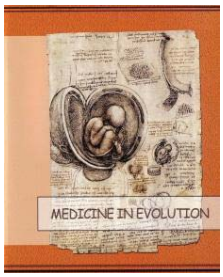
Dentoalveolar compensation assessment using PA cephalograms in orthodontic asymmetry patients



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Abstract

Asymmetry patients have various degrees of discrepancy between skeletal and dental relationships that are subject to the observation and correction of orthodontic or interdisciplinary teams of specialists. Dentoalveolar compensation is a system that helps maintain a state of occlusal balance in the maxillo-facial segment. *Aim*: The purpose of the present study is to assess the degree of dental compensation through dental midline shifting in patients with facial asymmetry. *Material and Methods*: 20 postero-anterior cephalograms of orthodontic patients with clinically visible facial asymmetry were studied using the Svanholt and Solow analysis. *Results:* Six of the patients included in this study presented both a maxillary and mandibular skeletal midline shift. Dentoalveolar compensation, defined by the shifting of the dental midlines was observed both in the upper and in the lower arch. *Conclusion:* Dentoalveolar compensation assessment is a necessary step of orthodontic diagnosis and treatment planning.

Keywords: orthodontics, postero-anterior cephalograms, asymmetry

INTRODUCTION

Malocclusions are three dimensional conditions and all orthodontic patients should have a three dimensional diagnostic approach. But the true benefit of anteroposterior cephalometric analysis is evident in patients with transverse discrepancies: functional mandibular shift, dental and skeletal lateral crossbites or facial asymmetries. [1,2] Fischer defined symmetry as the correspondence of parts on opposite sides of a plane or point. Asymmetry of the dentofacial complex can be unilateral or bilateral, as well as anteroposterior, supero-inferior, or mediolateral.[3]

During the diagnostic stage of the orthodontic treatment in non-growing patients the orthodontist should measure the amount of skeletal asymmetry, while taking into account the degree of dental compensation. [4,5] Dental compensation is a means of maintaining a state of occlusal balance in the maxillo-facial segment aiming to camouflage various skeletal patterns.[6] This kind of compensation usually follows the plane of the skeletal discrepancy thus it can be transversal, in arch dimension and midline shift to compensate for transvers skeletal discrepancies, vertical, in the excess or lack of dental eruption, to compensate for vertical skeletal discrepancy, and antero-posterior, in the inclination of frontal teeth to compensate for anteroposterior skeletal discrepancies.[7] When treatment using the movement of dental components is chosen, treatment objectives will include compensatory changes in the position of teeth relative to the basal bone. [8] When orthognathic surgery is the desired approach, treatment objectives include the elimination of pre-existing dentoalveolar compensation in order to obtain correct dental and skeletal relationships when the jaws are moved into the natural position in relation to the cranial base and to each other.[9,10]

PA cephalogram studies in literature include accuracy or assessment of head posture studies [11,12], calculating normal values for different groups of patients or populations [2,13,14,15] or quantifying transversal modifications during growth [16]. Many proposed PA cephalometric analysis focus on setting norms with adjustments for different age groups [17], comparing right and left triangular measurements [18] or the determination of harmonious proportions [19]. Svanholt and Solow (1977) proposed a method suitable for the assessment of skeletal and dental midline discrepancies. [20]

Aim and objectives

The purpose of the present study is to assess the degree of dental compensation (upper and lower midline shift using the method of Svanholt and Solow - 1977) in patients with facial asymmetry in order to provide a complete diagnostic information and obtain aesthetic final orthodontic treatment results.

MATERIALS AND METHODS

The study included 20 postero-anterior cephalograms of patients who met the following inclusion criteria: visible facial asymmetry upon clinical examination, non-growing patient, no prior orthodontic treatment, dental extractions or anodontia. Patients with trauma or surgery that affected the face, as well as patients with cranial diformities and genetic syndromes were excluded from the study. The patients were chosen sequentially from a private dental clinic in Timisoara, Romania. The mean age for the group was 25,6 years. Thirteen patients were women and seven were men.

The PA roentgenographs were made under standardized conditions and were traced using a computer software by a single investigator (orthodontics specialist). Linear and angular parameters of the dental and skeletal midline position were obtained. Values were measured using online angle and distance measurement computer software.

In this paper, to assess the relationships between the midlines of the jaws and the dental arches, the Svanholt and Solow analysis was chosen. The anthropometric points and reference planes are presented in Tables 1 and 2.

Table 1. Reference points used in PA cephalometric analysis

Reference POINTS	
Lo	*latero orbitale*
om	*orbitale midpoint*
mx	*maxillary midpoint*
Ag	*antegonion*
m	*mandibular midpoint*
Isf	*incisior superior frontale*
Iif	*incisior inferior frontale*

Table 2. Reference planes used in PA cephalometric analysis

Reference PLANES	
ORP	*orientation plane*
CLP	*compensation line*
MLP	*mandibular plane*
MXP	*maxillary plane*

The amount of movement of the midpoint of the dental arch away from the symmetry line within the jaw towards the compensation line (CPL) defined the degree of dental compensation. The following parameters were taken into consideration: transverse maxillary position (mx-om/ORP), transverse mandibular position (m-om/ORP), transverse jaw relationship (CPL/MXP), upper incisal position (isf-mx/MXP), lower incisal position (iif-m/MLP), upper incisal compensation (isf-mx/m) and lower incisal compensation (iif-m/mx). According to Svanholt and Solow, these variables were designed to be zero in symmetrical subject, and all the midpoints, dental and skeletal, should be on the same line.

RESULTS

After the clinical examination needed to determine the facial asymmetry for the patients in the study, a dental Class III molar relationship was observed in 50% of cases, 20% of cases presented a Class II molar relationship and 30% were in Class I molar relationship. PA cephalograms were analysed after being traced. Measuring of the parameters revealed mandibular skeletal midline shift in 60% of cases. Maxillary midline deviation with no mandibular deviation was observed in two of the cases included in this study, while both mandibular and maxillary skeletal midline shift was observed in 30% of the cases. Dental and skeletal findings are presented in Table 3.

Table 3. Percentage of skeletal asymmetry and dental compensation in the study group

Parameter	**% of cases**
Transverse mandibular shift	90
Transverse maxillary shift	40
Upper incisor compensation	70
Lower incisor compensation	60

Skeletal mandibular midline deviations towards the right side were recorded in 60% of cases. Maxillary midline shift followed the direction of the mandibular deviation. In the two cases of maxillary midline deviation without mandibular deviation, the shift was towards the right side of the patients. Complete dental compensation (when the dental arch midpoint reaches the compensation line) was more common in the upper arch, while the lower dental midpoint showed either incomplete compensation (when the midpoint of the dental arch

does not reach the compensation line) or no dental compensation at all (Figure 1). No displacements of the midlines of the dental arches in the direction opposite to the direction from the jaw symmetry line to the CPL were observed in this study.

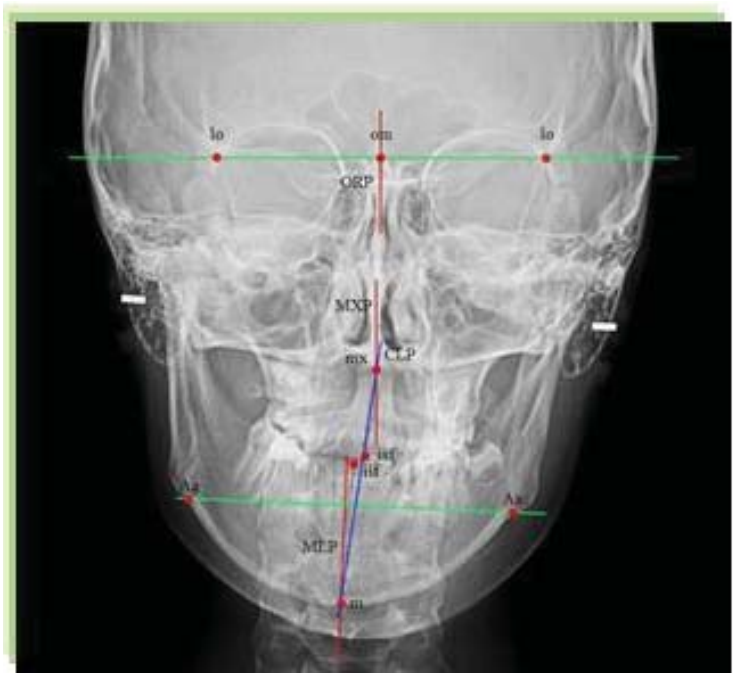

Figure 1. Transversal assessment of midline discrepancies: PA tracing of a facial asymmetry patient following the model of Svanholt and Solow (1977) showing complete upper arch dental compensation and lower arch incomplete dental compensation

DISCUSSIONS

Skeletal asymmetries were assessed using PA cephalograms. This radiological tool is valuable in the study of left and right structures because they are at a similar distance relative to the film and x-ray source. Two consequences of these characteristics would be less distortion and reduced effect of unequal enlargement. Even so, the geometric error of PA cephalogram analysis is even lower when dental and skeletal midpoints are compared to one another. The Svanholt and Solow method used in the present study excludes many sources of error that are evident when comparing lateral facial areas. Even so, the suggested method is vulnerable to incorrect head position in the cephalostat.[11]

Patients included in this study were selected sequentially and met inclusion criteria of clinically detectable facial asymmetry. Clinical examinations showed a majority of dental Class III malocclusions which is in accordance with other studies found in literature linking this kind of malocclusion with skeletal asymmetry [21,22]. Our study also revealed a prevalence of mandibular asymmetry which can be the effect of two factors: the mandible grows longer than the maxilla and so is more prone to deviation and the fact that the maxilla is connected rigidly to other skeletal structures, while the mandible is mobile.[23]

Adult patients with a skeletal discrepancy can be treated with orthodontic camouflage or orthognathic surgery, in which either dentoalveolar compensation or decompensation is required for a functional and aesthetic treatment result.[24,25,26]

There was a correlation between the degree of dental compensation and maxillary and mandibular midline position, tooth position being a camouflage for the underlying skeletal abnormality. Complete dental compensation was noticed in cases with the most mandibular shift, indicating that the dentoalveolar compensation was affected by the discrepancy in the opposing jaw, which is in accordance with the findings of other studies found in literature.[4]

Dental midlines are an important part of smile esthetics, especially the upper midline. Studies have shown that people without a dental education background are able to detect upper midline shift of 1mm and above.[27] Although a person can still have a beautiful smile even with a deviated upper midline, beauty is a subjective parameter and should be discussed at the beginning of the orthodontic treatment in cases where the dental midline shift could be a camouflage for underlying skeletal discrepancies.

CONCLUSIONS

Determining anterior dentoalveolar compensation is one of the main factors that can make a difference between a successful and an unsuccessful orthodontic treatment. The concept of facial aesthetics is based on subjectivity and should always be addressed in asymmetry orthodontic patients. The PA cephalogram analysis has been a valuable and accessible tool in providing complete information in transvers abnormalities and more research should be done using 3D technologies to further improve this type of investigation.

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