Proximity of the roots of posterior teeth to the maxillary sinus in different facial biotypes

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Introduction: Orthodontists consider facial growth pattern and oral function when developing a treatment plan. Less attention is given to the relationship between the maxillary posterior teeth and the maxillary sinus. We aimed to evaluate the relationship between the roots of the maxillary posterior teeth and the floor of the maxillary sinus. **Methods:** Proximity of the roots to the maxillary sinus was scored for the left and right first and second premolars and molars (scores, 0-3). Mean scores per patient and per tooth type were calculated. The influences of age, sex, and facial biotype on mean scores per patient and tooth were analyzed. **Results:** The mean scores per patient and the second molar scores were significantly lower in the normodivergent subjects compared with the hypodivergent subjects, and in the hypodivergent vs the hyperdivergent groups, indicating that the hypodivergent biotype had significantly fewer second molar roots into the sinus than the normodivergent and hyperdivergent biotypes. Age had no effect on mean score per patient, but in the hyperdivergent group, the second molar score increased with age, meaning that second molar roots tend to be closer to the sinus floor. **Conclusions:** In a young population (7-24 years), the positions of the apices of the maxillary second molar roots in relation to the maxillary sinus floor are associated with the facial biotype. In a hypodivergent biotype, the roots of the second molars are located farther from the sinus floor compared with the normodivergent and hyperdivergent facial patterns. (Am J Orthod Dentofacial Orthop 2018;154:346-55)

When determining a treatment plan for a patient, orthodontists consider the facial growth pattern and oral function. However, less attention is given to the relationship between the maxillary posterior teeth and the maxillary sinus floor. The maxillary sinuses are small at birth and enlarge with the growing maxilla. The maximum volume is reached in the second decade in girls and the third decade in men,[1] or by the age of 20 to 25 years as described by other authors.[2,3] Evaluating the position of the roots of the maxillary teeth in relation to the maxillary sinus is important for a comprehensive orthodontic diagnosis and treatment plan, especially when endodontic treatment might be needed, severely displaced impacted teeth are present, extractions or dental implants are considered, vertical control methods are required during treatment, or orthognathic surgery is planned.[4-6] Because maxillary sinus enlargement during facial growth is related to the vertical increase in the alveolar process, we expected to find a relationship between the facial growth pattern and the 3-dimensional (3D) position of the posterior maxillary teeth in relation to the maxillary sinus. Therefore, the aim of this study was to relate the proximity of the roots of the maxillary posterior teeth to the floor of the maxillary sinus in different facial growth patterns.

MATERIAL AND METHODS

This was a retrospective cross-sectional study based on the dental charts of 1455 patients from a private

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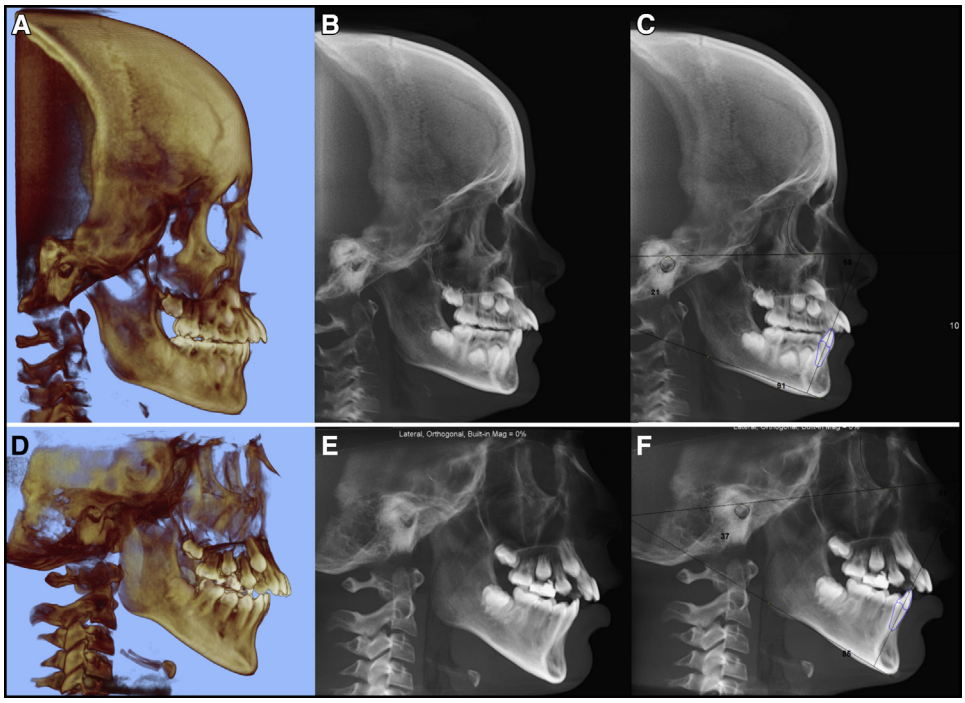

Fig 1. Images processed with Dolphin 3D software. *Upper row*: full size scans: **A,** 3D surface rendering; **B,** lateral cephalogram reformat obtained from the full size CBCT scan; **C,** digitized CBCT lateral cephalogram reformat obtained from the full size CBCT scan data. *Lower row*: limited field of view CBCT scans: **D,** CBCT 3D surface rendering; **E,** lateral cephalogram reconstructed from the limited field of view CBCT scan; **F,** digitized CBCT lateral cephalogram reconstructed from the limitied field of view CBCT scan data.

dental practice in Cluj-Napoca, Romania. Partial or full-size cone-beam computed tomography (CBCT) scans were available for these patients. CBCT imaging was performed for orthodontic and orthognathic treatment planning and the diagnosis of temporomandibular abnormalies. From these charts, patients were selected based on the following inclusion criteria: young adults, adolescents, and children (ages, 7-25 years), in either the mixed or permanent dentition. Exclusion criteria were craniofacial deformities, genetic syndromes, systemic diseases, previous injuries or trauma in the maxillofacial region, or previous orthodontic treatment.

The ethics commission of the Iuliu Haţieganu University of Medicine and Pharmacy, Cluj-Napoca, Romania, approved the study.

All CBCT images were acquired with the same i-CAT CBCT machine (Imaging Sciences International, Hatfield, Pa). The scanning parameters were 120 kV(p), 23.87 mA, exposure time of 10 to 20 seconds, and voxel size of 0.4 mm. The x-ray machine was calibrated twice a day, and the data were saved in DICOM format.

To determine the facial biotype, a lateral cephalogram was reconstructed from the CBCT data set with no built-in magnification. The images were processed using 3D software (version 11.7 Premium; Dolphin Imaging, Chatsworth, Calif). Because of the young age of the patients and since most scans had a limited field of view, cephalometric landmarks such as sella, nasion, and other cranial structures could not be identified on the scans (Fig 1). However, to personalize the cephalometric analysis, the following landmarks were identified on the lateral cephalogram: porion, orbitale, menton, gonion, mandibular incisor tip, and mandibular incisor root apex. The Frankfort mandibular plane angle (FMA) was calculated as the angle formed by the intersection of the Frankfort horizontal plane and the mandibular plane. A normal value was considered to be $25^\circ \pm 3^\circ$.[7]

Based on the Tweed triangle[7] and the FMA angle, the patients were divided into 3 facial biotype groups: group A, normodivergent (FMA, 22°-28°); group B, hypodivergent (FMA, $<22^\circ$); and group C, hyperdivergent (FMA, $>28^\circ$).

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