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CASE REPORTS

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Upper airway cavities morphologic features in facial asymmetries

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Abstract

Facial asymmetries have an important impact on the cranio-facial structures morphology, being the result of the genetic, environmental and dysfunctional factors and their impact on the dento-maxillary complex. Asymmetries can be identified in all craniofacial structures, including the upper airway cavities. Craniofacial asymmetries can influence general growth and development by altering the respiratory function. The present study aimed to evaluate morphologic correlations of the upper airway cavities changes in facial asymmetries. Most of the cases included in the study showed on the underdeveloped side that the nostril and nasal fossa were narrowed, while the paranasal sinuses were frequently larger. However, no correlation could be established to answer whether these changes were determined by asymmetry, or if they appeared as compensatory, or if only some structures of the upper airway cavities changed morphologically in a compensatory manner.

Keywords: craniofacial morphology, facial asymmetry, upper airway cavities.

Introduction

Absolute symmetry is considered an ideal in biology [1, 2], but asymmetry is a general anatomical and morphological characteristic of the normal individual, found also in the craniofacial structures. Differences from the median plane, found in various amounts in the population, can be so insignificant that they cannot be identified clinically, or can interfere with the dento-maxillary complex morphology and with the esthetic appearance.

Harmonious faces appear symmetrical, but show skeletal asymmetries, which implies that soft tissues are involved in eliminating the existing asymmetry [2–4]. Craniofacial asymmetries are recorded in the whole population [5–8]. The growth differences between the two sides of the faces are determined by genetic, environmental, and dysfunctional factors, as well as their interactions [6, 9–12]. Therefore, craniofacial asymmetry can be the expression of both heredity and muscular system function, especially regarding the masticatory muscles [1, 13, 14].

The relation between craniofacial asymmetries and dento-maxillary abnormalities have been studied by Thompson [15] and Cheney [16]; methods for evaluating and quantifying asymmetry have been developed and described by Harvold [17], Sassouni & Forrest [18], Burke [19], Vig & Hewitt [20]. Craniometry is the oldest method [8]. Postero-anterior photographs [6, 21], anthropometrics and stereophotogrammetry [14, 22] are also used. The method most frequently used is postero-anterior and axial cephalogram analysis [13, 23, 24]. Nevertheless, panoramic radiograph also has a role in this direction.

In a symmetric facial skeleton, the vertical line crossing the crista galli of the ethmoid, the anterior nasal spine and the maxillary and mandibular midlines must divide the face in two perfect symmetrical halves [24]. In the postero-anterior cephalometric analysis, such a vertical line is difficult to define [25], giving a certain degree of subjectivity to the cephalometric evaluation of facial asymmetries. Using bilateral anthropometric landmarks, and correlating their position with landmarks located on the median plane, is the method for a quantitative evaluation of craniofacial asymmetries [1].

Asymmetries can be identified in all craniofacial structures, including the upper airway cavities. Craniofacial asymmetries can influence general growth and development by altering the respiratory function.

This study aimed to evaluate the morphologic correlations of the upper airway cavities changes in facial asymmetries.

Case reports

In order to evaluate and quantify craniofacial asymmetries, the analysis of postero-anterior cephalograms was used. Frontal cephalometric head films from 41 patients, aged from 7 to 37 years, have been traced by two persons, three times each, in the same tracing conditions, for each landmark and parameter resulting six values, in order to minimize the measuring errors using their statistical mean. The postero-anterior cephalometric analysis consisted in the following planes [26, 27] (Figure 1).

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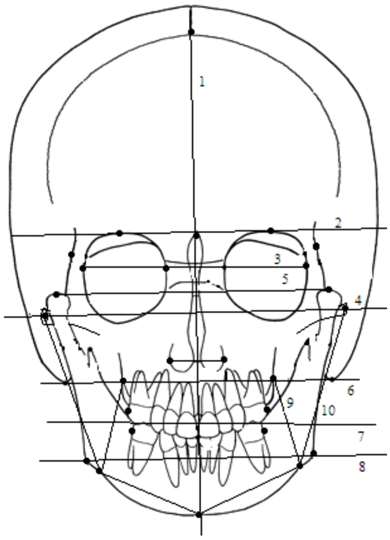

Figure 1 – ***Landmarks and planes used in postero-anterior cephalometric analysis. 1: Median line (V-N); 2: Supraorbital plane (Oph-Oph); 3: Horizontal orbito-frontal plane (Ek-Ek); 4: Bizygomatic plane (Zy-Zy); 5: Bicondillar plane (Kdl-Kdl); 6: Basal cranial plane (Ba-Ba); 7: Occlusal plane; 8: Bigoniac plane (Go-Go); 9: Buccal plane (buccal plane-AGo); 10: Fronto-facial plane (Zy-AGo).***

Case No. 1

The patient N.A. had a severe structural, morphological and developmental asymmetry, which could be diagnosed both genetically and radiographic in a moderate I, II branchial arch syndrome. The clinical exam (Figure 2) showed asymmetry located at all three facial levels, with Gn and Pg shifted to the right, the plenitude of the left goniac and zygomatic regions, and flattening controlateral regions, respectively. Also, the bipupilar and bicommissural planes were converging to each other on the right side. The nasal region examination revealed asymmetry of the nasal wings, with the flattening of the right nostril, and a deviation of the whole nasal pyramid to the right. The right side of the face, as a whole, was underdeveloped, both vertically and transversally.

The postero-anterior cephalogram analysis showed the asymmetry of the upper airway cavities, also contributing to the morphologic and functional diagnosis. The nasal septum deviation to the right, together with the volume difference of the nasal fossae, the left being about twice the size of the right nasal fossa, have been noted. Also, there was a lack of development of the left frontal sinus. The maxillary sinuses were also affected by asymmetry, the right one being larger than the left one, due to underdevelopment of the maxillary basal bone in this area.

During orthodontic treatment (Figure 3), we noticed the partial correction of the facial landmarks. By correcting the upper and lower midlines, there was an increased plenitude of the left goniac and right zygomatic region. The bipupilar plane was still descendent to the right. It also appeared a partial correction of the nose asymmetry, probably due to the therapeutic indication that the patient should use mainly the right nostril. The frontal cephalometric head film analysis showed the diminishing of the nasal septum deviation and of the nasal fossae volume difference.

Figure 2 – ***Frontal view and APceph of N.A., female, moderate I, II branchial arch syndrome, 10-year-old.***

Figure 3 – ***Frontal view and APceph of N.A., 12-year-old, with compensatory facial changes.***

Case No. 2

Patient M.I. had a left maxillary bone underdevelopment, with a high inclusion of tooth 23 and a complete lack of space for alignment. The asymmetry was observed by right goniac and zygomatic region fullness, diminishing of the controlateral regions, flattening and narrowing of the left nostril, and a left-ascendant bicommissural plane. The upper lip was underdeveloped vertically and transversally, with a modified contour on the same side with the narrowed nostril. In the upper airway cavities, the frontal cephalogram showed asymmetry of the nasal fossae, with the angulation and deviation of both maxillary and mandibular midlines. Also, volume differences in the maxillary sinuses have been recorded, with a larger left sinus (Figure 4).

Figure 4 – ***Frontal view and APceph of M.I., female, age 21, with significant anatomic asymmetry.***

The goals of the orthodontic treatment were correcting the malocclusion determined by asymmetry, therefore at the end of treatment we have recorded a symmetric arrangement of the maxillary bones; also, we have noticed that the nose and partially the bicommissural plane were still affected by asymmetry (Figure 5). The patient had an indication to continue breathing mainly on the left nostril. The frontal cephalogram showed an improvement of the symmetry in the upper airway cavities.

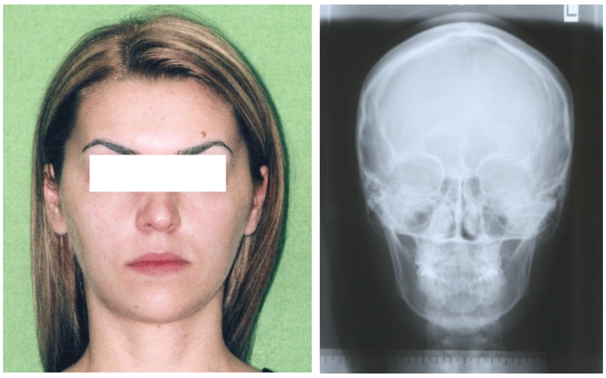

Figure 5 – ***Frontal view and APceph of M.I., age 24, with a significant improvement of the facial anatomic symmetry.***

Case No. 3

The patient G.M. had a unilateral anterior cleft lip and palate, treated surgically only regarding the soft tissues. His diagnosis was facial asymmetry following the congenital syndrome, with mandibular pseudoprognatism, maxillary micro-retrognatism and anatomized functional mandibular laterognatia.

The clinical examination (Figure 6) revealed facial asymmetry located mainly in the middle region of the face, due to the cleft which affected both the soft and bony structures, and also due to the soft tissue post-surgical sequelae. There was a flattening of the left nostril, the left commissure was upper than the right one, and the left half of the upper lip was short, with the alteration of Cupidon's arch. We also noted the roundness of the left goniac region, probably due to unilateral mastication.

The postero-anterior cephalometric analysis showed a good correspondence of the basal mandibular landmarks, while all maxillary landmarks were deviated to the right, with an important inequality in the nasal pyramid, along with the nasal septum deviation and a significant volumetric difference of the nasal fossae.

Figure 6 – ***Frontal view and APceph of patient G.M., male, age 29, with unilateral anterior cleft lip and palate.***

The orthodontic treatment accomplished a convenient alignment in the upper arch, also leveling the lower occlusal plane and closing all the spaces. There was an important correction of the maxillary asymmetry, following lower arch space closure, occlusal plane leveling, correcting the palatal defect and prosthetically restoring the upper anterior teeth.

At this stage, the analysis of the frontal cephalometric head film recorded significant improvements in the maxillary structures symmetry, but maintaining the nasal fossae, maxillary and frontal sinuses asymmetry (Figure 7); therefore, no signs of improvement of the respiratory function have been noted during this period.

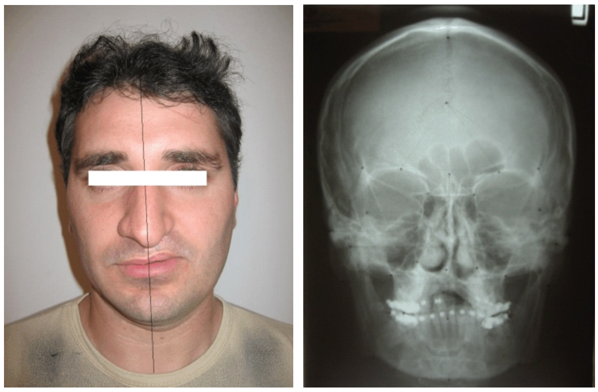

Figure 7 – ***Frontal view and APceph of G.M., age 33.***

Case No. 4

In a true progenic syndrome, aggravated by maxillary microretrognatism and right anatomical mandibular laterognatia, the patient O.E., from this research perspective, had a craniofacial asymmetry with Gn and Pg deviated to the right from the midline, with a generalized vertical and transversal underdevelopment of the left side of the face (Figure 8). The bipupilar plane was descendent to the right. In addition, the frontal cephalogram showed nasal fossae asymmetry, with a reduced volume on the right side.

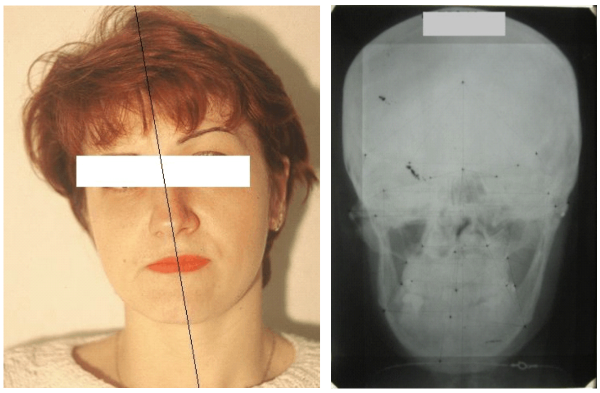

Figure 8 – ***Frontal view and APceph of patient O.E., female, age 38, with right anatomical mandibular laterognatia.***

Figure 9 shows the facial and cephalometric changes after orthodontic and respiratory functional treatment. There was an improvement in the symmetry of the facial structures, thus maintaining a slight asymmetry in the chin. There was a remarkable symmetry in the nostrils and the correspondent nasal fossae in this 40-year-old patient, who had a skeletal abnormality with severe morphologic disorders.

Figure 9 – ***Frontal view and APceph of patient O.E., age 40, significant improvement of the upper airway cavities, after correcting facial structures asymmetry.***

Discussion

The cases described have different areas of craniofacial structure asymmetry located. Regardless the cause of asymmetry, the factors that contributed were effective in altering the spatial positioning of the craniofacial components [21]. Therefore, asymmetry also caused alterations in the upper airway cavities' morphology.

The main difficulty in the assessment of the asymmetry is establishing a reference line, considering that the mean values of horizontal deviations have shown small deviations, thereby supporting the research of Farkas & Cheung [3], Thompson [15], Chebib & Chamma [21], and Yen [24]. Although previous studies on asymmetry used different landmarks for cephalometric evaluation, their results correlated on a general basis.

Most of the 41 patients with anatomical facial asymmetry included in the study showed on the underdeveloped side that the nostril and nasal fossa were narrowed, while the paranasal sinuses were frequently larger. The asymmetry found can be interpreted to imply the possibility of genetic predisposition, in which a greater growth potential was dominant on one side [11, 21]. No correlation could be established to answer if these changes were determined by asymmetry, or if they appeared as compensatory, or if only some structures of the upper airway cavities changed morphologically in a compensatory manner. Previous studies [8, 28] have shown the facial skeleton consisting of a number of semi-independent regions. While the orbits, the upper part of the nasal cavities and lower border of mandible showed a high degree of independence with their genetically determined size and shape, the lower part of the nasal cavities and the dentoalveolar area showed a greater response to functional adaptation. These findings may be supported by the present results.

In facial asymmetries, often more than one dentomaxillary structure is altered. Regardless the cause of asymmetry, the contributing factors are effective in altering the spatial positioning of the craniofacial components [21]. For this reason, in studying the functional alterations of asymmetry, a correlation between the functions of the dentomaxillary complex may provide additional useful information [2].

However, it is certain that there is a significant connection, because the association of functional respiratory indications during orthodontic treatment led to symmetry in the nostrils and nasal fossae, even in patients with significant morphologic discrepancies, and even in adult patients.

Conclusions

In order to obtain a clear and focused image on the interactions between craniofacial asymmetries and morphologic changes in the upper airway cavities, the analysis of other additional exams, such as axial cephalogram and computerized tomography is required along with the frontal cephalometric radiograph and the correspondent functional exams.

Conflict of interests

The authors declare that they have no conflict of interests.

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