

## Introduction

The first clinical use of rapid maxillary expansion (RME) was described over a century ago by Emerson C. Angell in 1860.<sup>1</sup> Since then, numerous appliances have been designed to apply orthopedic forces during expansion, thus limiting movement of teeth and maximizing skeletal displacement. However, a component of orthodontic effects following RME has been described by numerous authors. A relevant concern in this regard is represented by the possible periodontal consequences of RME because of risk of damage to the buccal cortical plate of alveolar bone in the correspondence of anchorage teeth and/or the development of recessions. Most investigations have analyzed the dentoskeletal effects of RME through bidimensional radiographic examination, which does not allow for exact identification of the thickness of the buccal and lingual bone plates because of the superimposition of many structures on different planes of space; Timms in 1982 used computed tomography (CT) for the first time in studying basal bone changes induced by RME. Scans obtained by CT, a noninvasive and reproducible technique, permit the clinician to quantify exactly the dentoalveolar modifications induced by orthopaedic forces. RME produced transverse effects in all patients, although dental, alveolar, and skeletal changes varied from subject to subject. These studies were undertaken before or after a very short period of retention. It should be noted that several authors reported that a retention period of at least 5 months is necessary to permit adequate mineralization of the midpalatal suture, in order to minimize the relapse tendency after rapid maxillary expansion.

The aim of this preliminary study is to evaluate, in 2D and 3D, the dental and peri-odontal effects of rapid maxillary expansion (RME), using a modified rep with bands on the upper first molar and palatal support by mean of low-dose Cone Beam Computed Tomography (CBCT) with focused FOV protocol.

## Materials and Methods:

We enrolled in this preliminary study 3 patients, age between 10 and 12 years in need of palatal expansion. (Aggiungere protocollo espansivo – quante attivazioni/die e per quanti giorni- più cenni sulle caratteristiche del REP modificato – assenza dei bracci anteriori)

CBCT scans were taken before rapid palatal expansion (T0), at the end of the active expansion phase (t1) by mean of Scanora 3D (Soredex). It was used a low-dose CBCT protocol (90kV, 12.5 mA, 4,5sec) with a focused FOV (cm 7.5 x 10).

Each radiographic dataset was analyzed by an expert user by mean of the open source medical software Osirix vers. 5.7.1. It was applied an MPR (MultiPlanarReconstruction) to each dataset and they were taken into account the following measures: Intermolar Width Coronal (IWC); Intermolar Width Apical (IWA); Interincisors Coronal Width (ICW); Interincisors Apical Width (IAW); Anterior Frontal Apical Suture Width (AFASW); Anterior Frontal Coronal Suture Width (AFCSW); Anterior Axial Suture Width (AASW); Posterior Axial Suture Width

(PASW). It was also evaluated the morphology of the buccal and palatal bone around the first maxillary molar (but measure were not taken into account for the statistical analysis because of the extreme anatomical variations between a patient and another).

#### Results:

The measures taken into account in this preliminary study showed a reduced increase in the suture opening, in comparison to the RME activation protocol (total expansion 6,25 mm). We noticed an average expansion of 3,68mm, at the crown of the first maxillary molar, and an average expansion of 1,96mm at the apical level. This difference is due to a vestibular tipping of the first molar, in accordance to the literature. (see the table 1 and 2)

The suture opening was measured in the axial projection (spline plane parallel to the hard palate) and in the front projection (spline plane parallel to the central incisors axis). Both the measure revealed no notable differences between anterior and posterior, upper and lower. (see the table 1 and 2)

The cortical bone vestibular to the first maxillary molar decreased (1mm or so) but we couldn't measure it well because of the extreme anatomical variations (there are no fixed reference points to do the before/after measures).

#### Conclusions:

We applied, in this preliminary study, a new protocol of CBCT scanning using the most focused FOV possible (on the Scanora 3D) that still permitted us to see the upper jaw and the cortical vestibular bone. On the contrary of the so called "low dose CT" protocol we reduced the effective dose to the patient: only 40 $\mu$ Sv in each dataset acquisition. This was obtained thanks to: a more sensitive sensor (the flat panel on the CBCT requires a lower radiation dose); the reduction of the exposed area with a focused FOV of 7,5x10 cm; the reduction of scan time. Moreover the resolution of the acquired x-ray images was better than the CT (100 $\mu$ m).

This preliminary, less invasive, study showed some analogies and some differences with the literature. On one side we have a 50% reduced dental expansion in comparison to the REP activation, in accordance to the literature. But on the other side we have a parallel suture opening (both on the axial and on the front projection), in disagreement with the literature.