

The background features a vibrant, abstract design with overlapping curved bands in shades of orange, red, yellow, and blue. Scattered throughout are soft, out-of-focus light spots in white and yellow, creating a bokeh effect. The overall aesthetic is modern and dynamic.

Clinical applications of CBCT in oral and maxillofacial pathology

Introduction

Radiographic evaluation of the lesion size and density, thickness of the adjacent bone, and distance from anatomical nearby structures can assist in the **preoperative evaluation** of certain lesions and conditions of the jaws, also **reduce the risk** of **intraoperative and postoperative complications**, and **reduce surgical stress of the surgeon**

although two-dimensional (2D) radiological studies provide good information, but have limitations, such as indicating the **location and size of a lesion, characteristics of the surface** (smooth or rough), and demonstrating **changes over time in order to evaluate progression**⁴ of the lesion. So three-dimensional (3D) studies are better to improve the diagnosis and treatment of these lesions.

Cone beam computed tomography (CBCT), is a relatively new technology in the field of oral and maxillofacial radiology enables a large quantity of data to be acquired with a short scan time and low dose of radiation compared with conventional computed tomography (CT).

Special Software programs and filters are used to provide primary reconstruction images in three planes:

- axial
- sagittal
- coronal



**Some Clinical applications in oral
and maxillofacial pathology.**

- Disorders of tooth eruption
- Supernumerary teeth
- Periapical disease
- Medication-related osteonecrosis of the jaws (MRONJs)
- Oral cancer

Disorders of tooth eruption

An important clinical application of CBCT is the diagnosis and planning of treatment for tooth eruption alterations. In this field, CBCT provides accurate multiplanar view of the position of the tooth and its relationship with neighboring anatomical structures, as well as the presence of associated conditions, such as **cystic degeneration of the dental follicle and root reabsorption of adjacent teeth**, all of which are important factors in decision-making process.

Regarding to **lower third molars**

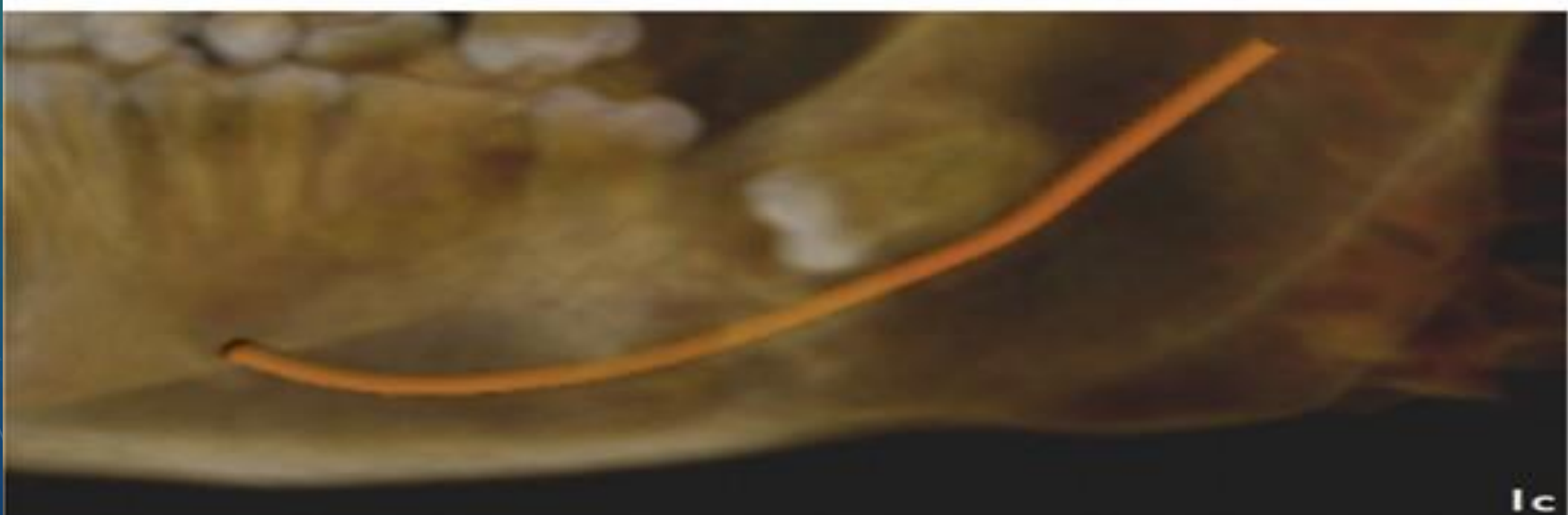
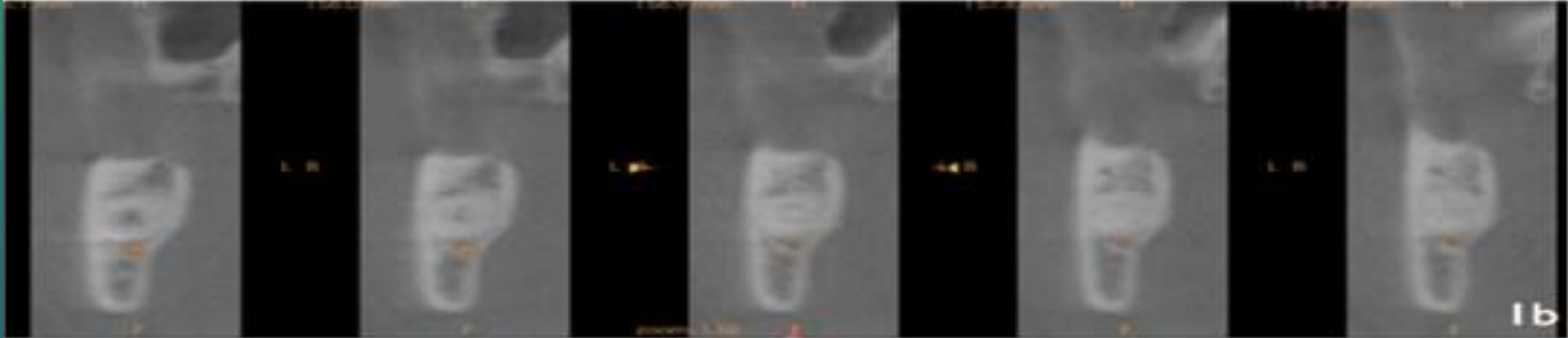
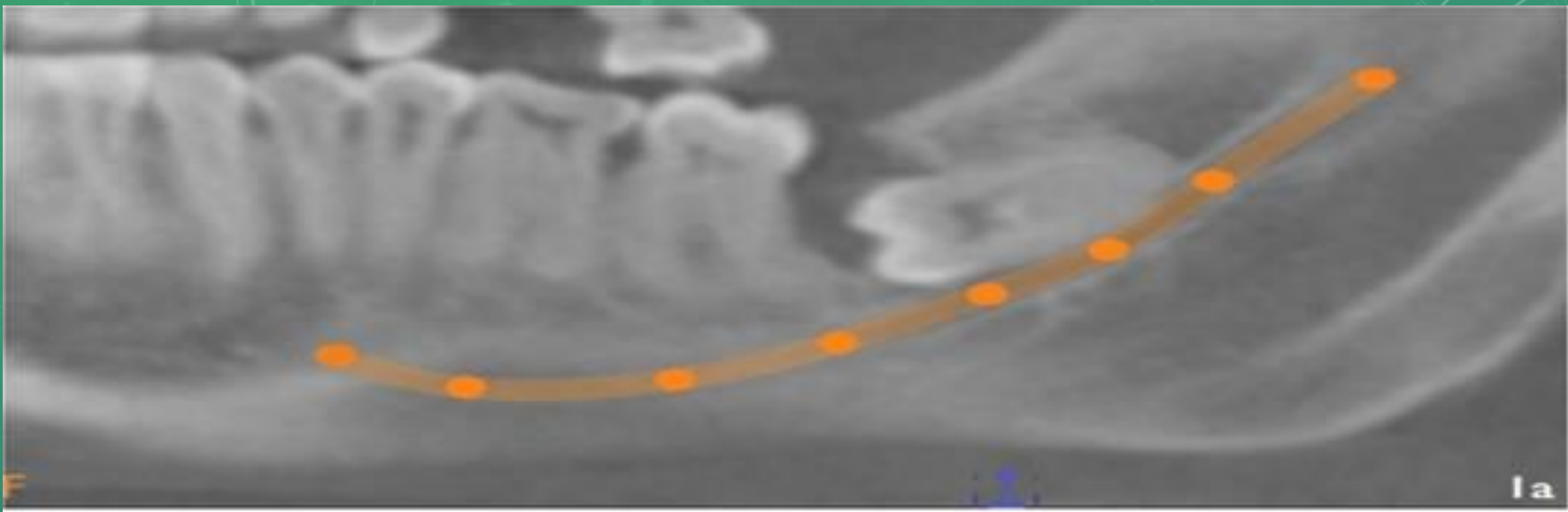
the characteristics that must be evaluated preoperatively are:

- angulation
- buccolingual inclination ,
- size and shape of the crown ,
- the presence of local lesions.
- the roots relationship with the mandibular canal
- number and shape of the roots and their development stage



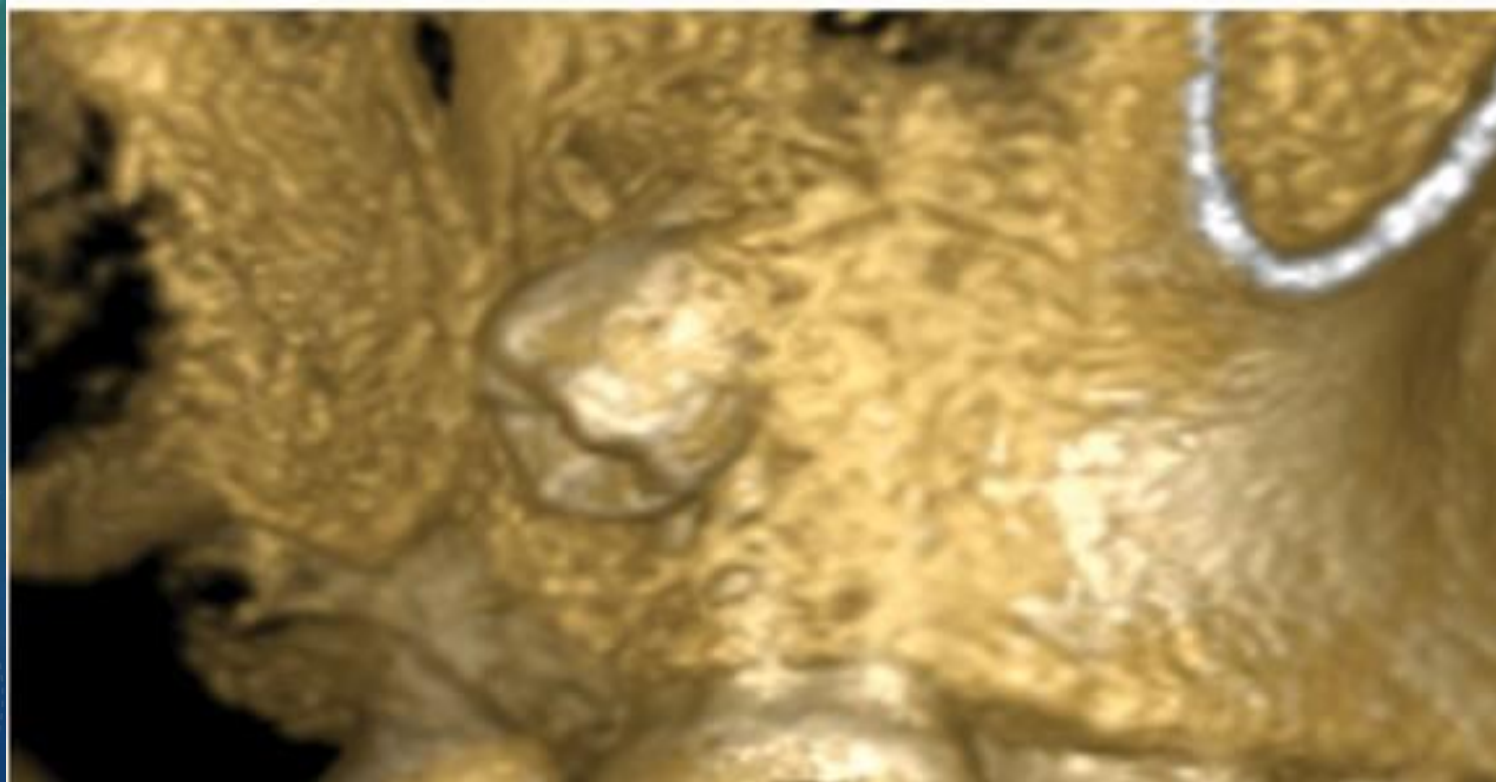
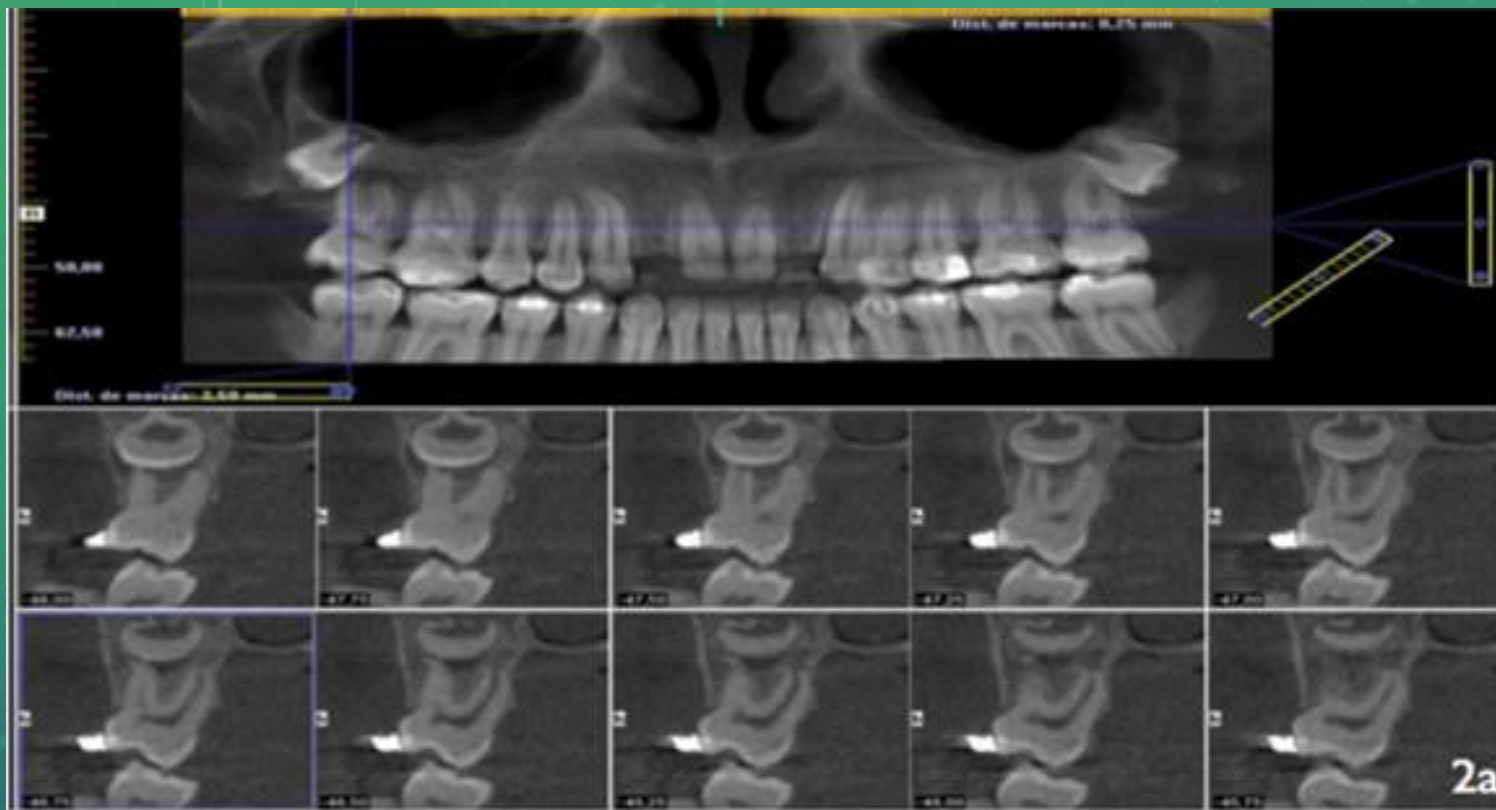
Many studies that based on images obtained by CBCT have shown higher detection quality of the relationship between the mandibular canal and the root tips of the third molars. In addition, it has also be able to identify accessory roots and apical anomalies/curvatures that not visible in the panoramic radiography

So it is very important to evaluate the topographical relationship between the third molar and these structures .



With respect to the **maxillary third molars**, CBCT can be used to evaluate the relationship between the roots and the floor of the maxillary sinus.

an important advantage of CBCT in the preoperative evaluation of maxillary third molar surgery is decreasing the surgeon's level of stress due to possibility of tooth entrance in maxillary sinus or causing oro-antrum fistula and reducing the duration of surgery



maxillary canine

is the second most common dental impaction after the third molars , Due to their functional and esthetic relevance, the main objective in the treatment of impacted canines is their repositioning in the dental arch. The 3 D localization is important both for diagnosis and for the surgical-orthodontic management; this localization can be particularly difficult to explore accurately with conventional radiological methods due to overlying anatomical structures

CBCCT can provide additional data not available with conventional 2D studies, such as

- size of the follicle
- degree of inclination of the tooth long axis
 - facial-palatal position
 - quantity of bone
- the proximity and reabsorption of adjacent roots,
 - stage of development of the tooth

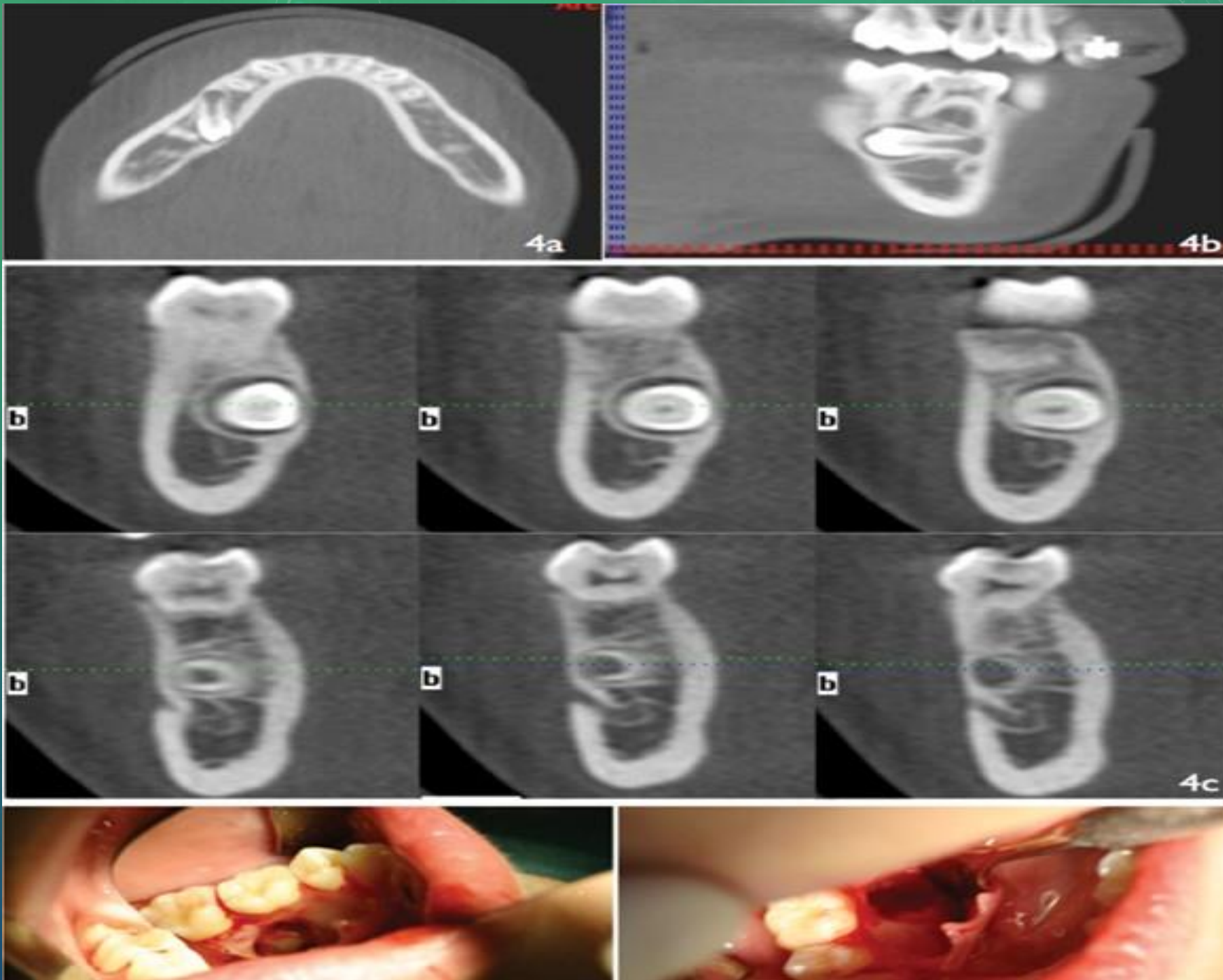
Supernumerary teeth

Supernumerary teeth are usually asymptomatic and are identified during routine radiological evaluation .

Traditionally, periapical, occlusal ,panoramic,and lateral skull radiographs are used .However, these radiographs frequently do not enable a 3D evaluation to be made of the supernumerary tooth with respect to adjacent teeth and neighboring anatomical structures this information can be important to determine the treatment plan.

CBCT qualified as “**excellent**” and it is superior to the panoramic and lateral skull radiographs for all radiological criteria evaluated. Based on these results, the authors recommended that the evaluation of supernumerary teeth should routinely be performed by CBCT, particularly in those cases with **multiple supernumerary teeth, malocclusions, or a high intramaxillary position.**

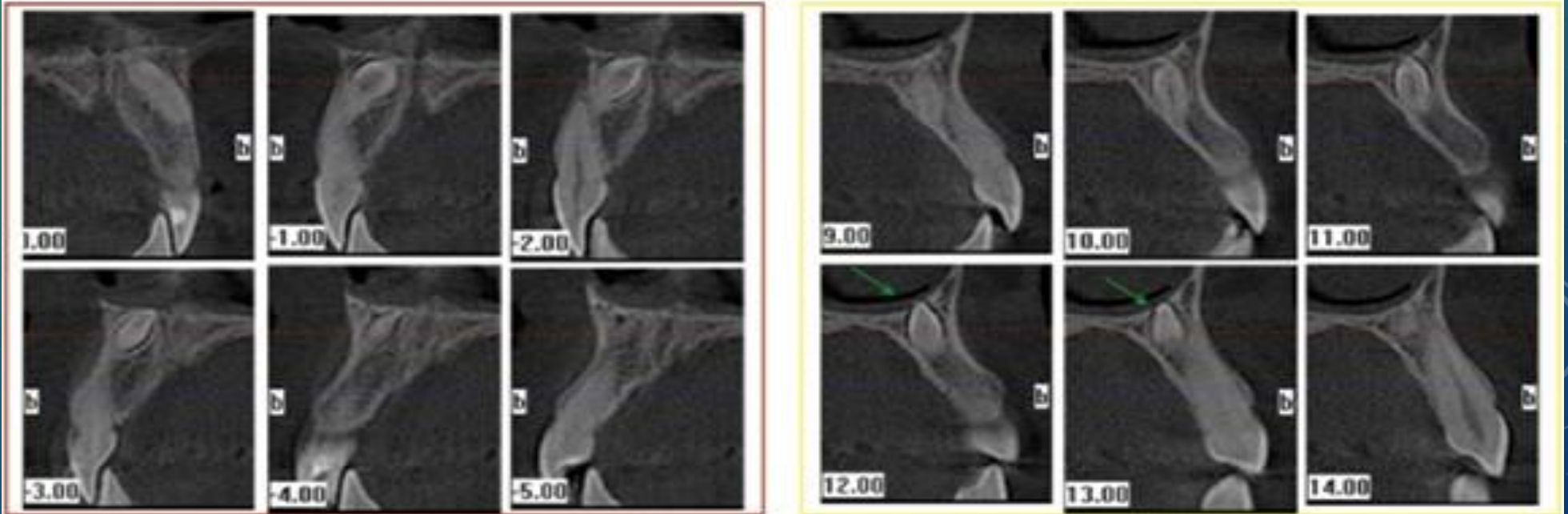
When extraction of supernumerary teeth is indicated, 3D localization by CBCT can help the surgeon in the choice of surgical access and identification of the tooth to be extracted, reducing trauma to the adjacent soft and hard tissues



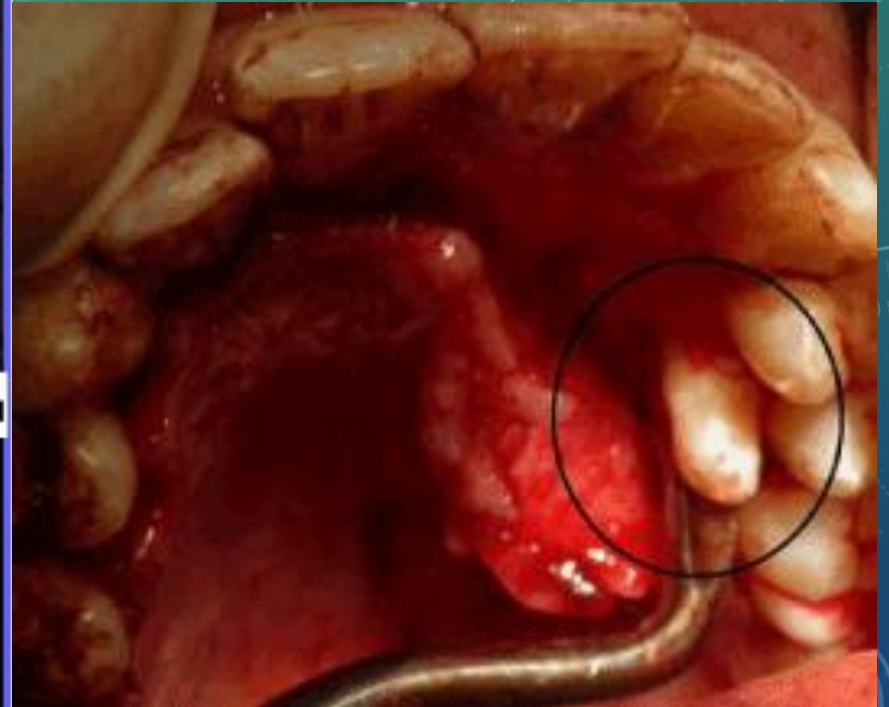
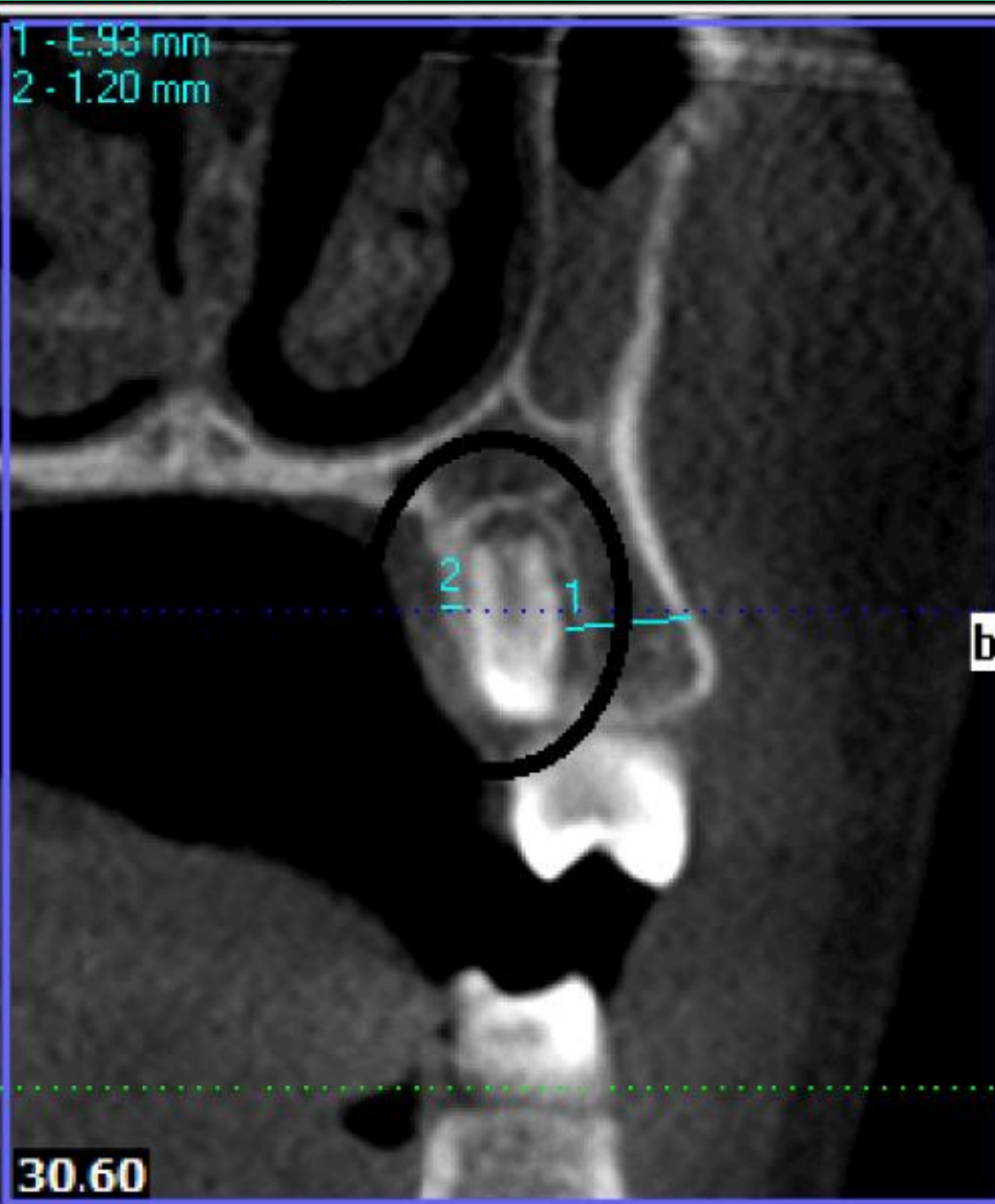
Supernumerary teeth in the posterior zone of the right inferior jaw. (relationship with the mental foramen



5b



Supernumerary teeth in the anterior portion of the upper jaw. relationship with adjacent anatomic structures. Notice a crown erupting in the nasal floor



Examination of the images from the CBCT shows the palatal location of tooth. Palatal approach was used to access and extract the supernumerary teeth

Periapical disease

Conventional radiographic techniques provide limited information about the origin, size, and situation of periapical lesions so it is necessary to perform a number of images from different angles .

Experimental studies have shown that CBCT is superior to digital or conventional intraoral radiography for the detection of mechanically induced periapical lesions .

Based on CBCT the authors proposed a new classification for the periapical pathosis index based on the **diameter** of the lesion and on **the expansion or destruction** of **cortical bone**.

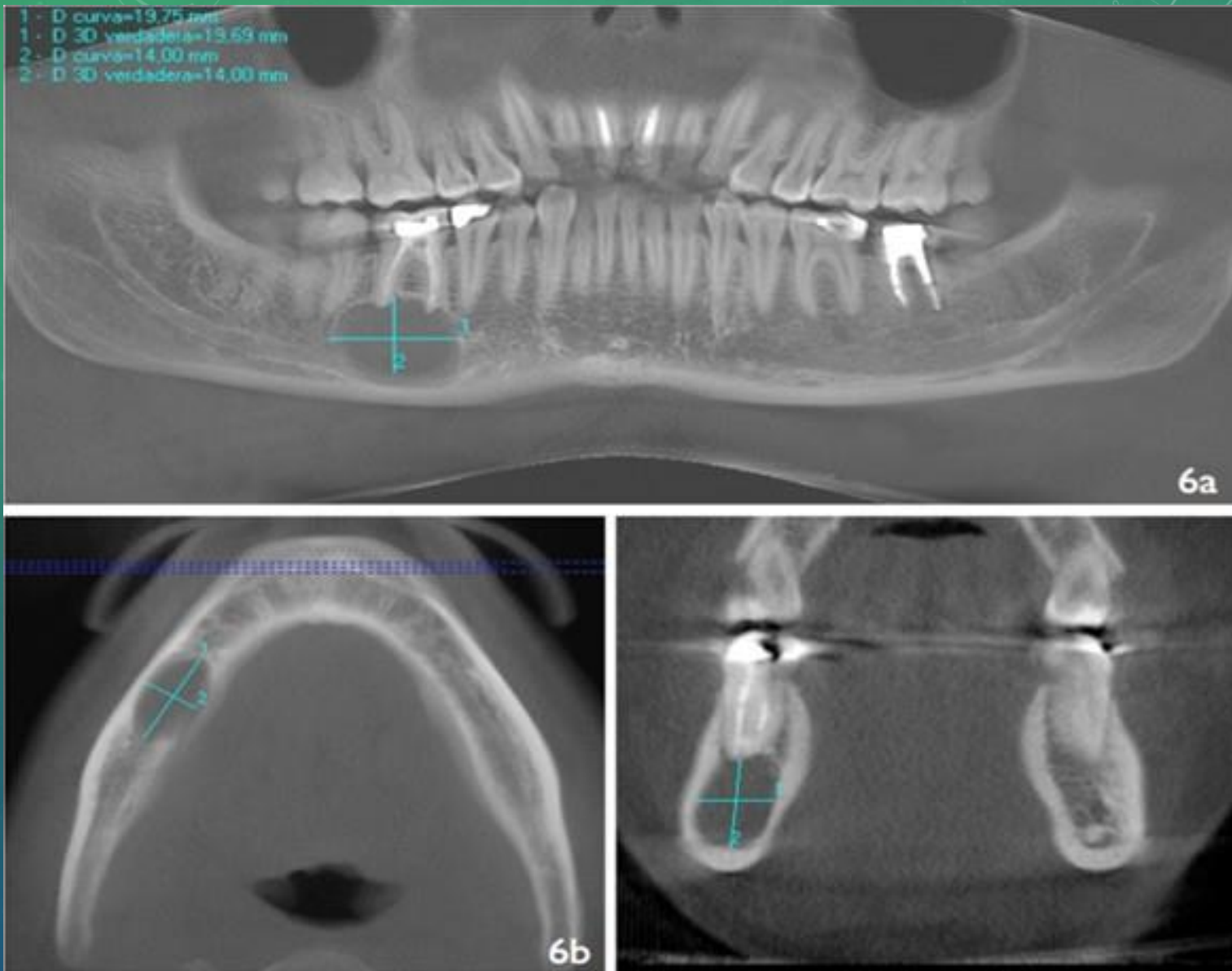
CBCT can also be used as a noninvasive diagnostic technique in periapical pathosis .

Many studies compared the diagnosis of large periapical lesions (granulomas vs. cysts) using CBCT and biopsy for lesions with a size equal to or greater than 1 cm × 1 cm, making a preoperative diagnosis based on the density of the lesions measured by CBCT and compared it to the histological study. The results suggest that CBCT could be a rapid diagnostic method without invasive surgery and/or prolonged periods of observation to see if a nonsurgical therapy is effective.

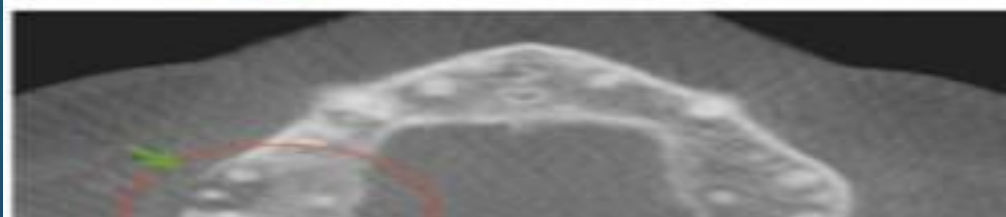
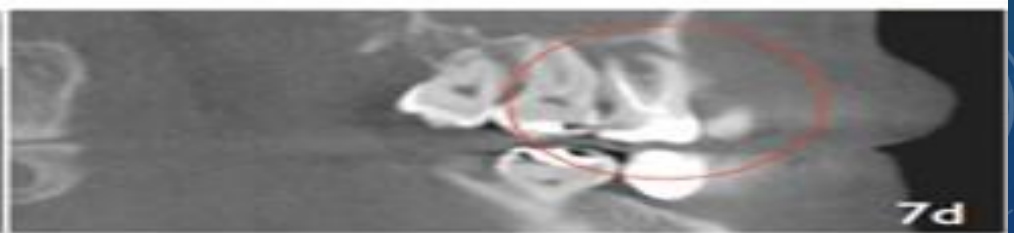
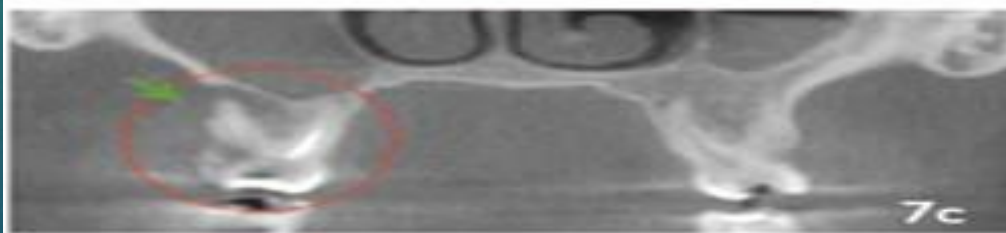
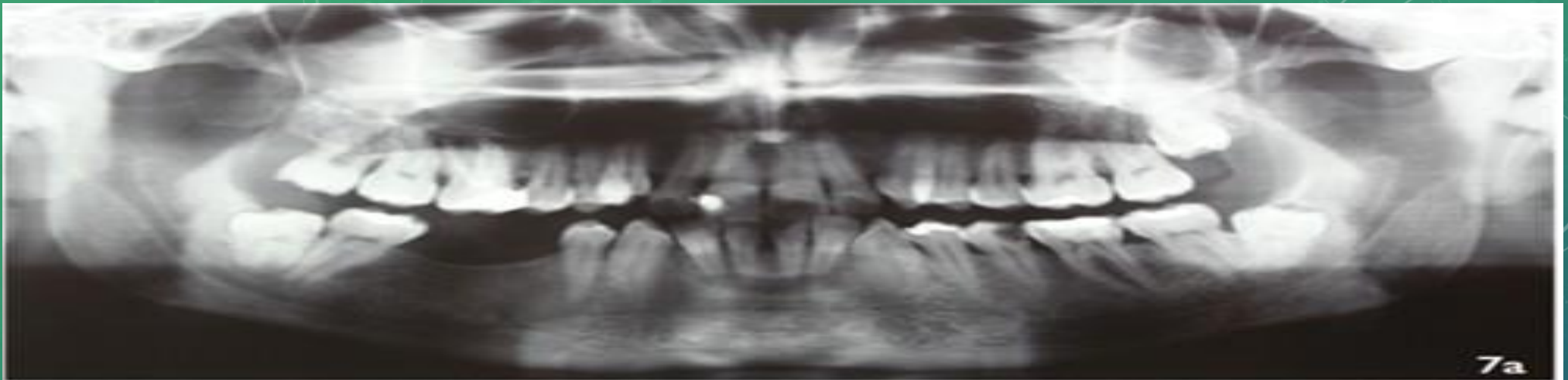
regarding the periapical surgical treatment

CBCT is using to view the regional anatomy of the area of the upper first molars facilitate apicoectomy of the palatal root of the maxillary first molars.

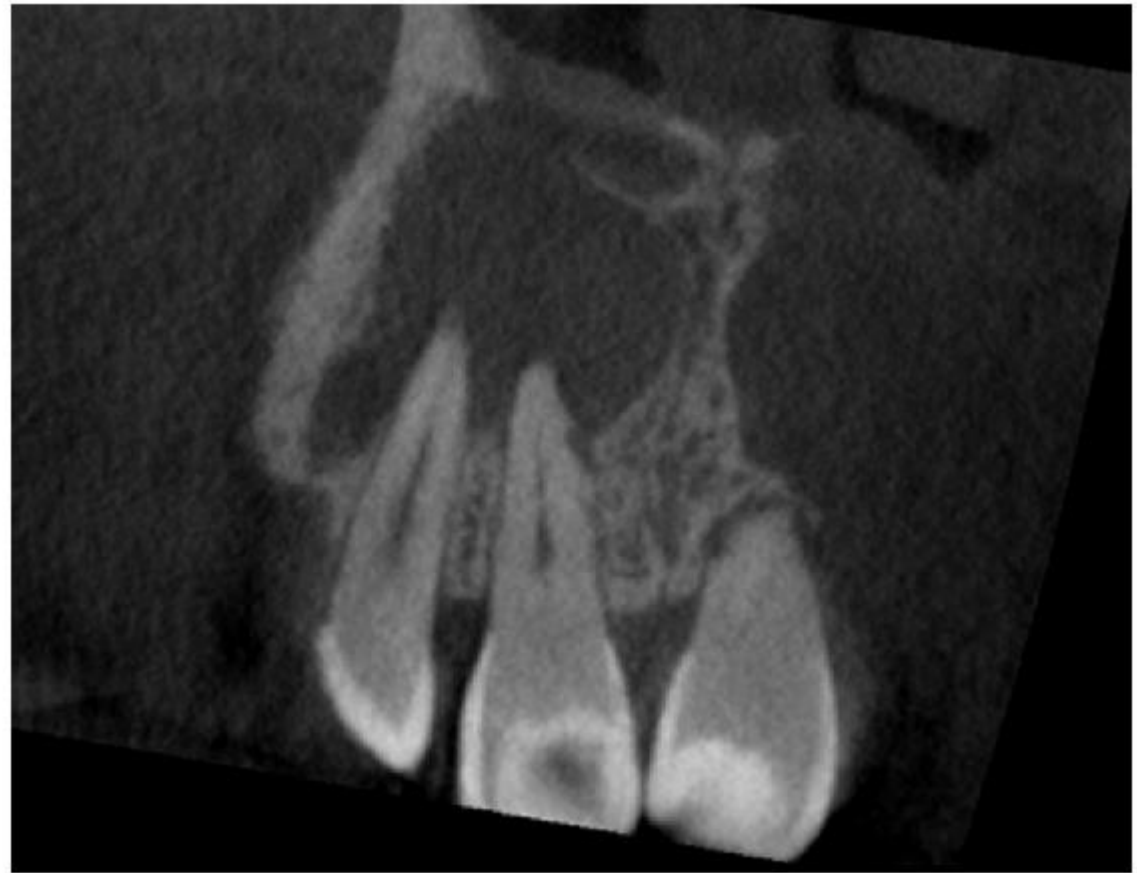




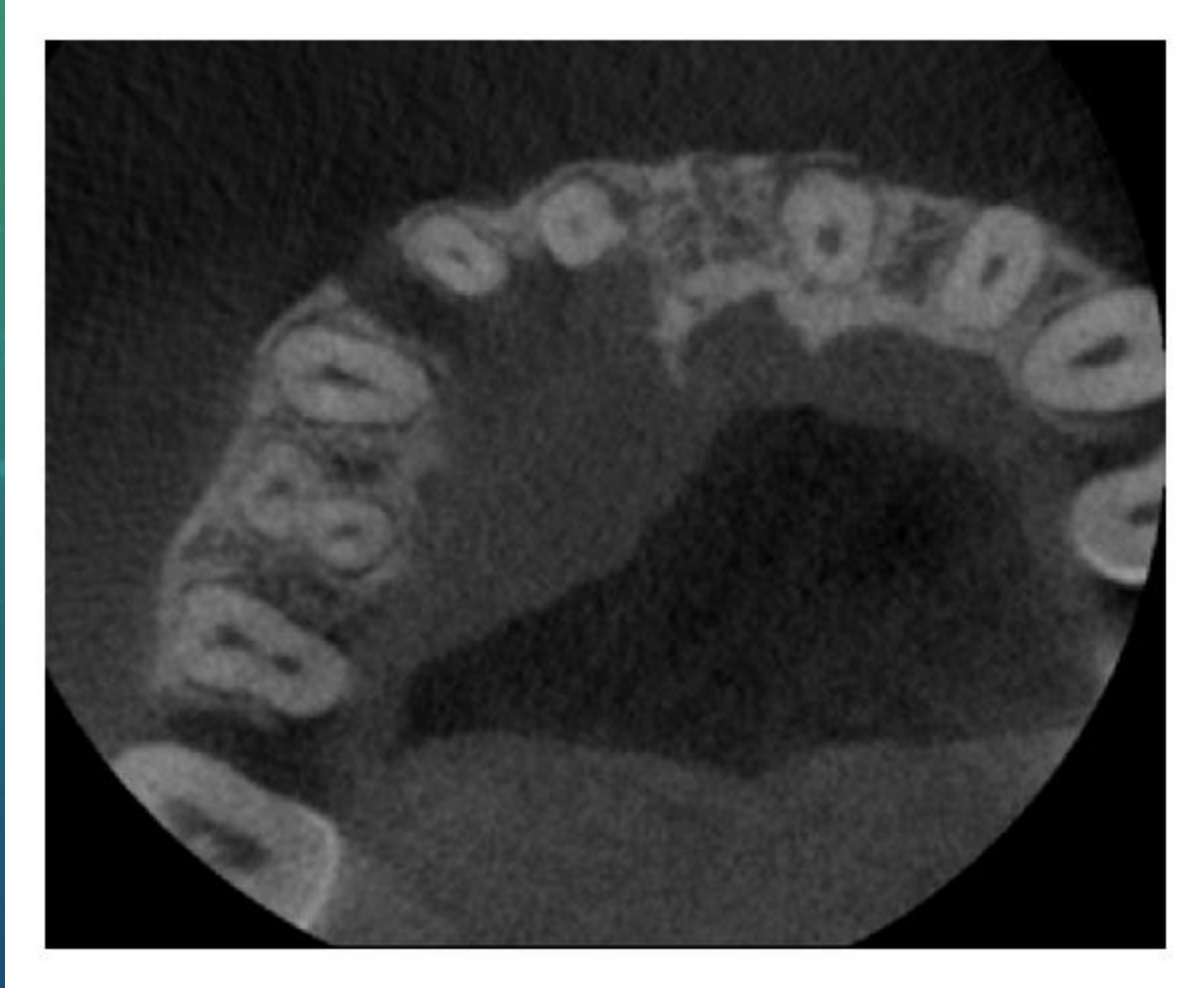
Well-defined radiolucent lesion at the apex of the lower right first molar. (a) Panoramic reconstruction of the CBCT. Two-dimensional measurement of lesion size (blue lines). (b, c) Measurement of the lesion in the axial and coronal sections.



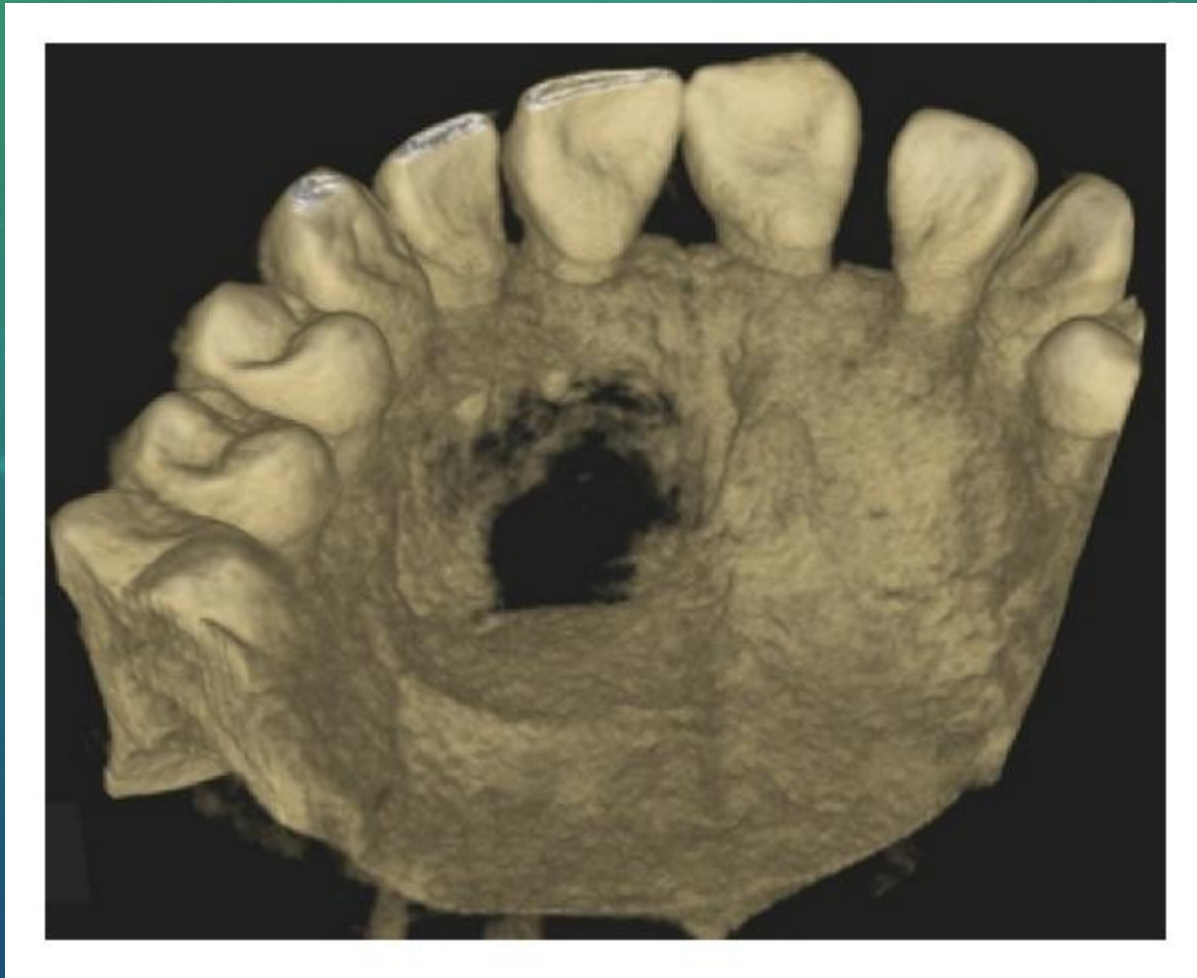
a periapical radiolucency in the first upper right molar poorly seen in the panoramic radiography and better identified in the CBCT



Pre-operative CBCT image in coronal plane showing presence of a large periapical lesion.



Pre-operative CBCT image in axial plane showing disruption of buccal and palatal cortex.



Reconstructed 3D CBCT image.

Medication-related osteonecrosis of the jaws (MRONJs)

Medication-related osteonecrosis of the jaw (MRONJ) (caused mainly by using bisphosphonates.)

Radiological evaluation is used to confirm the diagnosis and determine the extent of the lesions.

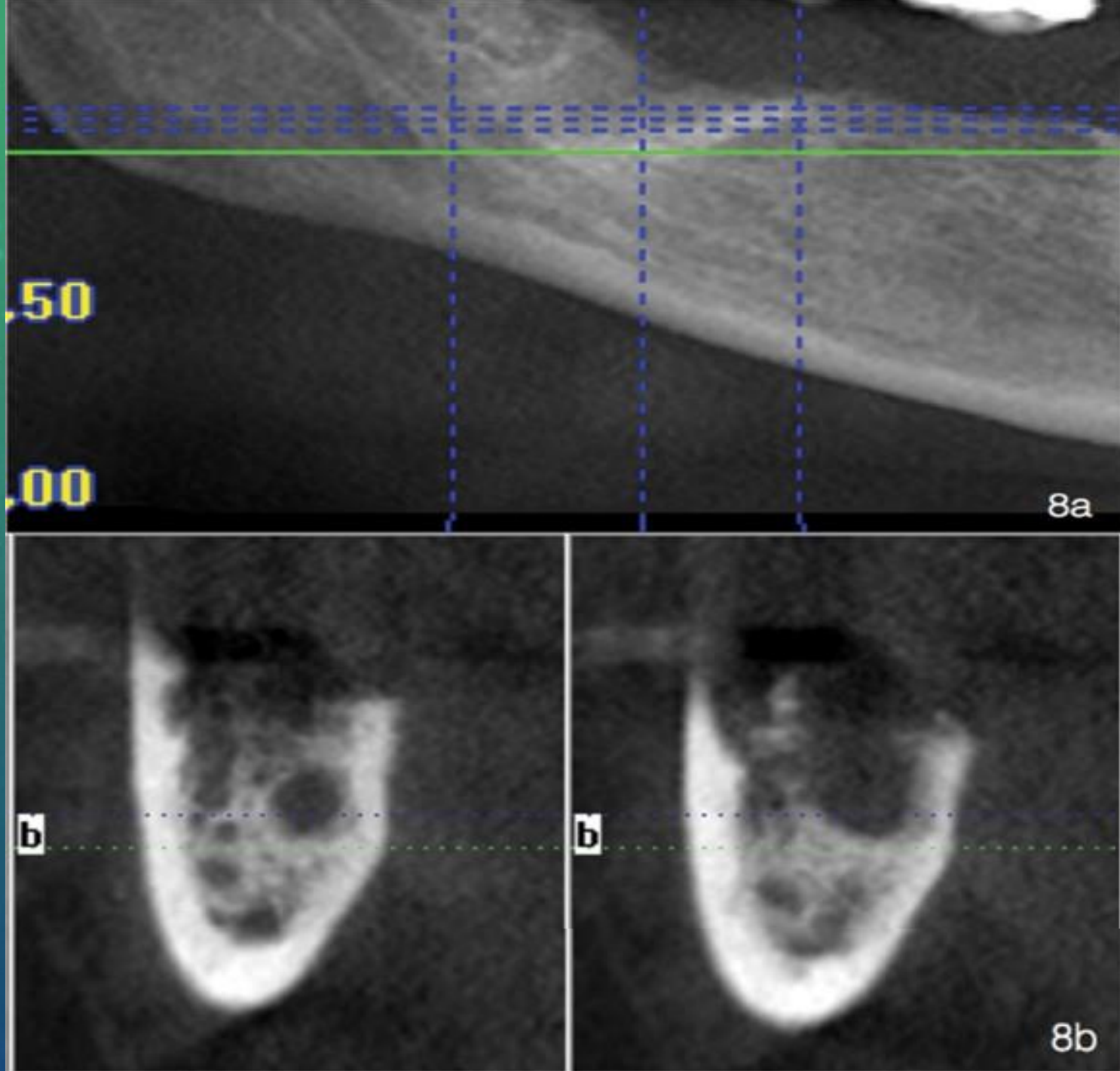
CBCT, as an alternative to CT, can provide detailed information about:

- cortical thickness
- medullary involvement
- irregularities after tooth extraction
- and density of the medullary bone

So it is described in the diagnosis, follow-up, and treatment of patients with MRONJ

A number of radiological signs of CBCT suggestive of osteonecrosis including:

- absence of bone healing
- osteosclerosis at the cortical margins of dental sockets after tooth extraction,
- widening of the periodontal ligament,
- osteolysis,
- altered medullary bone structure with increased density,
- and the formation of sequestra



Sectional views of the CBCT where the presence of osteolytic lesion is observed with small bone sequestra formation

Oral cancer

The preoperative study of patients with oral cancer usually includes physical examination, blood tests, endoscopy, and radiological examination.

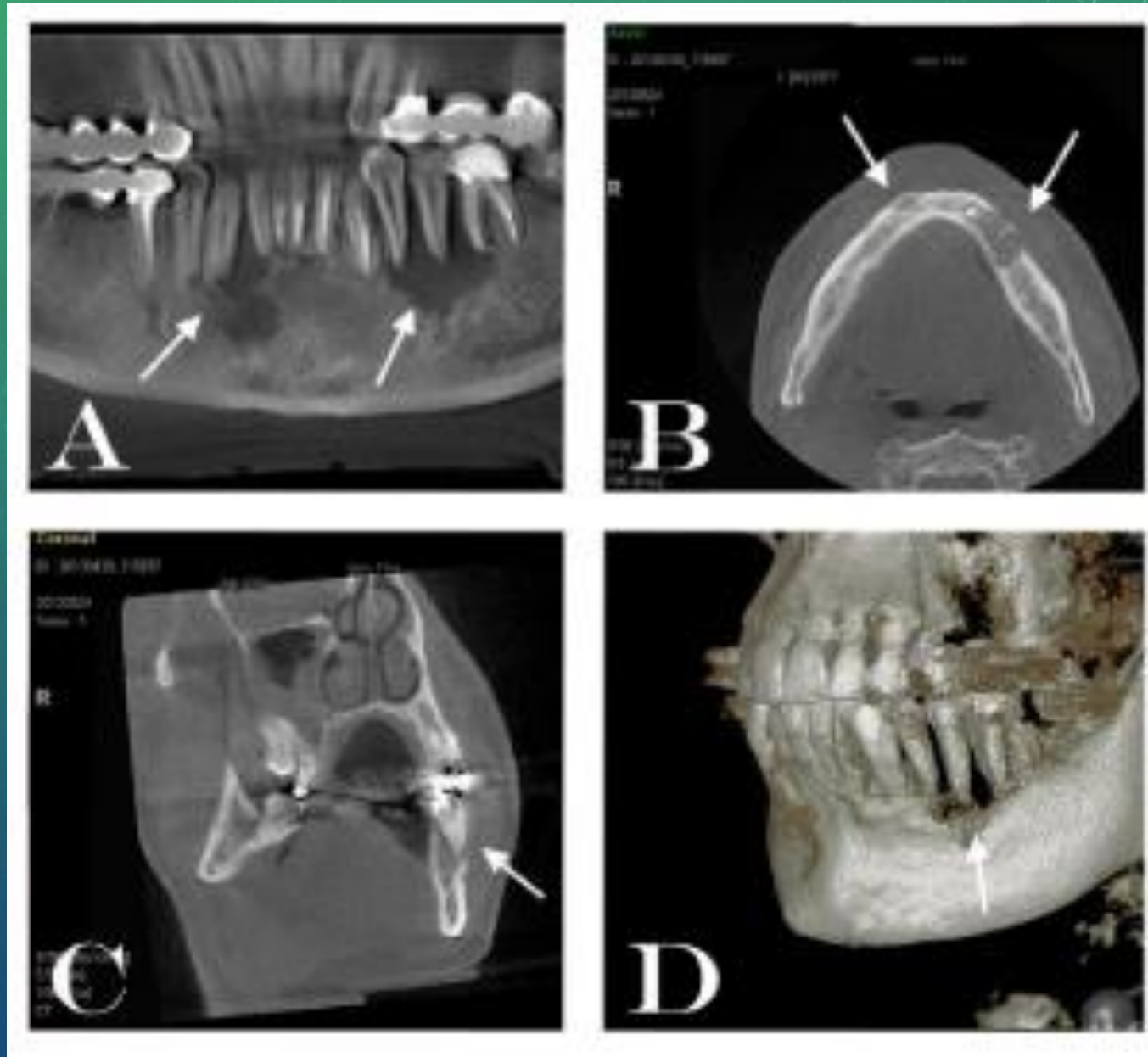
The radiological studies of choice are MRI is The technique of choice for viewing of **tumor size in the soft tissues and for evaluation of cervical lymph node involvement**, while CT is the technique of choice for evaluation of the **presence and extent of bone invasion**.

The introduction of CBCT represents an alternative for the preoperative study of patients with oral cancer to evaluate the extent of jaw bone invasion.

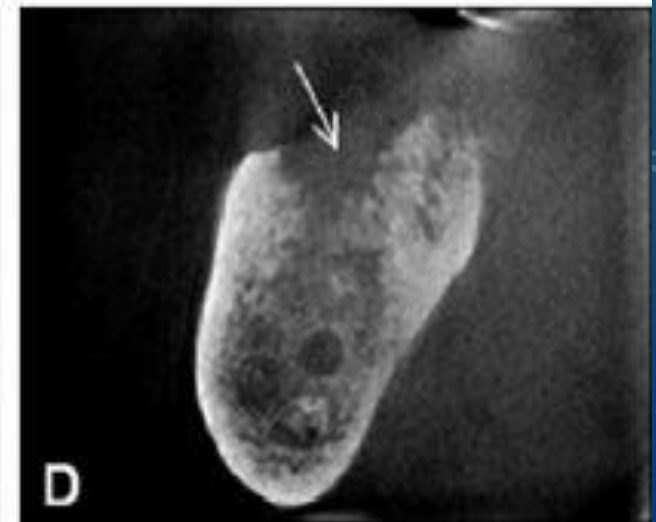
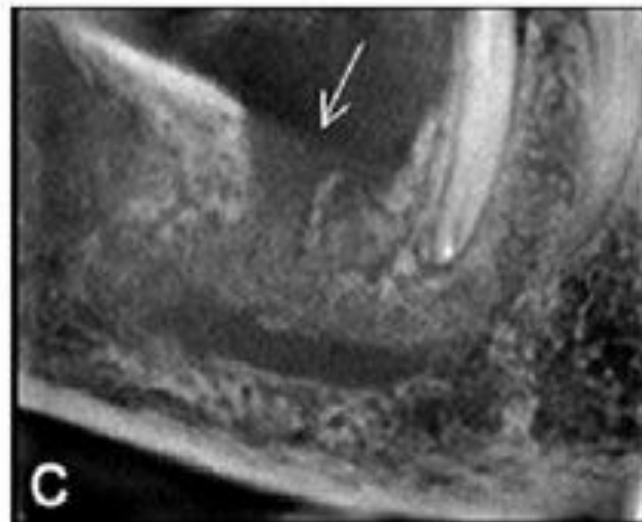
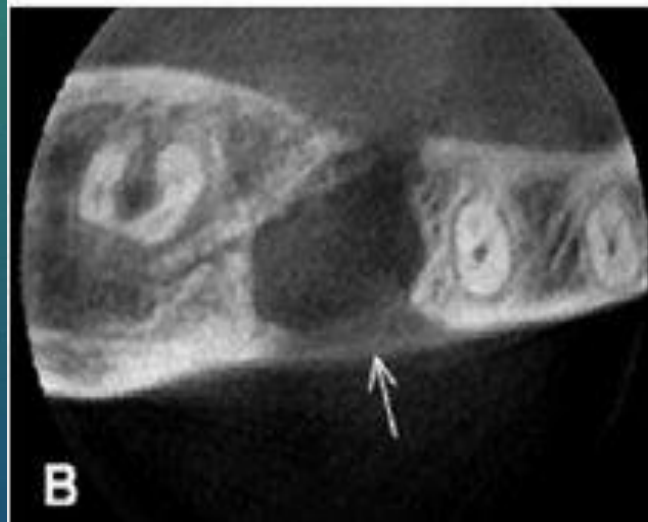
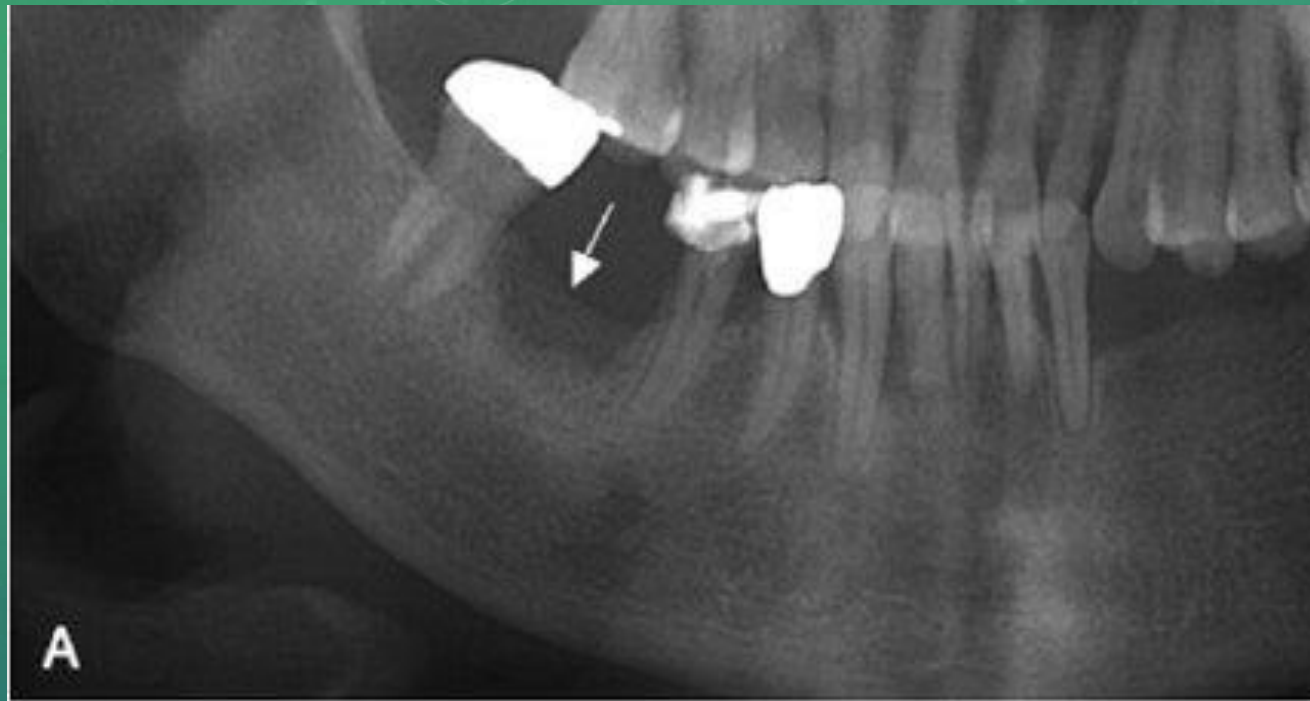
Examination by CBCT is superior to that of OPG and MRI for evaluation of mandibular invasion and the extent of the lesion in the hard tissues, with the **added advantage** of lower cost and lower radiation dose than CT.

The authors concluded that CBCT could be useful for the **preoperative staging of oral cancer** and **for determining the extent of surgical resection** necessary, as well as for **planning reconstruction techniques.**

extra-nodal non-Hodgkin's lymphoma in the mandible



CBCT images showing at: A) the extension of the lesions B) coronal CBCT images indicating the erosion of cortical plate; C) the axial image showing the displacement of the root D) 3D reconstruction of the lesion



Gingival carcinoma (A) panoramic image.
(B C D) CBCT images reveal bone destruction of the right mandible



Conclusions

The introduction of CBCT represents a great technological advance in the context of oral and maxillofacial radiology as it permits high-quality 3D images and dynamic navigation over an area of interest in real time, with a short scan time and lower dose of radiation than conventional CT.

This 3D imaging can facilitate diagnosis and/or treatment of many pathological conditions.





Thank You