Midpalatal suture maturation in 11- to 15-year-olds: A cone-beam computed tomographic study

Diego Luiz Tonello, Victor de Miranda Ladewig, Fábio Pinto Guedes, Ana Cláudia de Castro Ferreira Conti, Renata Rodrigues Almeida-Pedrin, and Leopoldino Capelozza-Filho
Bauru, São Paulo, Brazil

Introduction: We used cone-beam computed tomography to evaluate the maturation stages of the midpalatal sutures in children aged 11 to 15 years old. Maxillary expansion is successful for most patients in this age group, so we sought to identify the status of suture maturation in these subjects to use as a comparison for the prognosis of rapid maxillary expansion in older patients. **Methods:** Tomographic images in axial sections of the midpalatal sutures from 84 children (40 boys, 44 girls; ages, 11-15 years) were classified using a scale denoting the maturation stage of the midpalatal suture (A, B, C, D, and E). The chi-square test was applied to evaluate suture stages by sex and age groups. **Results:** Stage A was observed in only one 11-year-old girl. Stage B was present at all ages but was more prevalent in those less than 13 years of age. Stage C was the most prevalent in all evaluated ages. Stages D and E showed low prevalence rates. There were higher prevalences of the early stages of maturation in boys. **Conclusions:** The results of this study, which showed dominant prevalence of stage C, suggest that conventional, nonsurgical rapid maxillary expansion performed in patients over 15 years old is justified by a satisfactory prognosis when assessment of the sutural status indicates stage C. (Am J Orthod Dentofacial Orthop 2017;152:42-8)

The etiology of some dental disharmonies, such as crossbites and dental crowding, may be related to transversal atresia of the maxillary bone. Rapid maxillary expansion (RME) is routinely used in clinical orthodontics for the correction of maxillary atresia. These expander devices use heavy forces to promote the rupture of the midpalatal suture (MPS). The subsequent regional formation of new bone corrects the transverse maxillary deficiency, with a real increase in bone size.[1,2]

Since the RME procedure has been applied for the treatment of maxillary atresia, many studies have been conducted to clarify its dental and skeletal effects.[1-6] The advantages of RME are significant. It creates an increased dental arch perimeter, which facilitates the correction of malocclusions and avoids dental extractions in many patients.[7] In addition, some patients report improvement in airflow after RME, although evidence suggests that this is not likely to be a long-lasting effect.[8-10]

RME is only possible in patients who do not have a fully matured MPS, when the maxillary bones that make up the palatal vault have not fused or are not interdigitated enough to impose a higher tensile strength to rupture the MPS. In patients with a fully matured MPS, surgical expansion or surgically assisted expansion is recommended.[7] A recent study has suggested that when the suture is still present, RME with skeletal anchorage support is a possibility.[11]

Since the literature states that closure of the bony sutures tends to increase with age, there are many doubts about the prognosis of RME in patients who have already stopped growing[3,4,12]; thus, conventional RME is performed more often on young patients. The only way to know whether RME could be performed on a patient out of the growth phase was by trial and error, which resulted in negative side effects when the treatment was not successful.[13] Therefore, it would be a helpful if diagnostic imaging protocols and a means to diagnose the maturation stage of MPS before RME

From the Department of Orthodontics, Sagrado Coração University, Bauru, São Paulo, Brazil.
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Address correspondence to: Renata Rodrigues Almeida-Pedrin, Department of Orthodontics, Sagrado Coração University, 2-20 Leandro do Santos Martins st, Bauru, São Paulo 17017-900, Brazil; e-mail, repedrin@gmail.com.
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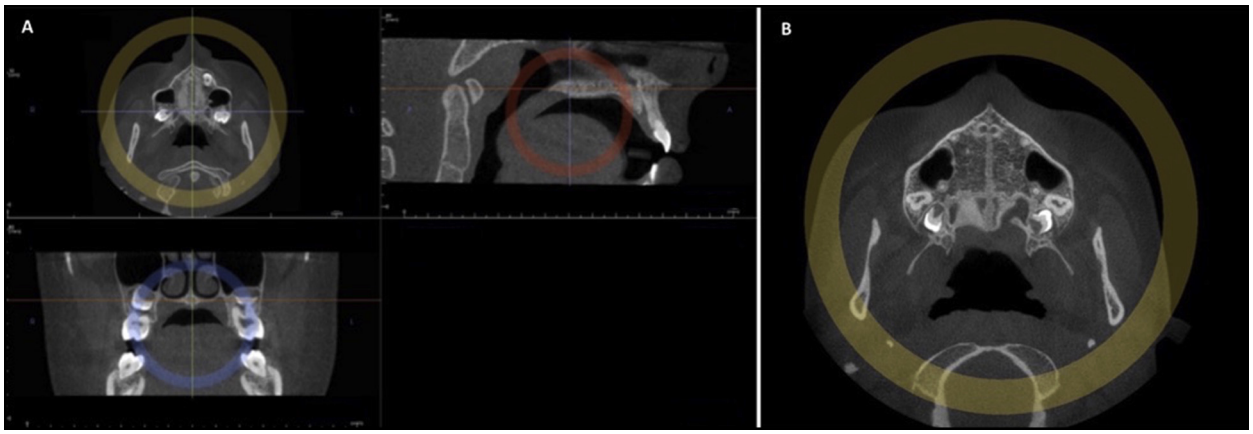

Fig 1. CBCT images: **A,** the main screen of the InVivo5 program with axial, sagittal, and coronal views and reference lines. Note in the sagittal view that the *orange line* is positioned through the center of the hard palate. **B,** The axial view after corrected reference lines were positioned.

are available. This would allow the orthodontist to establish a more accurate prognosis for older RME candidates or patients who have finished growing.

In this study, we aimed to determine the frequency of MPS maturation stages in children aged 11 to 15 years by using cone-beam computed tomography (CBCT). Since this age group has demonstrated a favorable prognosis with the RME procedure, we sought to identify the bone maturation status of the MPS in these patients to use as a comparison for RME prognosis in older patients. See Supplemental Materials for a short video presentation about this study.

MATERIAL AND METHODS

This study was approved by the ethics committee in research of Sagrado Coração University, Bauru, São Paulo, Brazil (protocol 1.302.307). For the evaluation of the skeletal maturation stages of MPS, 84 CBCT scans of children aged 11 to 15 years were chosen (40 boys, 44 girls). Inclusion criteria were age between 11 and 15 years and the availability of CBCT images. The exclusion criteria were history of previous orthodontic treatment or any appliance at the examination (previous maxillary expansion as an early interceptive orthodontic phase may affect suture status), cleft lip and palate, and syndromic conditions. The CBCT scans were obtained from a dental diagnostic imaging center. The primary justification for the CBCT request was the diagnosis of retained teeth.

All CBCT images used were obtained with the i-CAT scanner (Imaging Sciences International, Hatfield, Pa), adjusted to the following specifications: 8.9 to 30 seconds, a field of view of at least 11 cm, and voxel size of 0.2 to 0.3 mm. To standardize the position of the patients' heads in the 3 planes of space, they were instructed to remain seated with their heads positioned so that the Frankfort horizontal plane was parallel to the ground and the median sagittal plane was perpendicular to the ground. The CBCT images were acquired with DICOM.

InVivoDental5 (Anatomage, San Jose, Calif) was used to display the images.

First, in the multiplanar reconstruction screen, the skull image was manipulated so that the vertical and horizontal lines were overlaying the MPS in the axial and frontal cuts (Fig 1).

In the sagittal section, the subject's jaw was manipulated so that the horizontal reference line coincided with the median region of the palate, which is the cancellous bone between the upper and lower cortical bones. In the axial CBCT section, the visualization and classification of the skeletal maturation stage of the MPS were conducted according to the method of Angelieri et al[12] (Fig 1). For a curved palate, it was not possible to view the MPS in 1 axial section; therefore, 2 axial sections were made: 1 section was in the front and the other at the rear of the palate (Fig 2). The skeletal maturation stages of the MPS can be differentiated by using Table I and Figure 3.

One examiner (D.L.T.) assessed all images and selected the best axial image according to the method of Angelieri et al.[12] Subsequently, these images were saved as JPEG files and arranged sequentially in a presentation (PowerPoint for Mac 2008; Microsoft, Redmond, Wash). The images were identified only by numbers. Each patient was classified by the chief examiner, who was blinded, using a computer with a high-definition display in a dark room. This evaluation was considered the main evaluation.