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Cone beam computed tomography evaluation of midpalatal suture maturation in adults

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Abstract. The aim of this study was to evaluate midpalatal suture maturation in adults, as observed in cone beam computed tomography (CBCT) images. CBCT scans from 78 subjects (64 female and 14 male, age range from 18 to 66 years) were evaluated. Midpalatal suture maturation was verified on the central cross-sectional axial slice in the superior–inferior dimension of the palate, using methods validated previously. Intra-examiner agreement was analyzed by weighted kappa test. Multinomial logistic regression was used to test whether sex and chronological age (adults <30 years or ≥ 30 years) could be used as a predictor for the maturational stages of the midpalatal suture. The majority of the adults presented a fused midpalatal suture in the palatine (stage D) and/or maxillary bones (stage E). However, the midpalatal suture was not fused in 12% of the subjects. Sex and chronological age were not significant predictors of the maturational stages of the midpalatal suture. The individual assessment of midpalatal suture maturation by way of CBCT images may provide reliable information critical to making the clinical decision between rapid maxillary expansion and surgically assisted rapid maxillary expansion for the treatment of maxillary atresia in adults.

Key words: CBCT; midpalatal suture; adult; rapid maxillary expansion.

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The concept that the maxilla can be expanded by opening the midpalatal suture was first introduced by Angell in 1860[1]. A century later, Haas published the results of a study on the rapid expansion of the maxillary dental arch by opening the midpalatal suture[2], and since then, rapid maxillary expansion (RME) has been utilized for the treatment of posterior crossbite and maxillary deficiency (primarily for the correction of crossbite), as well as to increase the maxillary arch perimeter in individuals with moderate crowding of the dental arches[3]. The routine use of this therapy has, however, been limited to growing patients, since clinical failure of RME is typically observed in adults. Complications include serious pain, accentuated buccal tipping and gingival recession in the posterior teeth, palatal tissue ulceration or necrosis[4–7], buccal root resorp-

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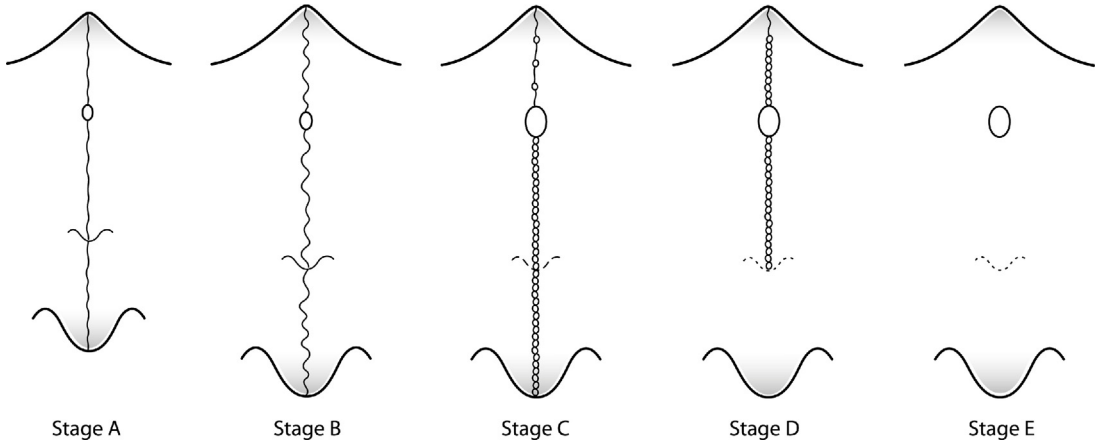

Fig. 1. Schematic drawing of the maturational stages of the midpalatal suture. Stage A of the morphology of the midpalatal suture is characterized by one relatively straight high-density midpalatal suture line. Stage B is observed as one scalloped, high-density line at the midline. Stage B may present some areas as two parallel, scalloped, high-density lines close to each other and separated by small low-density spaces. Stage C is visualized as two parallel, scalloped, high-density lines that are close to each other, separated in some areas by small low-density spaces. Stage D is visualized as two scalloped, high-density lines at the midline on the maxillary portion of the palate, but the midpalatal suture cannot be identified in palatine bone. At stage E, sutural fusion has occurred in the maxilla. The midpalatal suture cannot be identified, and the parasutural bone density is the same as in other regions of the palate. From Angelieri et al.[25].

tion[8,9], alveolar bone bending[10], fenestration of the buccal cortex[8], and instability of the expansion[10–12]. Surgical procedures have been recommended for the treatment of maxillary transverse deficiency in adults, such as multi-segment Le Fort I osteotomies or surgically assisted rapid maxillary expansion (SARME)[13].

Chronological age has been considered a fundamental factor for making the choice between RME and SARME/Le Fort osteotomy to treat maxillary deficiency. However, SARME for the treatment of maxillary deficiency has been recommended for patients older than 14 years[14], 16 years[15], 20 years[16], or 25 years of age[17]. Alpern and Yurosko have suggested a difference in chronological age between male and female patients, with SARME indicated in females older than 20 years of age and in males older than 25 years of age[18].

In addition to the absence of a well-defined chronological age threshold for the indication of SARME, many case reports have shown the possibility of successful sutural expansion with RME alone in much older adult patients[18–21]. Surgically assisted maxillary expansion, however, increases morbidity, treatment costs, and the number of days required for the patient to make a full recovery and to resume routine activities.

The variability in clinical outcomes of RME in late adolescent and young adult patients has also been highlighted in histological studies evaluating the maturation of the midpalatal suture in cadavers. No fusion of the midpalatal suture was observed in subjects aged 27 years, 32 years[22], 54 years[23], and even 71 years[24]. On the other hand, Persson and Thilander verified fusion of the midpalatal suture in adolescents ranging from 15 to 19 years of age[22].

Angelieri et al. have proposed a method of individual evaluation of midpalatal suture maturation with cone beam computed tomography (CBCT) as a way of providing more reliable clinical data when making the decision between RME only and surgically assisted maxillary expansion for adolescent and young adult patients[25]. CBCT has the advantage of being able to isolate the midpalatal suture without the overlapping of other anatomical structures, as occurs when occlusal radiographs are obtained[26].

Angelieri et al. also reported sex differences in the minimum age of fusion of the midpalatal suture[25]. The midpalatal suture was fused in the palatine (stage D) or/and maxillary bones (stage E) in female subjects older than 11 years of age and in male subjects older than 14 years of age (Fig. 1). Nevertheless, that study also described great variability in the distribution of the maturational stages of the midpalatal suture in subjects older than 11 years.

The aim of this study was to evaluate the maturation of the midpalatal suture in adults as viewed in CBCT images, as chronological age has been shown to be an unreliable parameter for making the clinical decision between RME alone and SARME/Le Fort I segmentation for these patients.

Subjects and methods

Baseline diagnostic CBCT images from 78 subjects were examined. Sixty-four were female and 14 were male, and they ranged in age from 18 to 66 years (Table 1). The sample was divided into two age groups: younger adults and older adults, i.e. younger or older than 30 years of age. The cut-off value of 30 years for the definition of young adulthood has been proposed in forensic radiology[27]. The CBCT images were obtained from the archives of the private practice of one oral and maxillofacial surgeon. These images had been required for diagnosis and treatment planning by the surgeon. This was a descriptive and retrospective study and was approved by the Institutional Review Board of Methodist University of São Paulo.

The inclusion criteria were age older than 18 years, malocclusion of any Angle class, any skeletal deformities, and good quality CBCT images. The exclusion criteria were craniofacial syndromes, systemic diseases, previous orthognathic surgery, and the presence of noise on the CBCT images or blurred images.

The CBCT images evaluated in the current study were obtained using an

Table 1. Demographic characteristics of the sample.

Sex	Age, years		Total
	<30	>30	
Female	30	34	64
Male	6	8	14
Total	36	42	78