Skeletal and dental asymmetries in Class II subdivision malocclusions using cone-beam computed tomography

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Introduction: The objective of this study was to compare the degrees of skeletal and dental asymmetry between subjects with Class II subdivision malocclusions and subjects with normal occlusions by using cone-beam computed tomography.

Methods: Thirty subjects with Angle Class II subdivision malocclusions (mean age, 13.99 years) and 30 subjects with normal occlusions (mean age, 14.32 years) were assessed with 3-dimensional cone-beam computed tomography scans. Independent t tests were used to compare orthogonal, linear, and angular measurements between sides and between groups.

Results: Total mandibular length and ramus height were shorter on the Class II side. Pogonion, menton, and the mandibular dental midline were deviated toward the Class II side. Gonion and the anterior condyle landmark were positioned more posteriorly on the Class II side. The mandibular dental landmarks were located more latero-postero-superiorly, and the maxillary dental landmarks more latero-antero-superiorly on the Class II side. There was loss of maxillary arch length, and the mandibular molar was closer to the ramus on the Class II side.

Conclusions: The etiology of Class II subdivision malocclusions is primarily due to an asymmetric mandible that is shorter and positioned posteriorly on the Class II side. A mesially positioned maxillary molar and a distally positioned mandibular molar on the Class II side are also minor contributing factors.

Read the full text online at: www.ajodo.org, pages 542.e1-542.e20.

EDITOR’S COMMENT

When I talk to experienced clinicians or board examiners, one of the most common complaints I hear is the misdiagnosis of and subsequent treatment problems younger orthodontists have with Class II subdivision malocclusions. Attempting to treat these patients without first diagnosing the source of the asymmetry often leads to long treatment times without resolution of the original problem. The objective of this study was to compare the degrees of skeletal and dental asymmetry between subjects with Angle Class II subdivision malocclusions and subjects with normal occlusions, based on true 3-dimensional (3D) analysis with cone-beam computed tomography (CBCT).

This is the first case-controlled study to use 3D volumetric imaging for the analysis of Class II subdivision malocclusions. Over 3000 patient records were reviewed to select the study sample based on specific inclusion and exclusion criteria. All sets of records included CBCT scans, dental models, and photographs. The most important factor initially considered was an occlusal assessment reflecting a Class II subdivision relationship. Evaluation of the other records confirmed the occlusal relationship found in the models; therefore, the Class II subdivision was consistent throughout the different records and thus most likely reflected the true occlusal relationship. It is important to highlight that a Class I occlusion does not mean a symmetric craniofacial complex. The importance of this factor is significant, since the intent of this study was to determine whether the Class II subdivision had a primarily dental or skeletal etiology. If the control sample had Class I occlusion but skeletal asymmetry (as could occur with dental compensation), analysis of the skeletal component would be significantly skewed because the “normal sample” was not really skeletally normal. Furthermore, the Class I occlusion subjects from this sample, who did not have apparent asymmetry, had some asymmetry when evaluated with a CBCT scan. This is why the authors believe that the between-sides evaluation might be more pertinent for the evaluation of symmetry than comparing the findings to a “normal group.”
because mild asymmetries are common even in clinically symmetrical persons.

The primary contributing factor of a Class II subdivision malocclusion was a deficient mandible on the Class II side, which accounted for 61% of the total molar discrepancy between the groups. Of equal importance is the finding that there were no significant asymmetries among condylar pole measurements in the Class II subdivision malocclusion group. Significant dentoalveolar asymmetries were also present in the subdivision group.

**Q & A**

**Turpin:** What additional plans do you have for studying this unique sample of patients with CBCT scans as a part of their records?

**Uribe:** We are currently analyzing the control sample reported in this study. Our evaluation will focus on the 3D skeletal and dental symmetry of those with “normal” occlusion (as defined by our inclusion criteria). Our preliminary results show that they might have some asymmetry when analyzed in 3D with CBCT.

**Turpin:** Are CBCT images also valuable for diagnosing dental as well as skeletal asymmetries?

**Uribe:** Absolutely. CBCT data is extremely valuable in the diagnosis of dental and skeletal asymmetries as we have shown in this study, but there are limitations. With 3D volumetric data, the measurements are precise, and the anatomic truth can be visualized. For this reason, CBCT data are considered the gold standard for craniofacial imaging, but software limitations must be considered. The traditional method of diagnosing radiographic data is to plot previously defined 2-dimensional (2D) cephalometric points. However, in 3 dimensions, points rarely exist. In our study and others previously published, 2D points were plotted by using 3D data. Using 2D landmarks with 3D data might seem like a step backward, and it has been suggested that future volumetric analyses will be based on masses instead of points.

**Turpin:** Based on the findings of this study, do you think the diagnosis of skeletal asymmetry will become a significant reason for taking CBCTs in practice?

**Uribe:** Our study was undertaken to evaluate the etiology (skeletal or dental) of the Class II subdivision malocclusion. The results show that patients with this malocclusion have a greater skeletal than dental contribution to the asymmetry. On average, the magnitude of skeletal asymmetry was small (<2 mm) and mostly in the mandible. Subjects without significant skeletal involvement might not need a CBCT, and camouflage treatment can be an option. If the skeletal asymmetry is small, correction of the malocclusion can be accomplished with a variety of treatment mechanics. A nonextraction treatment approach can include protracting the mandibular buccal segment or distalizing the maxillary buccal segment on the Class II side, and an extraction approach might involve either a 1-quadrant or a 3-quadrant extraction plan.

On the other hand, when a significant skeletal asymmetry involves all 3 planes of space, 3D volumetric imaging can be an extremely useful surgical planning tool. A new era of virtual surgical planning with CBCT data is emerging, and patients with significant asymmetries can definitely benefit from this type of radiographic evaluation.