

## Dental Cone Beam CT: a primer for clinical radiologists

e-Poster: EP-1

Congress: ESHNR 2014

Type: Educational Poster

Topic: ESHNR 2014

Authors: C. Vanhoenacker<sup>1</sup>, F. Vanhoenacker<sup>1</sup>, L. Vannitsen<sup>1</sup>, A. Bernaerts<sup>2</sup>, M. Vansevenant<sup>1</sup>, F. Catry<sup>1</sup>, S. Dekeyzer<sup>1</sup>, K. Chapelle<sup>1</sup>; <sup>1</sup>Duffel/BE, <sup>2</sup>Wilrijk/BE

Keywords: Mandible, Maxilla, Teeth, Cone Beam CT, Implants, Tumor and tumor-like conditions

Any information contained in this pdf file is automatically generated from digital material submitted to e-Poster by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ESHNR's endorsement, sponsorship or recommendation of the third party, information, product, or service. ESHNR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ESHNR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.eshnr.eu

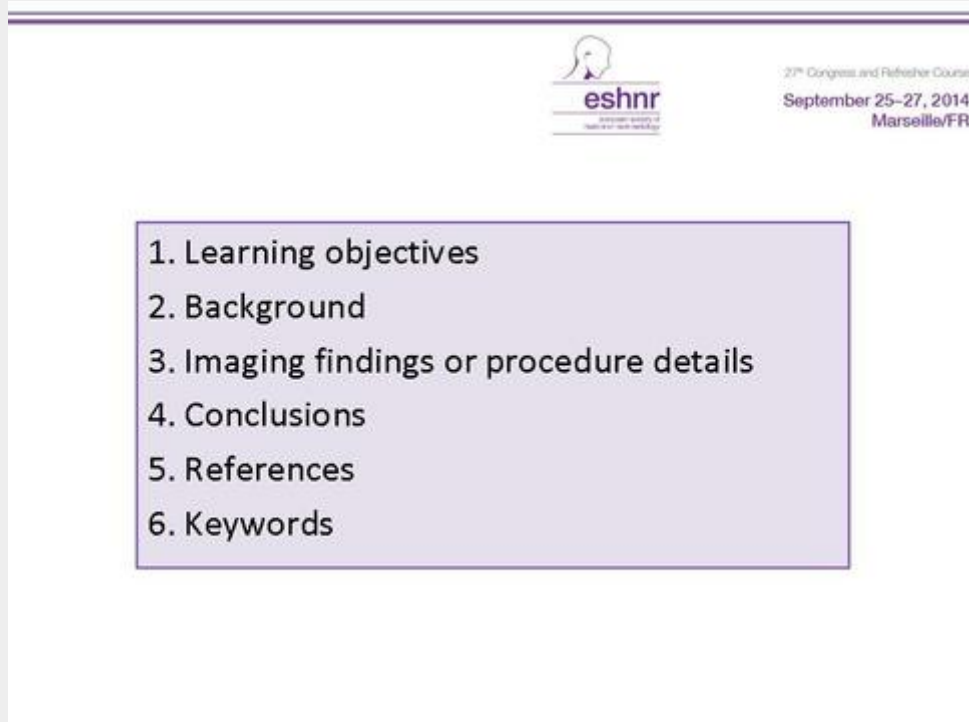
## 1. Learning Objectives

The purpose of this pictorial review is threefold: (1) to familiarize clinical radiologists with anatomy of the teeth and jaw bones (2) to provide simple guidelines for interpretation of Dental Cone Beam Computed Tomography (CBCT) (3) to illustrate the most frequent pathologic conditions seen on CBCT.

dia1.jpg



dia2.jpg

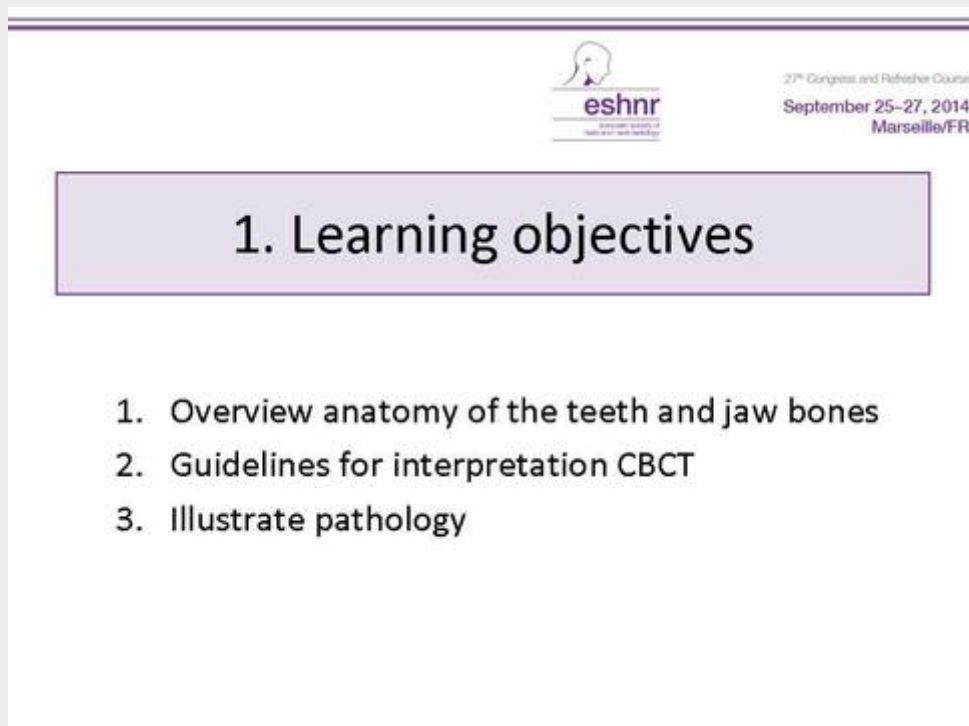


eshnr  
European Society of  
Oral and Maxillofacial Radiology

27<sup>th</sup> Congress and Refresher Course  
September 25-27, 2014  
Marseille/FR

1. Learning objectives
2. Background
3. Imaging findings or procedure details
4. Conclusions
5. References
6. Keywords

dia3.jpg



eshnr  
European Society of  
Oral and Maxillofacial Radiology

27<sup>th</sup> Congress and Refresher Course  
September 25-27, 2014  
Marseille/FR

1. Learning objectives

1. Overview anatomy of the teeth and jaw bones
2. Guidelines for interpretation CBCT
3. Illustrate pathology

## 2. Background

CBCT has become standard of care in dental radiology.

Whereas the technique was initially used in the clinical practice of dentists and oral surgeons, nowadays CBCT technology has been installed in many radiology departments for evaluation of a variety of dental and nondental applications. Traditionally, the curriculum of clinical radiologists does not include specific training in dento-alveolar pathology. Reporting dental CBCT examinations requires essential knowledge of dental anatomy and pathology as well as systematic analysis of all related structures.

In CBCT, a cone-shaped ray beam makes a single rotation around the patient and is projected on a flat panel detector, unlike Multi Detector CT (MDCT) where a fan-shaped beam and concave detector rotate in a helical fashion.

The major advantage of CBCT is high spatial resolution imaging, acquired at lower radiation doses than MDCT studies.

The disadvantages of CBCT include lower contrast resolution (i.e. soft tissue visualization) and a longer imaging time (susceptibility to movement artifacts). CBCT has also a limited field of view.

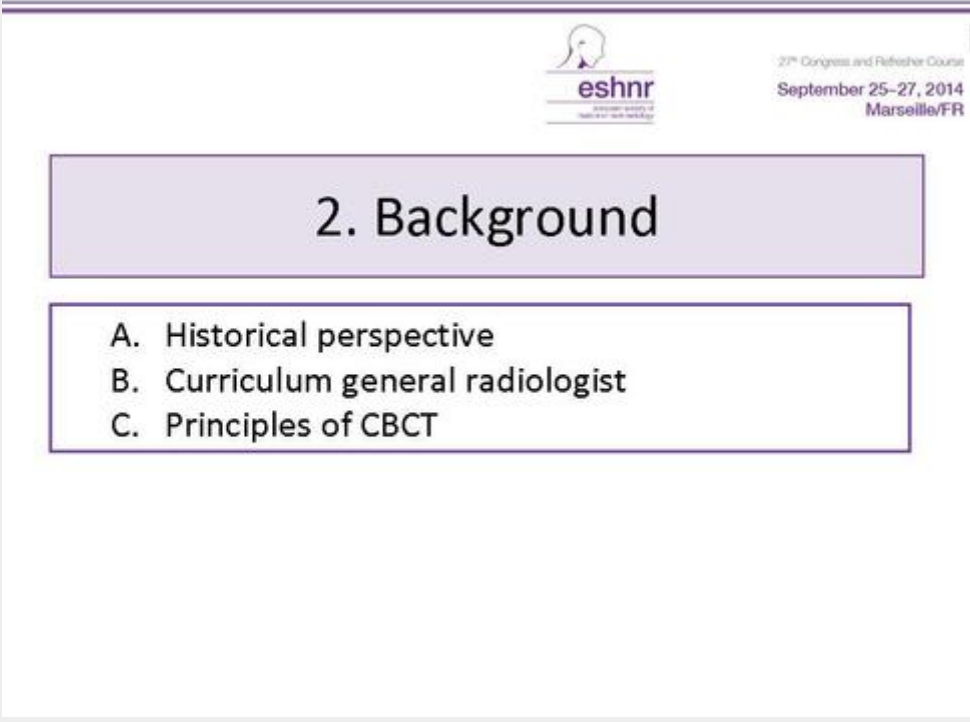
## slide 5.jpg

### A. Historical perspective

- **CBCT:** nowadays standard of care in dental radiology
- **Initially:** used in the clinical practice of dentists and oral surgeons
- **Nowadays:** installed in many radiology departments  
→ evaluation of a variety of dental and nondental applications



dia4.jpg



eshnr  
European Society of  
Head and Neck Radiology

27<sup>th</sup> Congress and Refresher Course  
September 25-27, 2014  
Marseille/FR

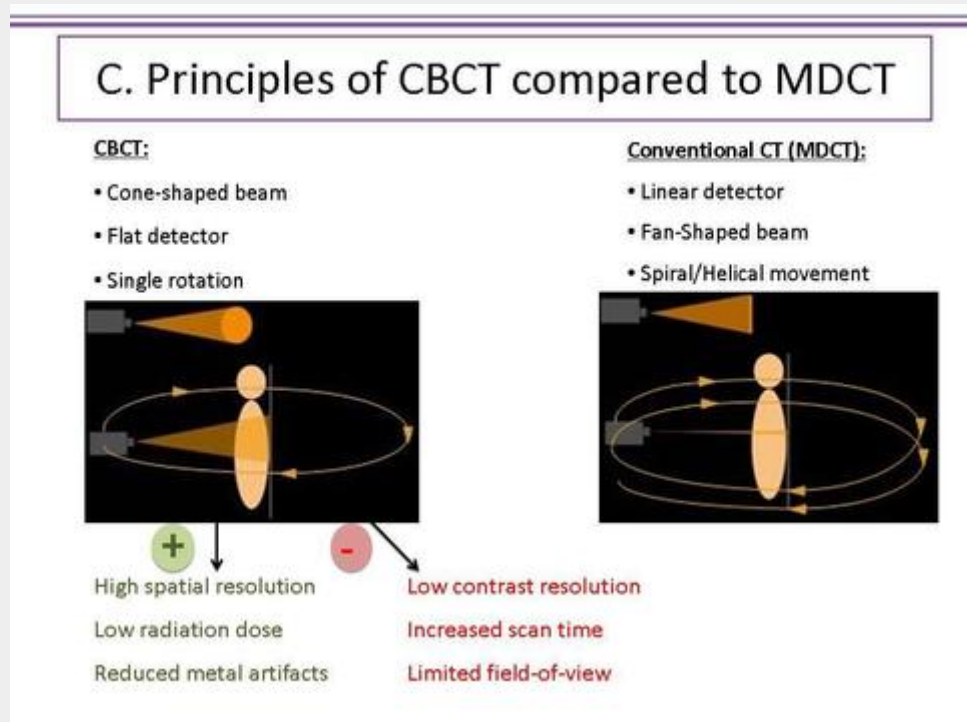
## 2. Background

- A. Historical perspective
- B. Curriculum general radiologist
- C. Principles of CBCT

dia6.jpg

### B. Curriculum general radiologist

- **Curriculum of clinical radiologists**  
The curriculum of clinical radiologists does not include specific training in dento-alveolar pathology.
- **Reporting dental CBCT examinations**  
Reporting dental CBCT examinations requires
  - essential knowledge of dental anatomy and pathology
  - systematic analysis of all related structures.
- **This exhibit aims to offer a primer for clinical radiologists in interpretation and reporting dental CBCT examinations**



### 3. Imaging Findings or Procedure Details

This pictorial review will briefly review teeth anatomy (enamel, dentin, pulp horn, chamber and canal and periodontal space) and jaw bone.

Imaging analysis starts usually with looking at scout views, followed by systematic scrolling through the axial, coronal and sagittal planes. The second step consists of specific assessment of the area of clinical interest. The third step is evaluation of multiplanar reconstructions, such as thick slice panoramic and parasagittal reconstructions.

Most frequent clinical indications for dental bone CBCT are:

- Preoperative (bone quality and quantity) and postoperative evaluation of implants.
- Anomalies in number and location of teeth and teeth impactions.
- Periapical inflammation and resorption.
- Radiolucent and radiopaque tumor-and tumorlike conditions. Radiolucent lesions are more frequent than radioopaque or mixed lesions. Although definitive diagnosis cannot be made solely on imaging, important semiologic criteria for differential diagnosis are location, evaluation of the margins, shape, displacement or destruction of adjacent structures and jaw expansion or destruction.
- Evaluation of dental and bony trauma.

Non dental pathology such as inflammation, retention cyst or mucocoele of the maxillary sinusses are often found. The radiologist should be able to suggest a nonodontogenic or odontogenic etiology of sinus pathology.

dia8.jpg



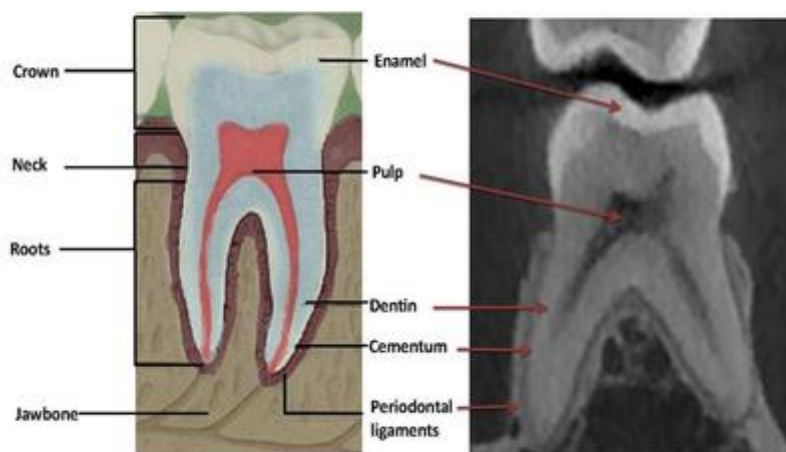
27<sup>th</sup> Congress and Refresher Course  
September 25-27, 2014  
Marseille/FR

### 3. Imaging Findings

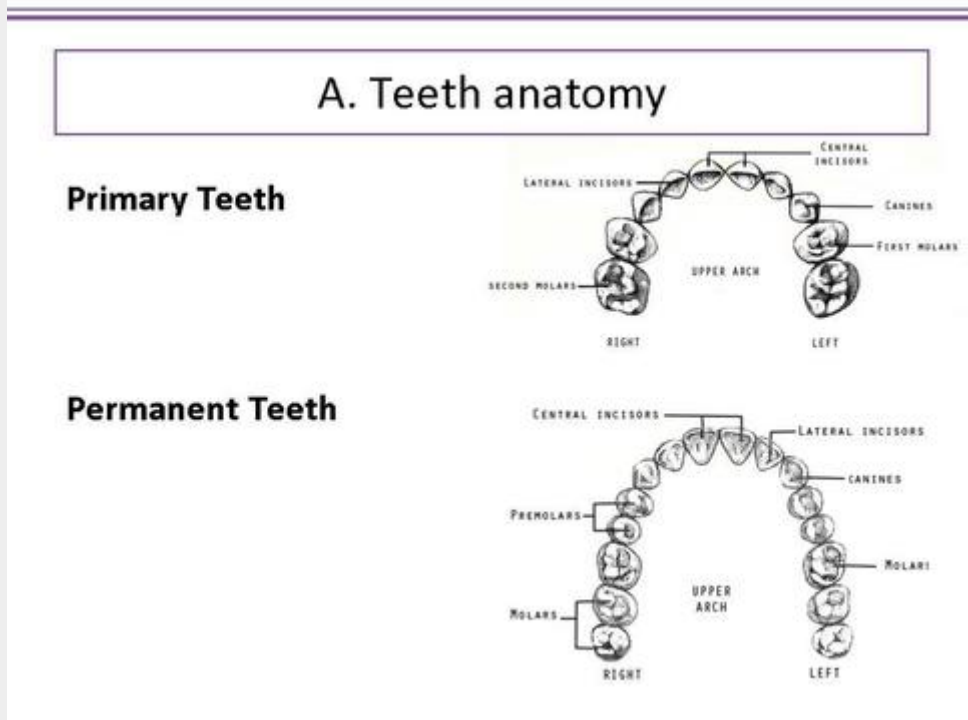
- A. Teeth anatomy
- B. Nomenclature and teeth numbering
- C. Systematic imaging analysis
- D. Clinical indications

dia9.jpg

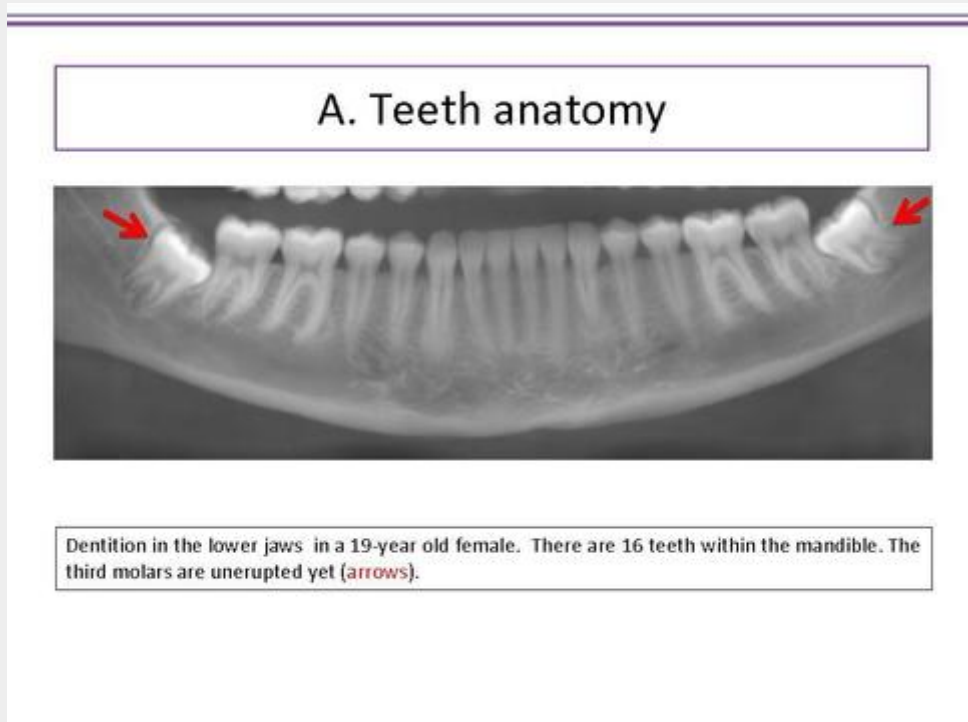
#### A. Teeth anatomy



dia10.jpg



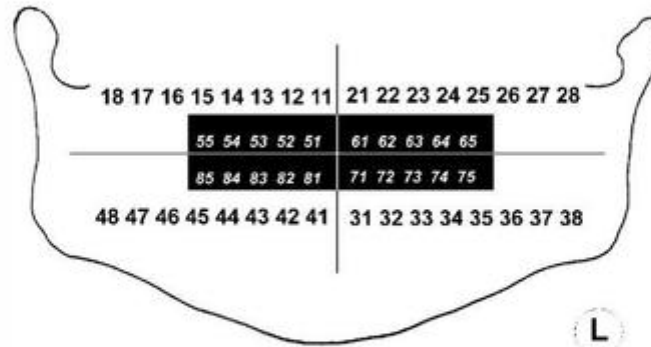
dia11.jpg





dia12.jpg

## B. Nomenclature and numbering



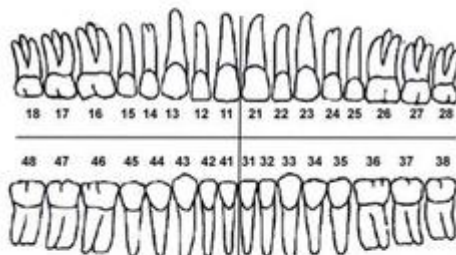
In the European nomenclature, each tooth has a unique number composed of 2 separate numbers: In **adults**, the first number indicates the quadrant in a clock-wise counter (e.g. 1 stands for the upper right quadrant of the jaw bone, 2 for the upper left quadrant etc). The second number indicates the number of the tooth within each quadrant, starting with the central incisor (1) and ending within the third molar (8). In **children**, the right upper quadrant is indicated by the 5, the upper left quadrant by 6 etc.

Ref. Bernaerts A. et al. JBR-BTR 2006

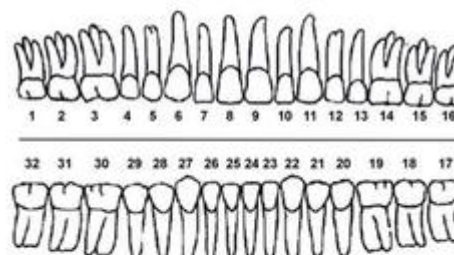
dia13.jpg

## B. Nomenclature and numbering

Dental numbering (Europe)



Dental numbering (USA)



In the USA, a different numbering system is used, starting with number 1 for the right upper third molar and progressing through the jaws in a clock-wise counter (ending with 32 for the third molar in the right lower mandible in an adult patient).

dia14.jpg

## B. Nomenclature and numbering

### Dental Arch Maxilla



The **anterior** teeth arch comprises the incisors and canines.  
The **posterior** teeth arch comprises premolars and molars.

dia15.jpg

## B. Nomenclature and numbering

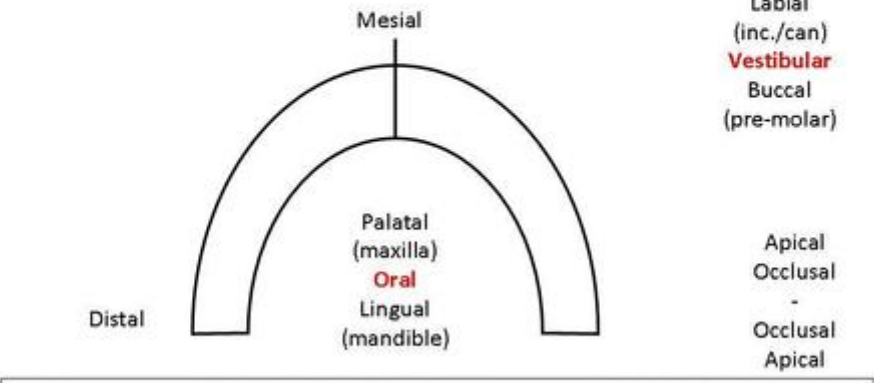
### Dental Arch Mandible



dia16.jpg

## B. Nomenclature and numbering

### Orientation Around Dental Arch



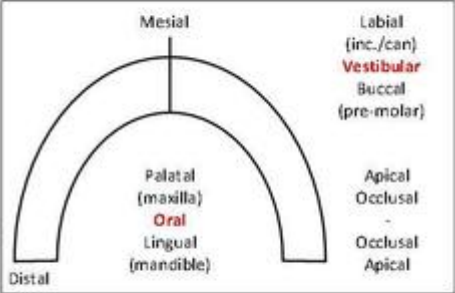
Dentists use a somewhat different terminology than medical doctors to designate the location of an abnormality within the dental arch e.g. mesial means to the midline (MD use medial)

dia17.jpg

## B. Nomenclature and numbering

### Nomenclature of orientation Around Dental Arch

- To the midline: **mesial**
- Posterolateral: **distal**
- Outer side: **vestibular**; subdivided in:
  - Anterior dental arch: **lingual**
  - Posterior dental arch: **buccal**
- Inner side: **oral**; subdivided in:
  - Towards the palate (maxilla): **palatal**
  - Towards the tongue (mandible): **lingual**
- Towards the root of the tooth: **apical**
- Towards the crown of the tooth: **occlusal**



dia18.jpg

## C. Systematic imaging analysis

1. Scout views
2. Axial
3. 6 panoramic slabs
4. Parasagittal reformatted
5. 3D rendering

For correct interpretation of CBCT examinations, systematic analysis of all image acquisitions in a fixed order is recommended, starting with analysis of the scout views, followed by axial images and ending with reformatted images.

dia19.jpg

## 1. Scout views



### Anteroposterior Scout view

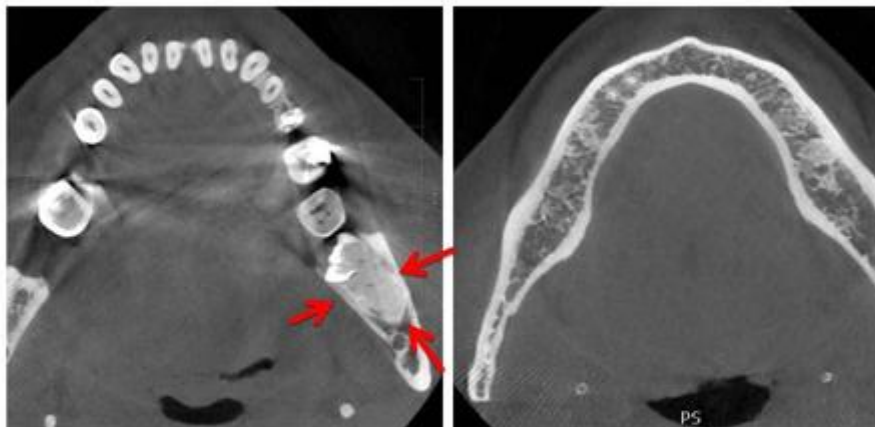
CBCT of the lower jaws, showing a non erupted wisdom tooth in the left mandible (arrow)

### Lateral Scout view

CBCT of the lower jaws (different patient), showing non erupted wisdom teeth in the upper and lower jaws (arrows)

dia20.jpg

## 2. Axial



Axial images of a CBCT of the lower jaws in a patient with a complex odontoma (arrows).

dia21.jpg

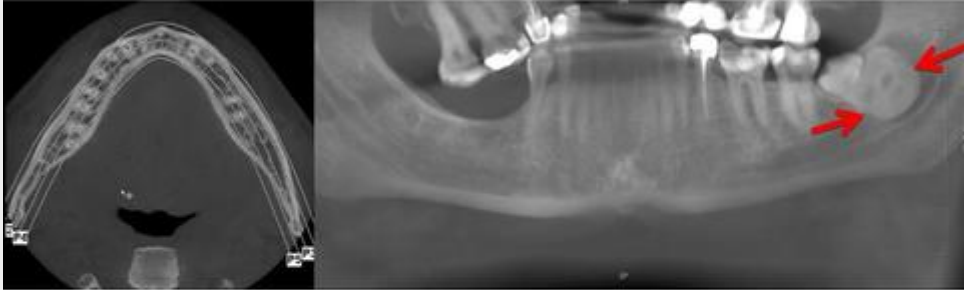
## 3. Panoramic slabs



A series of 5 to 6 adjacent panoramic reformatted images (10 mm thick) are performed through the mandible. An example of such a panoramic reformatted image is shown on the next slide.

dia22.jpg

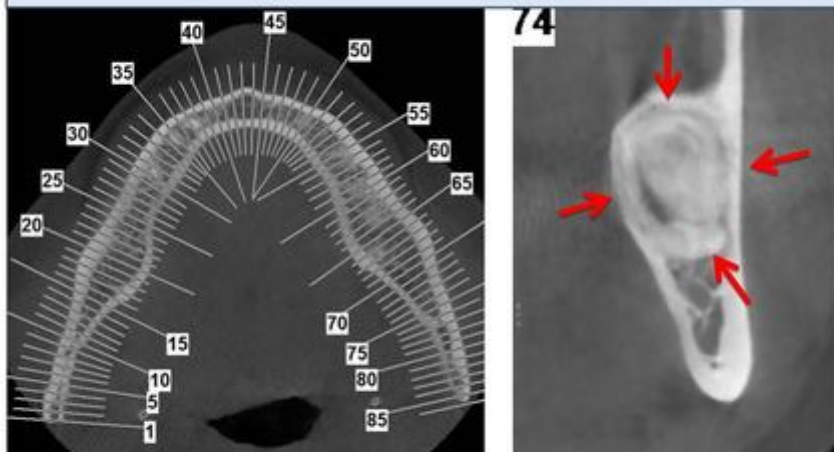
### 3. Panoramic slabs



A series of 5 to 6 adjacent panoramic reformatted images (10 mm thick) are performed through the mandible, of which a sample is shown here. Note a radio-opaque lesion (complex odontoma) in the left lower mandible angle in this patient (arrows).

dia23.jpg

### 4. Parasagittal reformatted

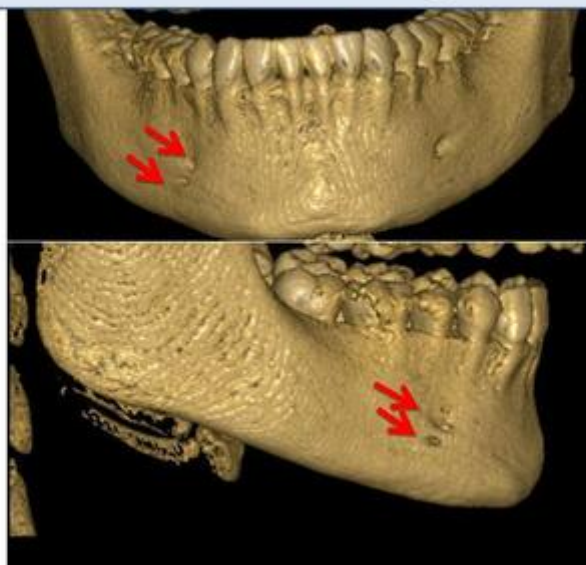


A series of multiple parasagittal reformatted images are performed through the mandibular arc, of which a sample is shown here at position 75. Note a radiopaque lesion (complex odontoma) in the left lower mandible angle in this patient (arrows).



dia25.jpg

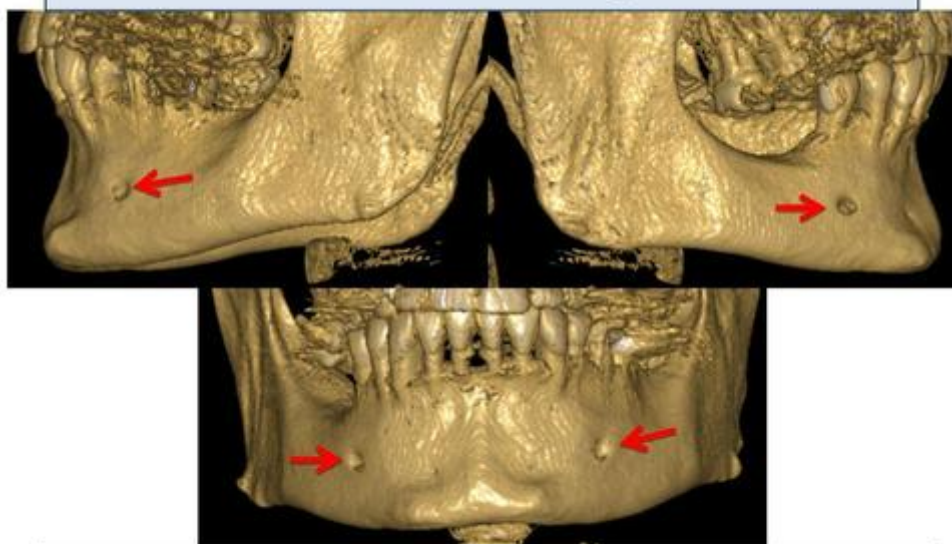
### 5. 3D rendering



3 D-VRT images in a patient with a **double foramen mentale** (arrows) on the right side.

dia24.jpg

### 5. 3D rendering



Additional 3 D-VRT images may be performed. Routinely, a set of at least 3 VRT images are enclosed in each dental CBCT examination. Anatomical details, such as the mental foramina (arrows) may be better visualized by 3 D images than on cross-sectional reformatted images.

dia26.jpg

## D. Clinical indications

### 1. Dental implants

- A. Preoperative evaluation
- B. Postoperative evaluation

### 2. Teeth impaction and noneruption

### 3. Structural Teeth Anomalies

- A. Number
- B. Location
- C. Morphology

### 4. (Peri-apical) infection/inflammation

### 5. Tumor- and tumorlike conditions

- A. Radiolucent lesions
- B. Radiopaque lesions
- C. Mixed density lesions

### 6. (Dental) trauma

dia27.jpg

## 1. Dental implants

- Most frequent indication of CBCT
- Aims to evaluate:
  - Bone height
  - Bone width
  - Bone quality
  - Bone quantity

### A. Preoperative evaluation of implants

1. Mandible
2. Maxilla
3. Evaluation of bone quality
4. Evaluation of bone quantity

### B. Postoperative evaluation of implants



dia28.jpg

## 1. Dental implants

- Most frequent indication of CBCT
- Aims to evaluate:
  - Bone height
  - Bone width
  - Bone quality
  - Bone quantity

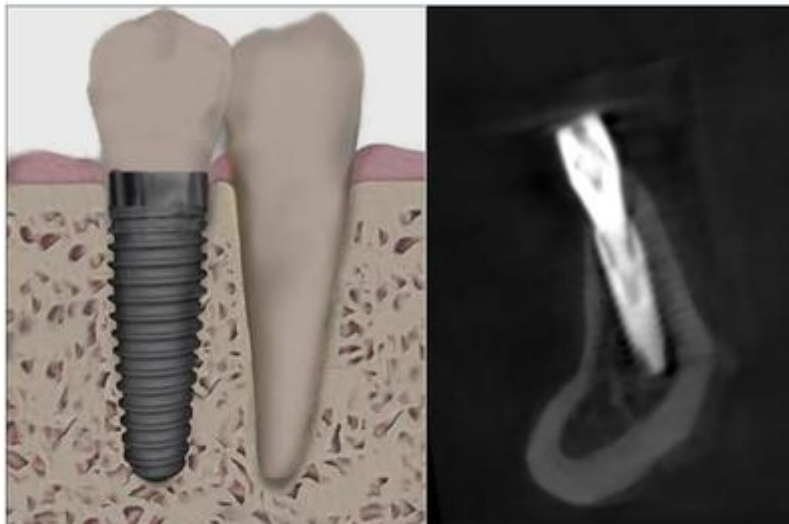
### A. Preoperative evaluation of implants

1. Mandible
2. Maxilla
3. Evaluation of bone quality
4. Evaluation of bone quantity

### B. Postoperative evaluation of implants

dia29.jpg

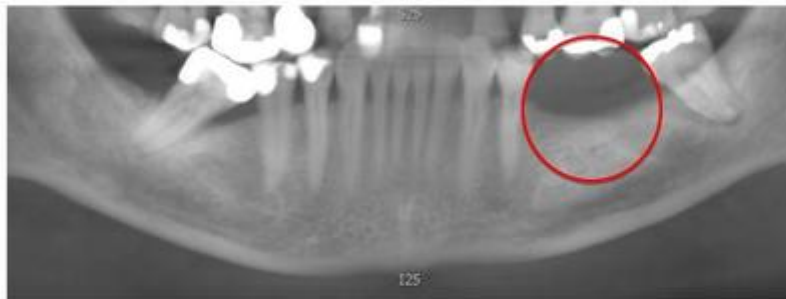
### A. Preoperative evaluation of implants



Preoperative evaluation of candidates for dental implants:  
needs determination if there is sufficient bone to accept the titanium implant.

dia30.jpg

## A. Preoperative evaluation of implants



Although panoramic views provides a rough estimation of the location of implants (circle), more detailed and accurate information is derived from analysis of parasagittal reformatted images.

dia31.jpg

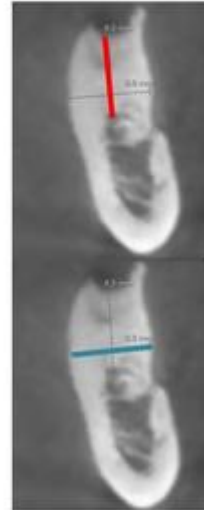
## A. Preoperative evaluation of implants

- Parasagittal images provides more precise evaluation of bone:
  - Height
  - Width
  - Quality
  - Quantity
- Measurement of the bone height differs in the mandible (1) compared to the maxilla (2).
- Evaluation of bone quantity and morphology according to the Cawood and Howell classification (3) is also different for the mandible compared to the maxilla.
- Evaluation of bone quality according to the Lekholm and Zarb classification (4) is restricted to the mandible.

dia32.jpg

## 1. Mandible

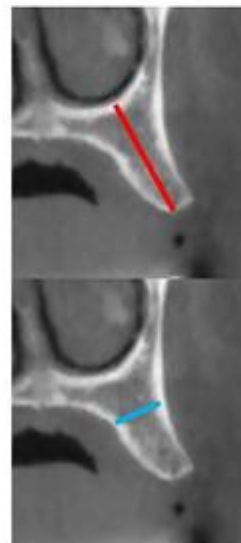
- **Bone height:**
  - measured from the top of the alveolar process to the mandibular canal, posterior to the mental foramen
  - should be at least 7 mm
- **Bone width:**
  - should be at least 5 mm
- **Bone quantity:**
  - different classes according to Cawood and Howell
- **Bone quality:**
  - different classes according to Lekholm and Zarb



dia33.jpg

## 2. Maxilla

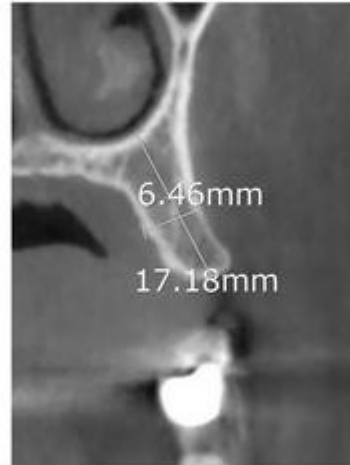
- **Bone height:**
  - measured from the top of the alveolar ridge to the sinus
  - should be at least 7 mm
- **Bone width:**
  - should be at least 5 mm
- **Bone quantity:**
  - different classes according to Cawood and Howell
- **Bone quality:**
  - different classes according to Lekholm and Zarb



dia34.jpg

## 2. Maxilla: example

- **Bone height:**
  - measured from the top of the alveolar ridge to the sinus
  - should be at least 7 mm
- **Bone width:**
  - should be at least 5 mm
- **Bone quantity:**
  - different classes according to Cawood and Howell
- **Bone quality:**
  - different classes according to Lekholm and Zarb

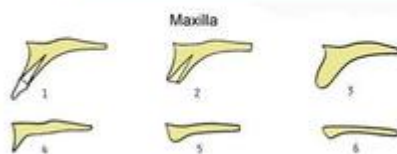


Implant candidate with sufficient bone height and width

dia35.jpg

## 3. Evaluation of bone atrophy

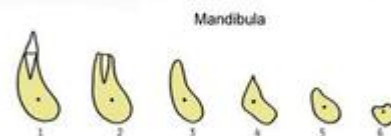
(Cawood and Howell)



1. Dentate
2. Immediately post extraction
3. Well-rounded ridge form, adequate in height and width



Implant candidate with bone atrophy class 4 (maxilla)



4. Knife-edge ridge form, adequate in height and inadequate in width
5. Flat ridge form, inadequate in height and width
6. Depressed ridge form, with some basal bone left



Implant candidate with bone atrophy class 4 knife-edge (mandible)

dia36.jpg

### 3. Evaluation of bone atrophy

Example



Preoperative evaluation for implant placement in the mandible in a 62-year-old man. Panoramic reformat (A), parasagittal reformat of the right mandible (B). Marked atrophy **Cawood and Howell stage 6** with severe bone loss and bare mandibular canal (arrows).

dia37.jpg

### 4. Evaluation of bone quality

(Lekholm and Zarb)

1

2

3

4



1. Almost the entire jawbone is composed of homogeneous compact bone
2. A thick layer of compact bone surrounds a core of dense trabecular bone
3. A thin layer of compact bone surrounds a core of dense trabecular bone of favourable strength
4. A thin layer of compact bone surrounds a core of low density trabecular bone

The amount of **cortical bone** is responsible for the primary stability of the implant, whereas **cancellous bone** is responsible for long-term stability.

**Class 2 and 3** yield the best long-term results.

The bone may be too hard for implantation in **class 1**.

**Class 4** results often in premature implant loss.

dia38.jpg

## 1. Dental implants

- Most frequent indication of CBCT
- Aims to evaluate:
  - Bone height
  - Bone width
  - Bone quality
  - Bone quantity

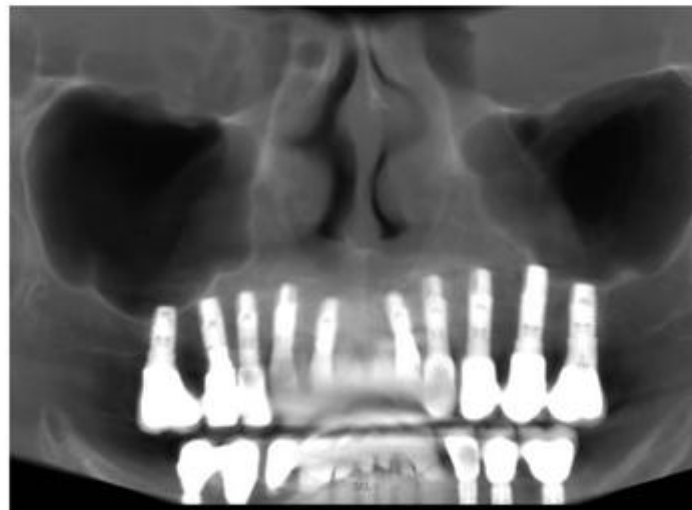
### A. Preoperative evaluation of implants

1. Mandible
2. Maxilla
3. Evaluation of bone quality
4. Evaluation of bone quantity

### B. Postoperative evaluation of implants

dia39.jpg

### B. Postoperative evaluation of implants





dia40.jpg

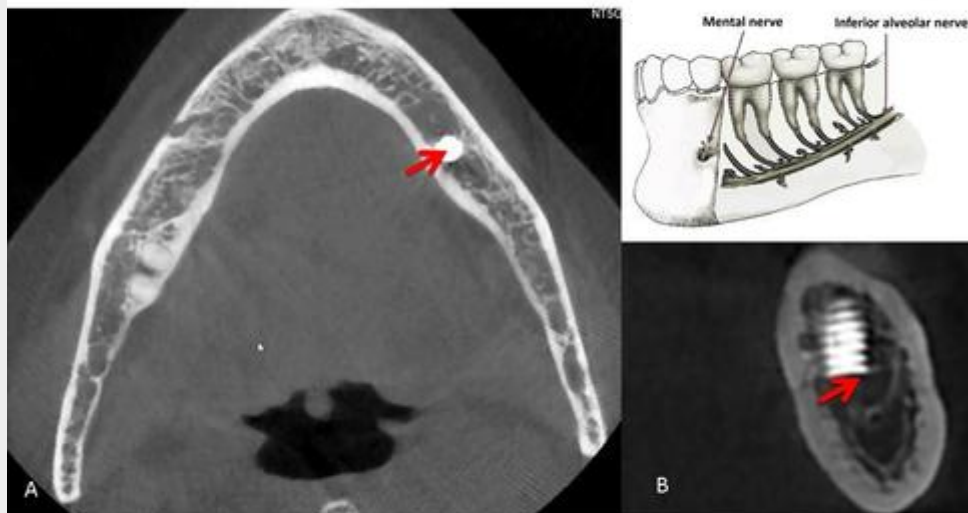
## B. Postoperative evaluation of implants

Aims to evaluate:

1. Abnormal position of implant
2. Implant loosening
3. Peri-implant fracture
4. Granuloma formation
5. Fistula

dia41.jpg

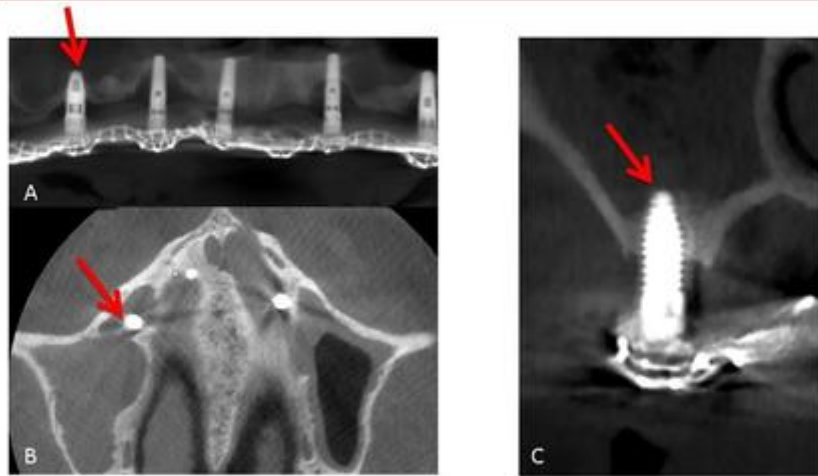
## 1. Abnormal position of implant



Axial image (A) and parasagittal reformat (B) of the mandible (arrow) in a 65-year old patient (after implant) presenting with paresthesia in the left lower jaw after implant placement. The tip of the implant protrudes within the mandibular canal (arrows).

dia42.jpg

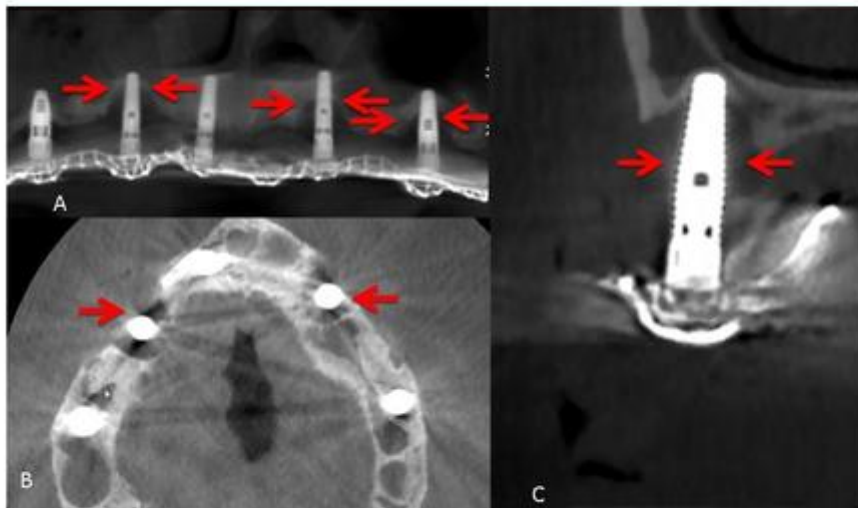
## 1. Abnormal position of implant



Panoramic reformat (A), axial image (B) and parasagittal reformat (C) of the upper jaw of a 54-year-old patient with multiple implants in the upper jaw. Perforation of floor of the maxillary sinus by the implant (arrow) with associated sinusitis.

dia43.jpg

## 2. Implant loosening

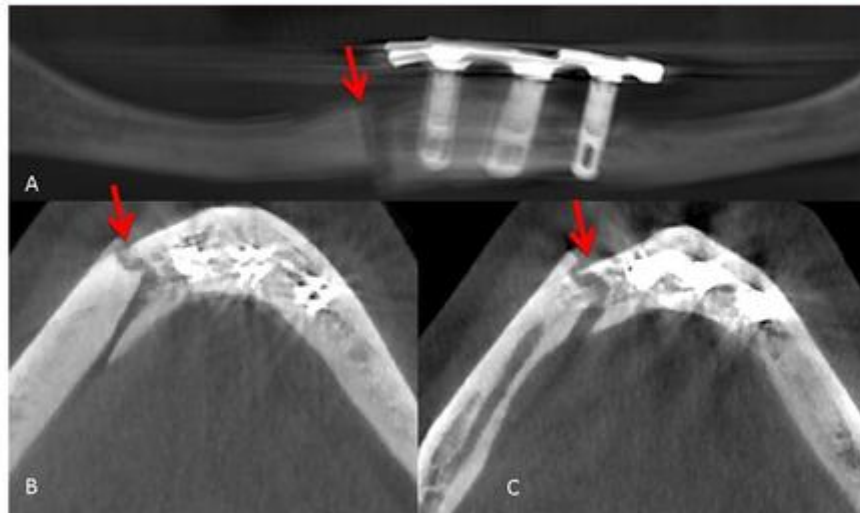


Panoramic reformat (A), axial image (B) and parasagittal reformat (C) of the upper jaw of a 54-year-old patient with multiple implants in the upper jaw. Radiolucency around the tip of the implant (arrows) in keeping with implant loosening.



dia44.jpg

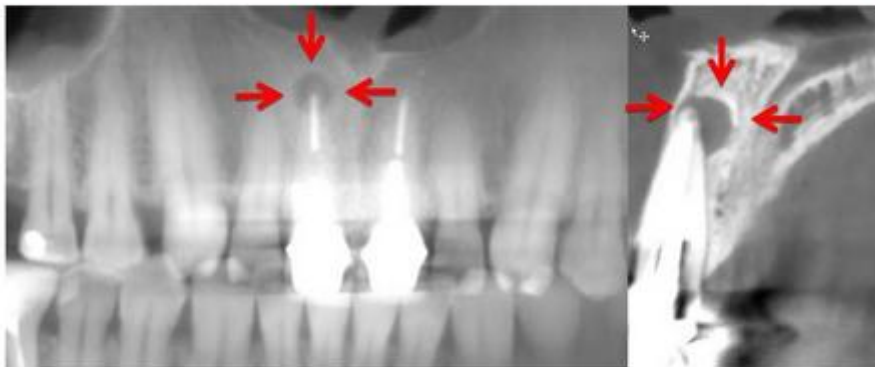
### 3. Peri-implant fracture



Panoramic reformat (A), axial images (B, C) of the mandible after implant placement show right paramedian fracture in the mandible (arrows) adjacent to the implant.

dia45.jpg

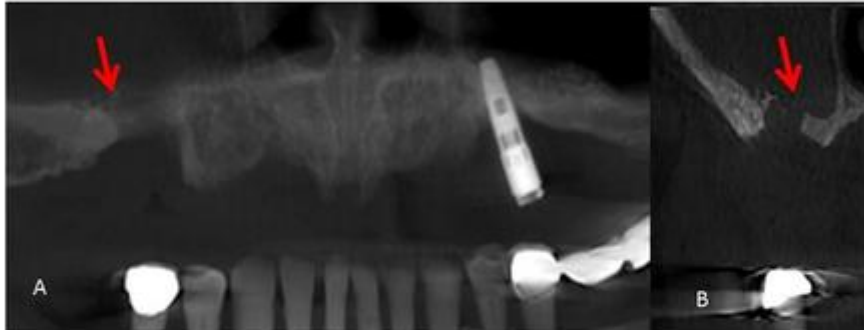
### 4. Peri-apical granuloma



42-year-old patient with previous placement of crowns 11 and 21. Panoramic (A) and parasagittal reformatted images show a small peri-apical granuloma at the apex of 11 (arrows).

dia46.jpg

## 5. Oro-antral fistula



63-year-old female with previous bilateral sinuslifting and placement of implants in the upper jaws. Panoramic reformat (A), and parasagittal reformat (B) of the right maxilla show communication of the oral cavity and the right maxillary sinus (arrows), in keeping with oro-antral fistula. Note complete loss of implant in the right upper jaw.

dia47.jpg

## D. Clinical indications

1. Dental implants
  - A. Preoperative evaluation
  - B. Postoperative evaluation
2. Teeth impaction and noneruption
3. Structural Teeth Anomalies
  - A. Number
  - B. Location
  - C. Morphology
4. (Peri-apical) infection/inflammation
5. Tumor- and tumorlike conditions
  - A. Radiolucent lesions
  - B. Radiopaque lesions
  - C. Mixed density lesions
6. (Dental) trauma

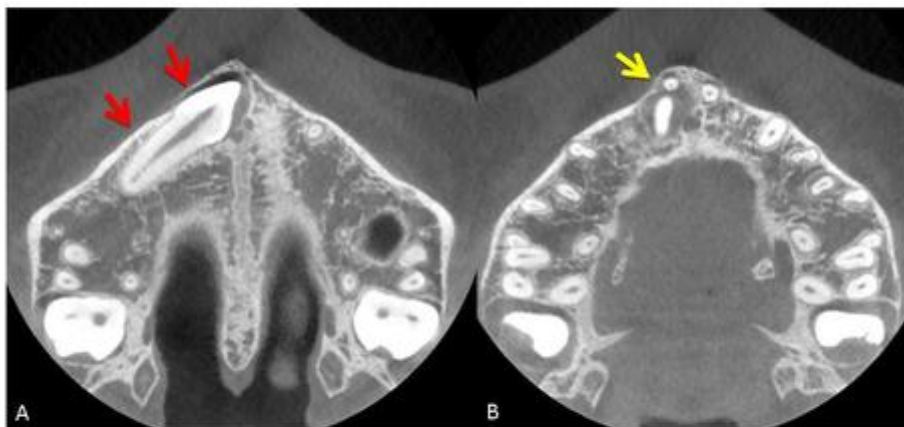
dia48.jpg

## 2. Teeth impaction and noneruption

- May cause:
  - Mass effect on adjacent structures
  - Apical erosion of adjacent teeth
  - Vascular compromise of adjacent teeth
- Important to report relationship with the mandibular canal in order to avoid neural damage during extraction (e.g. wisdom teeth)!

dia49.jpg

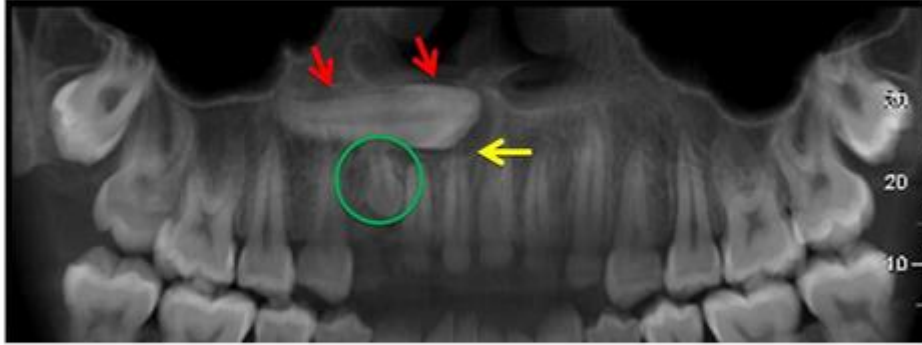
## 2. Teeth impaction and noneruption



15-year-old female. Axial images showing noneruption and mesiodistal angulation of 13 (arrow) (A), causing erosion of the apex of 11 (B) (arrow).

dia50.jpg

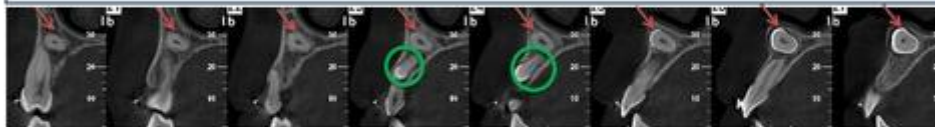
## 2. Teeth impaction and noneruption



15-year-old female. Panoramic reformat showing noneruption and mesiodistal angulation of 13 (arrow) (A), causing erosion of the apex of 11 (B) (arrow). Note a residual milk-tooth 53 (green circle).

dia51.jpg

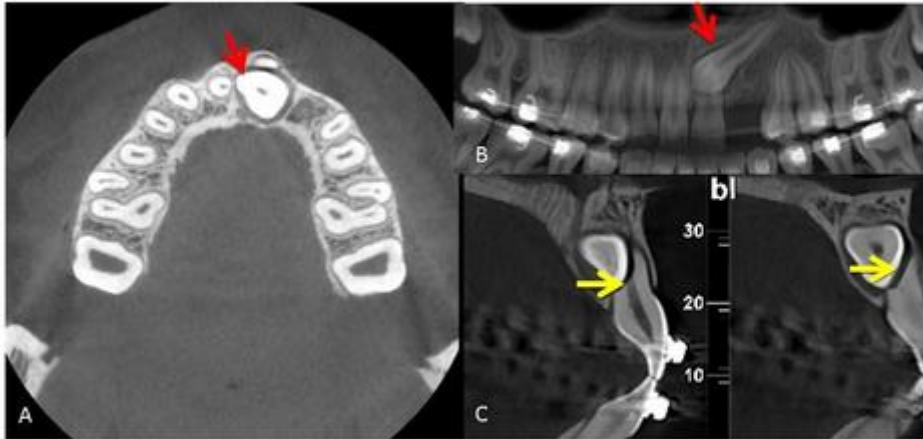
## 2. Teeth impaction and noneruption



15-year-old female with nonerupted 13 (arrow). Subtle erosion of the apex of 11 is best seen on parasagittal reformatted images (yellow arrow on enlarged view). Residual milk-tooth 53 (green circle).

dia52.jpg

## 2. Teeth impaction and noneruption



16-year-old female. Axial image (A) and panoramic reformatted image (B) showing noneruption and mesiodistal angulation of 23 (arrows) (A). Erosion of the apex of 11 is best seen on the parasagittal reformatted images (C) (arrow).

dia53.jpg

## 2. Teeth impaction and noneruption

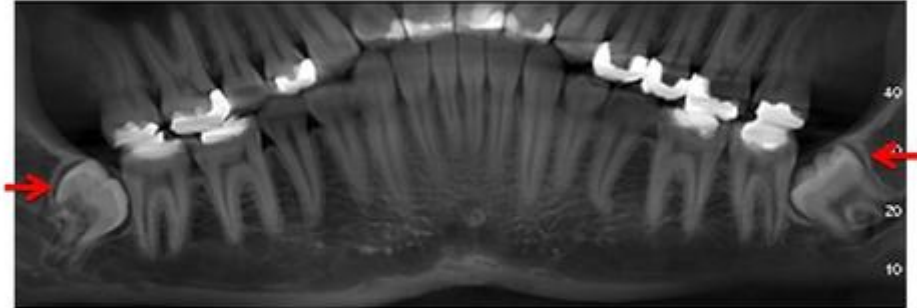


20-year-old male with non erupted wisdom teeth (arrows) within the mandible. Axial images (A, B) showing intimate relationship of the roots of the right third molar with the mandibular nerve (arrow in B).



dia54.jpg

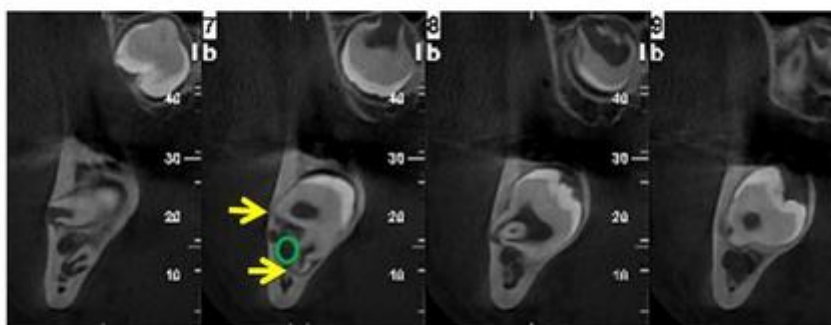
## 2. Teeth impaction and noneruption



20-year-old male with nonerupted wisdom teeth (**arrows**) within the mandible. Correct analysis of relationship of the non erupted teeth should be done by comparison of axial and parasagittal images and not solely on panoramic images (partial volume effect may cause errors in evaluation on the latter images).

dia55.jpg

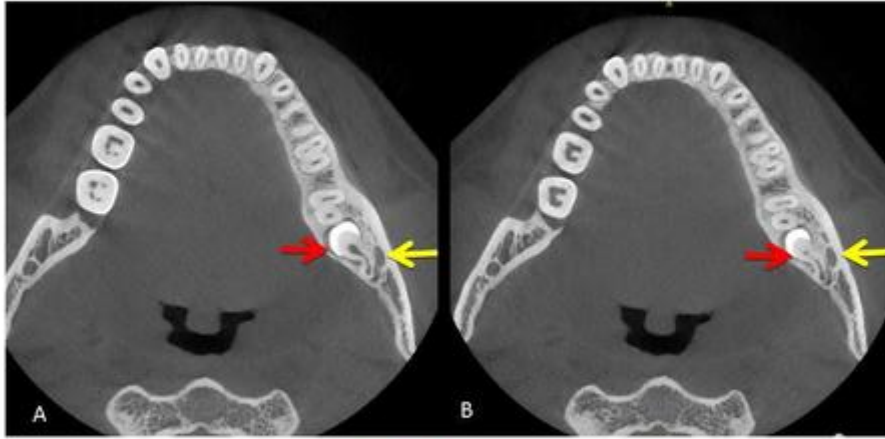
## 2. Teeth impaction and noneruption



20-year-old male with non erupted wisdom teeth (**arrows**) within the mandible. Parasagittal reformatted images. The mandibular nerve (**green circle**) runs between the roots of the third molar (**arrow**), which may complicate extraction.

dia56.jpg

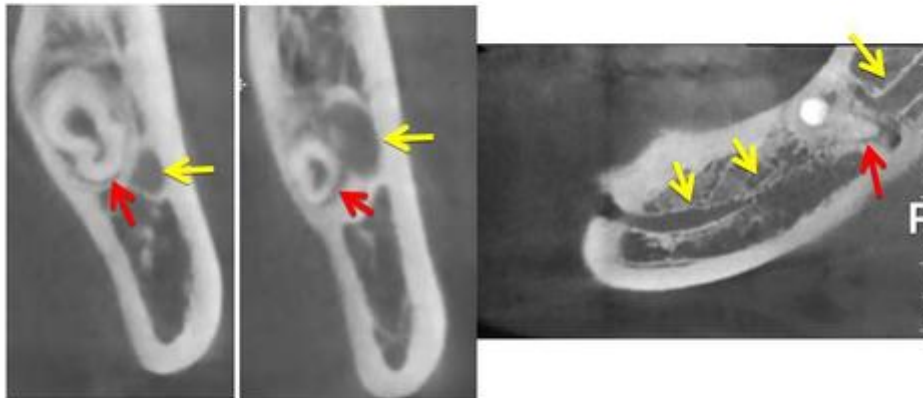
## 2. Teeth impaction and noneruption



24-year-old male with nonerupted 38 (arrows). Axial images (A, B) showing intimate relationship of the roots of the right third molar with the mandibular nerve (arrow) in B.

dia57.jpg

## 2. Teeth impaction and noneruption



24-year-old male with non erupted 38 (arrows). Parasagittal reformatted images (A, B) showing intimate relationship of the roots of the right third molar with the mandibular nerve. This is even better illustrated on oblique reformatted images (arrow in C).

dia58.jpg

## D. Clinical indications

1. Dental implants
  - A. Preoperative evaluation
  - B. Postoperative evaluation
2. Teeth impaction and noneruption
3. Structural Teeth Anomalies
  - A. Number
  - B. Location
  - C. Morphology
4. (Peri-apical) infection/inflammation
5. Tumor- and tumorlike conditions
6. (Dental) trauma

dia59.jpg

## B. Anomalies in number

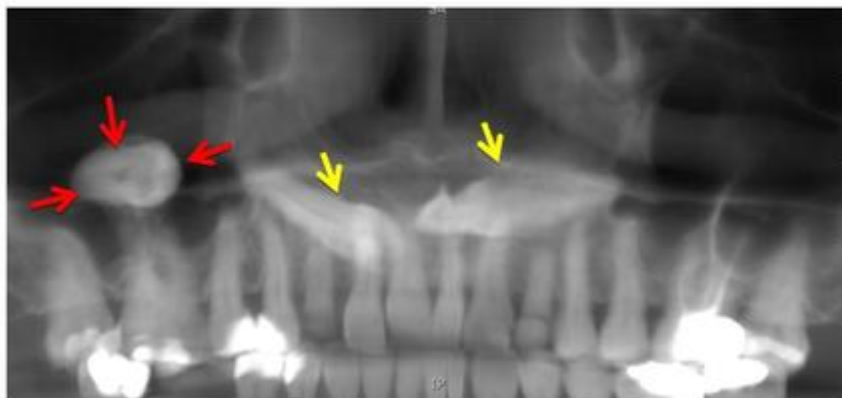


Panoramic image showing 17 teeth in the upper arch, due to a residual milk tooth (arrow).



dia60.jpg

## B. Anomalies in location



Panoramic image shows a premolar within the right maxillary sinus, a.k.a. "dens in ante" (arrows). Note also non erupted canines (arrows).

dia61.jpg

## C. Anomalies in morphology



Dilaceration. Panoramic image shows an abnormal curve of the tooth root of 11 (arrows). Root dilaceration may be clinically silent or may complicate extraction or endodontic or orthodontic treatment.

dia62.jpg

## D. Clinical indications

1. Dental implants
  - A. Preoperative evaluation
  - B. Postoperative evaluation
2. Teeth impaction and noneruption
3. Structural Teeth Anomalies
  - A. Number
  - B. Location
  - C. Morphology
4. (Peri-apical) infection/inflammation
5. Tumor- and tumorlike conditions
  - A. Radiolucent lesions
  - B. Radiopaque lesions
  - C. Mixed density lesions
6. (Dental) trauma

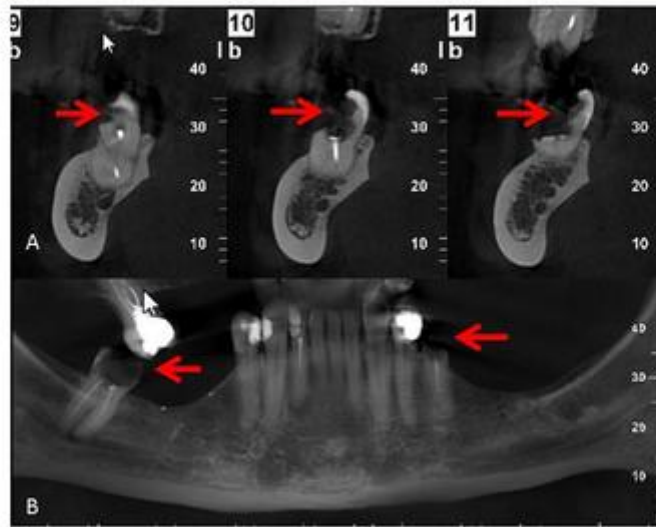
dia63.jpg

## 4. (Peri-apical) infection/inflammation

- A. Caries
- B. Peri-apical granuloma
- C. Osteomyelitis
- D. Sinusitis

dia64.jpg

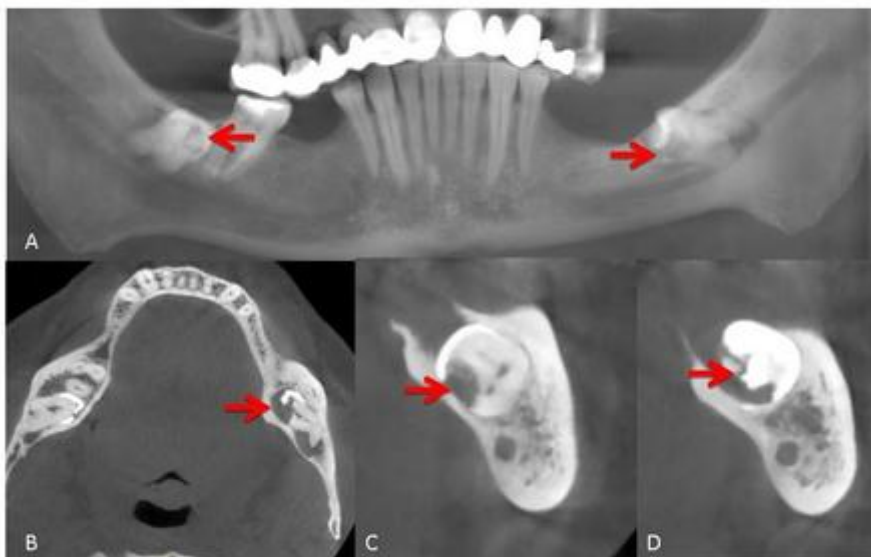
### A. Caries



54-year-old patient with marked caries (arrows). Parasagittal reformatted images (A). Panoramic image (B).

dia65.jpg

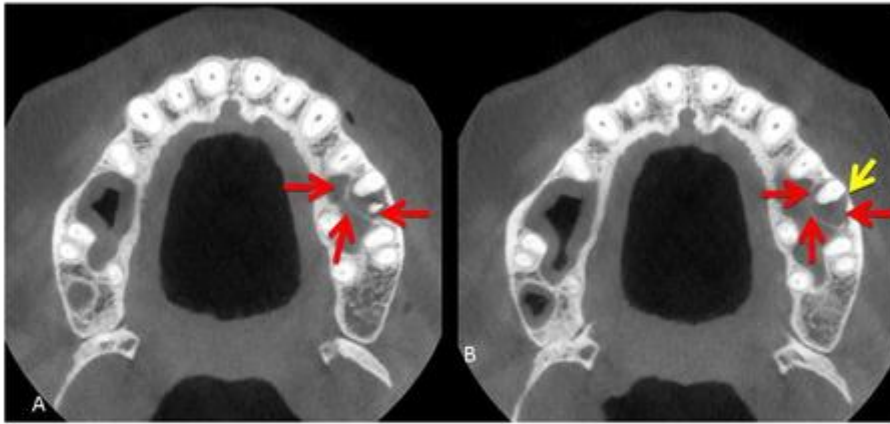
### A. Caries



Panoramic reformatted image (A), axial image (B) and parasagittal reformatted images (C, D). 55-year-old patient with marked caries in 2 nonerupted wisdom teeth (arrows).

dia66.jpg

### B. Peri-apical granuloma



26-year-old patient with previous partial root filling 26. Adjacent axial images (A, B) of the upper jaw reveal a sclerotic delineated radiolucency around the tip of the apex of 26 (arrows), in keeping with a peri-apical granuloma. Note focal thinning of the buccal cortical bone of the maxilla (yellow arrow)

dia67.jpg

### B. Peri-apical granuloma



26-year-old patient with previous partial root filling 26. Detailed panoramic reformat (A) and parasagittal reformat (B) of the upper jaw reveal a sclerotic delineated radiolucency around the tip of the apex of 26 (arrows), in keeping with a peri-apical granuloma. Note focal thinning of the mesiobuccal cortical bone of the maxilla (yellow arrow)

dia68.jpg

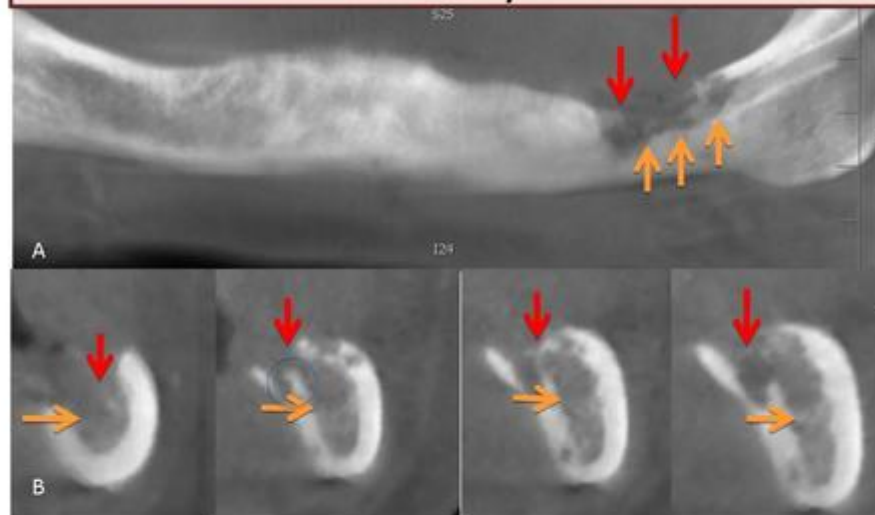
## B. Peri-apical granuloma



28-year-old patient with history of pain and abscess in the left upper jaws. Panoramic reformatted image of the upper jaw reveals a sclerotic delineated radiolucency around the tip of the mesiobuccal root of 26 (arrows), in keeping with a peri-apical granuloma. There is elevation of the floor of the left maxillary sinus (yellow arrow) and formation of a retention cyst in the left maxillary sinus (asterisk). Extension of the lesion within the maxillary sinus predisposes to oro-antral fistula formation after tooth extraction.

dia69.jpg

## C. Osteomyelitis



64-year-old diabetic patient with pain, swelling, red skin and paresthesia in the left mandible. Panoramic reformatted image (A) and parasagittal reformatted images (B) reveal a poor circumscribed radiolucency in the left mandible communicating with the oral cavity (arrows), and causing loss of the cortical lining of the left mandibular canal and exposure of the inferior alveolar canal (arrows). Note a sequestrum (circle).



dia70.jpg

## D. Sinusitis



51-year-old male presenting with shooting tooth pain, tenderness on percussion of the left premolar and paresthesia in the left cheek. Clinical examination revealed no dental anomalies. Panoramic reformatted image (A) confirm absence of dental abnormalities, but shows complete opacification of the left maxillary sinus (arrows). On T2-WI (B) the left maxillary sinus was filled with hyperintense mucus (arrows).

Sinusitis is a common mimicker of dental pathology and should always be reported on CBCT examinations

dia71.jpg

## D. Clinical indications

1. Dental implants
  - A. Preoperative evaluation
  - B. Postoperative evaluation
2. Teeth impaction
3. Structural Teeth Anomalies
  - A. Number
  - B. Location
  - C. Morphology
4. (Peri-apical) infection/inflammation
5. Tumor- and tumorlike conditions
  - A. Radiolucent lesions
  - B. Radiopaque lesions
  - C. Mixed density lesions
6. (Dental) trauma

dia72.jpg

## 5. Tumor- and tumorlike conditions

- Tumor-and tumorlike lesions of the jaws represent a heterogeneous group of lesions, which are classified histologically in the **WHO classification of Head and Neck tumors (2005)**.
- The main role of imaging is to describe the precise **location and extent** of these lesions.
- Although **characterization** on imaging is often difficult and impossible due to overlapping imaging characteristics, imaging is helpful for grading of lesions and to define which lesions should be referred for imaging.
- Location and density are the **cardinal criteria** for potential characterization on imaging. Radiologically, lesions may be either radiolucent, radiopaque or of mixed density.
- **Additional criteria** include lesion demarcation, morphology, cortical breakthrough, periosteal reaction and adjacent soft tissue changes.

dia73.jpg

## 5. Tumor- and tumorlike conditions

- A. Radiolucent lesions
- B. Radiopaque lesions
- C. Mixed density lesions

### Cardinal criteria:

Density

Location with regard to adjacent tooth structures and within the jaw

### Additional criteria:

Demarcation

Morphologic characteristics

Cortical involvement

Periosteal changes

Soft tissue changes

dia74.jpg

A. Radiolucent lesions			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
Radicular cyst	Dentigerous cyst	Nasopalatine duct cyst	Keratocystic odontogenic tumor
Lateral periodontal cyst	Odontogenic keratocyst	Static bone cyst	Ameloblastoma
Acute osteomyelitis	Ameloblastoma	Globulomaxillary cyst	Giant cell lesion of hyperparathyroidism
Periapical cemental dysplasia	Calcifying odontogenic cyst*		Residual cyst
Cementoblastoma	Calcifying epithelial odontogenic tumor*		Osteomyelitis
Cemento-ossifying fibroma*			Direct neoplastic extension
			Odontogenic myxoma*
			Aneurysmal bone cavity*
			Calcifying epithelial odontogenic tumor*
			Idiopathic bone cavity*
			Primary lymphoma*
			Calcifying odontogenic cyst*

common, uncommon\*

dia75.jpg

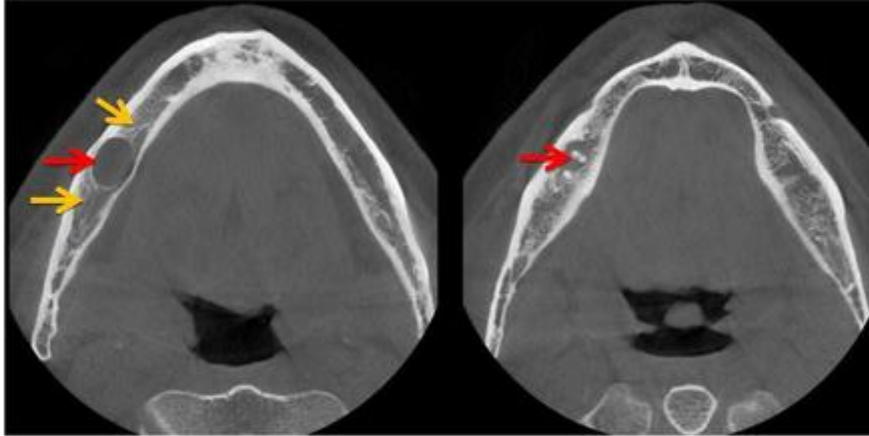
A. Radiolucent lesions: examples			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
<u>Radicular cyst</u>	Dentigerous cyst	Nasopalatine duct cyst	Keratocystic odontogenic tumor
Lateral periodontal cyst	Keratocystic odont. tumor	Static bone cyst	Ameloblastoma
Acute osteomyelitis	Ameloblastoma	Globulomaxillary cyst	Giant cell lesion of hyperparathyroidism
Periapical cemental dysplasia	Calcifying odontogenesis cyst*		Residual cyst
Cementoblastoma	Calcifying epithelial odontogenic tumor*		Osteomyelitis
Cemento-ossifying fibroma*			Direct neoplastic extension
			Odontogenic myxoma*
			Aneurysmal bone cavity*
			Calcifying epithelial odontogenic tumor*
			Idiopathic bone cavity*
			Primary lymphoma*
			Calcifying odontogenic cyst*

common, uncommon\*



dia76.jpg

### Radicular cyst



42-year-old patient. Axial images showing a well-delineated radiolucent lesion around the roots of tooth 16, in keeping with a radicular cyst (arrows). Note intimate relationship with the right mandibular canal (arrows). Radicular cysts are the most frequent odontogenic lesions resulting from proliferation, expansion and cystification of a dental granuloma. They may cause root resorption and are often larger than 1 cm.

dia77.jpg

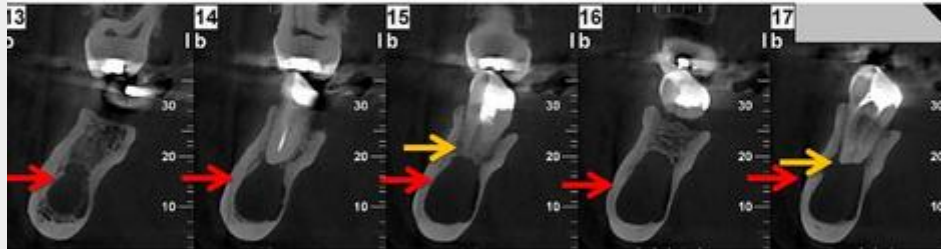
### Radicular cyst



42-year-old patient. Panoramic image showing a well-delineated radiolucent lesion around the roots of tooth 46, in keeping with a radicular cyst (arrows). Note intimate relationship with the right mandibular canal (arrows). Radicular cysts are the most frequent odontogenic lesions resulting from proliferation, expansion and cystification of a dental granuloma. They may cause root resorption and are often larger than 1 cm.

dia78.jpg

## Radicular cyst



42-year-old patient. Parasagittal reformatted images showing a well-delineated radiolucent lesion around the roots of tooth 46, in keeping with a radicular cyst (arrows). Note apical root resorption (arrows). Radicular cyst are most often unilocular like in this case.

dia79.jpg

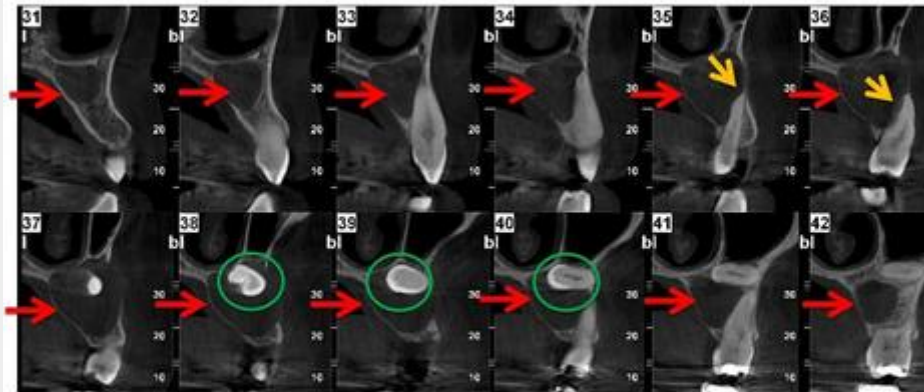
## A. Radiolucent lesions

A. Radiolucent lesions			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
Radicular cyst	Dentigerous cyst	Nasopalatine duct cyst	Keratocystic odontog. tumor
Lateral periodontal cyst	Keratocystic odontog. tumor	Static bone cyst	Ameloblastoma
Acute osteomyelitis	Ameloblastoma	Globulomaxillary cyst	Giant cell lesion of hyperparathyroidism
Periapical cemental dysplasia	Calcifying odontogenic cyst*		Residual cyst
Cementoblastoma	Calcifying epithelial odontogenic tumor*		Osteomyelitis
Cemento-ossifying fibroma*			Direct neoplastic extension
			Odontogenic myxoma*
			Aneurysmal bone cavity*
			Calcifying epithelial odontogenic tumor*
			Idiopathic bone cavity*
			Primary lymphoma*
			Calcifying odontogenic cyst*

common, uncommon\*

dia80.jpg

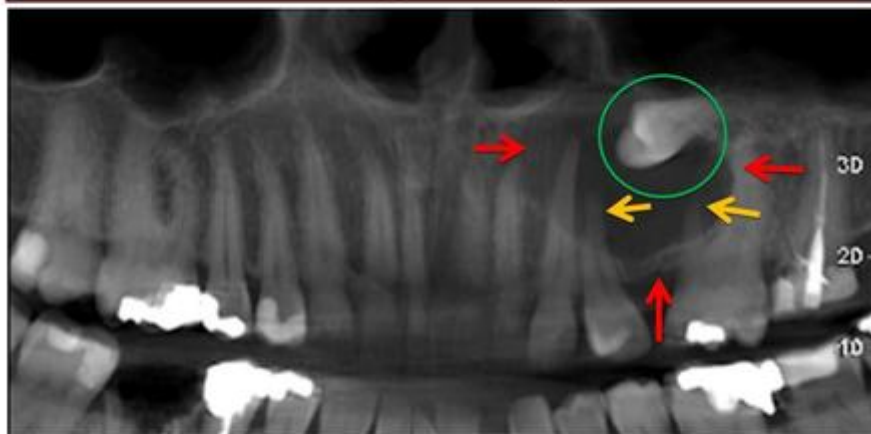
### Dentigerous cyst



39-year-old patient. Parasagittal reformatted images showing a well-delineated radiolucent lesion (arrows) around the crown (green circle) of tooth 46, in keeping with a dentigerous or follicular cyst. Dentigerous cysts arise from fluid accumulation between the follicular epithelium and the crown of the developing or unerupted tooth. They are the second most frequent odontogenic cysts. Pericoronal location and association with unerupted teeth are the key diagnostic features. Erosion of adjacent teeth may occur like in this case (arrow). There is often extension in the sinus or nasal cavity.

dia81.jpg

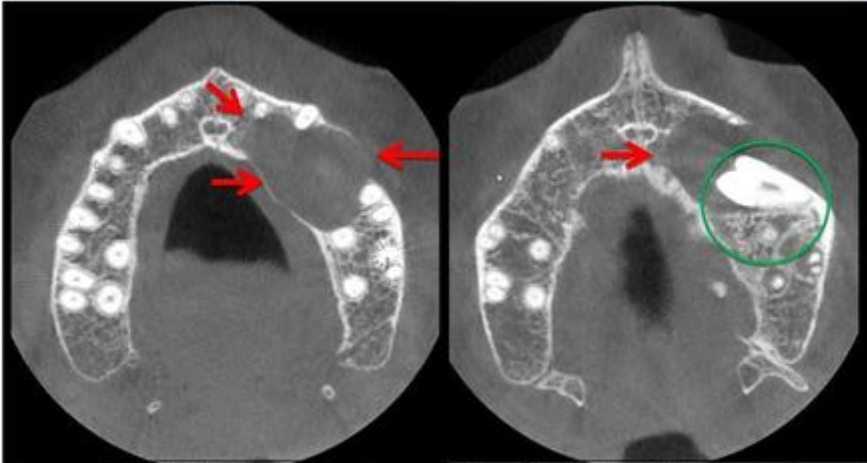
### Dentigerous cyst



39-year-old patient. Parasagittal reformatted images showing a well-delineated radiolucent lesion (arrows) around the crown (green circle) of tooth 46, in keeping with a dentigerous or follicular cyst. Dentigerous cysts arise from fluid accumulation between the follicular epithelium and the crown of the developing or unerupted tooth. They are the second most frequent odontogenic cysts. Pericoronal location and association with unerupted teeth are the key diagnostic features. Erosion of adjacent teeth may occur like in this case (arrow). There is often extension in the sinus or nasal cavity.

dia82.jpg

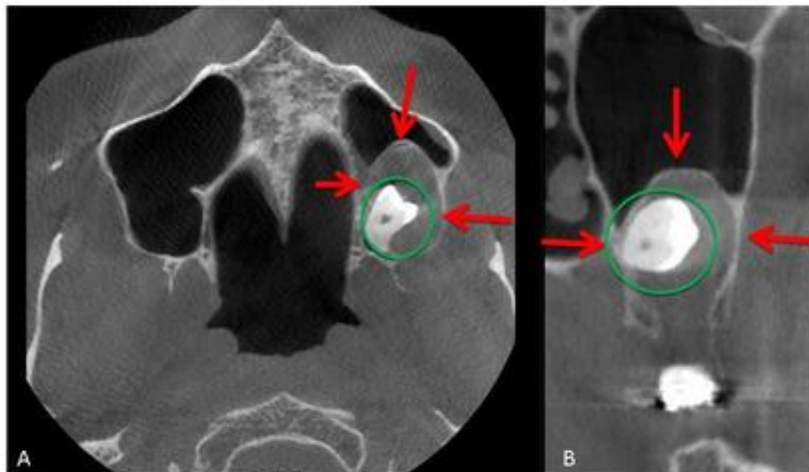
### Dentigerous cyst



39-year-old patient. Axial images showing a well-delineated radiolucent lesion (**arrows**) around the **crown (green circle)** of tooth 46, in keeping with a dentigerous or follicular cyst. Dentigerous cysts arise from fluid accumulation between the follicular epithelium and the crown of the developing or unerupted tooth. They are the second most frequent odontogenic cysts. Pericoronal location and association with unerupted teeth are the key diagnostic features.

dia83.jpg

### Dentigerous cyst

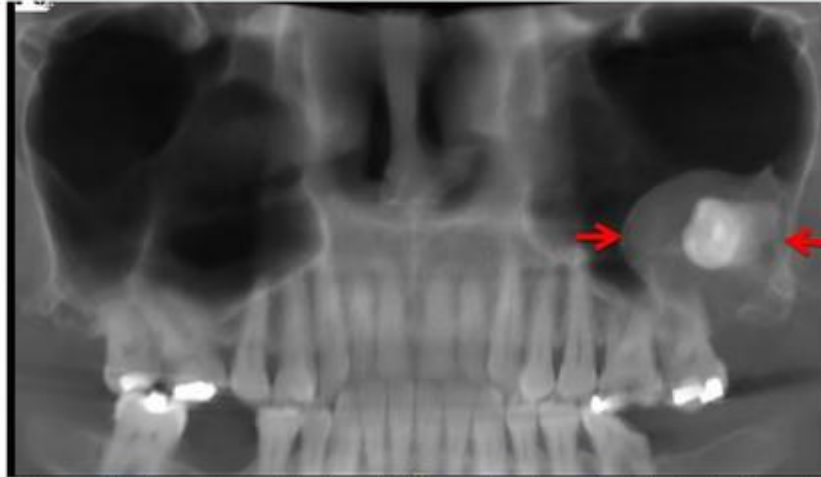


54-year-old patient. Axial image (A) and parasagittal reformatted image (B) showing a well-delineated radiolucent lesion around the **crown of 28 (green circle)**. The lesion extends within the left maxillary sinus (**arrows**).



dia84.jpg

## Dentigerous cyst



54-year-old patient. Panoramic reformatted image showing a well-delineated radiolucent lesion around the  **crown**  of 28. The lesion extends within the left maxillary sinus (**arrows**).

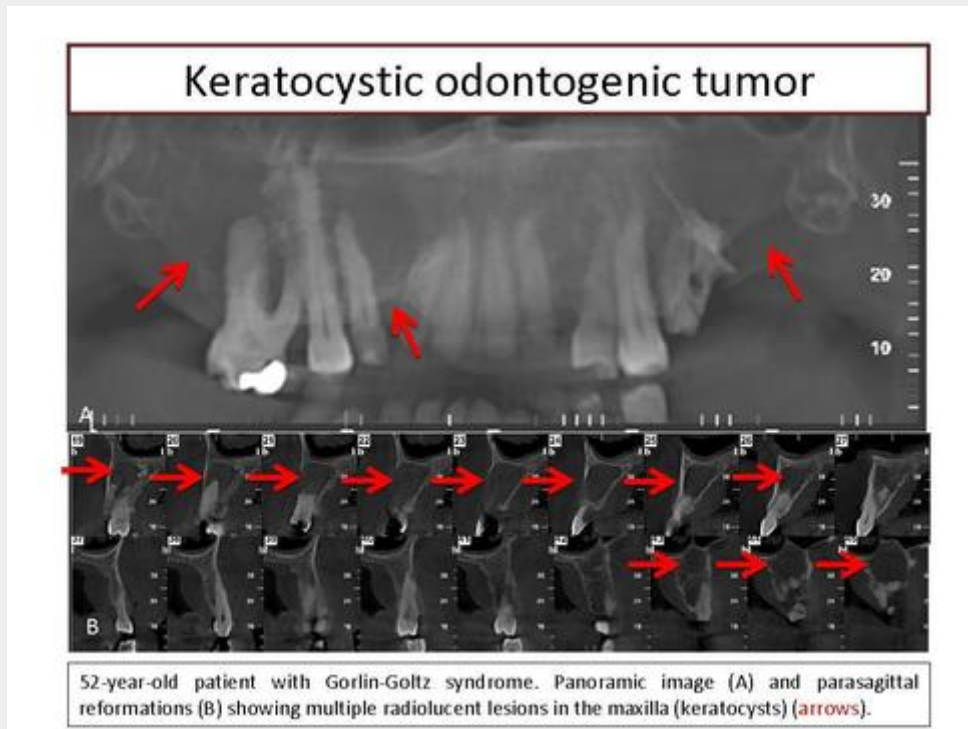
dia85.jpg

## A. Radiolucent lesions

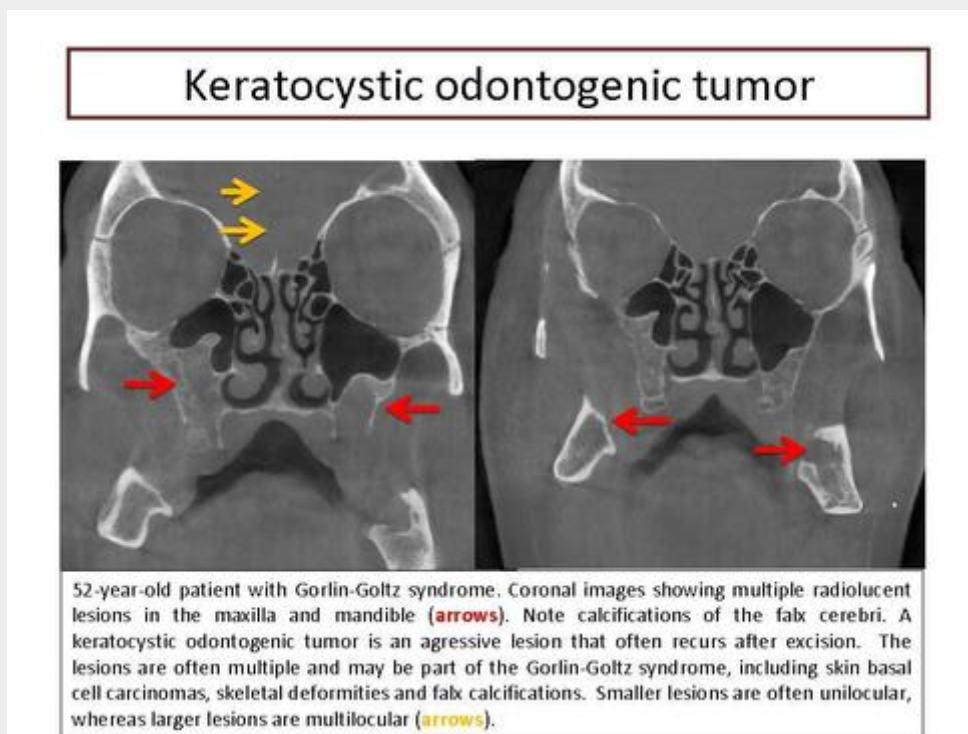
A. Radiolucent lesions			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
Radicular cyst	Dentigerous cyst	Nasopalatine duct cyst	Keratocystic odontogenic T
Lateral periodontal cyst	Keratocystic odont. tumor	Static bone cyst	Ameloblastoma
Acute osteomyelitis	Ameloblastoma	Globulomaxillary cyst	Giant cell lesion of hyperparathyroidism
Periapical cemental dysplasia	Calcifying odontogenic cyst*		Residual cyst
Cementoblastoma	Calcifying epithelial odontogenic tumor*		Osteomyelitis
Cemento-ossifying fibroma*			Direct neoplastic extension
			Odontogenic myxoma*
			Aneurysmal bone cavity*
			Calcifying epithelial odontogenic tumor*
			Idiopathic bone cavity*
			Primary lymphoma*
			Calcifying odontogenic cyst*

common, uncommon\*

dia86.jpg



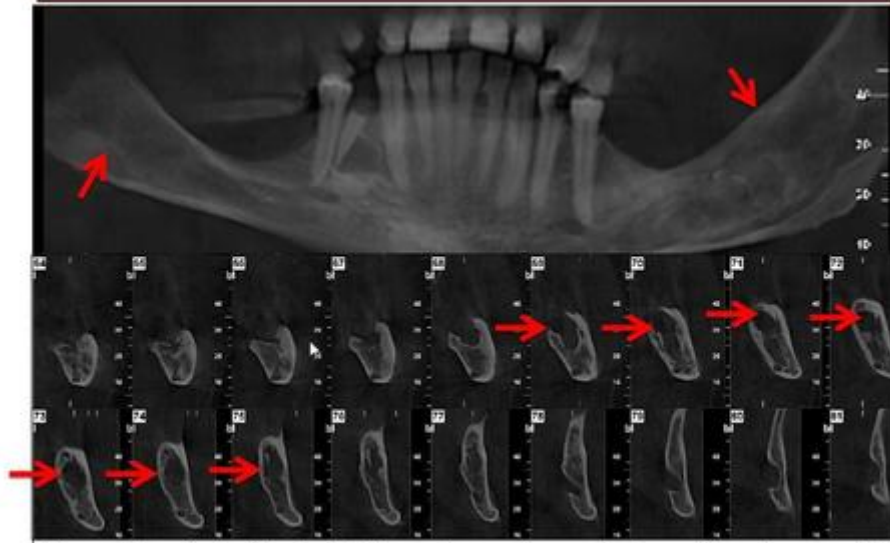
dia87.jpg





dia88.jpg

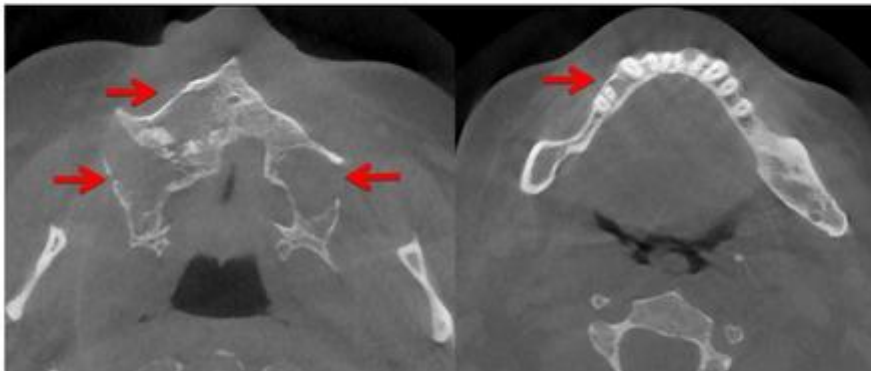
### Keratocystic odontogenic tumor



52-year-old patient with Gorlin-Goltz syndrome. Panoramic image (A) and parasagittal reformations (B) showing multiple radiolucent lesions in the mandible (keratocysts) (arrows).

dia89.jpg

### Keratocystic odontogenic tumor



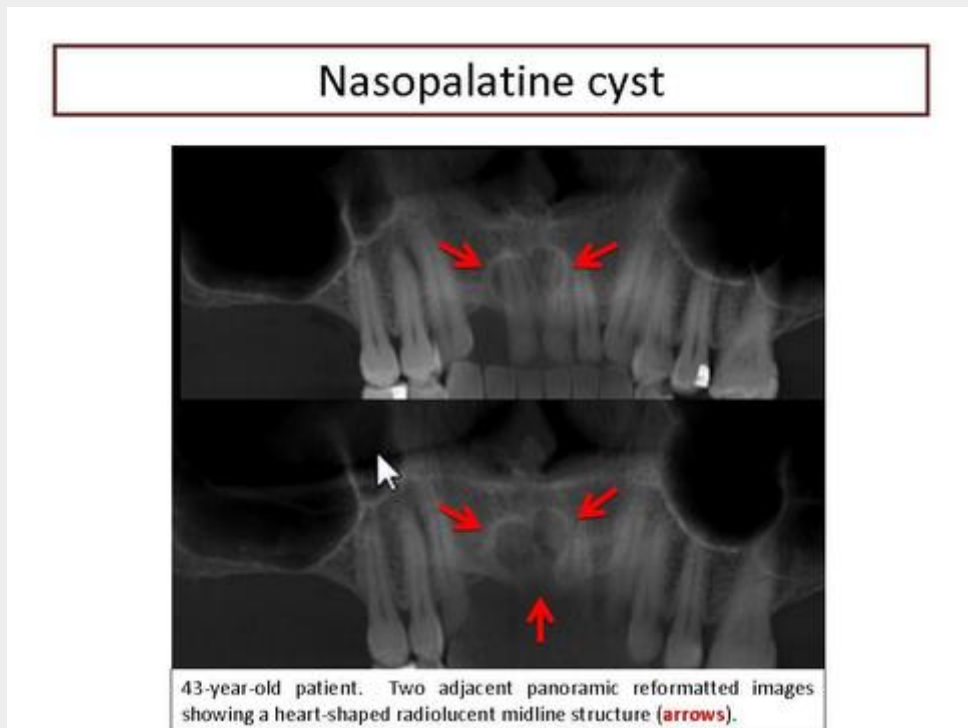
52-year-old patient with Gorlin-Goltz syndrome. Axial images showing multiple radiolucent lesions in the maxilla and mandible (arrows). Note cortical breakthrough of the maxillary lesions indicating aggressive biological nature of these lesions.

dia90.jpg

A. Radiolucent lesions			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
Radicular cyst	Dentigerous cyst	Nasopalatine duct cyst	Keratocystic odontogenic T
Lateral periodontal cyst	Keratocystic odont. tumor	Static bone cyst	Ameloblastoma
Acute osteomyelitis	Ameloblastoma	Globulomaxillary cyst	Giant cell lesion of hyperparathyroidism
Periapical cemental dysplasia	Calcifying odontogenic cyst*		Residual cyst
Cementoblastoma	Calcifying epithelial odontogenic tumor*		Osteomyelitis
Cemento-ossifying fibroma*			Direct neoplastic extension
			Odontogenic myxoma*
			Aneurysmal bone cavity*
			Calcifying epithelial odontogenic tumor*
			Idiopathic bone cavity*
			Primary lymphoma*
			Calcifying odontogenic cyst*

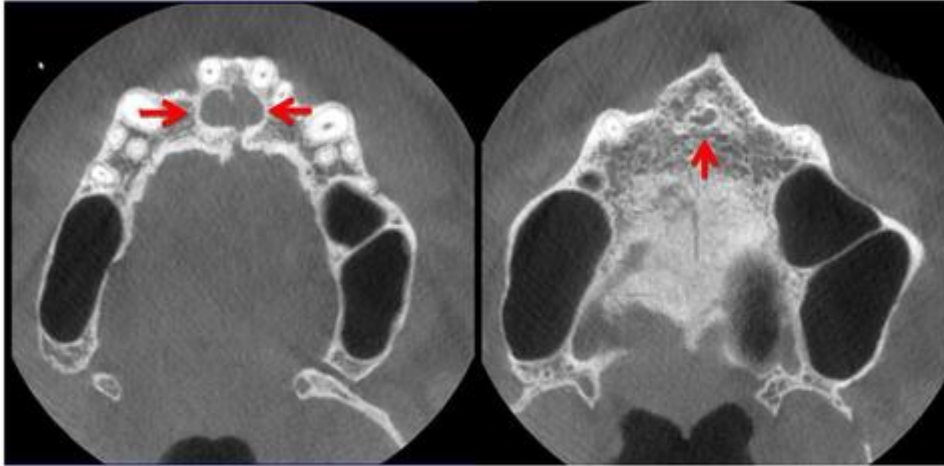
common, uncommon\*

dia91.jpg



dia92.jpg

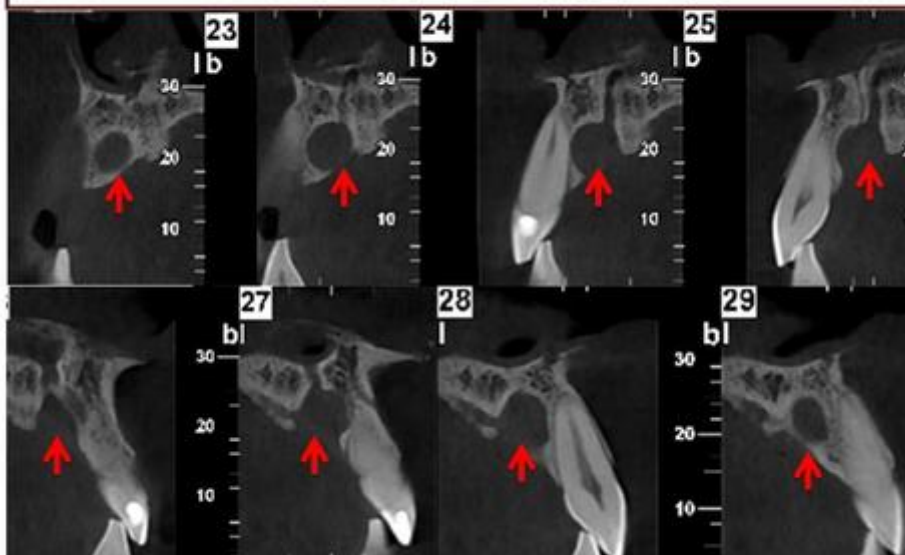
### Nasopalatine cyst



43-year-old patient. Two adjacent axial images. The lesion is typically located on the course of the nasopalatine duct posteriorly to the central incisors (arrows) and is well demarcated.

dia93.jpg




### Nasopalatine cyst



43-year-old patient. Parasagittal reformatted images showing adjacent sections through a well-delineated radiolucent lesion on the course of the nasopalatine duct (arrows).

dia94.jpg




## B. Radiopaque lesions

B. Radiopaque lesions			
Periapical 	Pericoronal 	Specific anatomic anomalies	Not necessarily contact with tooth 
Cementoblastoma	Odontoma	<u>Torus mandibularis</u>	Odontoma
Periapical cemental dysplasia		<u>Torus palatinus</u>	Bone island (osteoma)
Condensing osteitis			Fibrous dysplasia
Cemento-ossifying fibroma			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*

common, uncommon\*

dia95.jpg

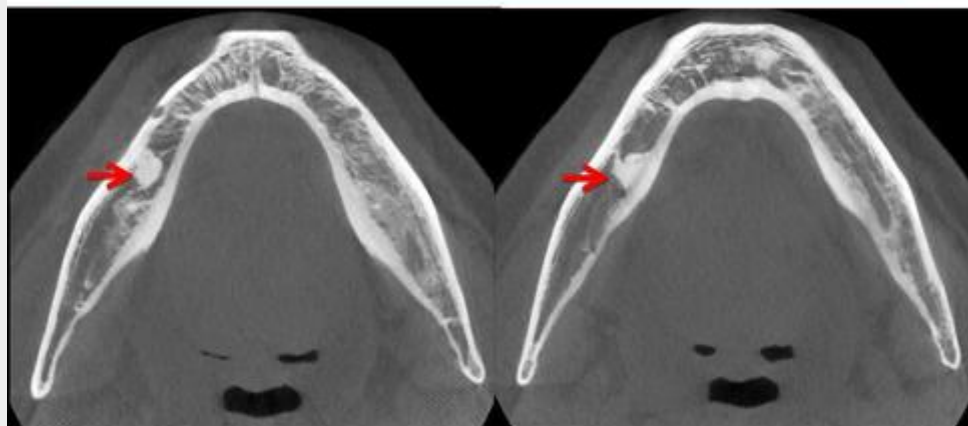
## B. Radiopaque lesions: examples

B. Radiopaque lesions			
Periapical 	Pericoronal 	Specific anatomic anomalies	Not necessarily contact with tooth 
Cementoblastoma	Odontoma	<u>Torus mandibularis</u>	Odontoma
Periapical cemental dysplasia		<u>Torus palatinus</u>	<b>Bone island (osteoma)</b>
Condensing osteitis			Fibrous dysplasia
Cemento-ossifying fibroma			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*

common, uncommon\*

dia96.jpg

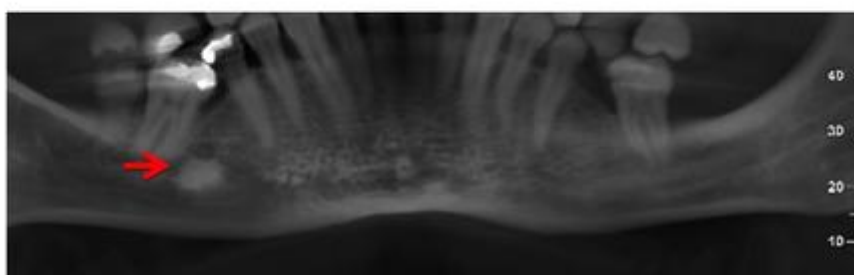
### Bone island



51-year-old patient. Axial images showing a dense bone island with spicular margins within the right mandible (**arrows**). The lesion has no specific relationship with a teeth. It should be differentiated from sclerosing (condensing) osteitis, which represents a chronic inflammation usually around the apex of a tooth. In the latter, there is often associated widening of the periodontal ligament around the tooth.

dia97.jpg

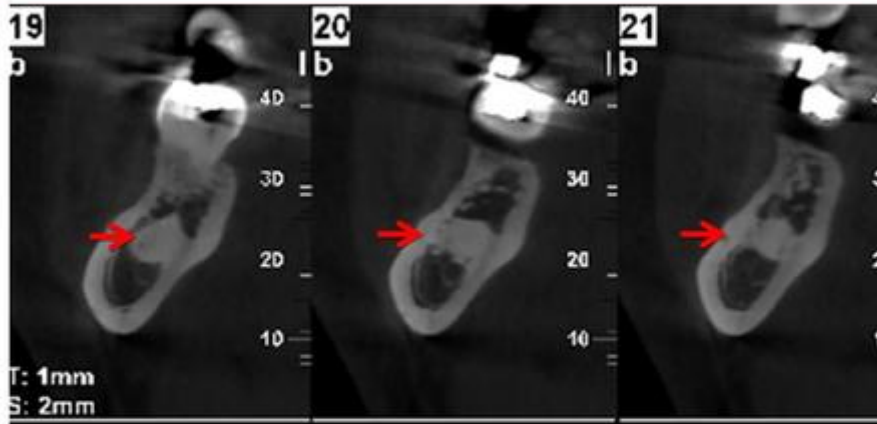
### Bone island



51-year-old patient. Panoramic reformatted image showing a dense bone island with spicular margins within the right mandible (**arrow**). The lesion has no relationship with the teeth.

dia98.jpg

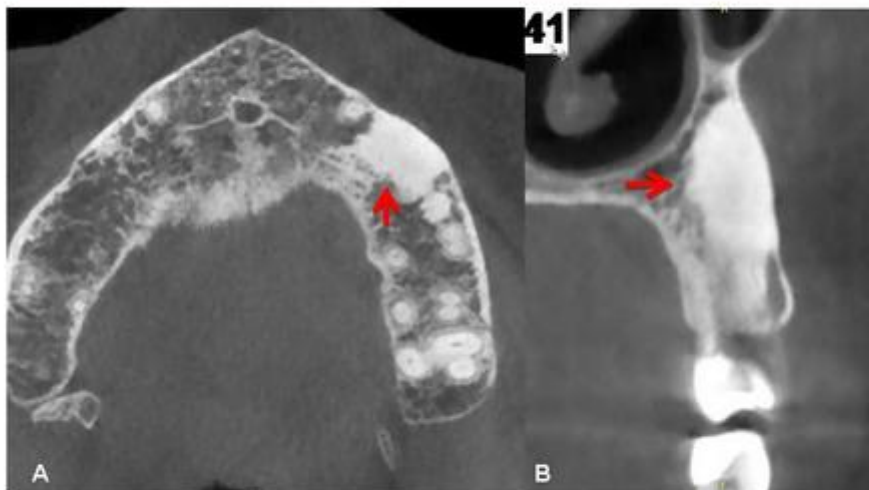
### Bone island



51-year-old patient. Parasagittal image showing a dense bone island with spiculated margins (arrow). Note absence of relationship with the adjacent tooth.

slide 99.jpg

### Bone island (osteoma)

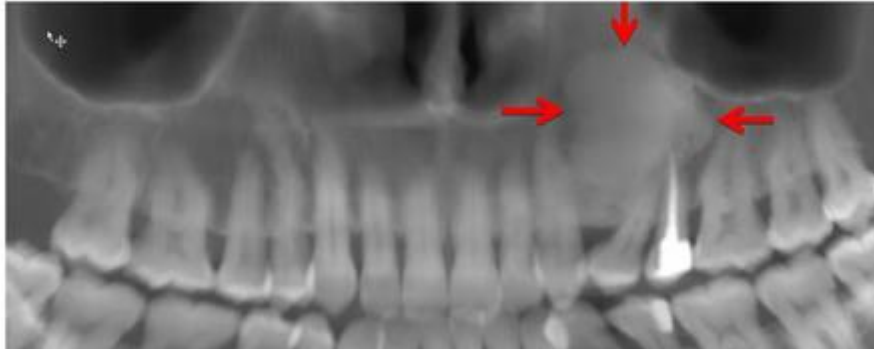


43-year-old patient. Axial (A) and parasagittal reformatted image (B) showing a radioopaque lesion (osteoma) within the left maxilla (arrows). There is subtle bulging of the vestibular cortical bone.



slide100.jpg




## Bone island (osteoma)



43-year-old patient. Panoramic image showing a radiopaque lesion (osteoma) within the left maxilla (arrows). Multiple osteomas are associated with Gardner syndrome (including desmoid and colorectal polyposis, lipomas, leiomyomas and cutaneous epidermoid cysts).

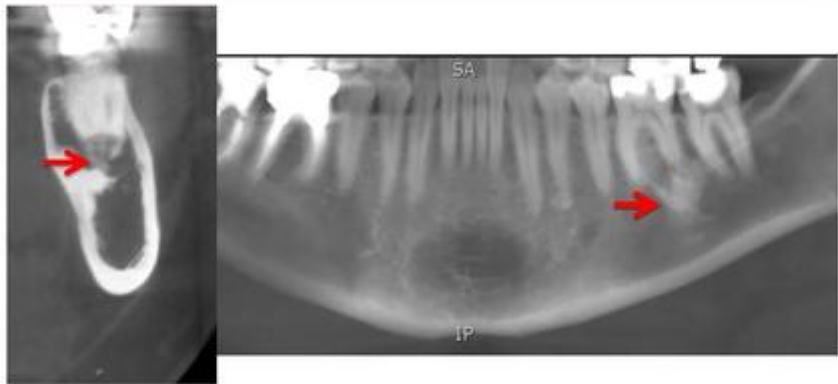
dia101.jpg

## B. Radiopaque lesions

B. Radiopaque lesions			
Periapical 	Pericoronal 	Specific anatomic anomalies	Not necessarily contact with tooth 
Cementoblastoma	Odontoma	<u>Torus mandibularis</u>	Odontoma
Periapical cemental dysplasia		<u>Torus palatinus</u>	Bone island (osteoma)
Condensing osteitis			Fibrous dysplasia
Cemento-ossifying fibroma			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*
common, uncommon*			

dia102.jpg




### Sclerosing (condensing) osteitis



29-year-old patient. Parasagittal reformatted image and panoramic reformatted image showing a sclerotic focus with spicular margins within the right mandible (arrow). In contradistinction to a dense bone island, the lesion lies adjacent to the root of the adjacent tooth.

dia103.jpg

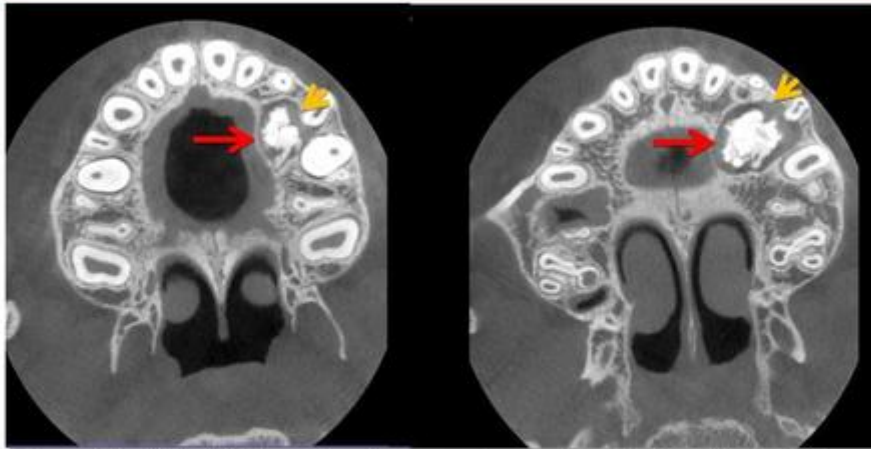
### B. Radiopaque lesions

B. Radiopaque lesions			
Periapical 	Pericoronal 	Specific anatomic anomalies	Not necessarily contact with tooth 
Cementoblastoma	<b>Odontoma</b>	Torus mandibularis	Odontoma
Periapical cemental dysplasia		Torus palatinus	Bone island (osteoma)
Condensing osteitis			Fibrous dysplasia
Cemento-ossifying fibroma			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*

common, uncommon\*

slide 104.jpg

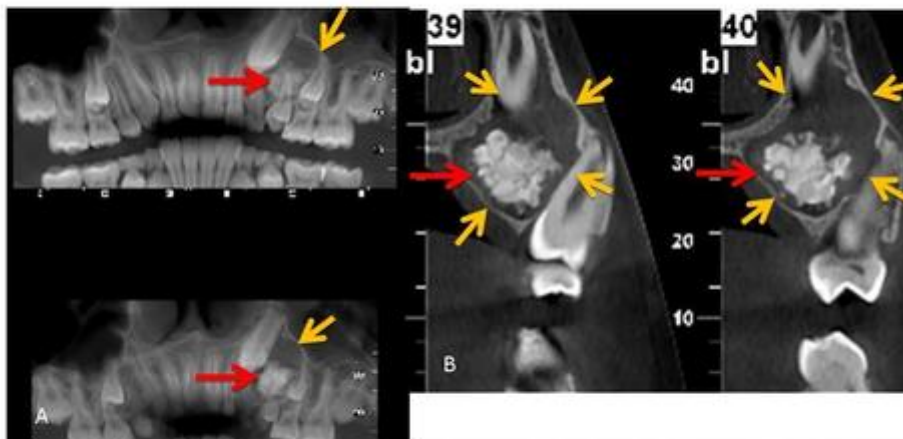
### Odontoma (complex type)



11-year-old patient. Axial images showing an amorphous radiopaque lesion within the left upper jaws (**arrows**). Odontomas are hamartomas of aborted tooth formation. There are 2 types. **Type 1** or compound odontoma consists of multiple small tooth-like structures. **Type 2** or complex odontoma consists of an amorphous calcified mass. Odontomas are usually surrounded by a lucent follicle formed by a fibrous capsule (**small arrows**). The lesion is usually seen in children and young adults.

dia105.jpg




### Odontoma (complex type)



11-year-old patient. Panoramic images (A) and parasagittal reformatted images (B) showing an amorphous radiopaque lesion within the left upper jaws around the crown of 24 (**arrows**), surrounded by a radiolucent follicle (**small arrows**).

dia106.jpg

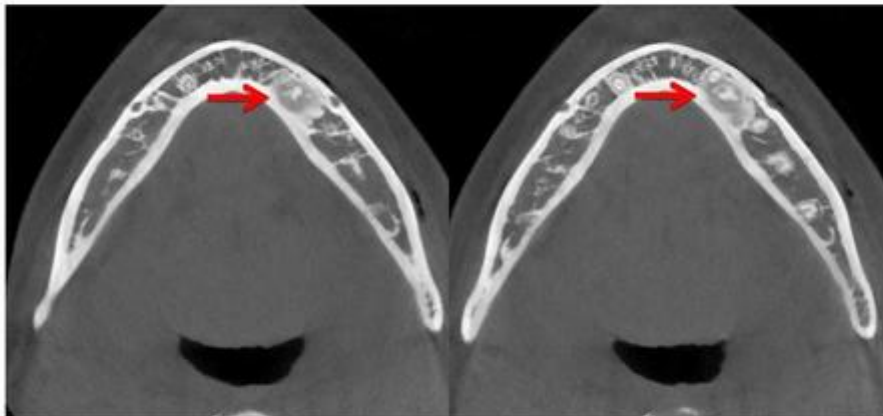
## B. Radiopaque lesions

B. Radiopaque lesions			
Periapical 	Pericoronal 	Specific anatomic anomalies	Not necessarily contact with tooth 
Cementoblastoma	Odontoma	<u>Torus mandibularis</u>	Odontoma
Periapical cemental dysplasia		<u>Torus palatinus</u>	Bone island (osteoma)
Condensing osteitis			Fibrous dysplasia
<b>Cemento-ossifying fibroma</b>			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*

common, uncommon\*

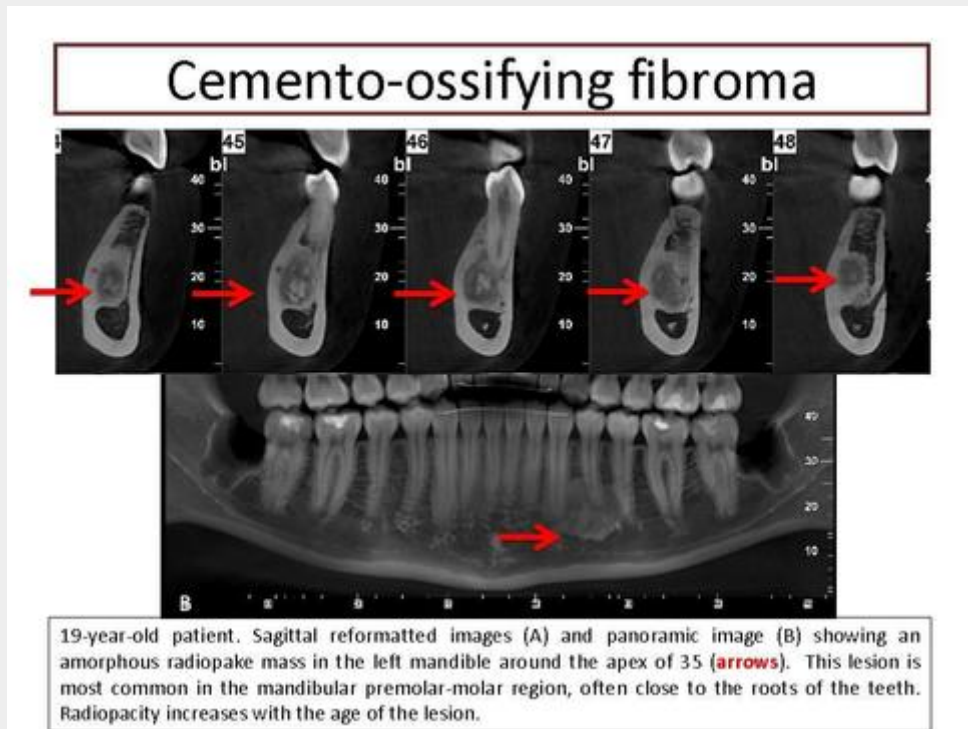
dia107.jpg

## Cemento-ossifying fibroma



19-year-old patient. Axial images showing an amorphous radiopaque mass in the left mandible around the apex of 35 (arrows).

dia108.jpg



dia109.jpg

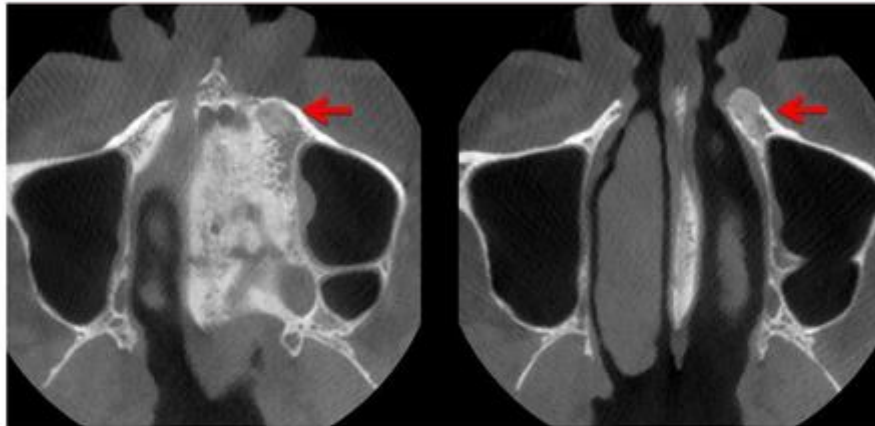
### B. Radiopaque lesions

B. Radiopaque lesions			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
Cementoblastoma	Odontoma	<u>Torus mandibularis</u>	Odontoma
Periapical cemental dysplasia		<u>Torus palatinus</u>	Bone island (osteoma)
Condensing osteitis			Fibrous dysplasia
Cemento-ossifying fibroma			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*
<small>common, uncommon*</small>			



dia110.jpg

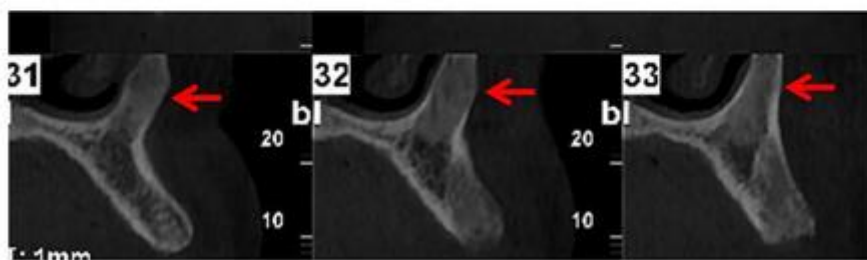
## Fibrous dysplasia



44-year-old patient. Adjacent axial images showing characteristic ground glass and slight bony expansion of the maxilla (**arrow**). There is no relationship with the teeth. Fibrous dysplasia can be monostotic or polyostotic and may involve other skeletal elements and is not restricted to the craniofacial bones. Craniofacial fibrous dysplasia of the maxilla is often monostotic.

dia111.jpg

## Fibrous dysplasia






44-year-old patient. Adjacent parasagittal reformatted images showing characteristic ground glass and slight bony expansion of the maxilla (**arrow**). There is no relationship with the teeth. Fibrous dysplasia can be monostotic or polyostotic and may involve other skeletal elements and is not restricted to the craniofacial bones. Craniofacial fibrous dysplasia of the maxilla is often monostotic. In jaws lesions, there is often lack of sharp margination and the lamina dura of the teeth is often effaced. Mandibular lesions may cause superior displacement of the mandibular canal, which is not seen in most other jaw lesions.



dia112.jpg

## C. Mixed density lesions

Mixed radiolucent- radiopaque lesions		
Periapical 	Pericoronaral 	Not necessarily contact with tooth 
Cemento-ossifying fibroma	Adenomatoid odontogenic tumor	Osteomyelitis
Periapical cemental dysplasia	Calcifying epithelial odontogenic tumor	Fibrous dysplasia
Cementoblastoma	Calcifying odontogenic cyst	Page's disease
		Calcifying epithelial odontogenic tumor
		Calcifying odontogenic cyst
		Osteoblastic metastasis*
		Osteosarcoma*
		Chondroma*
		Odontogenic myxoma*
		Florid cemental dysplasia*

uncommon\*

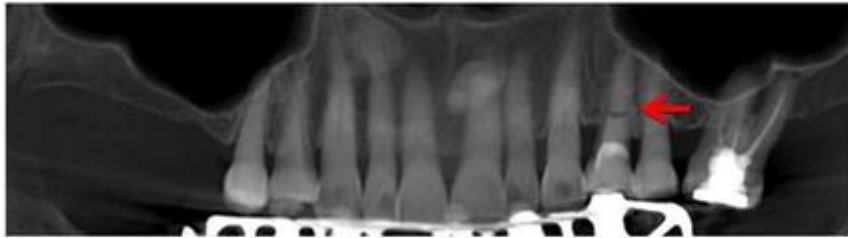
dia113.jpg

## D. Clinical indications

1. Dental implants
  - A. Preoperative evaluation
  - B. Postoperative evaluation
2. Teeth impaction
3. Structural Teeth Anomalies
  - A. Number
  - B. Location
  - C. Morphology
4. (Peri-apical) infection/inflammation
5. Tumor- and tumorlike conditions
  - A. Radiolucent lesions
  - B. Radiopaque lesions
  - C. Mixed density lesions
6. (Dental) trauma

dia114.jpg

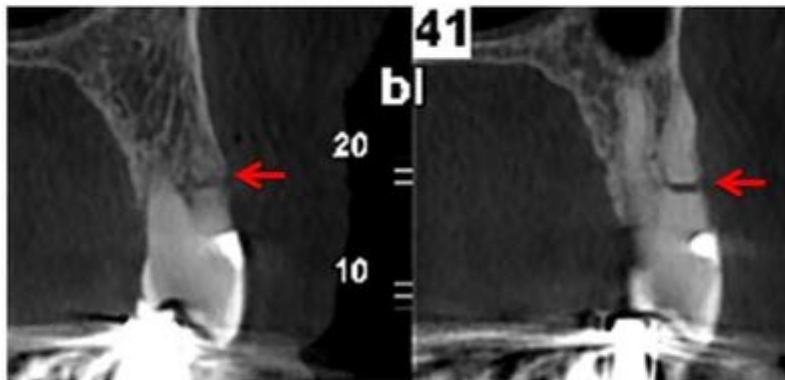
## 6. Dental trauma



73-year-old patient presenting after direct blow at the maxilla. Panoramic reformat showing a horizontal fracture at the buccal root of 25 (**arrow**).

dia115.jpg

## 6. Dental trauma



73-year-old patient presenting after direct blow at the maxilla. Parasagittal reformat showing a horizontal fracture at the buccal root of 25 (**arrows**).

## 4. Conclusion

For correct interpretation of dental CBCT, knowledge of dento-alveolar anatomy and pathology is a

prerequisite. The radiologic report should be systematic and complete.

## 5. References

### References

- Koenig LJ (2012). Diagnostic Imaging: Oral and Maxillofacial Imaging. Amirsys
  - Cawood J.I., Howell R.A. (1988). A classification of the edentulous jaws. Int J Oral Maxillofac Surg, 17:232-236.
  - Lekholm U., Zarb G.A. (1985): Patient selection and interpretation. In: Osseo-integration in clinical dentistry. Edited by Branemark P.I, et al. Printed by Quintessence, Chicago, pp199-209.
  - Bernaerts A, et al. (2006). Conventional dental radiology: what the general radiologist needs to know; JBR-BTR, 89(1):23-32
  - Bernaerts A, et al. (2006). The role of dental CT imaging in dental implantology. JBR-BTR, 89(1):32-42
  - Sedentex CT website: <http://www.sedentext.eu/>
  - Jacobs R (2014). Heb al eens goed gekeken naar de beelden?". Tandheelkundige Tijdingen 41 (4)
  - Barnes L, Eveson JW, Reichart P, Sidransky D. (2005) World Health Organization classification of tumours. Pathology and genetics of head and neck tumours (1st edn). Lyon: IARC Press.
- <http://www.dentaltraumaguide.org/>
- Casselmann JW, et al (2013). Cone Beam CT: Non-dental applications. JBR-BTR, 96 (6):333-353

## 6. Mediafiles

### Dental Cone Beam CT: a primer for clinical radiologists

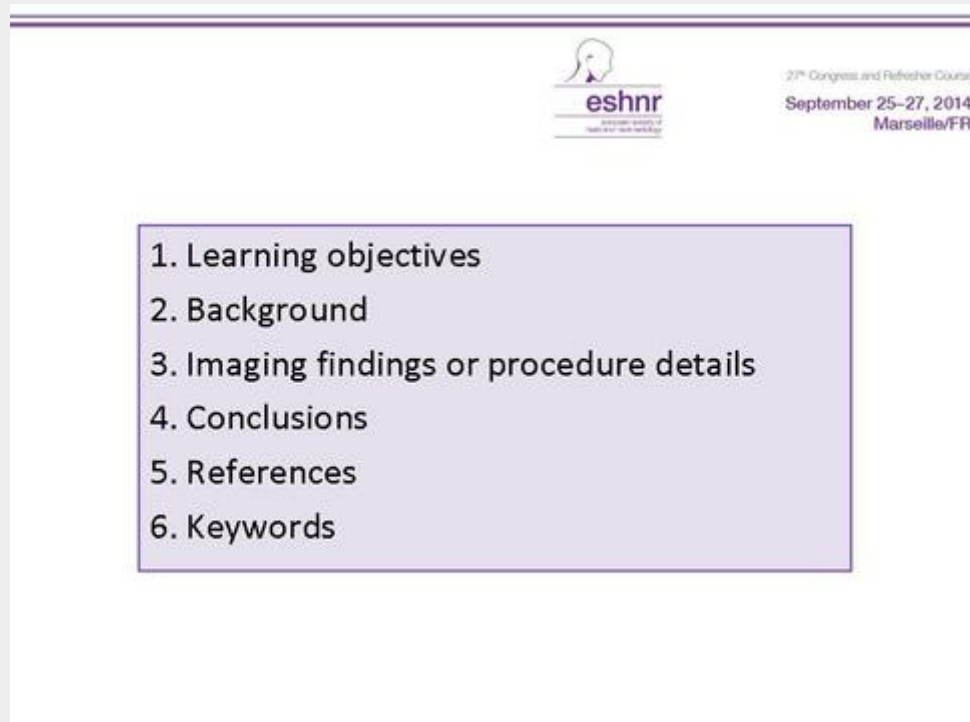


pdf version 100714

dia1.jpg



dia2.jpg

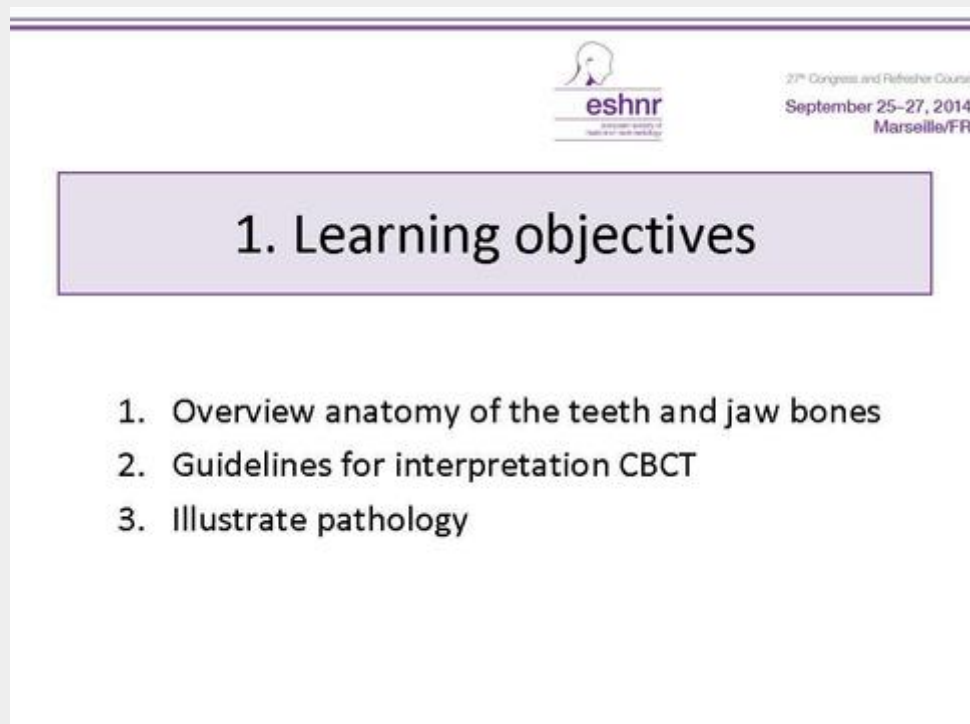


eshnr  
European Society of  
Head & Neck Radiology

27<sup>th</sup> Congress and Refresher Course  
September 25-27, 2014  
Marseille/FR

1. Learning objectives
2. Background
3. Imaging findings or procedure details
4. Conclusions
5. References
6. Keywords

dia3.jpg



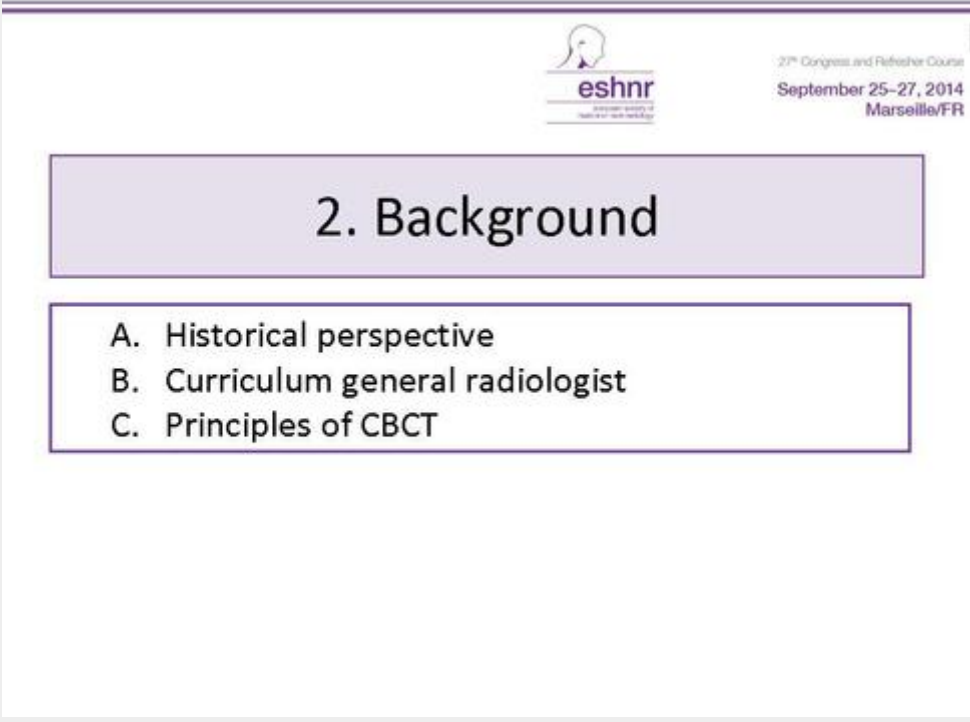
eshnr  
European Society of  
Head & Neck Radiology

27<sup>th</sup> Congress and Refresher Course  
September 25-27, 2014  
Marseille/FR

1. Learning objectives

1. Overview anatomy of the teeth and jaw bones
2. Guidelines for interpretation CBCT
3. Illustrate pathology

dia4.jpg



eshnr  
European Society of  
Head and Neck Radiology

27<sup>th</sup> Congress and Refresher Course  
September 25-27, 2014  
Marseille/FR

## 2. Background

- A. Historical perspective
- B. Curriculum general radiologist
- C. Principles of CBCT

dia6.jpg

### B. Curriculum general radiologist

- **Curriculum of clinical radiologists**  
The curriculum of clinical radiologists does not include specific training in dento-alveolar pathology.
- **Reporting dental CBCT examinations**  
Reporting dental CBCT examinations requires
  - essential knowledge of dental anatomy and pathology
  - systematic analysis of all related structures.
- **This exhibit aims to offer a primer for clinical radiologists in interpretation and reporting dental CBCT examinations**

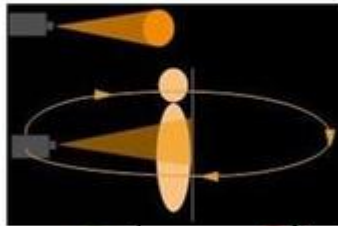


dia7.jpg

## C. Principles of CBCT compared to MDCT

### CBCT:

- Cone-shaped beam
- Flat detector
- Single rotation

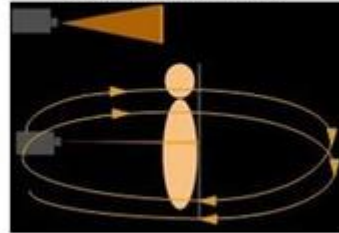


**+**  
High spatial resolution  
Low radiation dose  
Reduced metal artifacts

**-**  
Low contrast resolution  
Increased scan time  
Limited field-of-view

### Conventional CT (MDCT):

- Linear detector
- Fan-Shaped beam
- Spiral/Helical movement



dia8.jpg



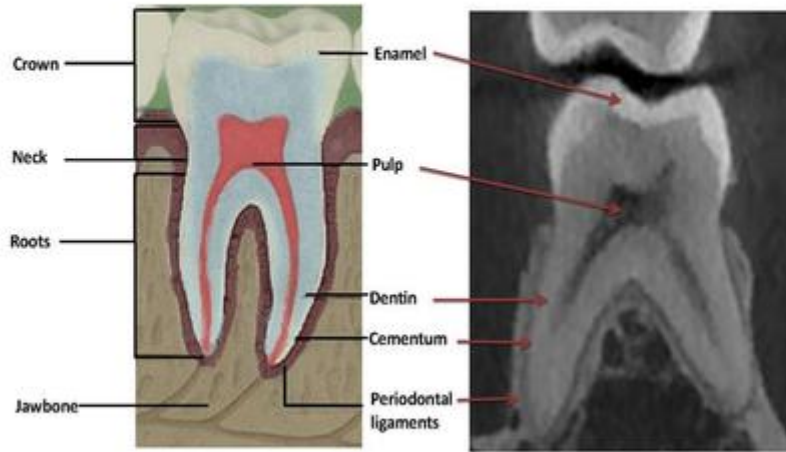
27<sup>th</sup> Congress and Refresher Course  
September 25-27, 2014  
Marseille/FR

## 3. Imaging Findings

- A. Teeth anatomy
- B. Nomenclature and teeth numbering
- C. Systematic imaging analysis
- D. Clinical indications

dia9.jpg

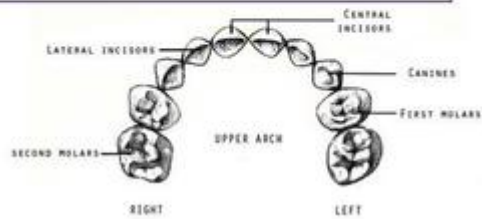
### A. Teeth anatomy



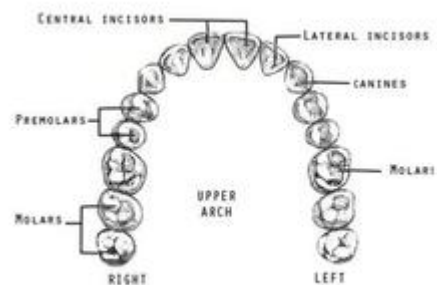
dia10.jpg

### A. Teeth anatomy

#### Primary Teeth

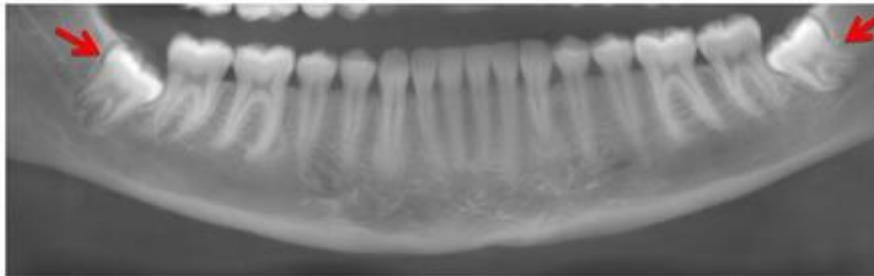


#### Permanent Teeth



dia11.jpg

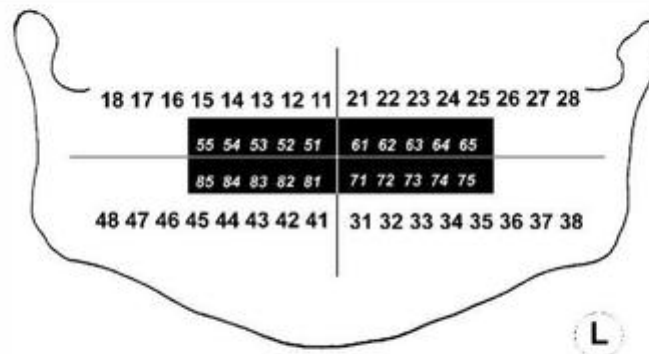
## A. Teeth anatomy



Dentition in the lower jaws in a 19-year old female. There are 16 teeth within the mandible. The third molars are unerupted yet (arrows).

dia12.jpg

## B. Nomenclature and numbering



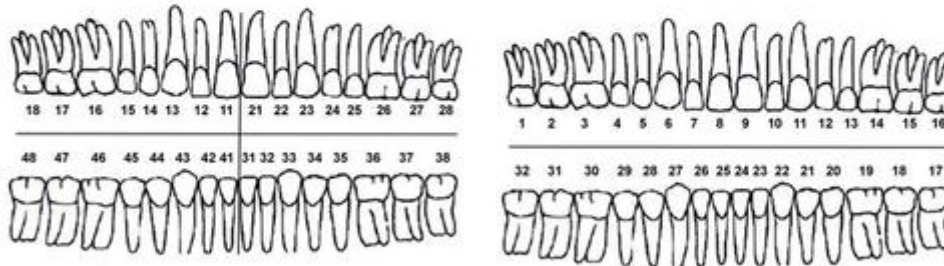
In the European nomenclature, each tooth has a unique number composed of 2 separate numbers: In **adults**, the first number indicates the quadrant in a clock-wise counter (e.g. 1 stands for the upper right quadrant of the jaw bone, 2 for the upper left quadrant etc). The second number indicates the number of the tooth within each quadrant, starting with the central incisor (1) and ending within the third molar (8). In **children**, the right upper quadrant is indicated by the 5, the upper left quadrant by 6 etc.

Ref. Bernaerts A. et al. JBR-BTR 2006

dia13.jpg

## B. Nomenclature and numbering

Dental numbering (Europe)      Dental numbering (USA)



In the USA, a different numbering system is used, starting with number 1 for the right upper third molar and progressing through the jaws in a clock-wise counter (ending with 32 for the third molar in the right lower mandible in an adult patient).

dia14.jpg

## B. Nomenclature and numbering

Dental Arch Maxilla



The **anterior** teeth arch comprises the incisors and canines.  
The **posterior** teeth arch comprises premolars and molars.

dia15.jpg

## B. Nomenclature and numbering

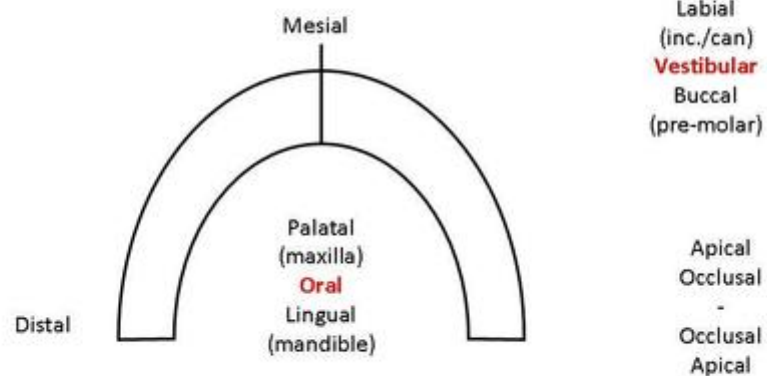
### Dental Arch Mandible



dia16.jpg

## B. Nomenclature and numbering

### Orientation Around Dental Arch



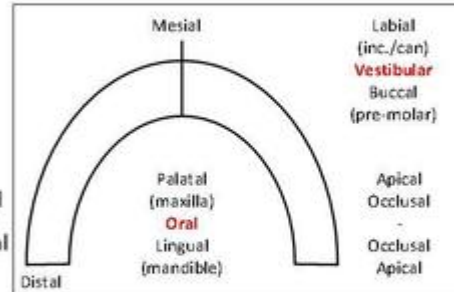
Dentists use a somewhat different terminology than medical doctors to designate the location of an abnormality within the dental arch e.g. mesial means to the midline (MD use medial)

dia17.jpg

## B. Nomenclature and numbering

### Nomenclature of orientation Around Dental Arch

- To the midline: **mesial**
- Posterolateral: **distal**
- Outer side: **vestibular**; subdivided in:
  - Anterior dental arch: **lingual**
  - Posterior dental arch: **buccal**
- Inner side: **oral**; subdivided in:
  - Towards the palate (maxilla): **palatal**
  - Towards the tongue (mandible): **lingual**
- Towards the root of the tooth: **apical**
- Towards the crown of the tooth: **occlusal**



dia18.jpg

## C. Systematic imaging analysis

1. Scout views
2. Axial
3. 6 panoramic slabs
4. Parasagittal reformatted
5. 3D rendering

For correct interpretation of CBCT examinations, systematic analysis of all image acquisitions in a fixed order is recommended, starting with analysis of the scout views, followed by axial images and ending with reformatted images.



dia19.jpg

## 1. Scout views



### Anteroposterior Scout view

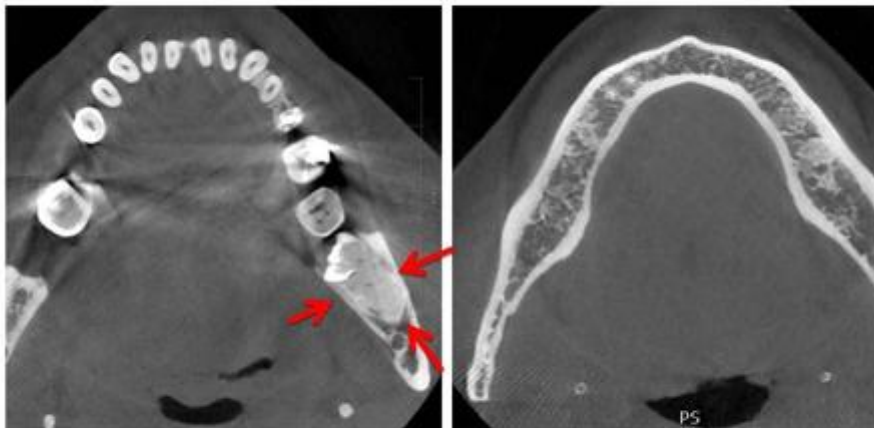
CBCT of the lower jaws, showing a non erupted wisdom tooth in the left mandible (**arrow**)

### Lateral Scout view

CBCT of the lower jaws (different patient), showing non erupted wisdom teeth in the upper and lower jaws (**arrows**)

dia20.jpg

## 2. Axial



Axial images of a CBCT of the lower jaws in a patient with a complex odontoma (**arrows**).

dia21.jpg

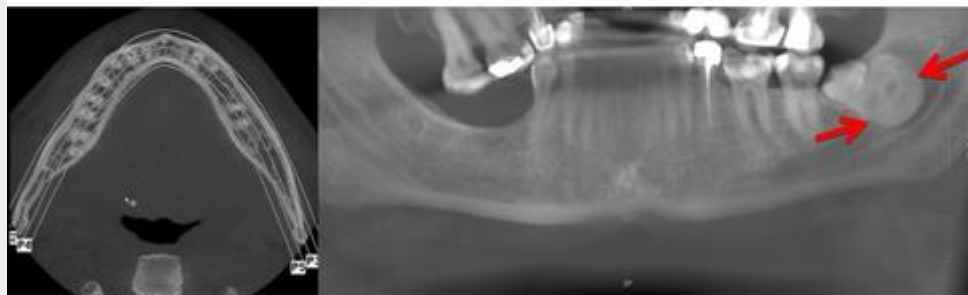
### 3. Panoramic slabs



A series of 5 to 6 adjacent panoramic reformatted images (10 mm thick) are performed through the mandible. An example of such a panoramic reformatted image is shown on the next slide.

dia22.jpg

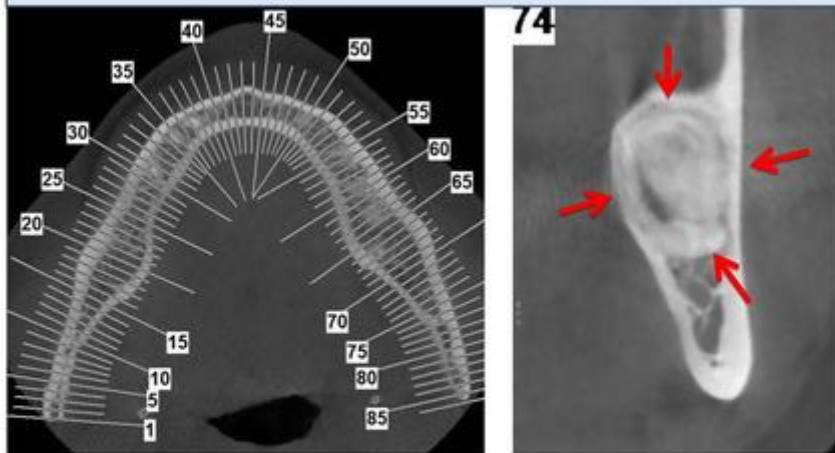
### 3. Panoramic slabs



A series of 5 to 6 adjacent panoramic reformatted images (10 mm thick) are performed through the mandible, of which a sample is shown here. Note a radio-opaque lesion (complex odontoma) in the left lower mandible angle in this patient (arrows).

dia23.jpg

#### 4. Parasagittal reformatted



A series of multiple parasagittal reformatted images are performed through the mandibular arc, of which a sample is shown here at position 75. Note a radiopaque lesion (complex odontoma) in the left lower mandible angle in this patient (arrows).

dia24.jpg

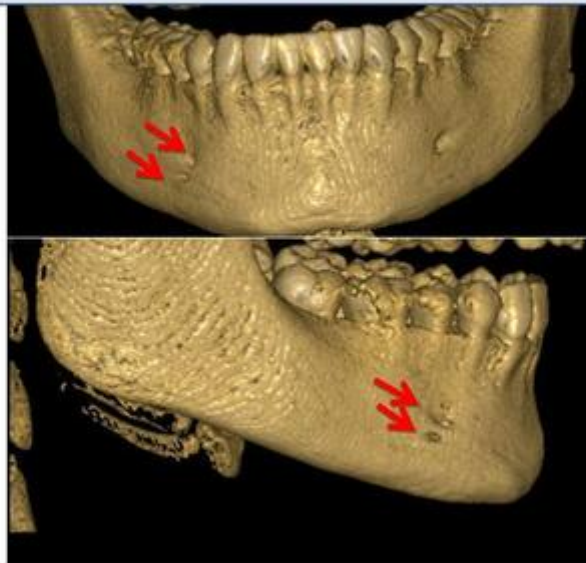
#### 5. 3D rendering



Additional 3 D-VRT images may be performed. Routinely, a set of at least 3 VRT images are enclosed in each dental CBCT examination. Anatomical details, such as the mental foramina (arrows) may be better visualized by 3 D images than on cross-sectional reformatted images.

dia25.jpg

## 5. 3D rendering



3 D-VRT images in a patient with a **double foramen mentale** (arrows) on the right side.

dia26.jpg

## D. Clinical indications

### 1. Dental implants

- A. Preoperative evaluation
- B. Postoperative evaluation

### 2. Teeth impaction and noneruption

### 3. Structural Teeth Anomalies

- A. Number
- B. Location
- C. Morphology

### 4. (Peri-apical) infection/inflammation

### 5. Tumor- and tumorlike conditions

- A. Radiolucent lesions
- B. Radiopaque lesions
- C. Mixed density lesions

### 6. (Dental) trauma

dia27.jpg

## 1. Dental implants

- Most frequent indication of CBCT
- Aims to evaluate:
  - Bone height
  - Bone width
  - Bone quality
  - Bone quantity

### A. Preoperative evaluation of implants

1. Mandible
2. Maxilla
3. Evaluation of bone quality
4. Evaluation of bone quantity

### B. Postoperative evaluation of implants

dia28.jpg

## 1. Dental implants

- Most frequent indication of CBCT
- Aims to evaluate:
  - Bone height
  - Bone width
  - Bone quality
  - Bone quantity

### A. Preoperative evaluation of implants

1. Mandible
2. Maxilla
3. Evaluation of bone quality
4. Evaluation of bone quantity

### B. Postoperative evaluation of implants



dia29.jpg

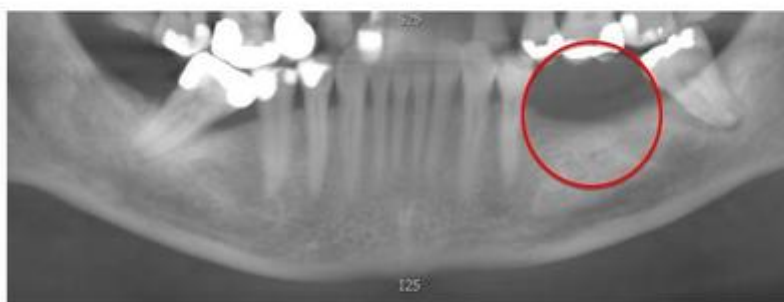
### A. Preoperative evaluation of implants



Preoperative evaluation of candidates for dental implants: needs determination if there is sufficient bone to accept the titanium implant.

dia30.jpg

### A. Preoperative evaluation of implants



Although panoramic views provides a rough estimation of the location of implants (circle), more detailed and accurate information is derived from analysis of parasagittal reformatted images.



dia31.jpg

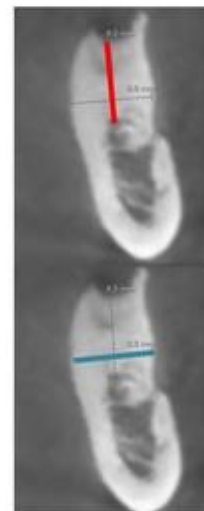
## A. Preoperative evaluation of implants

- Parasagittal images provides more precise evaluation of bone:
  - Height
  - Width
  - Quality
  - Quantity
- Measurement of the bone height differs in the mandible (1) compared to the maxilla (2).
- Evaluation of bone quantity and morphology according to the Cawood and Howell classification (3) is also different for the mandible compared to the maxilla.
- Evaluation of bone quality according to the Lekholm and Zarb classification (4) is restricted to the mandible.

dia32.jpg

## 1. Mandible

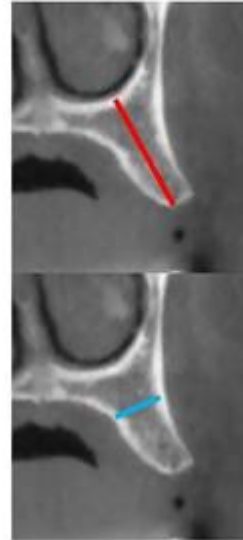
- **Bone height:**
  - measured from the top of the alveolar process to the mandibular canal, posterior to the mental foramen
  - should be at least 7 mm
- **Bone width:**
  - should be at least 5 mm
- **Bone quantity:**
  - different classes according to Cawood and Howell
- **Bone quality:**
  - different classes according to Lekholm and Zarb



dia33.jpg

## 2. Maxilla

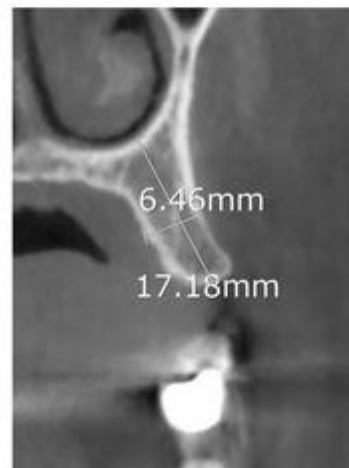
- **Bone height:**
  - measured from the top of the alveolar ridge to the sinus
  - should be at least 7 mm
- **Bone width:**
  - should be at least 5 mm
- **Bone quantity:**
  - different classes according to Cawood and Howell
- **Bone quality:**
  - different classes according to Lekholm and Zarb



dia34.jpg

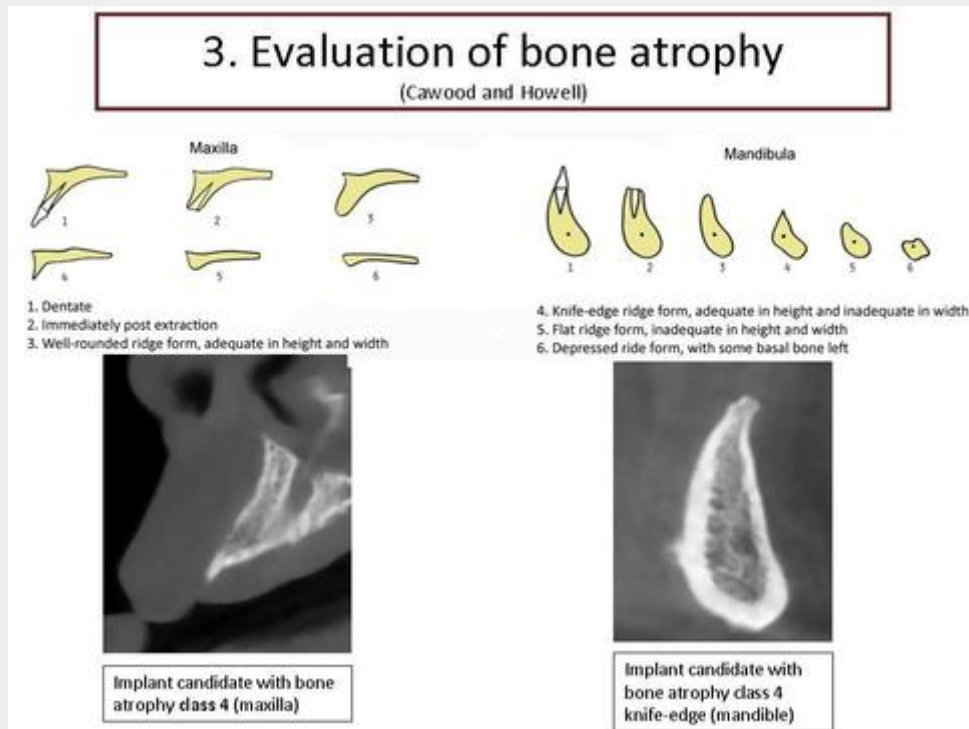
## 2. Maxilla: example

- **Bone height:**
  - measured from the top of the alveolar ridge to the sinus
  - should be at least 7 mm
- **Bone width:**
  - should be at least 5 mm
- **Bone quantity:**
  - different classes according to Cawood and Howell
- **Bone quality:**
  - different classes according to Lekholm and Zarb

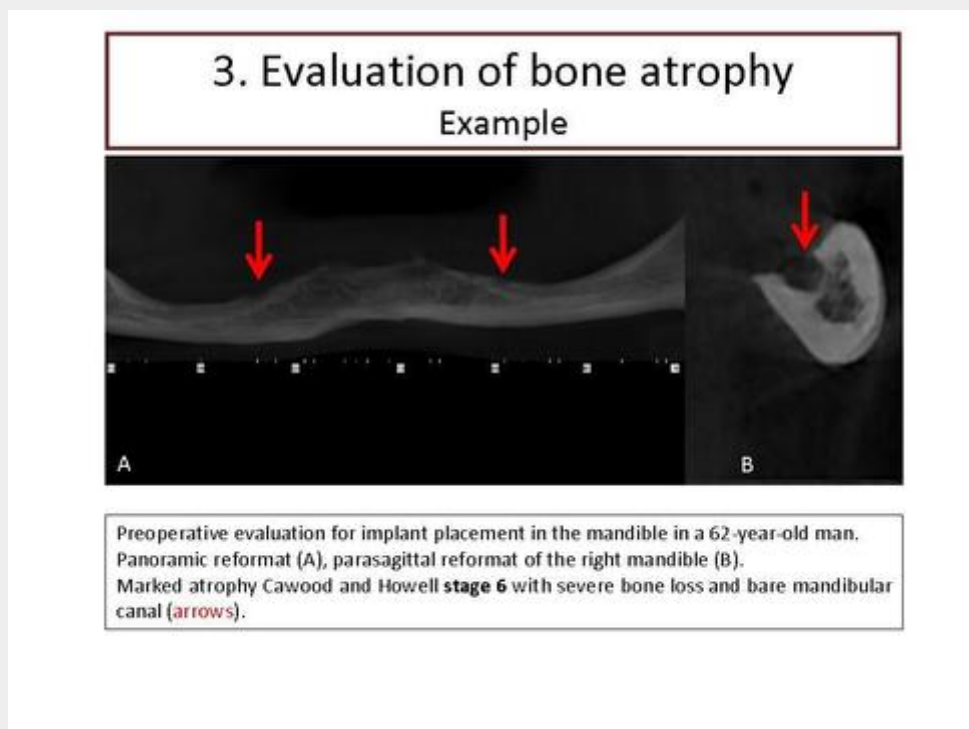


Implant candidate with sufficient bone height and width

dia35.jpg



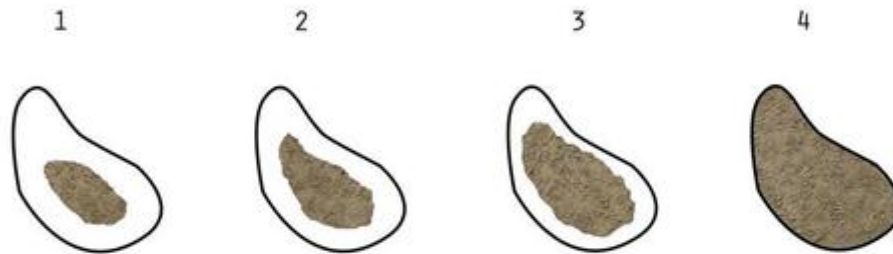
dia36.jpg



dia37.jpg

## 4. Evaluation of bone quality

(Lekholm and Zarb)



1. Almost the entire jawbone is composed of homogeneous compact bone
2. A thick layer of compact bone surrounds a core of dense trabecular bone
3. A thin layer of compact bone surrounds a core of dense trabecular bone of favourable strength
4. A thin layer of compact bone surrounds a core of low density trabecular bone

The amount of **cortical bone** is responsible for the primary stability of the implant, whereas **cancellous bone** is responsible for long-term stability.

**Class 2 and 3** yield the best long-term results.

The bone may be too hard for implantation in **class 1**.

**Class 4** results often in premature implant loss.

dia38.jpg

## 1. Dental implants

- Most frequent indication of CBCT
- Aims to evaluate:
  - Bone height
  - Bone width
  - Bone quality
  - Bone quantity

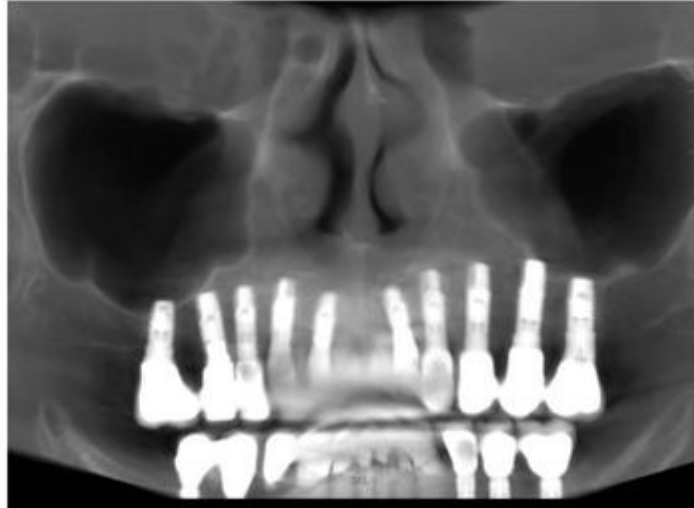
### A. Preoperative evaluation of implants

1. Mandible
2. Maxilla
3. Evaluation of bone quality
4. Evaluation of bone quantity

### B. Postoperative evaluation of implants

dia39.jpg

### B. Postoperative evaluation of implants



dia40.jpg

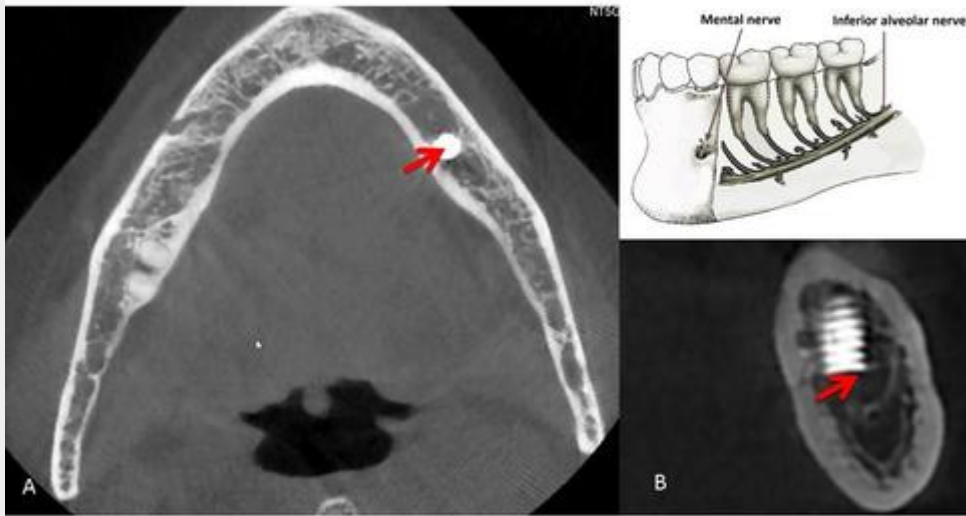
### B. Postoperative evaluation of implants

Aims to evaluate:

1. Abnormal position of implant
2. Implant loosening
3. Peri-implant fracture
4. Granuloma formation
5. Fistula

dia41.jpg

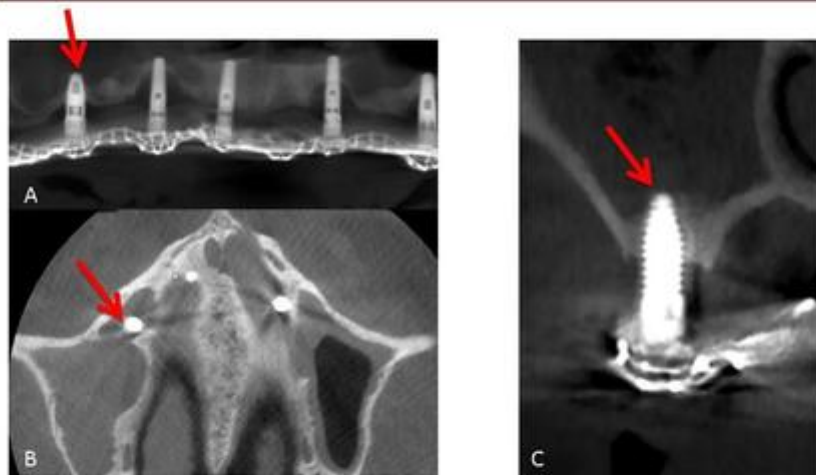
## 1. Abnormal position of implant



Axial image (B) and parasagittal reformat (B) of the mandible (**arrow**) in a 65-year old patient (after implant) presenting with paresthesia in the left lower jaw after implant placement. The tip of the implant protrudes within the mandibular canal (**arrows**).

dia42.jpg

## 1. Abnormal position of implant

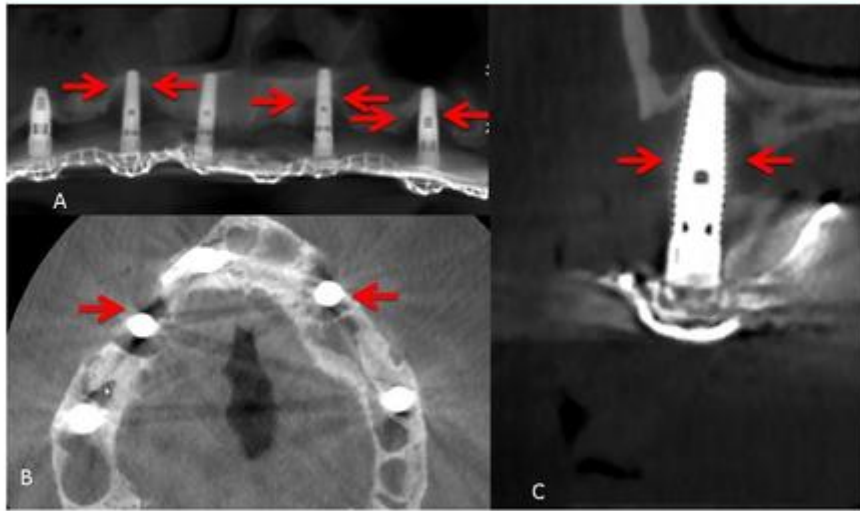


Panoramic reformat (A), axial image (B) and parasagittal reformat (C) of the upper jaw of a 54-year-old patient with multiple implants in the upper jaw. Perforation of floor of the maxillary sinus by the implant (**arrow**) with associated sinusitis.



dia43.jpg

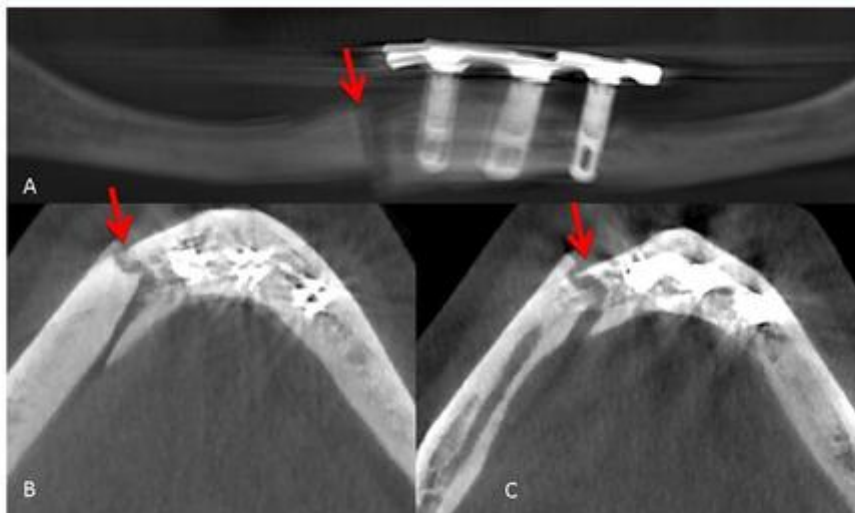
## 2. Implant loosening



Panoramic reformat (A), axial image (B) and parasagittal reformat (C) of the upper jaw of a 54-year-old patient with multiple implants in the upper jaw. Radiolucency around the tip of the implant (arrows) in keeping with **implant loosening**.

dia44.jpg

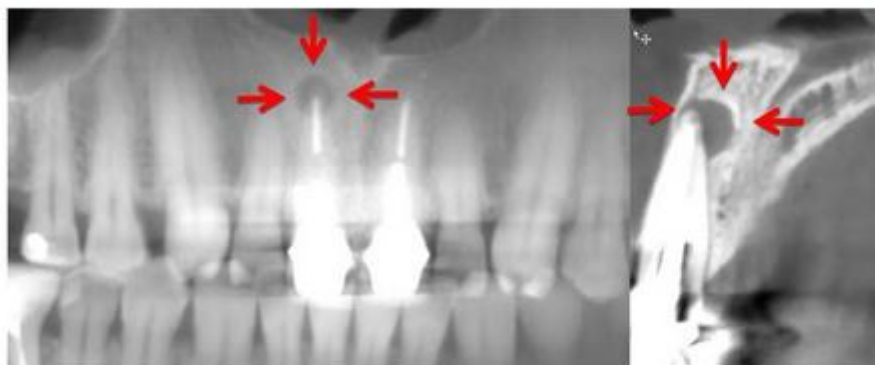
## 3. Peri-implant fracture



Panoramic reformat (A), axial images (B, C) of the mandible after implant placement show right paramedian **fracture** in the mandible (arrows) adjacent to the implant.

dia45.jpg

## 4. Peri-apical granuloma



42-year-old patient with previous placement of crowns 11 and 21. Panoramic (A) and parasagittal reformatted images show a small peri-apical granuloma at the apex of 11 (arrows).

dia46.jpg

## 5. Oro-antral fistula



63-year-old female with previous bilateral sinuslifting and placement of implants in the upper jaws. Panoramic reformat (A), and parasagittal reformat (B) of the right maxilla show communication of the oral cavity and the right maxillary sinus (arrows), in keeping with oro-antral fistula. Note complete loss of implant in the right upper jaw.

dia47.jpg

## D. Clinical indications

1. Dental implants
  - A. Preoperative evaluation
  - B. Postoperative evaluation
2. Teeth impaction and noneruption
3. Structural Teeth Anomalies
  - A. Number
  - B. Location
  - C. Morphology
4. (Peri-apical) infection/inflammation
5. Tumor- and tumorlike conditions
  - A. Radiolucent lesions
  - B. Radiopaque lesions
  - C. Mixed density lesions
6. (Dental) trauma

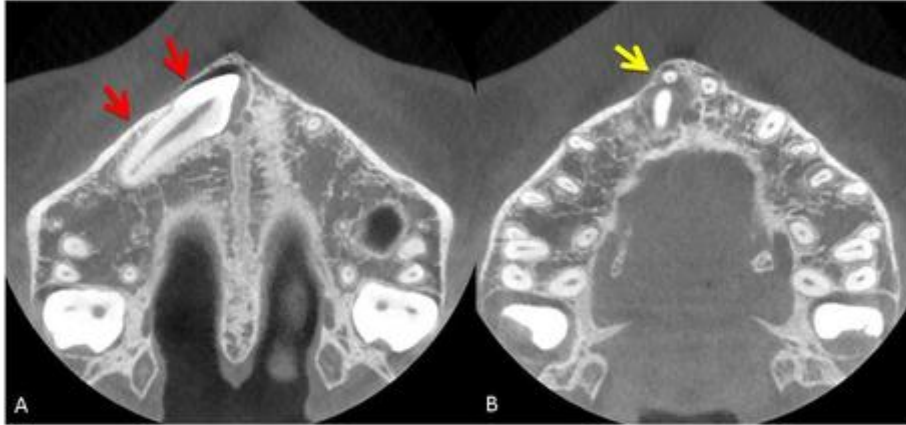
dia48.jpg

## 2. Teeth impaction and noneruption

- May cause:
  - Mass effect on adjacent structures
  - Apical erosion of adjacent teeth
  - Vascular compromise of adjacent teeth
- Important to report relationship with the mandibular canal in order to avoid neural damage during extraction (e.g. wisdom teeth)!

dia49.jpg

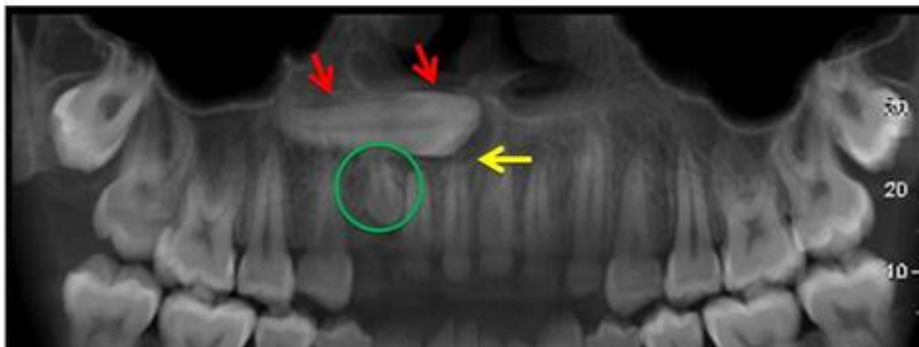
## 2. Teeth impaction and noneruption



15-year-old female. Axial images showing noneruption and mesiodistal angulation of 13 (arrow) (A), causing erosion of the apex of 11 (B) (arrow).

dia50.jpg

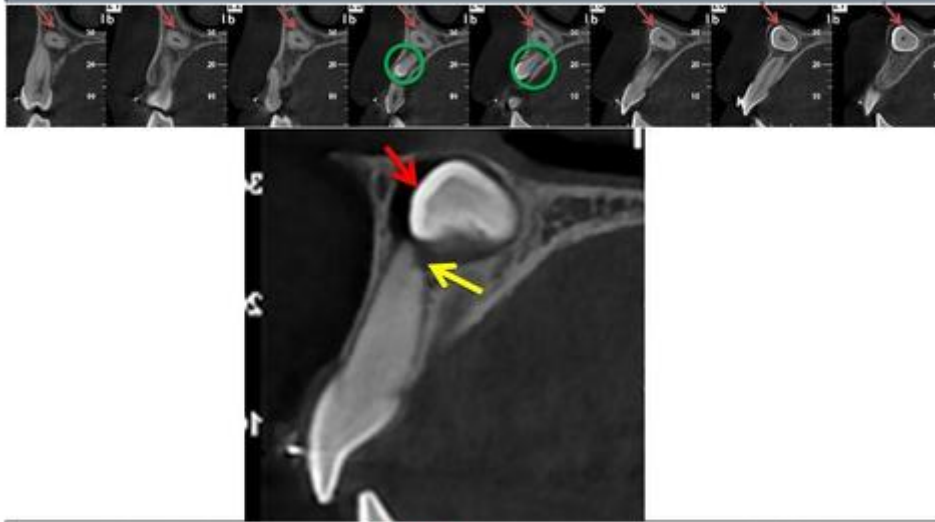
## 2. Teeth impaction and noneruption



15-year-old female. Panoramic reformat showing noneruption and mesiodistal angulation of 13 (arrow) (A), causing erosion of the apex of 11 (B) (arrow). Note a residual milk-tooth 53 (green circle).

dia51.jpg

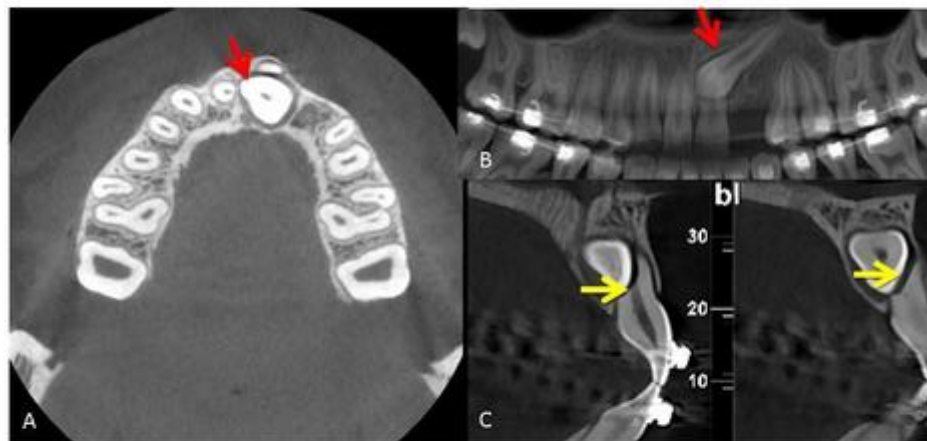
## 2. Teeth impaction and noneruption



15-year-old female with nonerupted 13 (arrow). Subtle erosion of the apex of 11 is best seen on parasagittal reformatted images (yellow arrow on enlarged view). Residual milk-tooth 53 (green circle).

dia52.jpg

## 2. Teeth impaction and noneruption



16-year-old female. Axial image (A) and panoramic reformatted image (B) showing noneruption and mesiodistal angulation of 23 (arrows) (A). Erosion of the apex of 11 is best seen on the parasagittal reformatted images (C) (arrow).



dia53.jpg

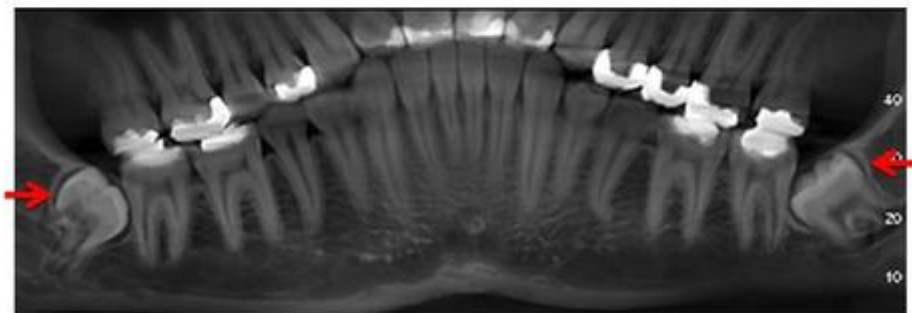
## 2. Teeth impaction and noneruption



20-year-old male with non erupted wisdom teeth (**arrows**) within the mandible. Axial images (A, B) showing intimate relationship of the roots of the right third molar with the mandibular nerve (**arrow in B**).

dia54.jpg

## 2. Teeth impaction and noneruption

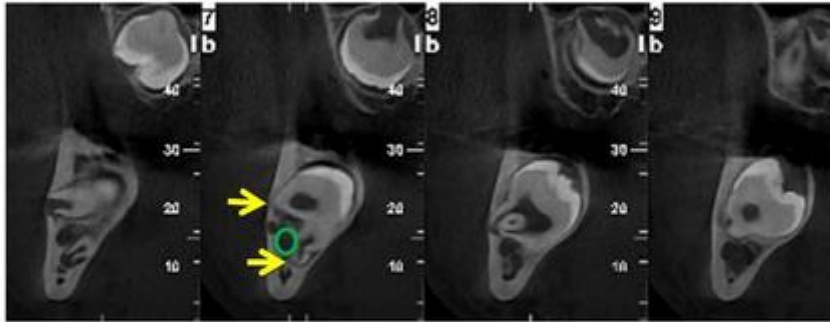


20-year-old male with nonerupted wisdom teeth (**arrows**) within the mandible. Correct analysis of relationship of the non erupted teeth should be done by comparison of axial and parasagittal images and not solely on panoramic images (partial volume effect may cause errors in evaluation on the latter images).



dia55.jpg

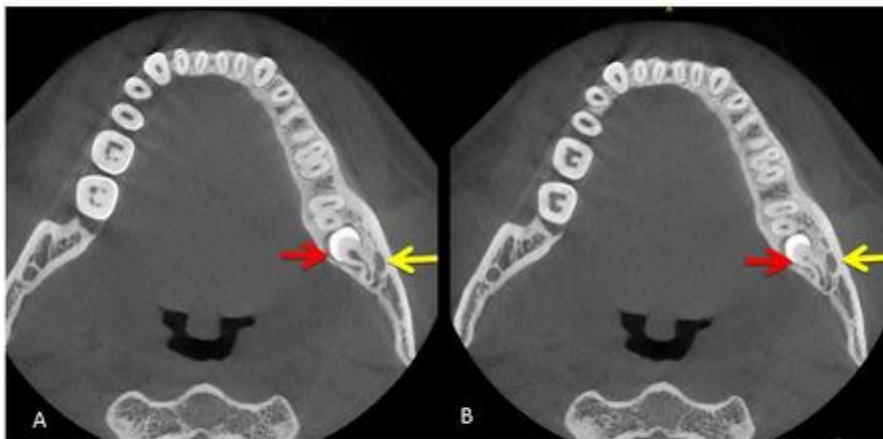
## 2. Teeth impaction and noneruption



20-year-old male with non erupted wisdom teeth (arrows) within the mandible. Parasagittal reformatted images. The mandibular nerve (green circle) runs between the roots of the third molar (arrow), which may complicate extraction.

dia56.jpg

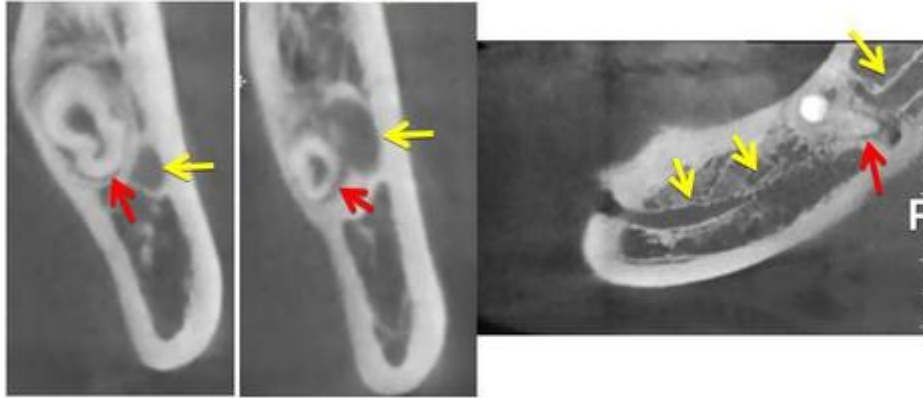
## 2. Teeth impaction and noneruption



24-year-old male with nonerupted 38 (arrows). Axial images (A, B) showing intimate relationship of the roots of the right third molar with the mandibular nerve (arrow) in B.

dia57.jpg

## 2. Teeth impaction and noneruption



24-year-old male with non erupted 38 (arrows). Parasagittal reformatted images (A, B) showing intimate relationship of the roots of the right third molar with the mandibular nerve. This is even better illustrated on oblique reformatted images (arrow in C).

dia58.jpg

## D. Clinical indications

1. Dental implants
  - A. Preoperative evaluation
  - B. Postoperative evaluation
2. Teeth impaction and noneruption
3. Structural Teeth Anomalies
  - A. Number
  - B. Location
  - C. Morphology
4. (Peri-apical) infection/inflammation
5. Tumor- and tumorlike conditions
6. (Dental) trauma

dia59.jpg

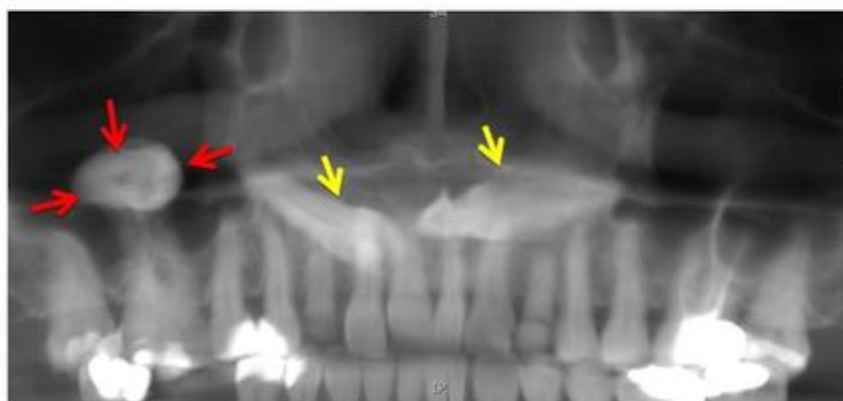
## B. Anomalies in number



Panoramic image showing 17 teeth in the upper arch, due to a residual milk tooth (arrow).

dia60.jpg

## B. Anomalies in location



Panoramic image shows a premolar within the right maxillary sinus, a.k.a. "dens in ante" (arrows). Note also non erupted canines (arrows).

dia61.jpg

### C. Anomalies in morphology



Dilaceration. Panoramic image shows an abnormal curve of the tooth root of 11 (arrows). Root dilaceration may be clinically silent or may complicate extraction or endodontic or orthodontic treatment.

dia62.jpg

### D. Clinical indications

1. Dental implants
  - A. Preoperative evaluation
  - B. Postoperative evaluation
2. Teeth impaction and noneruption
3. Structural Teeth Anomalies
  - A. Number
  - B. Location
  - C. Morphology
4. (Peri-apical) infection/inflammation
5. Tumor- and tumorlike conditions
  - A. Radiolucent lesions
  - B. Radiopaque lesions
  - C. Mixed density lesions
6. (Dental) trauma

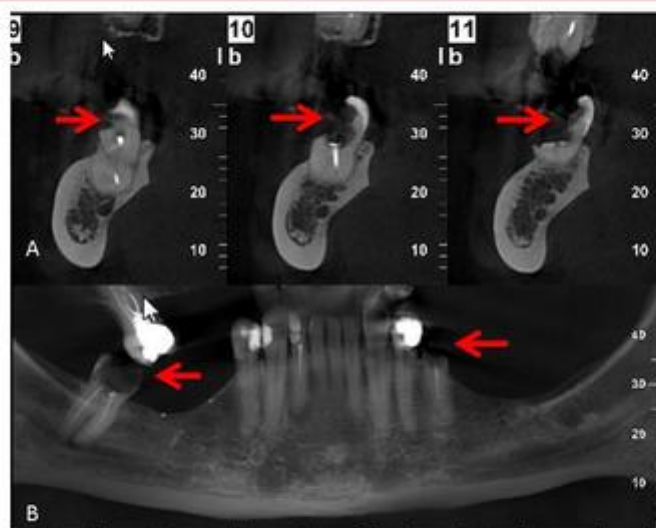
dia63.jpg

#### 4. (Peri-apical) infection/inflammation

- A. Caries
- B. Peri-apical granuloma
- C. Osteomyelitis
- D. Sinusitis

dia64.jpg

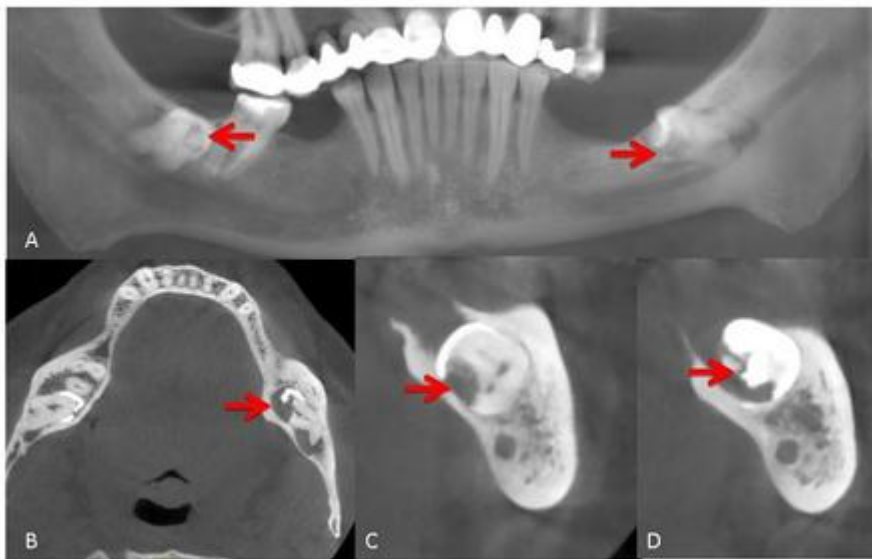
#### A. Caries



54-year-old patient with marked caries (arrows). Parasagittal reformatted images (A). Panoramic image (B).

dia65.jpg

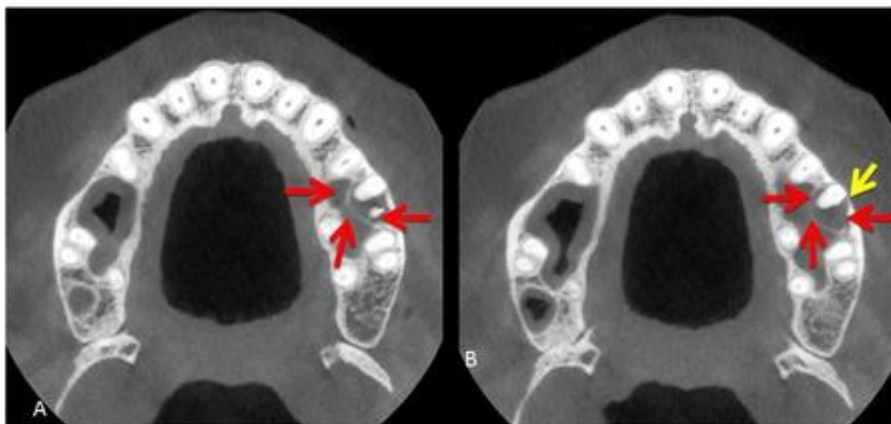
### A. Caries



Panoramic reformatted image (A), axial image (B) and parasagittal reformatted images (C, D). 55-year-old patient with marked caries in 2 nonerupted wisdom teeth (arrows).

dia66.jpg

### B. Peri-apical granuloma



26-year-old patient with previous partial root filling 26. Adjacent axial images (A, B) of the upper jaw reveal a sclerotic delineated radiolucency around the tip of the apex of 26 (arrows), in keeping with a peri-apical granuloma. Note focal thinning of the buccal cortical bone of the maxilla (yellow arrow).



dia67.jpg

## B. Peri-apical granuloma



26-year-old patient with previous partial root filling 26. Detailed panoramic reformat (A) and parasagittal reformat (B) of the upper jaw reveal a sclerotic delineated radiolucency around the tip of the apex of 26 (arrows), in keeping with a peri-apical granuloma. Note focal thinning of the mesiobuccal cortical bone of the maxilla (yellow arrow)

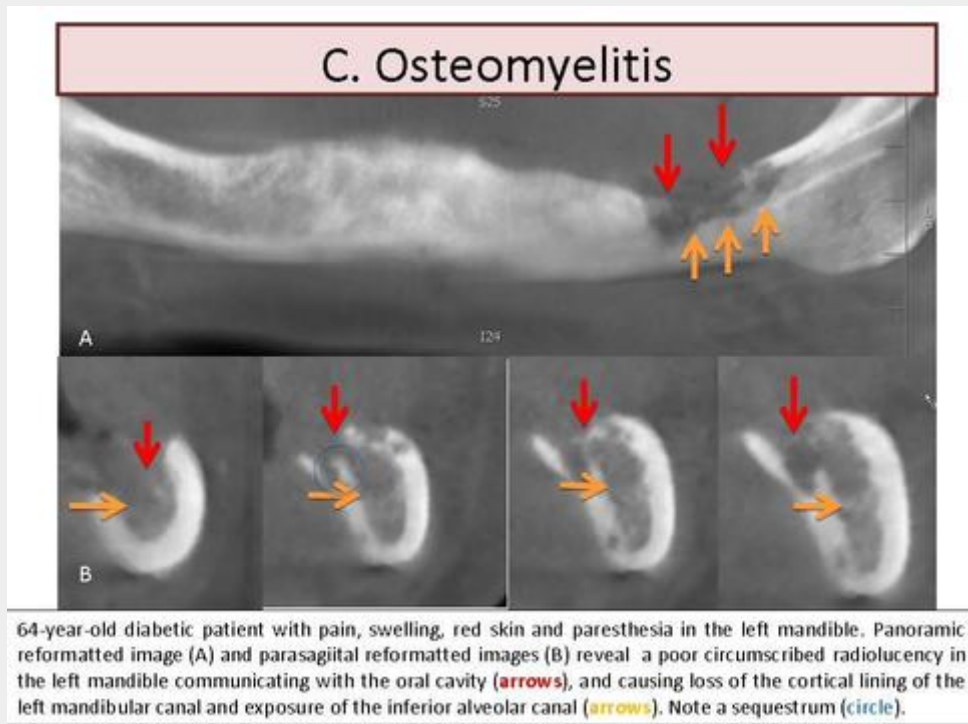
dia68.jpg

## B. Peri-apical granuloma

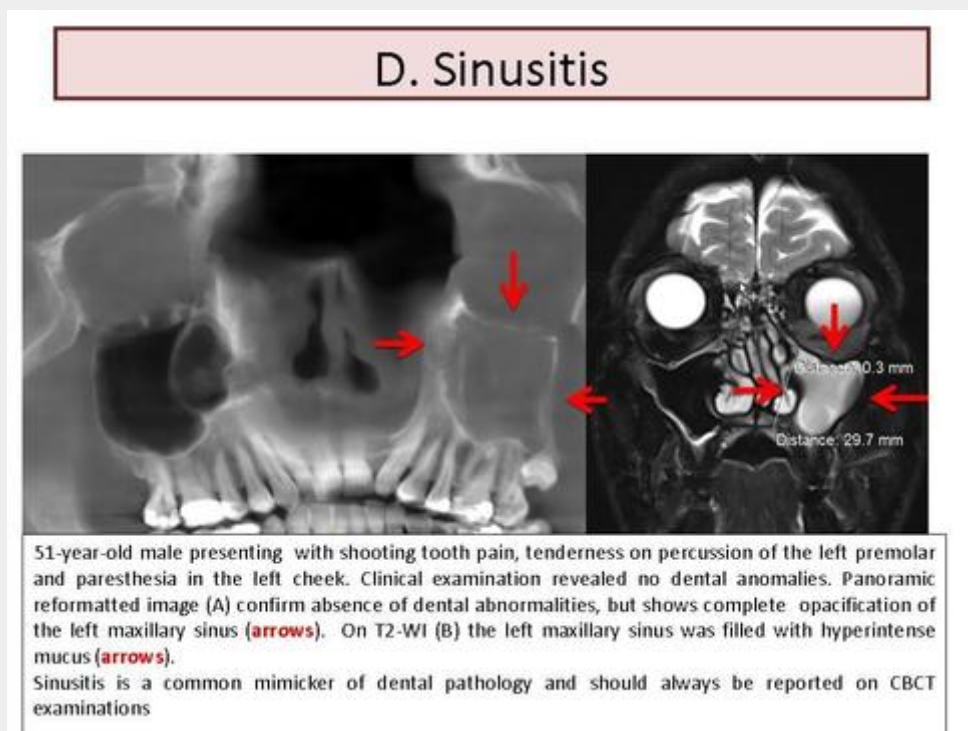


28-year-old patient with history of pain and abscess in the left upper jaws. Panoramic reformatted image of the upper jaw reveals a sclerotic delineated radiolucency around the tip of the mesiobuccal root of 26 (arrows), in keeping with a peri-apical granuloma. There is elevation of the floor of the left maxillary sinus (yellow arrow) and formation of a retention cyst in the left maxillary sinus (asterisk). Extension of the lesion within the maxillary sinus predisposes to oro-antral fistula formation after tooth extraction.

dia69.jpg



dia70.jpg



dia71.jpg

## D. Clinical indications

1. Dental implants
  - A. Preoperative evaluation
  - B. Postoperative evaluation
2. Teeth impaction
3. Structural Teeth Anomalies
  - A. Number
  - B. Location
  - C. Morphology
4. (Peri-apical) infection/inflammation
5. Tumor- and tumorlike conditions
  - A. Radiolucent lesions
  - B. Radiopaque lesions
  - C. Mixed density lesions
6. (Dental) trauma

dia72.jpg

## 5. Tumor- and tumorlike conditions

- Tumor- and tumorlike lesions of the jaws represent a heterogeneous group of lesions, which are classified histologically in the **WHO classification of Head and Neck tumors (2005)**.
- The main role of imaging is to describe the precise **location and extent** of these lesions.
- Although **characterization** on imaging is often difficult and impossible due to overlapping imaging characteristics, imaging is helpful for grading of lesions and to define which lesions should be referred for imaging.
- Location and density are the **cardinal criteria** for potential characterization on imaging. Radiologically, lesions may be either radiolucent, radiopaque or of mixed density.
- **Additional criteria** include lesion demarcation, morphology, cortical breakthrough, periosteal reaction and adjacent soft tissue changes.

dia73.jpg

## 5. Tumor- and tumorlike conditions

- A. Radiolucent lesions
- B. Radiopaque lesions
- C. Mixed density lesions

### Cardinal criteria:

- Density
- Location with regard to adjacent tooth structures and within the jaw

### Additional criteria:

- Demarcation
- Morphologic characteristics
- Cortical involvement
- Periosteal changes
- Soft tissue changes

dia74.jpg

## A. Radiolucent lesions

A. Radiolucent lesions			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
Radicular cyst	Dentigerous cyst	Nasopalatine duct cyst	Keratocystic odontogenic tumor
Lateral periodontal cyst	Odontogenic keratocyst	Static bone cyst	Ameloblastoma
Acute osteomyelitis	Ameloblastoma	Globulomaxillary cyst	Giant cell lesion of hyperparathyroidism
Periapical cemental dysplasia	Calcifying odontogenic cyst*		Residual cyst
Cementoblastoma	Calcifying epithelial odontogenic tumor*		Osteomyelitis
Cemento-ossifying fibroma*			Direct neoplastic extension
			Odontogenic myxoma*
			Aneurysmal bone cavity*
			Calcifying epithelial odontogenic tumor*
			Idiopathic bone cavity*
			Primary lymphoma*
			Calcifying odontogenic cyst*

common, uncommon\*

dia75.jpg

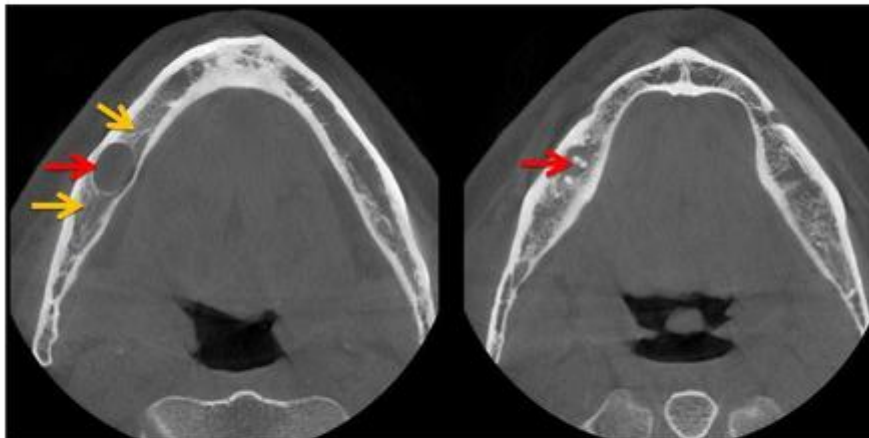
## A. Radiolucent lesions: examples

A. Radiolucent lesions			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
<u>Radicular cyst</u>	Dentigerous cyst	Nasopalatine duct cyst	Keratocystic odontogenic tumor
Lateral periodontal cyst	Keratocystic odont. tumor	Static bone cyst	Ameloblastoma
Acute osteomyelitis	Ameloblastoma	Globulomaxillary cyst	Giant cell lesion of hyperparathyroidism
Periapical cemental dysplasia	Calcifying odontogenesis cyst*		Residual cyst
Cementoblastoma	Calcifying epithelial odontogenic tumor*		Osteomyelitis
Cemento-ossifying fibroma*			Direct neoplastic extension
			Odontogenic myxoma*
			Aneurysmal bone cavity*
			Calcifying epithelial odontogenic tumor*
			Idiopathic bone cavity*
			Primary lymphoma*
			Calcifying odontogenic cyst*

common, uncommon\*

dia76.jpg

## Radicular cyst

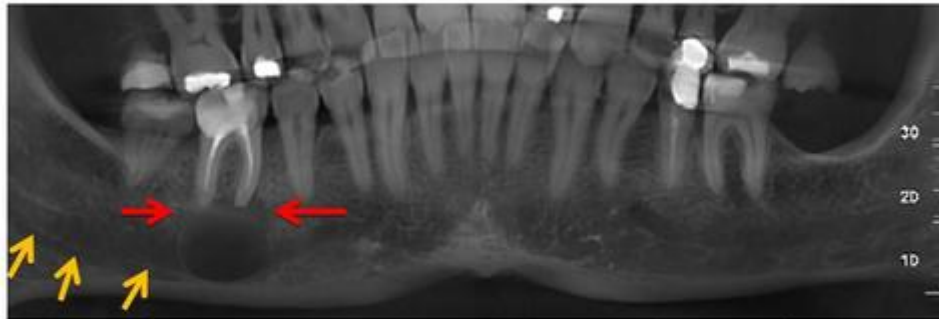


42-year-old patient. Axial images showing a well-delineated radiolucent lesion around the roots of tooth 16, in keeping with a radicular cyst (arrows). Note intimate relationship with the right mandibular canal (arrows). Radicular cysts are the most frequent odontogenic lesions resulting from proliferation, expansion and cystification of a dental granuloma. They may cause root resorption and are often larger than 1 cm.



dia77.jpg

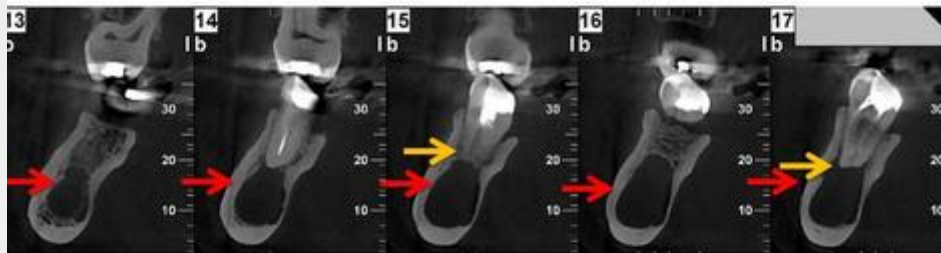
## Radicular cyst



42-year-old patient. Panoramic image showing a well-delineated radiolucent lesion around the **roots** of tooth 46, in keeping with a radicular cyst (**arrows**). Note intimate relationship with the right mandibular canal (**arrows**). Radicular cysts are the most frequent odontogenic lesions resulting from proliferation, expansion and cystification of a dental granuloma. They may cause root resorption and are often larger than 1 cm.

dia78.jpg

## Radicular cyst



42-year-old patient. Parasagittal reformatted images showing a well-delineated radiolucent lesion around the roots of tooth 46, in keeping with a radicular cyst (**arrows**). Note apical root resorption (**arrows**). Radicular cyst are most often unilocular like in this case.



dia79.jpg

A. Radiolucent lesions			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
Radicular cyst	Dentigerous cyst	Nasopalatine duct cyst	Keratocystic odontog. tumor
Lateral periodontal cyst	Keratocystic odontog. tumor	Static bone cyst	Ameloblastoma
Acute osteomyelitis	Ameloblastoma	Globulomaxillary cyst	Giant cell lesion of hyperparathyroidism
Periapical cemental dysplasia	Calcifying odontogenic cyst*		Residual cyst
Cementoblastoma	Calcifying epithelial odontogenic tumor*		Osteomyelitis
Cemento-ossifying fibroma*			Direct neoplastic extension
			Odontogenic myxoma*
			Aneurysmal bone cavity*
			Calcifying epithelial odontogenic tumor*
			Idiopathic bone cavity*
			Primary lymphoma*
			Calcifying odontogenic cyst*

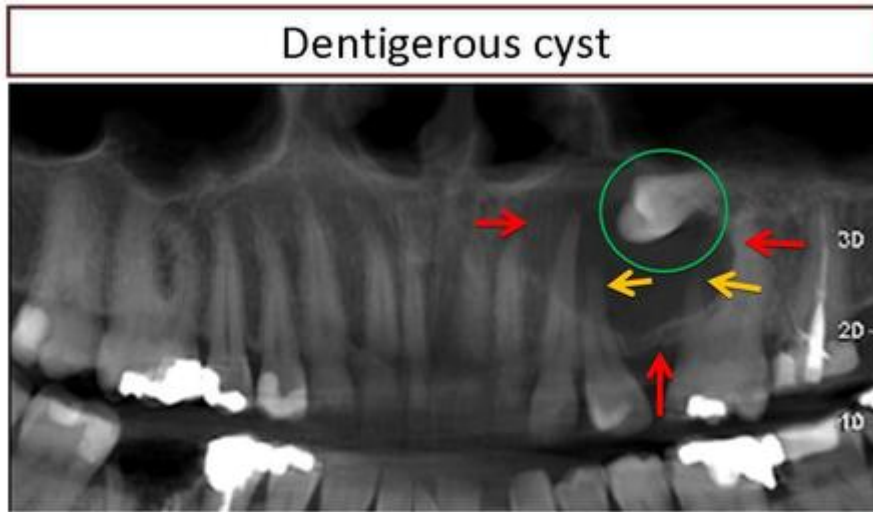
common, uncommon\*

dia80.jpg

### Dentigerous cyst

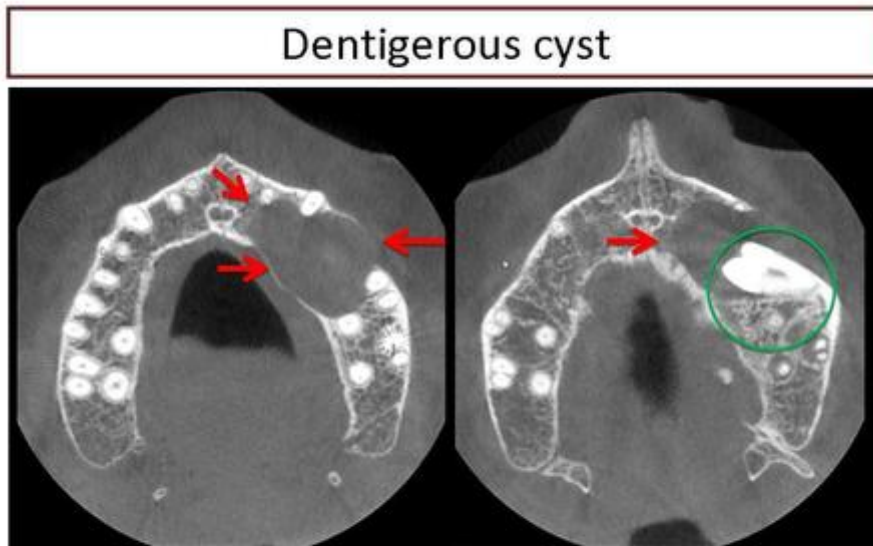
39-year-old patient. Parasagittal reformatted images showing a well-delineated radiolucent lesion (arrows) around the crown (green circle) of tooth 46, in keeping with a dentigerous or follicular cyst. Dentigerous cysts arise from fluid accumulation between the follicular epithelium and the crown of the developing or unerupted tooth. They are the second most frequent odontogenic cysts. Pericoronal location and association with unerupted teeth are the key diagnostic features. Erosion of adjacent teeth may occur like in this case (arrow). There is often extension in the sinus or nasal cavity.

dia81.jpg



39-year-old patient. Parasagittal reformatted images showing a well-delineated radiolucent lesion (**arrows**) around the **crowns (green circle)** of tooth 46, in keeping with a dentigerous or follicular cyst. Dentigerous cysts arise from fluid accumulation between the follicular epithelium and the crown of the developing or unerupted tooth. They are the second most frequent odontogenic cysts. Pericoronal location and association with unerupted teeth are the key diagnostic features. Erosion of adjacent teeth may occur like in this case (**arrow**). There is often extension in the sinus or nasal cavity.

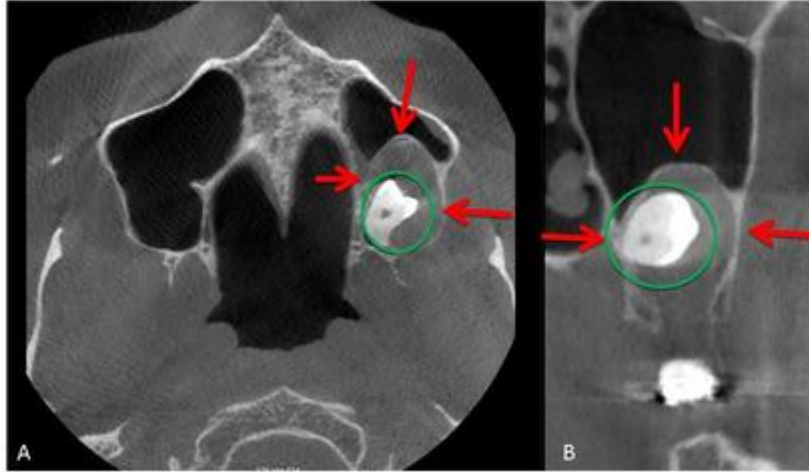
dia82.jpg



39-year-old patient. Axial images showing a well-delineated radiolucent lesion (**arrows**) around the **crowns (green circle)** of tooth 46, in keeping with a dentigerous or follicular cyst. Dentigerous cysts arise from fluid accumulation between the follicular epithelium and the crown of the developing or unerupted tooth. They are the second most frequent odontogenic cysts. Pericoronal location and association with unerupted teeth are the key diagnostic features.

dia83.jpg

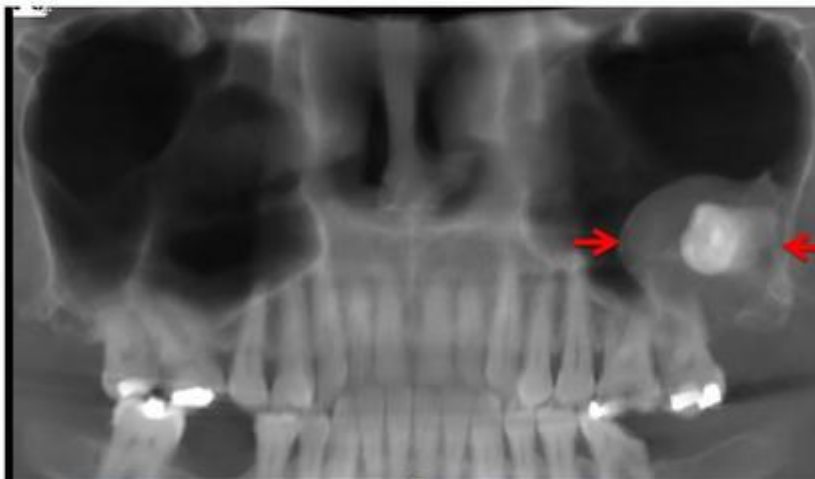
### Dentigerous cyst



54-year-old patient. Axial image (A) and parasagittal reformatted image (B) showing a well-delineated radiolucent lesion around the **crow**n of 28 (**green circle**). The lesion extends within the left maxillary sinus (**arrows**).

dia84.jpg

### Dentigerous cyst



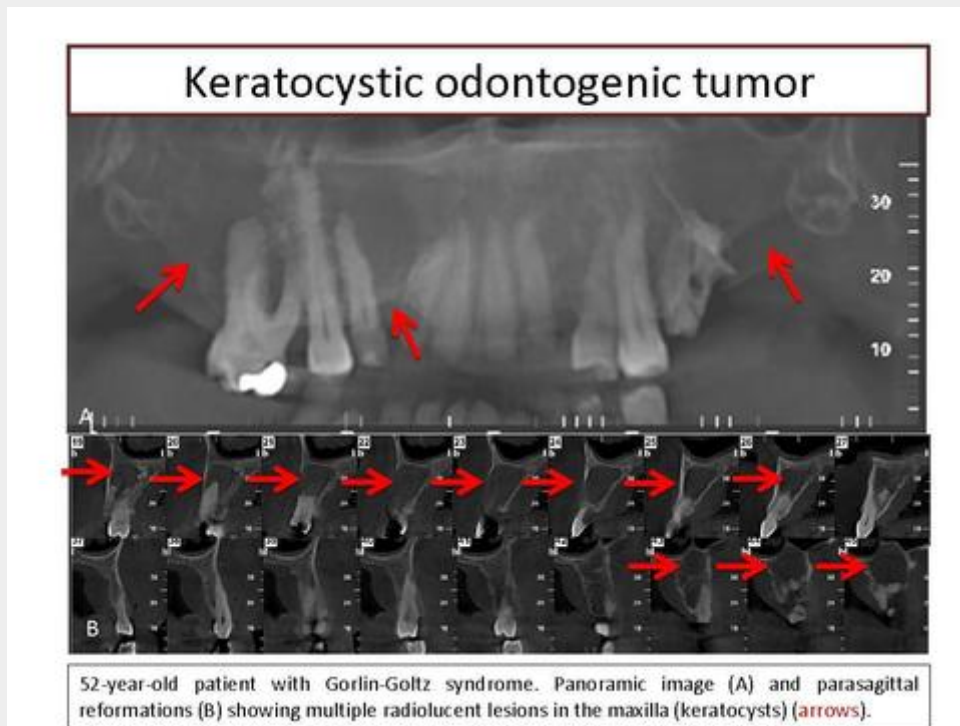
54-year-old patient. Panoramic reformatted image showing a well-delineated radiolucent lesion around the **crow**n of 28. The lesion extends within the left maxillary sinus (**arrows**).

dia85.jpg

A. Radiolucent lesions			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
Radicular cyst	Dentigerous cyst	Nasopalatine duct cyst	Keratocystic odontogenic T
Lateral periodontal cyst	keratocystic odont. tumor	Static bone cyst	Ameloblastoma
Acute osteomyelitis	Ameloblastoma	Globulomaxillary cyst	Giant cell lesion of hyperparathyroidism
Periapical cemental dysplasia	Calcifying odontogenic cyst*		Residual cyst
Cementoblastoma	Calcifying epithelial odontogenic tumor*		Osteomyelitis
Cemento-ossifying fibroma*			Direct neoplastic extension
			Odontogenic myxoma*
			Aneurysmal bone cavity*
			Calcifying epithelial odontogenic tumor*
			Idiopathic bone cavity*
			Primary lymphoma*
			Calcifying odontogenic cyst*

common, uncommon\*

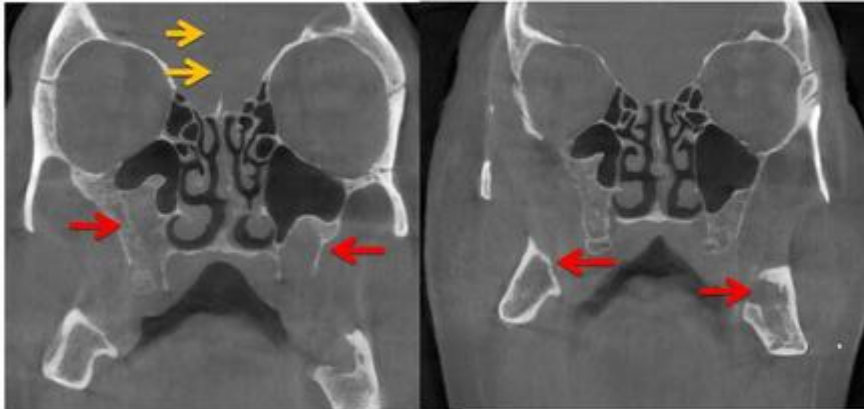
dia86.jpg





dia87.jpg

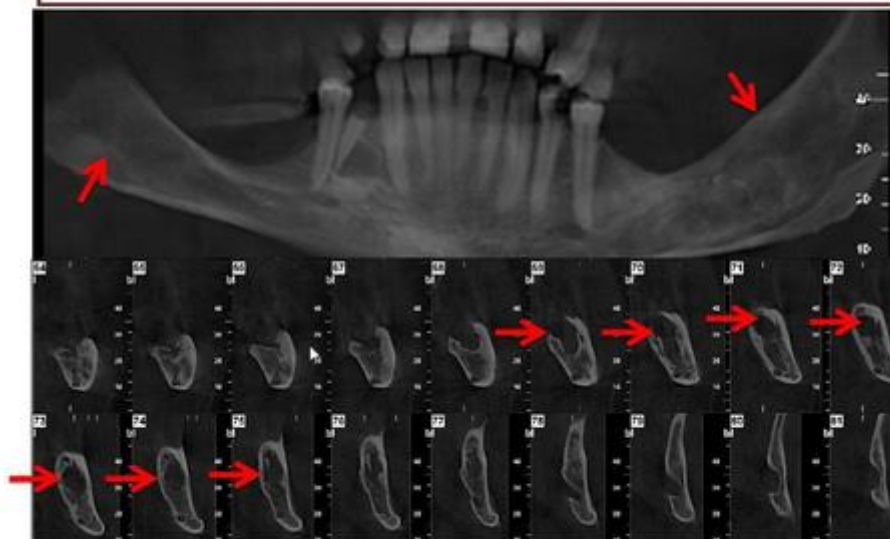
### Keratocystic odontogenic tumor



52-year-old patient with Gorlin-Goltz syndrome. Coronal images showing multiple radiolucent lesions in the maxilla and mandible (arrows). Note calcifications of the falx cerebri. A keratocystic odontogenic tumor is an aggressive lesion that often recurs after excision. The lesions are often multiple and may be part of the Gorlin-Goltz syndrome, including skin basal cell carcinomas, skeletal deformities and falx calcifications. Smaller lesions are often unilocular, whereas larger lesions are multilocular (arrows).

dia88.jpg

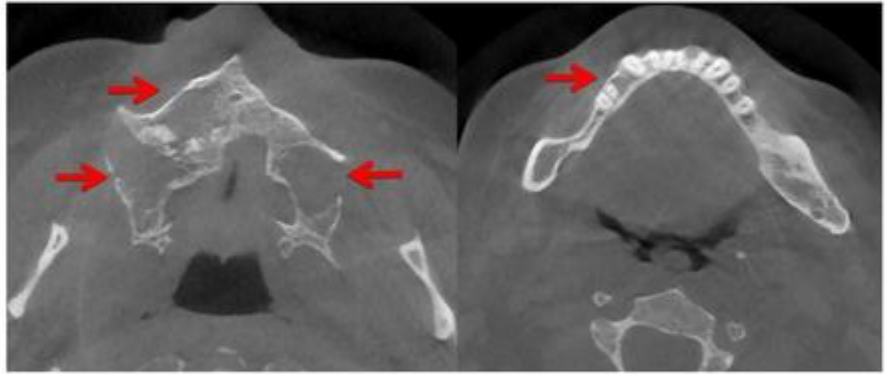
### Keratocystic odontogenic tumor



52-year-old patient with Gorlin-Goltz syndrome. Panoramic image (A) and parasagittal reformations (B) showing multiple radiolucent lesions in the mandible (keratocysts) (arrows).

dia89.jpg

## Keratocystic odontogenic tumor



52-year-old patient with Gorlin-Goltz syndrome. Axial images showing multiple radiolucent lesions in the maxilla and mandible (arrows). Note cortical breakthrough of the maxillary lesions indicating aggressive biological nature of these lesions.

dia90.jpg

## A. Radiolucent lesions

A. Radiolucent lesions			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
Radicular cyst	Dentigerous cyst	Nasopalatine duct cyst	Keratocystic odontogenic T
Lateral periodontal cyst	Keratocystic odont. tumor	Static bone cyst	Ameloblastoma
Acute osteomyelitis	Ameloblastoma	Globulomaxillary cyst	Giant cell lesion of hyperparathyroidism
Periapical cemental dysplasia	Calcifying odontogenic cyst*		Residual cyst
Cementoblastoma	Calcifying epithelial odontogenic tumor*		Osteomyelitis
Cemento-ossifying fibroma*			Direct neoplastic extension
			Odontogenic myxoma*
			Aneurysmal bone cavity*
			Calcifying epithelial odontogenic tumor*
			Idiopathic bone cavity*
			Primary lymphoma*
			Calcifying odontogenic cyst*

common, uncommon\*



dia91.jpg

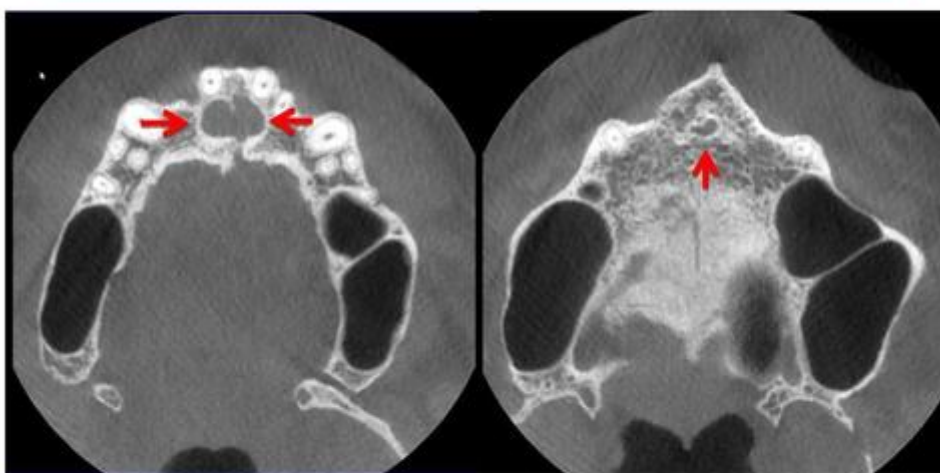
### Nasopalatine cyst



43-year-old patient. Two adjacent panoramic reformatted images showing a heart-shaped radiolucent midline structure (arrows).

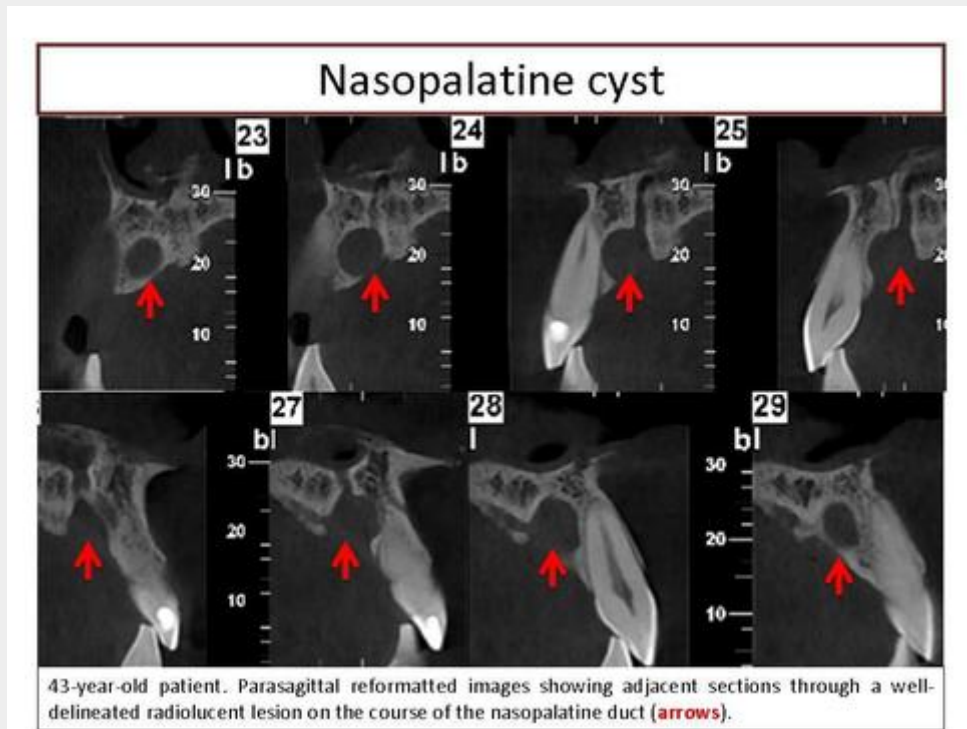
dia92.jpg

### Nasopalatine cyst






43-year-old patient. Two adjacent axial images. The lesion is typically located on the course of the nasopalatine duct posteriorly to the central incisors (arrows) and is well demarcated.

dia93.jpg



dia94.jpg




### B. Radiopaque lesions

B. Radiopaque lesions			
Periapical 	Pericoronal 	Specific anatomic anomalies	Not necessarily contact with tooth 
Cementoblastoma	Odontoma	<u>Torus mandibularis</u>	<u>Odontoma</u>
Periapical cemental dysplasia		<u>Torus palatinus</u>	<u>Bone island (osteoma)</u>
Condensing osteitis			Fibrous dysplasia
Cemento-ossifying fibroma			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*

common, uncommon\*

dia95.jpg

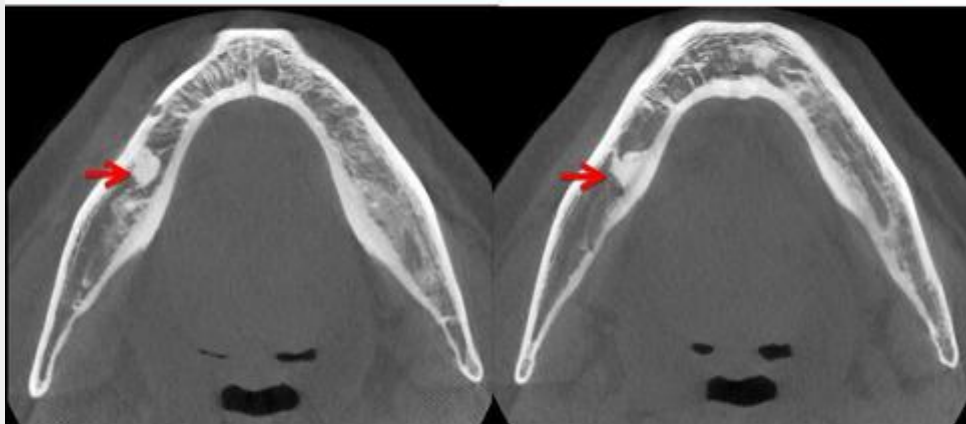
## B. Radiopaque lesions: examples

B. Radiopaque lesions			
Periapical 	Pericoronal 	Specific anatomic anomalies	Not necessarily contact with tooth 
Cementoblastoma	Odontoma	Torus mandibularis	Odontoma
Periapical cemental dysplasia		Torus palatinus	<b>Bone island (osteoma)</b>
Condensing osteitis			Fibrous dysplasia
Cemento-ossifying fibroma			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*

common, uncommon\*

dia96.jpg

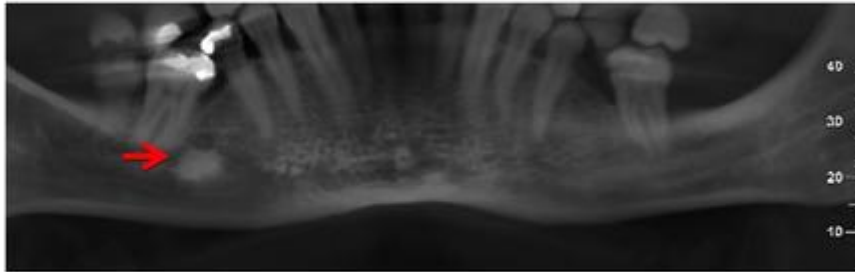
## Bone island



51-year-old patient. Axial images showing a dense bone island with spicular margins within the right mandible (**arrows**). The lesion has no specific relationship with a teeth. It should be differentiated from sclerosing (condensing) osteitis, which represents a chronic inflammation usually around the apex of a tooth. In the latter, there is often associated widening of the periodontal ligament around the tooth.

dia97.jpg

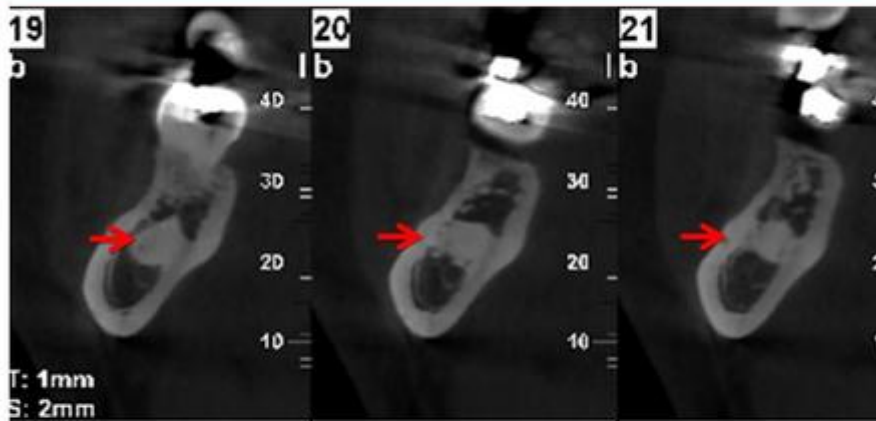
### Bone island



51-year-old patient. Panoramic reformatted image showing a dense bone island with spicular margins within the right mandible (arrow). The lesion has no relationship with the teeth.

dia98.jpg




### Bone island



51-year-old patient. Parasagittal image showing a dense bone island with spicular margins (arrow). Note absence of relationship with the adjacent tooth.

dia101.jpg

## B. Radiopaque lesions

B. Radiopaque lesions			
Periapical 	Pericoronal 	Specific anatomic anomalies	Not necessarily contact with tooth 
Cementoblastoma	Odontoma	<u>Torus mandibularis</u>	Odontoma
Periapical cemental dysplasia		<u>Torus palatinus</u>	Bone island (osteoma)
<b>Condensing osteitis</b>			Fibrous dysplasia
Cemento-ossifying fibroma			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*

common, uncommon\*

dia102.jpg




## Sclerosing (condensing) osteitis



29-year-old patient. Parasagittal reformatted image and panoramic reformatted image showing a sclerotic focus with spicular margins within the right mandible (arrow). In contradistinction to a dense bone island, the lesion lies adjacent to the root of the adjacent tooth.

dia103.jpg

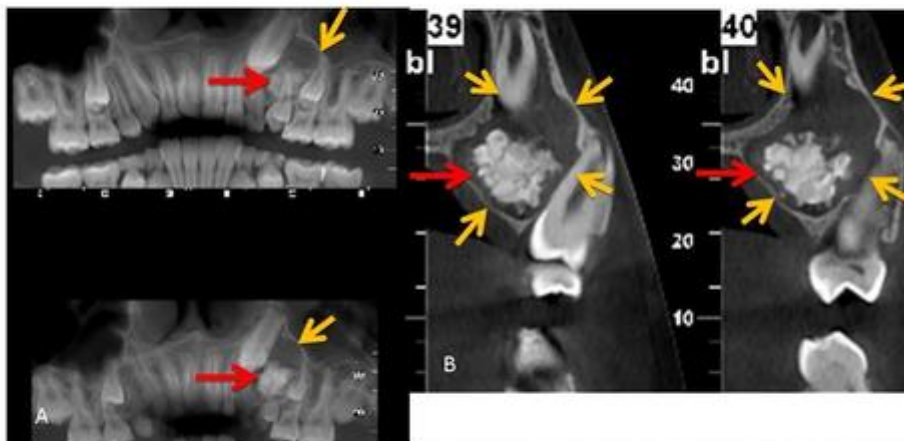
## B. Radiopaque lesions

B. Radiopaque lesions			
Periapical 	Pericoronal 	Specific anatomic anomalies	Not necessarily contact with tooth 
Cementoblastoma	<b>Odontoma</b>	Torus mandibularis	Odontoma
Periapical cemental dysplasia		Torus palatinus	Bone island (osteoma)
Condensing osteitis			Fibrous dysplasia
Cemento-ossifying fibroma			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*

common, uncommon\*

dia105.jpg

## Odontoma (complex type)






11-year-old patient. Panoramic images (A) and parasagittal reformatted images (B) showing an amorphous radiopaque lesion within the left upper jaws around the crown of 24 (arrows), surrounded by a radiolucent follicle (small arrows).



dia106.jpg

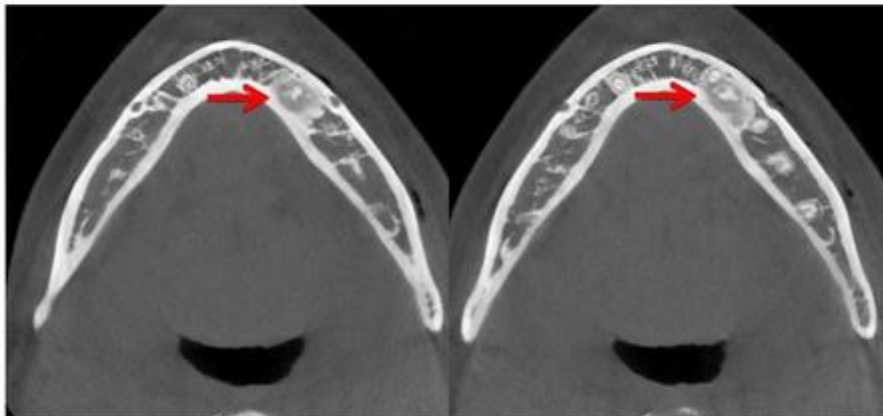
## B. Radiopaque lesions

B. Radiopaque lesions			
Periapical 	Pericoronal 	Specific anatomic anomalies	Not necessarily contact with tooth 
Cementoblastoma	Odontoma	<u>Torus mandibularis</u>	Odontoma
Periapical cemental dysplasia		<u>Torus palatinus</u>	Bone island (osteoma)
Condensing osteitis			Fibrous dysplasia
<b>Cemento-ossifying fibroma</b>			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*

common, uncommon\*

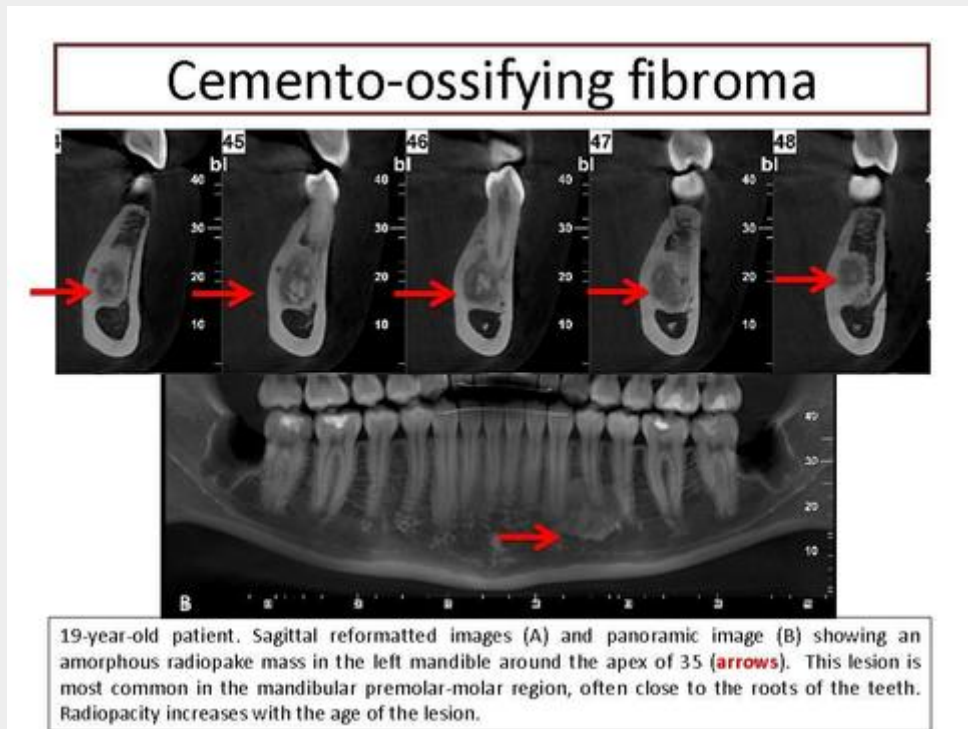
dia107.jpg

## Cemento-ossifying fibroma



19-year-old patient. Axial images showing an amorphous radiopaque mass in the left mandible around the apex of 35 (arrows).

dia108.jpg



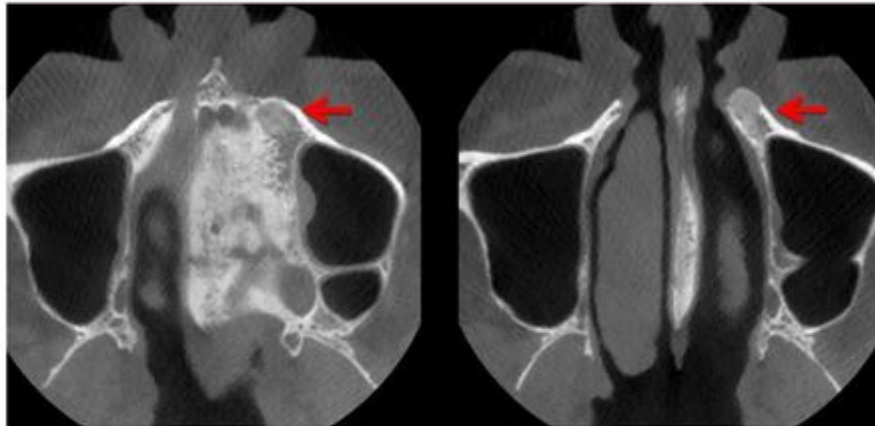
dia109.jpg

### B. Radiopaque lesions

B. Radiopaque lesions			
Periapical	Pericoronal	Specific anatomic anomalies	Not necessarily contact with tooth
Cementoblastoma	Odontoma	<u>Torus mandibularis</u>	<u>Odontoma</u>
Periapical cemental dysplasia		<u>Torus palatinus</u>	<u>Bone island (osteoma)</u>
Condensing osteitis			<u>Fibrous dysplasia</u>
Cemento-ossifying fibroma			Sclerosing osteomyelitis
			Paget's disease
			Osteochondroma*
			Chondroma*
			Osteoblastic metastasis*
<small>common, uncommon*</small>			

dia110.jpg

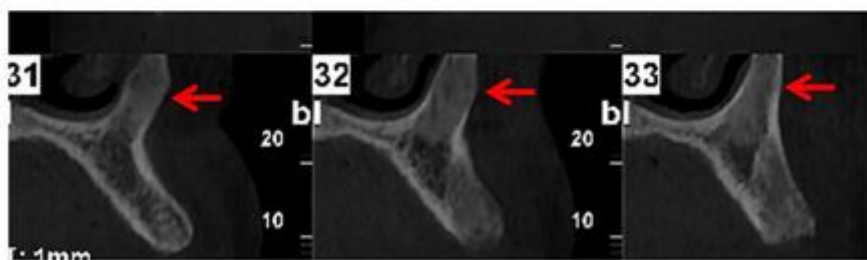
## Fibrous dysplasia



44-year-old patient. Adjacent axial images showing characteristic ground glass and slight bony expansion of the maxilla (**arrow**). There is no relationship with the teeth. Fibrous dysplasia can be monostotic or polyostotic and may involve other skeletal elements and is not restricted to the craniofacial bones. Craniofacial fibrous dysplasia of the maxilla is often monostotic.

dia111.jpg




## Fibrous dysplasia



44-year-old patient. Adjacent parasagittal reformatted images showing characteristic ground glass and slight bony expansion of the maxilla (**arrow**). There is no relationship with the teeth. Fibrous dysplasia can be monostotic or polyostotic and may involve other skeletal elements and is not restricted to the craniofacial bones. Craniofacial fibrous dysplasia of the maxilla is often monostotic. In jaws lesions, there is often lack of sharp margination and the lamina dura of the teeth is often effaced. Mandibular lesions may cause superior displacement of the mandibular canal, which is not seen in most other jaw lesions.

dia112.jpg

## C. Mixed density lesions

Mixed radiolucent- radiopaque lesions		
Periapical 	Pericoronar 	Not necessarily contact with tooth 
Cemento-ossifying fibroma	Adenomatoid odontogenic tumor	Osteomyelitis
Periapical cemental dysplasia	Calcifying epithelial odontogenic tumor	Fibrous dysplasia
Cementoblastoma	Calcifying odontogenic cyst	Page's disease
		Calcifying epithelial odontogenic tumor
		Calcifying odontogenic cyst
		Osteoblastic metastasis*
		Osteosarcoma*
		Chondroma*
		Odontogenic myxoma*
		Florid cemental dysplasia*

uncommon\*

dia113.jpg

## D. Clinical indications

1. Dental implants
  - A. Preoperative evaluation
  - B. Postoperative evaluation
2. Teeth impaction
3. Structural Teeth Anomalies
  - A. Number
  - B. Location
  - C. Morphology
4. (Peri-apical) infection/inflammation
5. Tumor- and tumorlike conditions
  - A. Radiolucent lesions
  - B. Radiopaque lesions
  - C. Mixed density lesions
6. (Dental) trauma

dia114.jpg

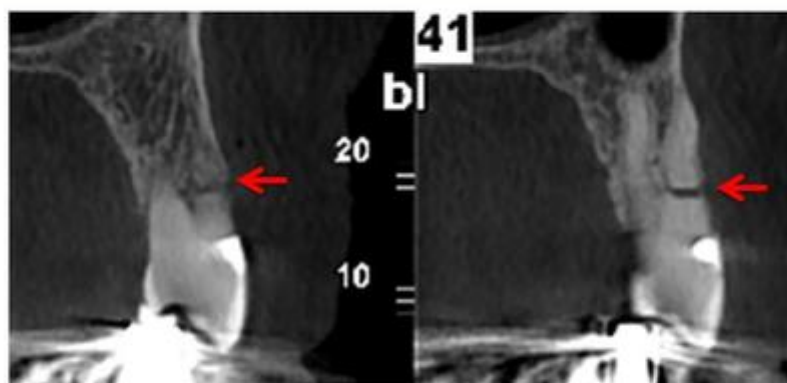
## 6. Dental trauma



73-year-old patient presenting after direct blow at the maxilla. Panoramic reformat showing a horizontal fracture at the bucal root of 25 (**arrow**).

dia115.jpg

## 6. Dental trauma



73-year-old patient presenting after direct blow at the maxilla. Parasagittal reformat showing a horizontal fracture at the bucal root of 25 (**arrows**).

slide 5.jpg

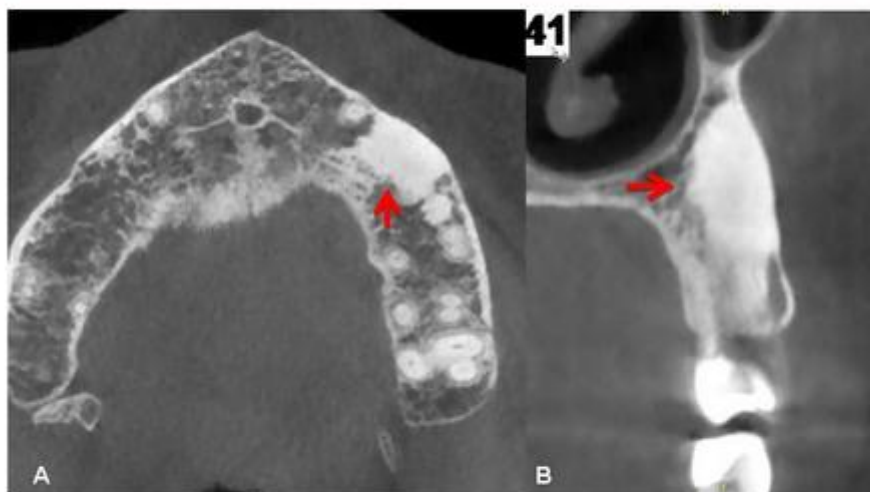
## A. Historical perspective

- **CBCT:** nowadays standard of care in dental radiology
- **Initially:** used in the clinical practice of dentists and oral surgeons
- **Nowadays:** installed in many radiology departments  
→ evaluation of a variety of dental and nondental applications



slide 99.jpg

## Bone island (osteoma)

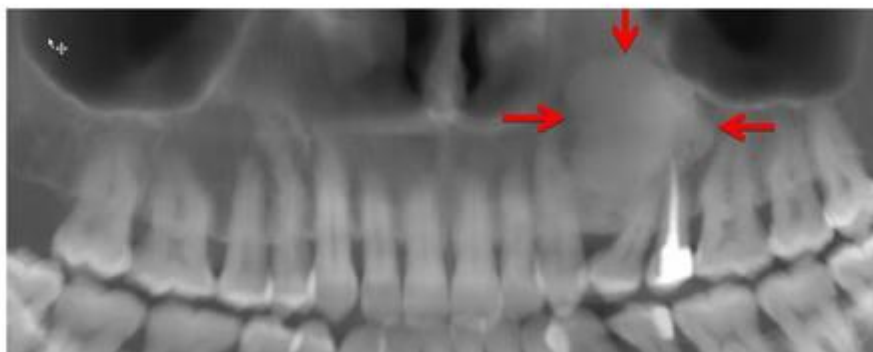


43-year-old patient. Axial (A) and parasagittal reformatted image (B) showing a radioopaque lesion (osteoma) within the left maxilla (arrows). There is subtle bulging of the vestibular cortical bone.



slide100.jpg

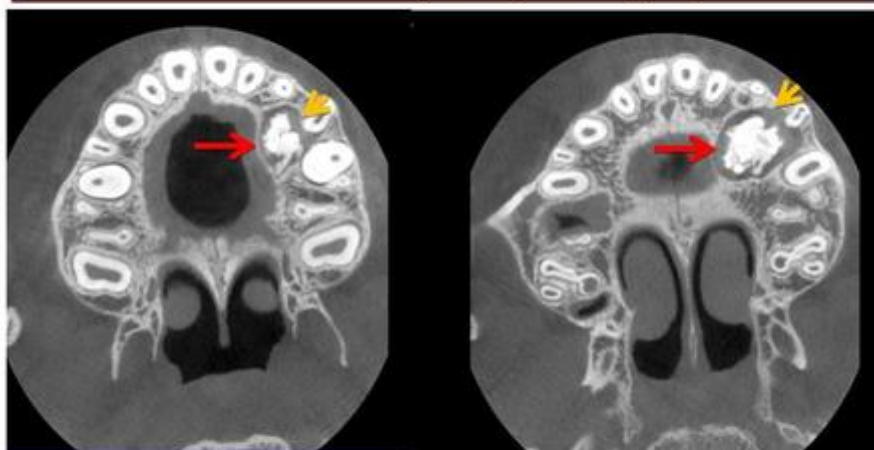
### Bone island (osteoma)



43-year-old patient. Panoramic image showing a radiopaque lesion (osteoma) within the left maxilla (arrows). Multiple osteomas are associated with Gardner syndrome (including desmoid and colorectal polyposis, lipomas, leiomyomas and cutaneous epidermoid cysts).

slide 104.jpg

### Odontoma (complex type)



11-year-old patient. Axial images showing an amorphous radiopaque lesion within the left upper jaws (arrows). Odontomas are hamartomas of aborted tooth formation. There are 2 types.

**Type 1** or compound odontoma consists of multiple small tooth-like structures.

**Type 2** or complex odontoma consists of an amorphous calcified mass. Odontomas are usually surrounded by a lucent follicle formed by a fibrous capsule (small arrows). The lesion is usually seen in children and young adults.