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# Rapid maxillary expansion in adults: Can multislice computed tomography help choose between orthopedic or surgical treatment?

Expansion rapide des maxillaires chez l'adulte : le scanner peut-il aider à choisir entre traitement orthopédique et chirurgical ?

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## Summary

**Introduction.** The aim of this study was to evaluate the accuracy of Multislice Computed Tomography (MSCT) in the detection resistance areas on the midpalatal suture (MPS) and thus to evaluate if MSCT could be a help in the kind of maxillary expansion to be used (pure orthodontic or surgically-aided) for the correction of transverse maxillary deficiencies in adults.

**Methods.** Ten MSCT were obtained from 10 MPS removed from fresh corpses (mean age: 79.4; extreme: 70–86). Three standardized radiological regions of interest (ROI) were identified on each MPS and were classified into “open” (group 1) or “closed” (group 2) by 3 independent radiologists. The 30 ROI were then histologically analyzed according to 3 criteria: mean suture width (MSW), obliteration index (OI) and interdigitation index (Ii).

**Results.** Nine ROI were classified in group 1 (closed) and 21 in group 2 (open). On the histological examination, the mean MSW was 396.9  $\mu\text{m}$  in group 1 and 227.1  $\mu\text{m}$  in group 2. OI was 3.098% and 9.309% and Ii was 1.25 and 1.34 respectively. Statistically significant difference between the 2 groups was only found for the MSW. We conclude that MSCT allows for the evaluation of the width of the MPS, but not for the evaluation of the other possible parameters of resistance we used. Therefore, it cannot predict precisely the amount of resistance in the MPS and is not suited for the choice between pure orthodontic or surgically-aided expansion.

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## Résumé

**Introduction.** Le but de cette étude était d'évaluer le degré de précision dans la détection de zones de résistance au niveau de la suture palatine médiane (SPM) du scanner multi-coups et ainsi d'être une aide dans le choix du type d'expansion maxillaire à utiliser (orthodontique pure ou chirurgicalement assistée) pour la correction de l'insuffisance transversale du maxillaire chez l'adulte.

**Matériel et méthode.** Dix scanners ont été réalisés sur des SPM prélevées sur des pièces anatomiques (corps âgés de 79,4 ans en moyenne ; extrêmes : 70–86). Trois régions d'intérêt radiologique (RIR) standardisées ont été identifiées sur chaque suture de manière standardisée et classées en « ouverte » (groupe 1) ou en « fermée » (groupe 2) par 3 radiologues indépendants. Les 30 RIR ont ensuite été analysées histologiquement en fonction de 3 critères : largeur moyenne de la suture (LMS), index d'oblitération (IO) et index d'interdigitation (II).

**Résultats.** Neuf RIR ont été classées dans le groupe 1 et 21 dans le groupe 2. À l'examen histologique, la valeur moyenne de LMS était de 396,9  $\mu\text{m}$  dans le groupe 1 et de 227,1  $\mu\text{m}$  dans le groupe 2. L'OI était de 3,098 % et 9,309 % et l'IS était de 1,25 et 1,34 respectivement. Une différence statistiquement significative a été retrouvée uniquement pour LM. Nous en concluons que le scanner permet d'évaluer la largeur de la suture intermaxillaire mais ne permet pas d'évaluer les autres critères de résistance potentielle que nous avons utilisés. Le scanner ne nous semble de ce fait pas être en mesure de prédire l'importance de la résistance de la SPM et ne permet pas

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d'orienter le choix vers une distraction orthodontique pure ou chirurgicalement assistée.

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**Mots clés :** Expansion maxillaire, Scanner, Histologie

## Introduction

Transverse maxillary deficiency is a common form of dental and skeletal dysmorphia. Several treatments are available for the expansion of the midpalatal suture (MPS), whether these are orthopedic, such as rapid maxillary expansion (RME), surgical or orthodontico-surgical [1]. Surgical treatment is suggested when the orthopedic treatment is risky because of excessive resistance, or after failure of RME.

The histological study of the MPS showed histomorphometric changes during growth. These changes are sources of resistance [2,3]. During maturation, the MPS presents 3 main changes: a reduction of its width, ossification and an increasingly sinuous path. This resistance is responsible for the failure of orthopedic treatment or the onset of pain and periodontal disease [4].

How patient and when does it propose surgical treatment to prevent failure of RME? There is no consensus regarding to chronological age [4]. Regarding the physiological age, wrist radiographs are typically used to assess the end of bone growth. However, the MPS continues to change once bones have stopped growing. Its ossification is unpredictable until the age of 30 years [3,5]. Radiology that allows the diagnosis should be focused on the MPS. The occlusal radiography enables it, but the superimposition of bony structures is responsible for 50% false positive results [6].

Multislice computed tomography (MSCT) allows 3D vision and excellent resolution of bone and soft tissue. Is MSCT able to help us in our therapeutic choice for the correction of the transverse maxillary?

The purpose of this study was to find out if MSCT of the midpalatal suture could inform us of visible histological parameters of resistance to select an appropriate treatment for transverse maxillary deficiency.

## Material and method

### Material

Ten maxillary bones were from fresh corpses. The subjects were between 70 and 86 year-old, with an average age of 79.4 years.

### MSCT

A 64-slice scanner (Brilliance 64, Philips Medical System®, Eindhoven, the Netherlands) was used. The acquisitions of

the MPS were obtained from a standard protocol for a facial skeleton. The parameters were as follows: 120 kV, 200 mAs, thickness: 0.9 mm; increment: 0.45 mm, and average DLP: 850 mGy-cm.

In the frontal plane 3 radiological regions of interest (ROI) were selected: the anterior in front of the incisal foramen (region 1), the median midway between the anterior nasal spine and the posterior (region 2), 10 mm in front of the posterior nasal spine of the hard palate (region 3) (fig. 1).

The images were analyzed with OsiriX software (open-source software version 5.8.5 32-bit). The ROI were identified at exactly the place where the cuts into the maxillaries were performed.

Thirty ROI were obtained. One image per ROI was selected. These images were integrated into a PowerPoint® presentation (Microsoft Office PowerPoint 2011; Microsoft, Redmond, Wash). The zoom was set at 280%. The window was centered on 797 HU and its width was 2953 HU. None of the parameters could be changed.

These images were analyzed by 3 radiologists and classified into 2 groups:

- group 1 or "Open": the MPS was visible on more than 50% of its length (fig. 2a and b);
- group 2 or "Closed": MPS was visible on less than 50% of its length (fig. 3a and b).

When the results were not identical between the 3 radiologists, the classification of the ROI was determined by the majority.

The reproducibility between the radiologists was evaluated statistically by Fleiss' kappa coefficient via ReCal3 (version 0.1 Alpha for 3+ coders).

## Histology

ROI 1, 2 and 3 were identified after thawing. The measurements were performed using a millimeter compass. The cuts in the maxilla were made in the exact locations of the ROI using a saw with an "EXAKT cutting system 310" saw. Each slice had a thickness of between 3 and 4 mm. Specimens were fixed in 10% neutral formalin, decalcified (Decalc, Histolab) and embedded in paraffin. Sections of 4 micrometers thickness of each paraffin block were obtained. They were stained with the standard hematoxylin-eosin-saffron (HES) and then scanned using the Hamamatsu digital pathology system® (Hamamatsu Technologies, DNanoZoomer 2.0 RS).

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