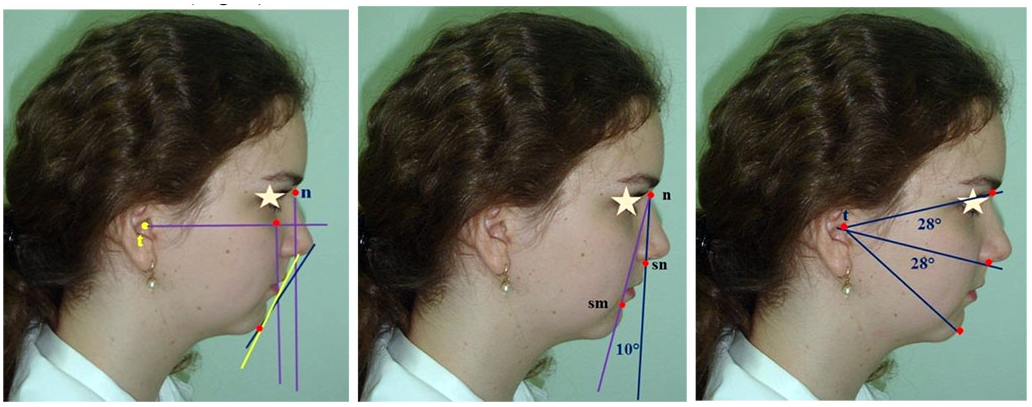
It was noted that people with physiological occlusion and the progenic face type had their lips not reaching Rickett's and Steiner's lines, which can be explained by the chin extended forward and reaching Dreyfus's nasal vertical (Fig. 5).



a b c

Figure 5 – Specifics of the anatomical structures location in relation to Rickett's and Steiner's face aesthetic lines (a), nasal verticals (b) and radial lines (c) in case of the progenic face type

An analysis of the upper lip position in relation to the nasal line revealed that the upper lip, as a rule, touched the specified mark. The profile angle, which determines the jaws relative position and makes up the nasal and the nasal-supramental vertical lines fell within the normal range being about 10 degrees. The radial lines separating the nasal and the gnathic parts of the face matched the normal values making up an average of 27.12+0.94 degrees. People with physiological occlusion and the retrogenic face type featured the lips reaching Rickett's and Steiner's lines, which could be accounted for by the chin location behind Simon's orbital vertical (Fig. 6).



a b c

Figure 6 – Specific features of the anatomical structures location in relation to Rickett's and Steiner's face aesthetic lines (a), nasal verticals (b) and radial lines (c) in case of the retrogenic type of face

When analyzing the upper lip position in relation to the nasal line, the upper lip, as a rule, it was noted to be touching the mark in question. The profile angle, which determines the relative position of the jaws and is shaped by the nasal and the nasal-supramental vertical lines was within the normal range at about 10 degrees. The radial lines separating the nasal and the gnathic parts of the face matched the norm with an average of 28.17± 0.56 degrees.

Through Stage 2 of the study, we identified the lips position taking into account the trusive type of dental arches (Fig. 7)

a b c

Figure 7 – The lips position in case of mesotrusive (a), protrusive (b) and retrusive types of dental arches (c)

The mesotrusive type of dental arches more often came along with various types of the meso-arcade normodontia type, with 24 patients featuring this, which, if expressed in relative numbers, was 26.67+0.49% of the total number of patients. Dolicho-arcade microdontia arches were observed in patients (6.67±0.28%), whereas brachy-arcade macrodontia dental arches were found in 3 patients (3.33±0.2%). Virtually all the patients of this group had the upper lip touching the nasal line, the lower lip showing somewhat posterior retreat, the occlusal relationships matching the age norm, and the inter-incisal angle being 135.24 ± 3.09 degrees. In 30 patients (33.33±0.52%) with *the protrusive type* of dental arches, meso-arcade macrodontia types were more common – in 15 persons, i.e., 16.67± 0.41% of the total number of the patients. Dolicho-arcade normodontia arches were identified in 9 patients (10.0±0.33%), whereas dolicho-arcade macrodontia arches were to be seen in 6 patients (6.67±0.28%). Almost all the patients of this group had the upper and lower lips in an anterior position from the nasal, while the occlusal relationships fell within the age norm, the inter-incisal angle being 116.24 =3.02 degrees. As far as *the retrusive type* of dental arches is concerned, more common were here the brachy-arcade microdontia types – in 15 patients, that accounting for 16.67 ± 0.41% of the total number of the patients. Brachy-arcade normodontia arches were identified in 8 patients (8.89=0.32%), and meso-arcade microdontia dental arches in 4 patients (4.44=0.23%). Almost all patients of this group had the upper and lower lips located behind the nasal line, while the occlusal relationships matched the age norm, and the inter-incisal angle was 146.24+3.34 degrees.

The above means that the method proposed for identifying the lips position based on the nasal line can be employed to evaluate their location aesthetics in view of the individual morphological features pertaining to the facial gnathic part.

CONCLUSIONS

1. Based on the regularities identified in the facial skull structure, the detected correlation between the morphometric parameters of the dental arches, jaws, facial bone structures, as well as the relationship between the facial and cerebral skull bones and the soft-tissue profile contour, a method was proposed for evaluating the lips facial contour position in people with physiological occlusion and various trusive types of the dental arches.
2. When constructing a nasal line on a profile photostatic image, the first anthropometric mark relies on the upper nasal *n* (nasion) point, the other anthropometric mark point being the profile subnasal *sn* (subnasale) point.
3. The upper lip was observed to touch the nasal line mainly in people with the mesotrusive type of dental arches and physiological occlusal relationships. In patients with protrusive type of dental arches and physiological occlusion, the upper and lower lips were mostly in an anterior position relative the nasal line, while in case of physiological retrusion of the frontal teeth, the upper and lower lips were typically located behind the nasal line.
4. The newly obtained data offered above will expand and complement the ideas to be found in respective research literature focusing the topography of the upper and lower lips facial contour in patients with different types of dental arches, and are of great importance in terms of data verification when evaluating the aesthetic profile of the face soft tissues, while taking into account individual features, as well as the results of aesthetic and morphofunctional rehabilitation of patients suffering from dental pathologies.

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