

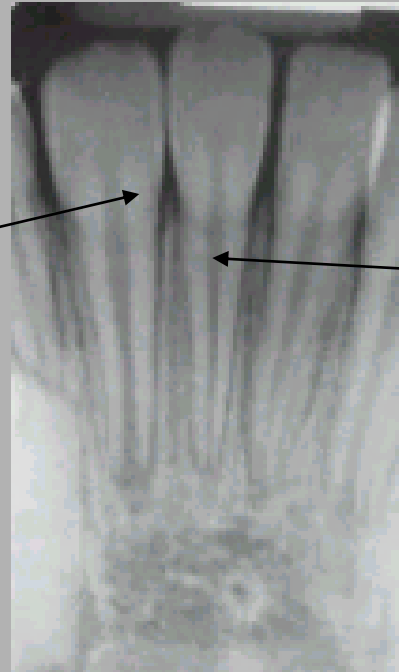
# Radiology for stomatologists – plain Xray imaging – principles, pathology



# X-ray - attributes

- Electromagnetic radiation of short wavelength produced when high-speed electrons strike a solid target
- Ability to pass through tissues where is partially absorbed

Radio-opacity  
(light)



Radiolucency  
(dark)

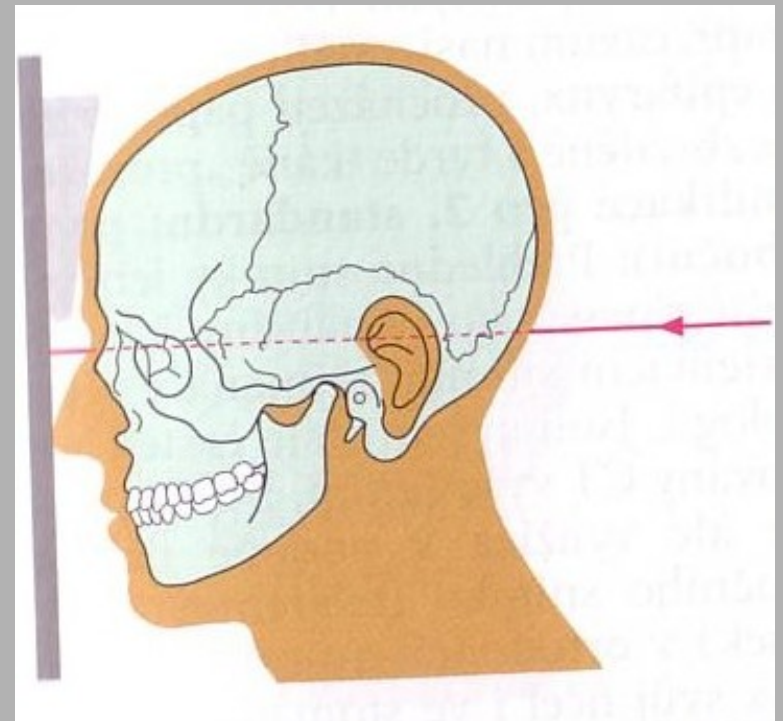
# Plain X ray imaging

- 1) Imaging of skull – basic projections
- 2) Dental radiographs
  - A) Intraoral imaging
  - B) Extraoral imaging

# 1) Skull skiagrams - basic projections

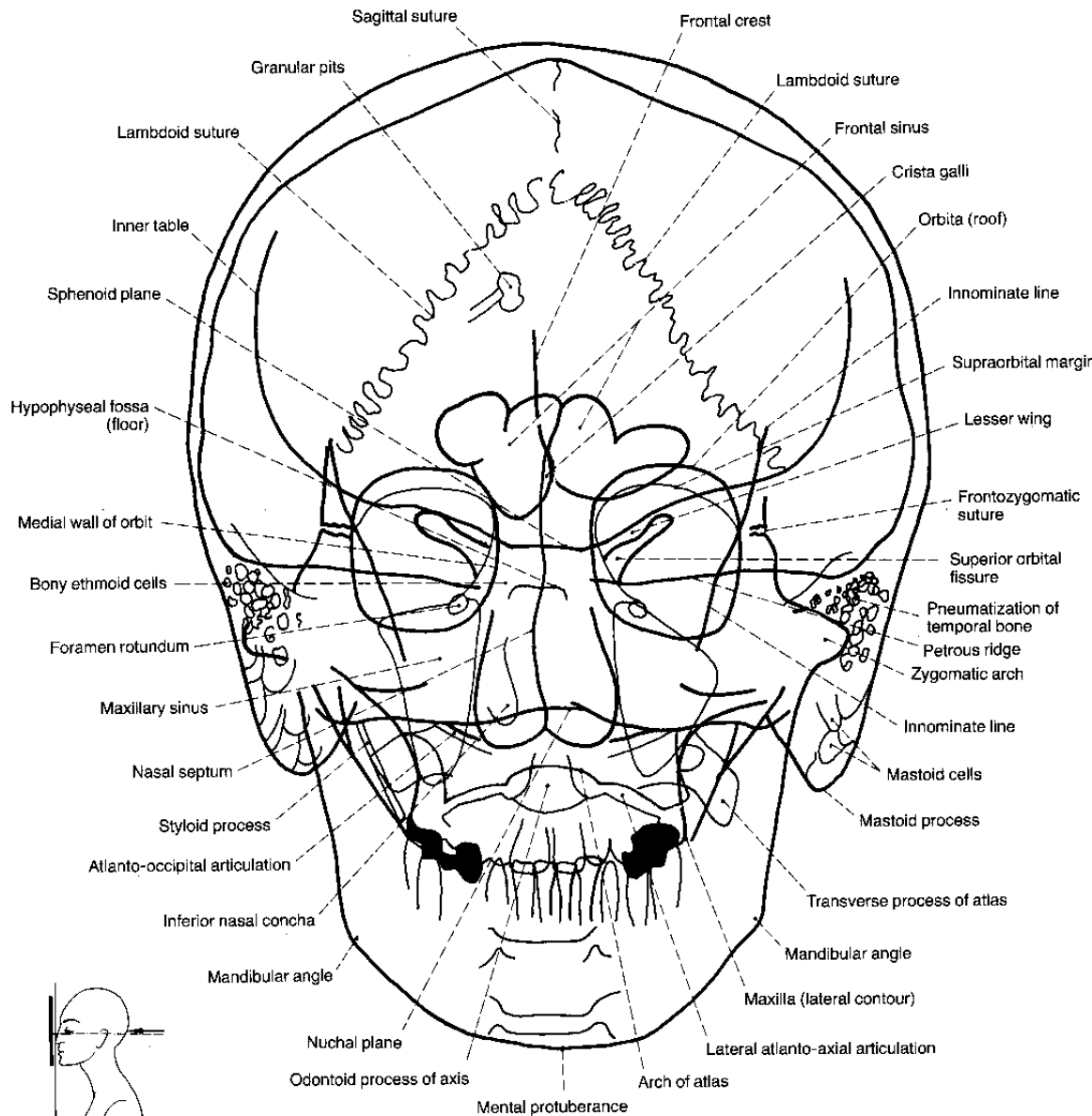
- Picture of the cranium – traumatic
- Projection of paranasal sinuses
- Orbits
- Os temporale
- Temporo-Mandibular Joint

# Cranium – dorso-ventral and lateral projection

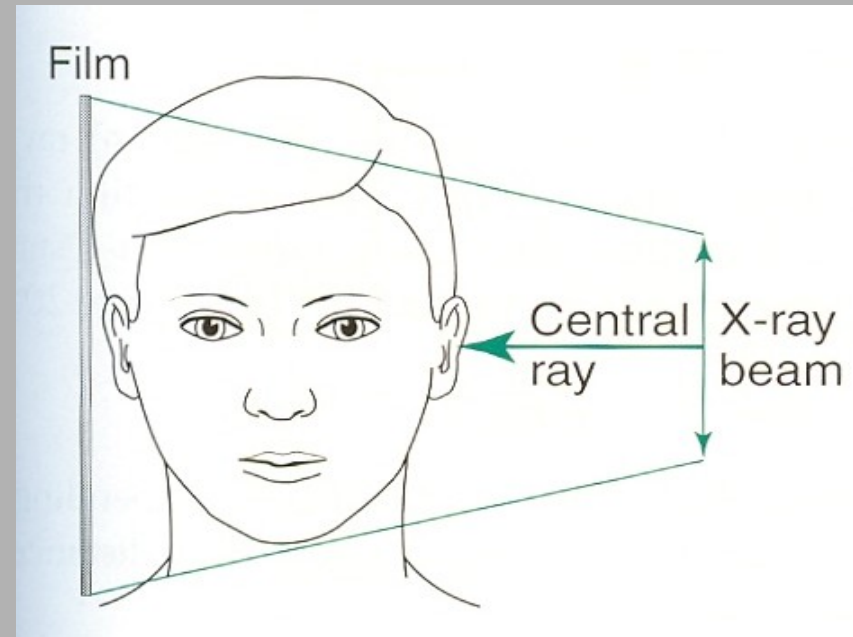
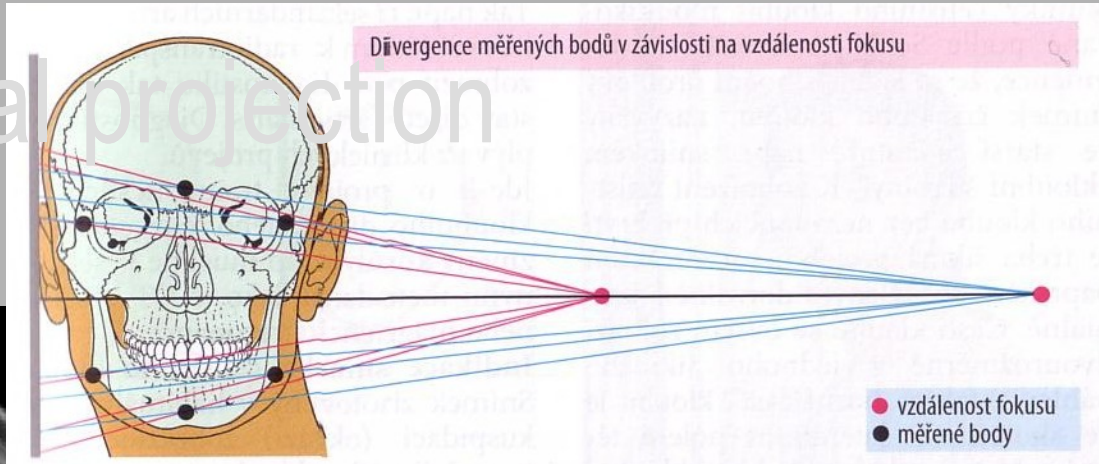


- Nose and forehead touch the cassette
- X-ray pass through the protuber. occipitalis perpendicularly to cassette

# Cranium – dorso-ventral and lateral projection

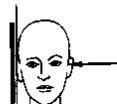
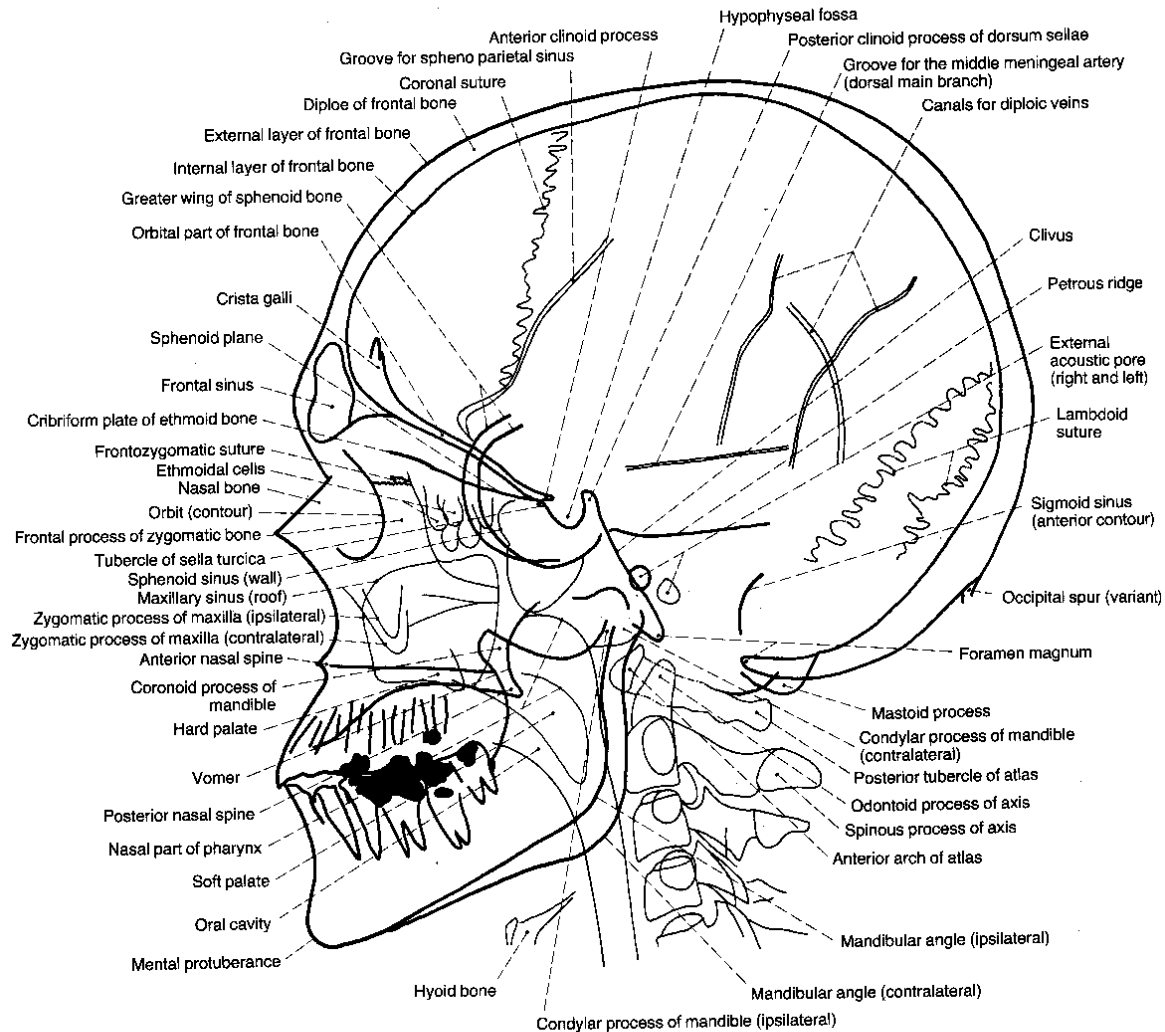


# Cranium – lateral projection



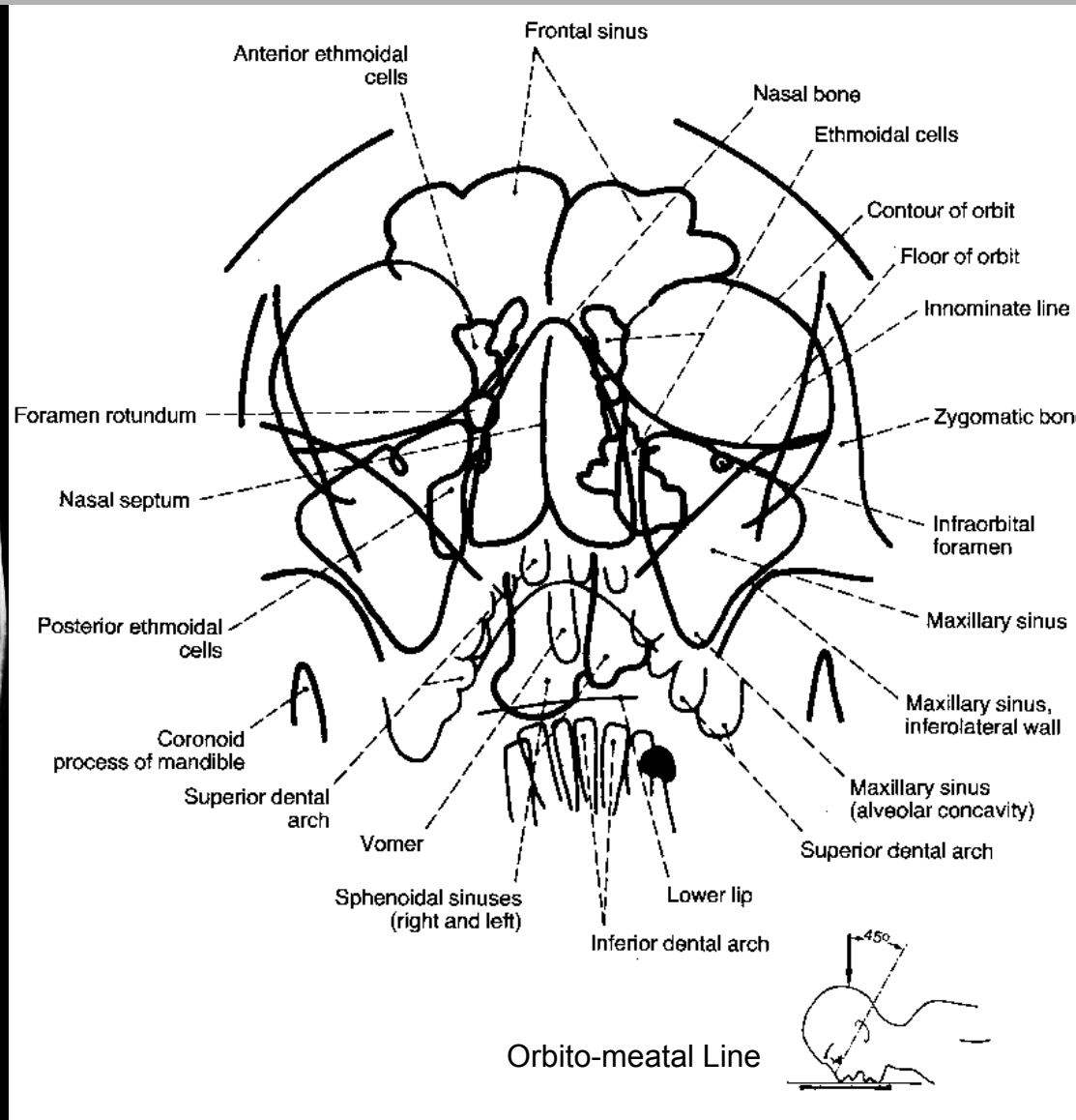
- Central beam goes through the acoustic meatus
- Perpendicular to the cassette

# Cranium – lateral projection

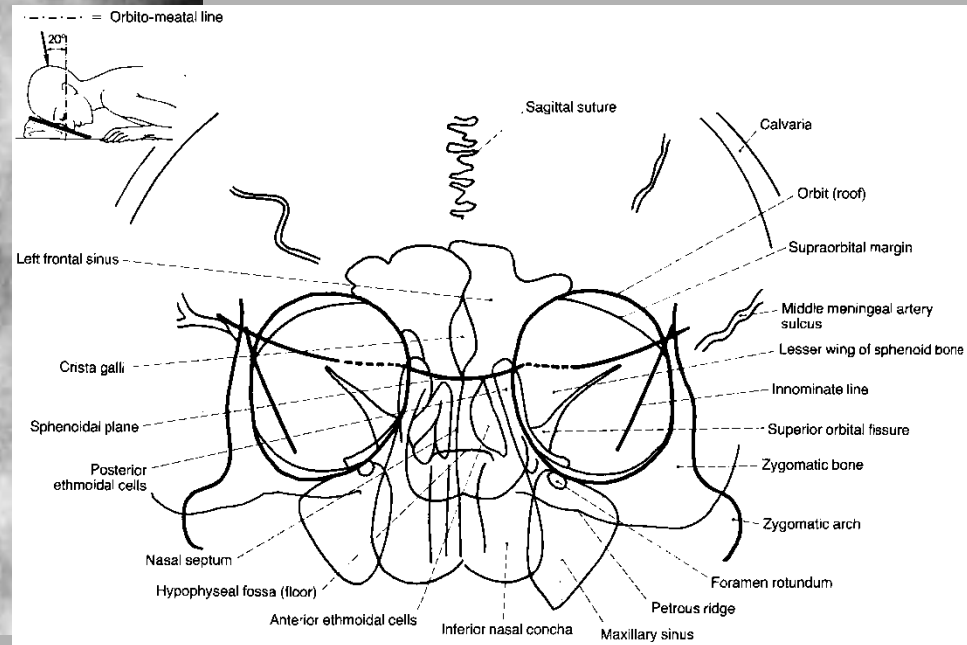
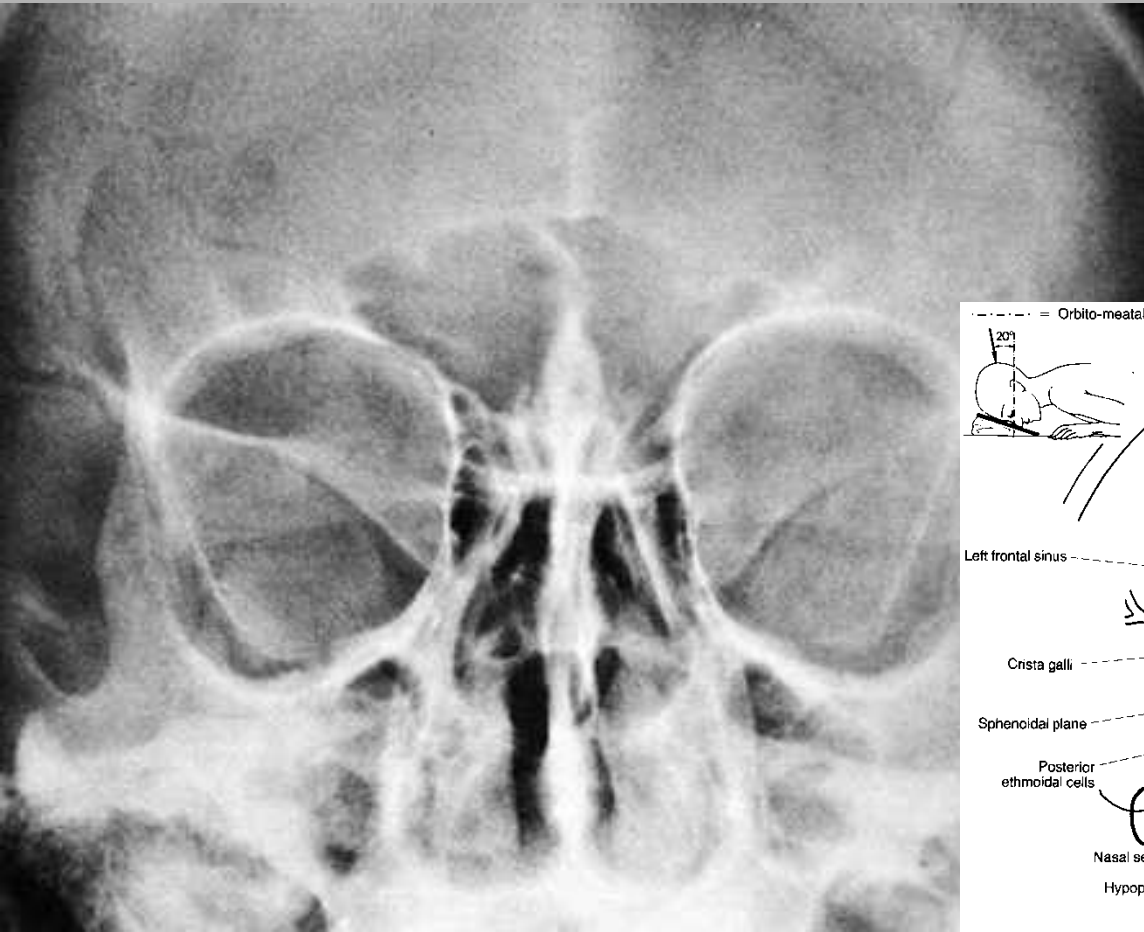




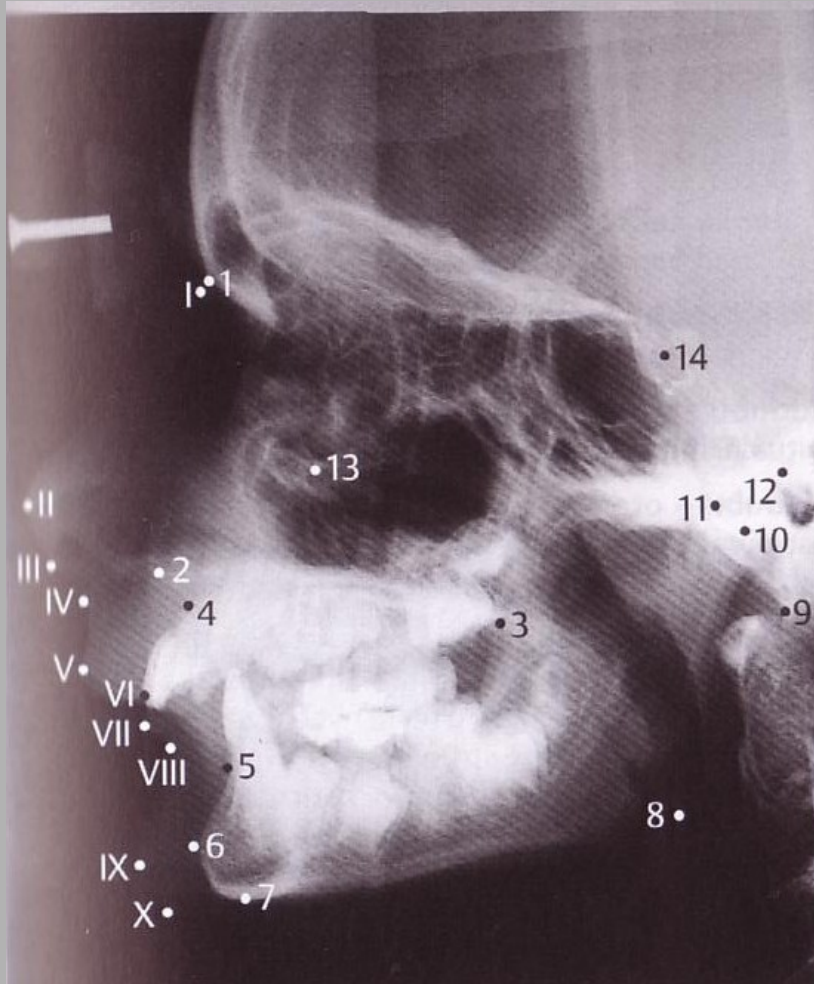
# Paranasal sinuses – Water's projection



# Orbits – dorso-ventral projection



# Orbits – lateral projection



## Skeleton Points

- |    |                         |
|----|-------------------------|
| 1  | Nasion                  |
| 2  | Spina nasalis anterior  |
| 3  | Spina nasalis posterior |
| 4  | Bod A                   |
| 5  | Bod B                   |
| 6  | Pogonion                |
| 7  | Menton                  |
| 8  | Gonion                  |
| 9  | Basion                  |
| 10 | Articulare              |
| 11 | Condylion               |
| 12 | Porion                  |
| 13 | Orbitale                |

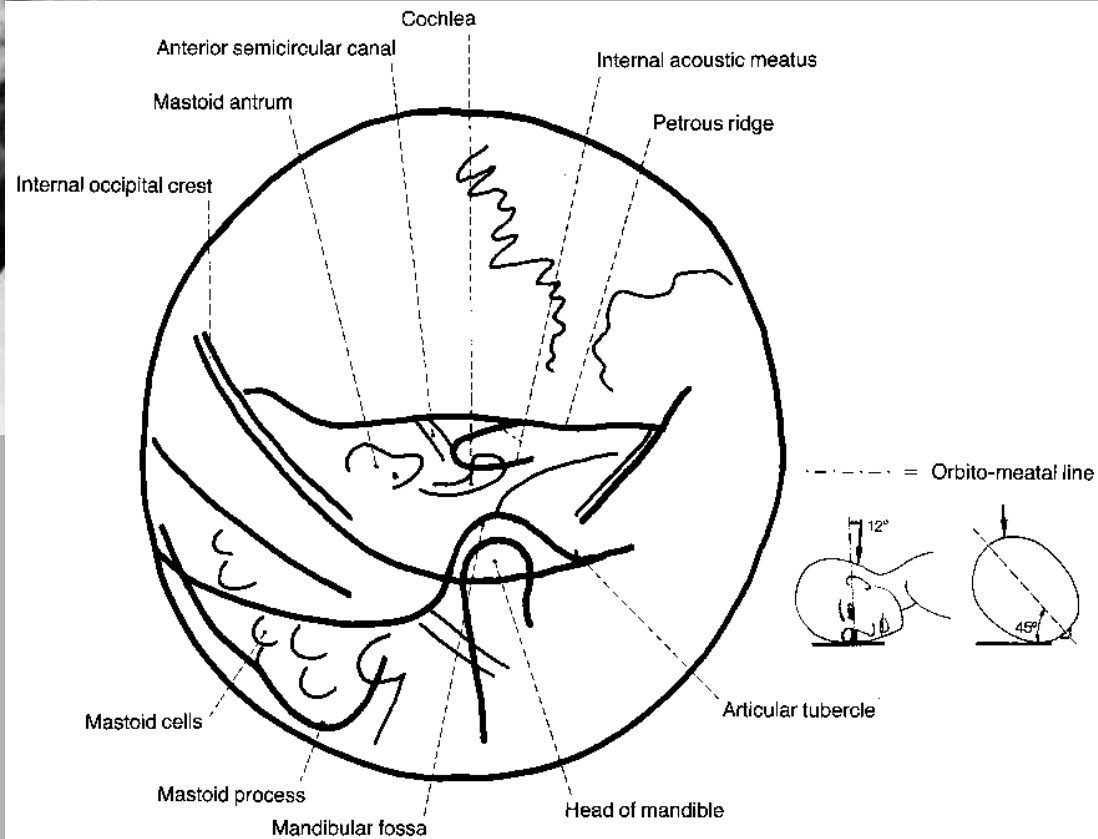
14 sella

## Soft Tissue Points

- |      |                  |
|------|------------------|
| I    | Kožní nasion     |
| II   | Špička nosu      |
| III  | Subnasale        |
| IV   | Subspinale       |
| V    | Labrale superius |
| VI   | Stomion          |
| VII  | Labrale inferius |
| VIII | Submentale       |
| IX   | Kožní pogonion   |
| X    | Kožní gnathion   |

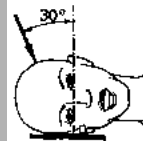
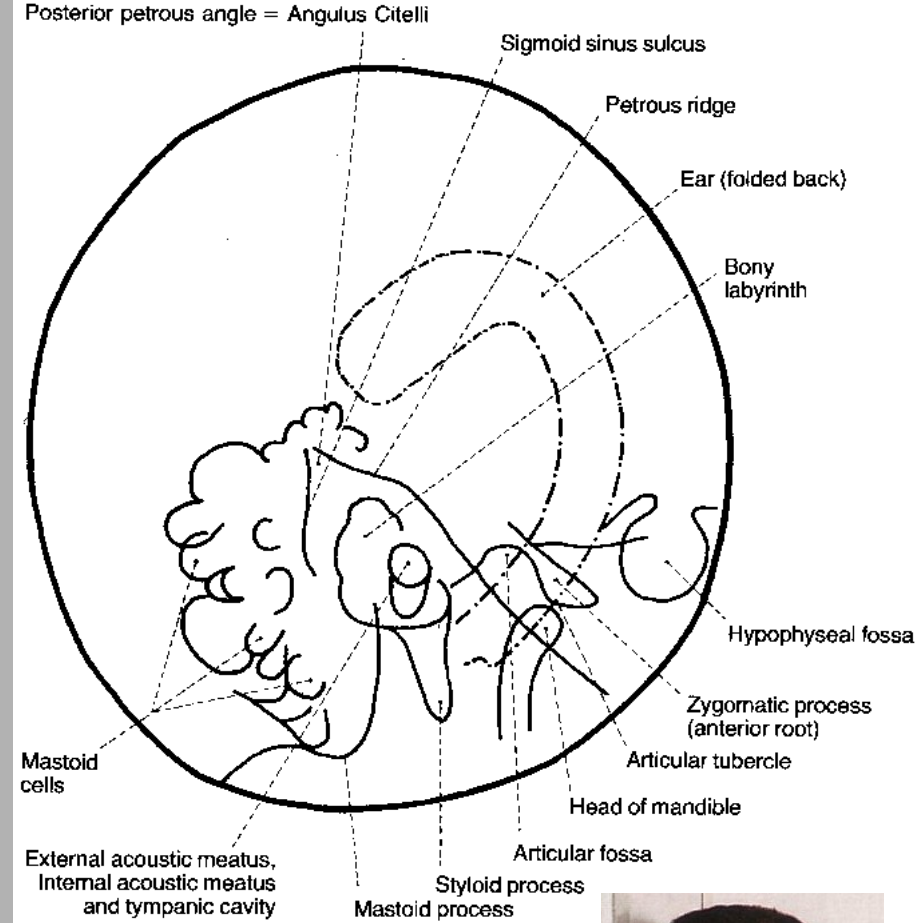
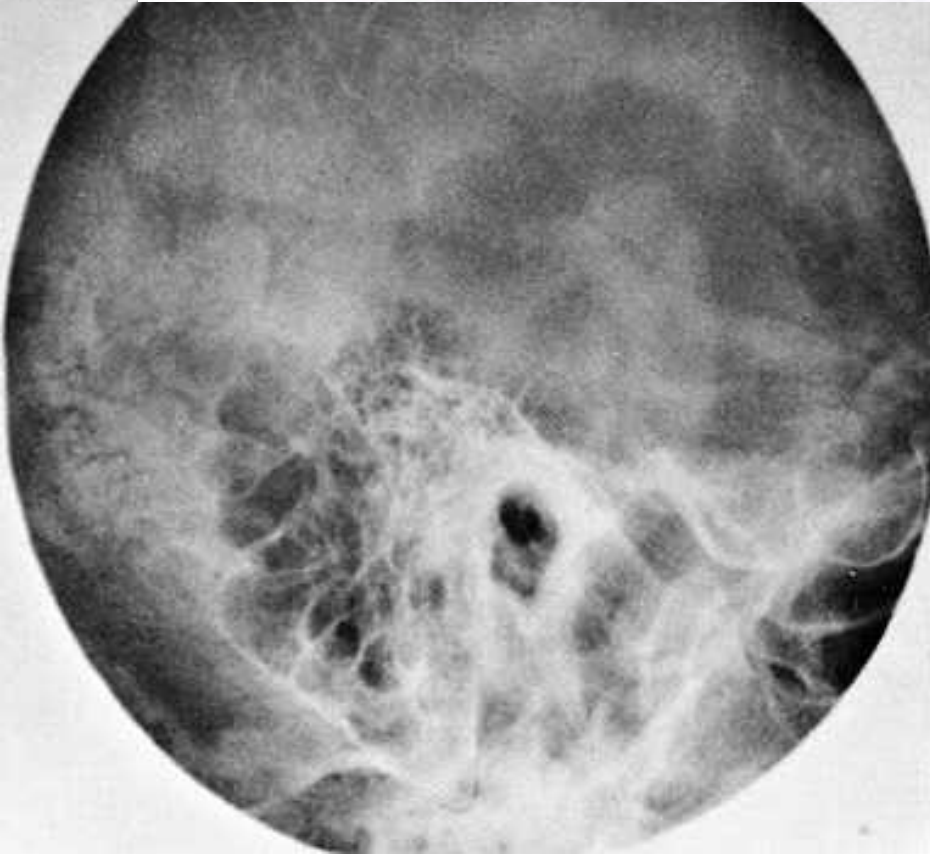
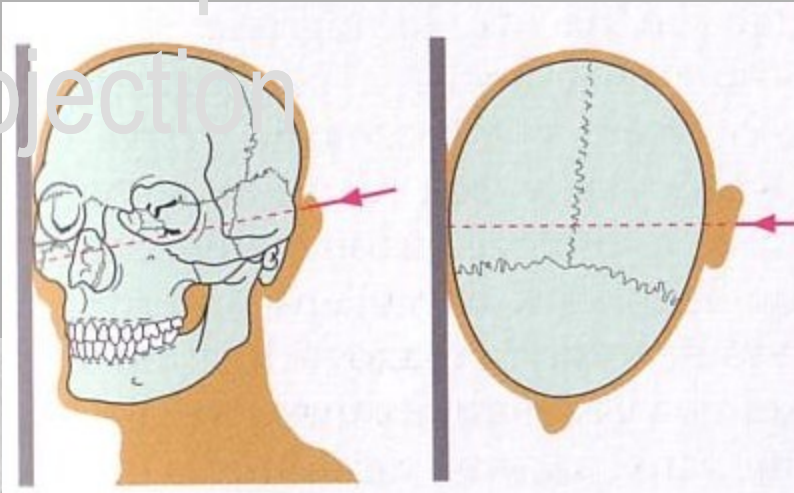
# Os temporale – Stenver's – semisagittal pr.

- [http://rtg.misto.cz/\\_MAIL\\_/hlava/11.jpg](http://rtg.misto.cz/_MAIL_/hlava/11.jpg)



# Os temporale – Schüller's – semilateral projection

[http://rtg.misto.cz/\\_MAIL\\_/hlava/12.jpg](http://rtg.misto.cz/_MAIL_/hlava/12.jpg)

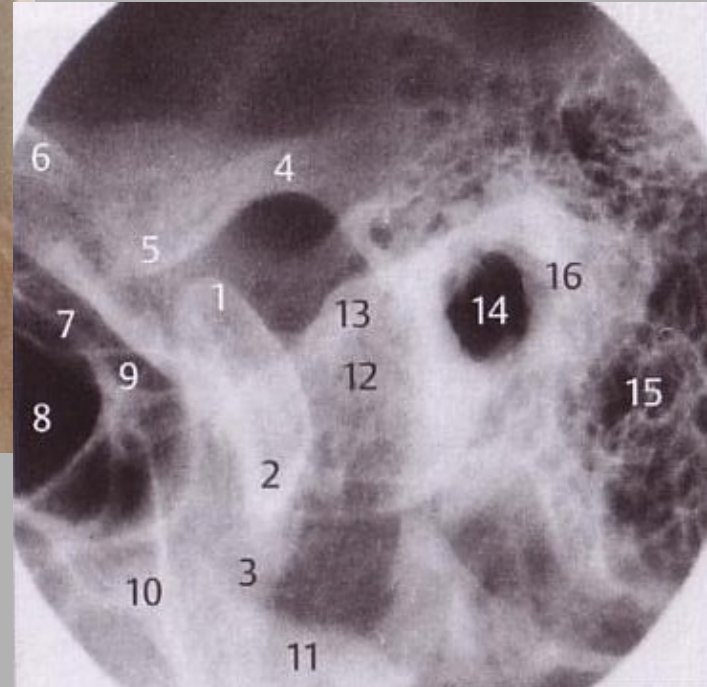
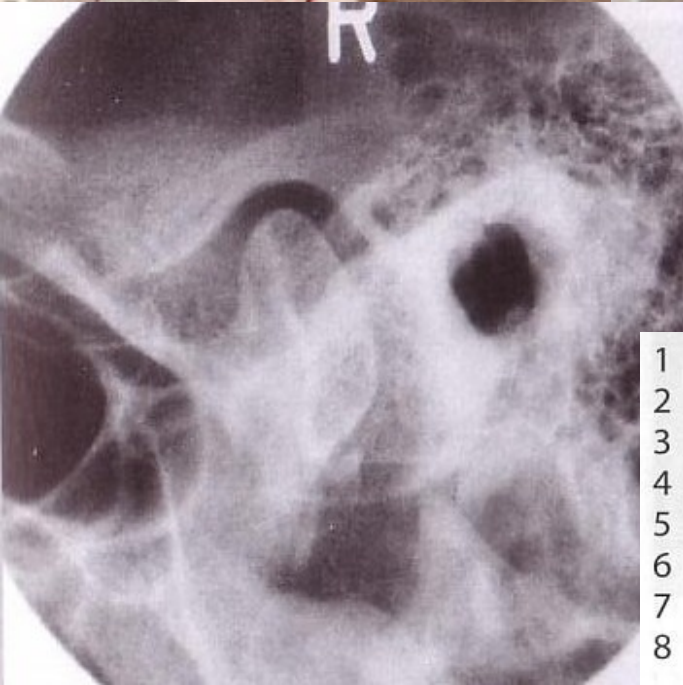


----- = Orbito-meatal line



# Os temporale – Schüller's – semilateral

projection

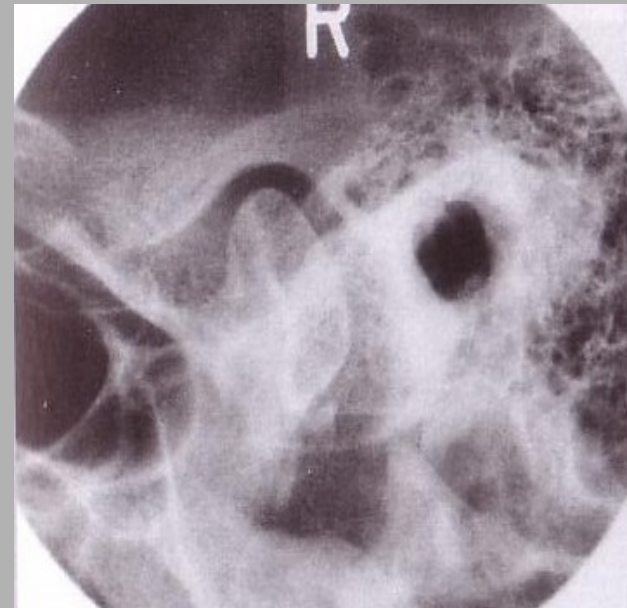
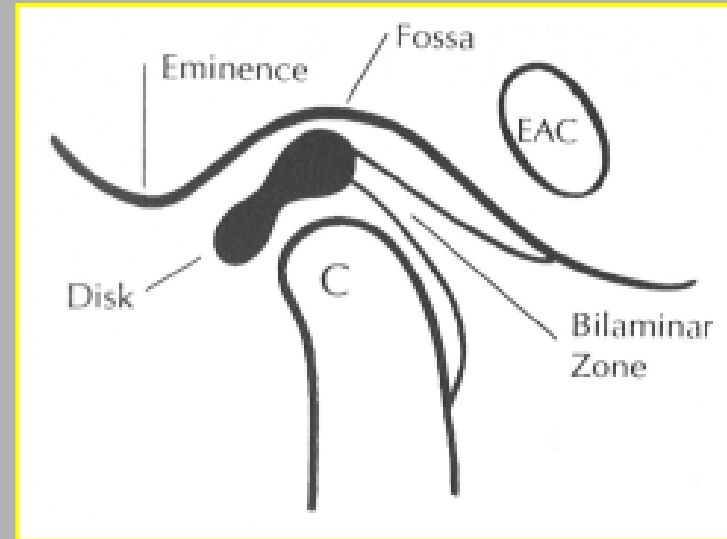


- 1 Kondylus, laterální pól
- 2 Kondylus, mediální pól
- 3 Processus condylaris mandibulae
- 4 Fossa glenoidalis, laterální části
- 5 Eminentia articularis, laterální části
- 6 Arcus zygomaticus
- 7 Sella turcica
- 8 Sinus sphenoidalis

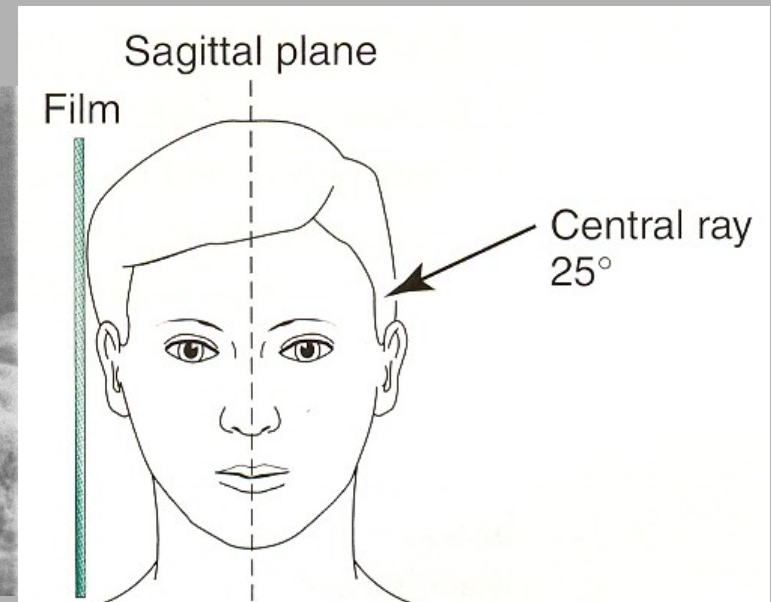
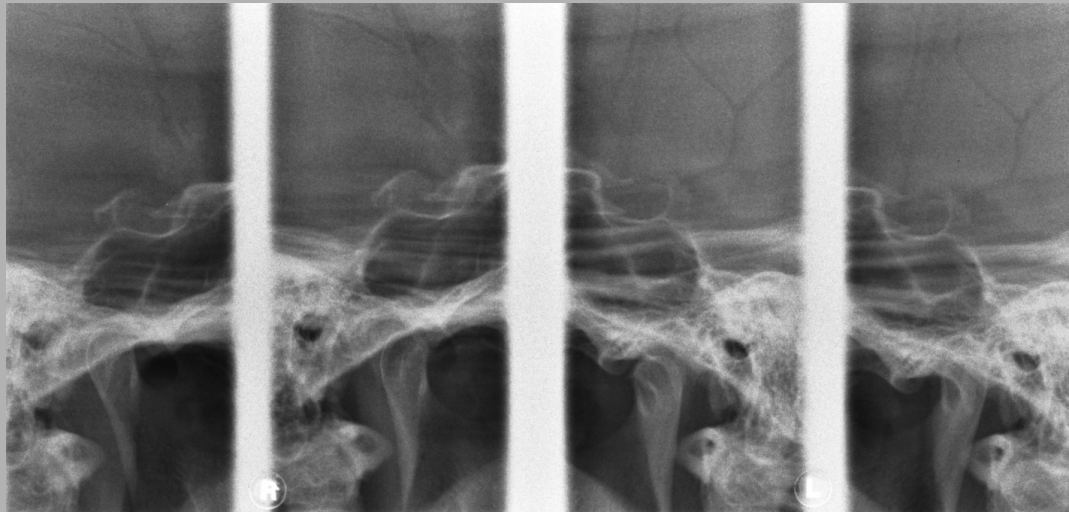
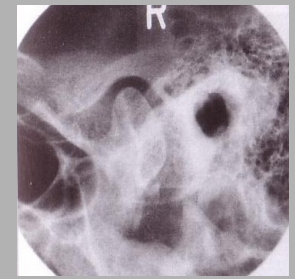
- 9 Processus clinoideus posterior
- 10 Clivus
- 11 Pars petrosa (vzdálenější)
- 12 Pars petrosa (přilehlá)
- 13 Horní hrana pyramid (přilehlá)
- 14 Porus acusticus externus
- 15 Celullae mastoideae
- 16 Pars tympanica ossis temporalis

# Temporomandibular joint (TMJ)

- Intracapsul. disease = diskopathy- we can see calcifications
- Correct position of temporo mandible joint (TMJ)



# Temporomandibular joint - TMJ



## serial radiogram TMJ

- x-ray beam pass vertical +25° to center of film
- entering 6-7cm over meatus acusticus.

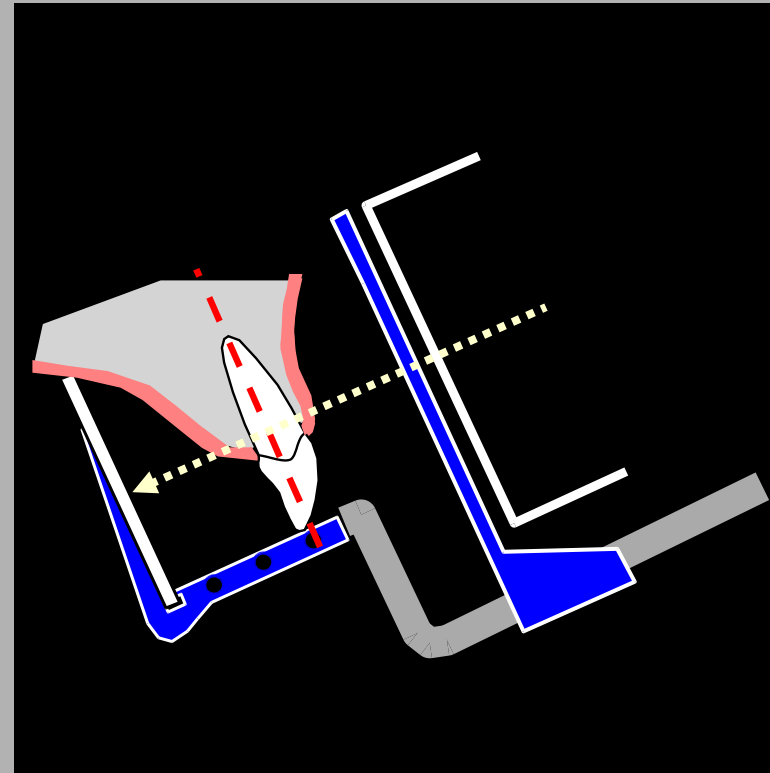
- condyl head
- fossa glenoidalis
- close mouth
- open mouth





# Intraoral X-ray device

- voltage of X-ray tube
  - 50-90 kV
- filtration of primary beam
  - 1,5 mm Al -  $U < 70$  kV
  - 2,5 mm Al -  $U > 70$  kV
- body tube
  - length of body tube = 10-30 cm



# RADIATION PROTECTION

- Use of proper exposure and processing techniques
- Patients should be shielded with lead aprons and thyroid shields.
- These shields should have at least 0.5 mm of lead equivalent.
- Film badges



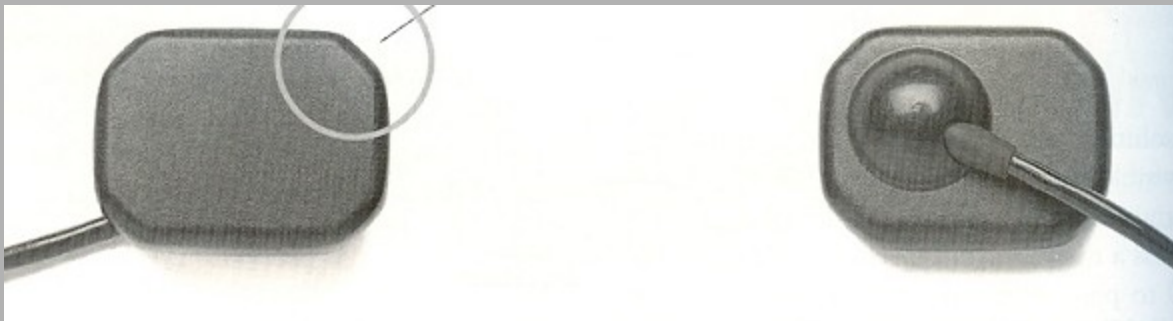
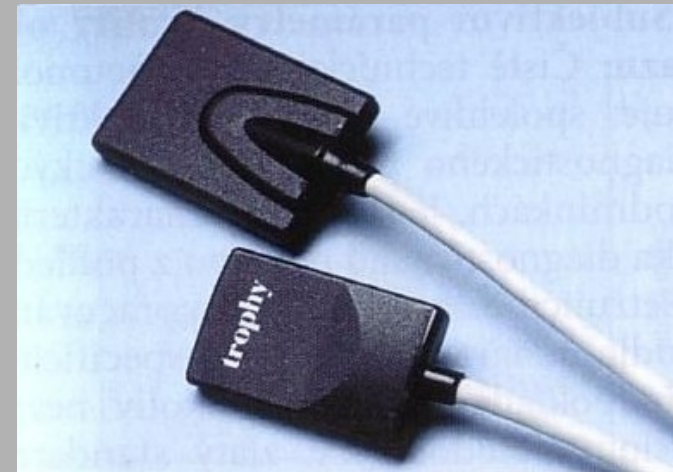
# IMAGE RECEPTORS

- **RADIOGRAPHIC FILM**
- **DIGITAL RECEPTORS**
- **indirect digital imaging**



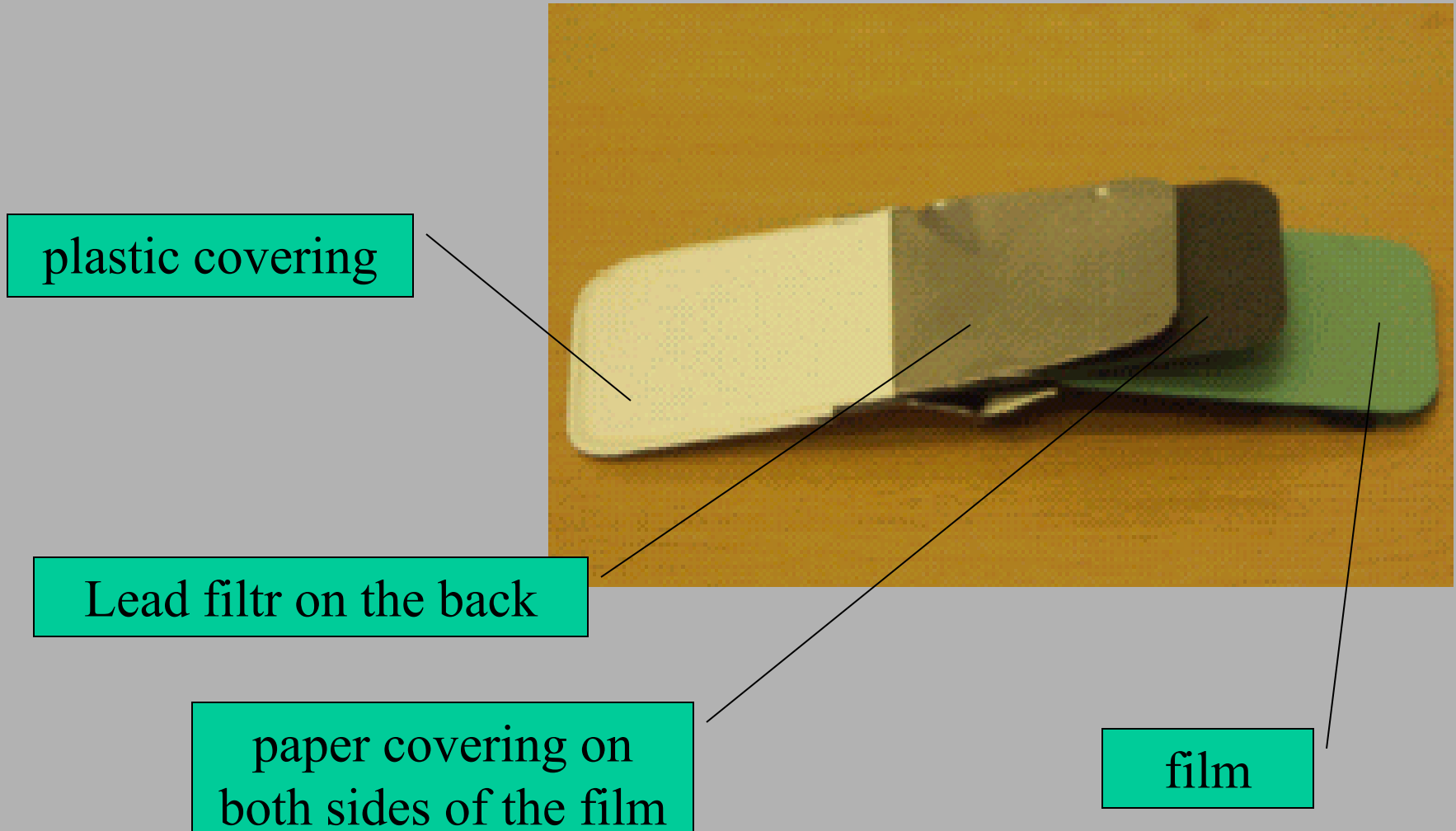
# Conventional and digital technique

- Digital:
  - CCD (charged coupled device) as a sensor



# Films for intraoral exposure

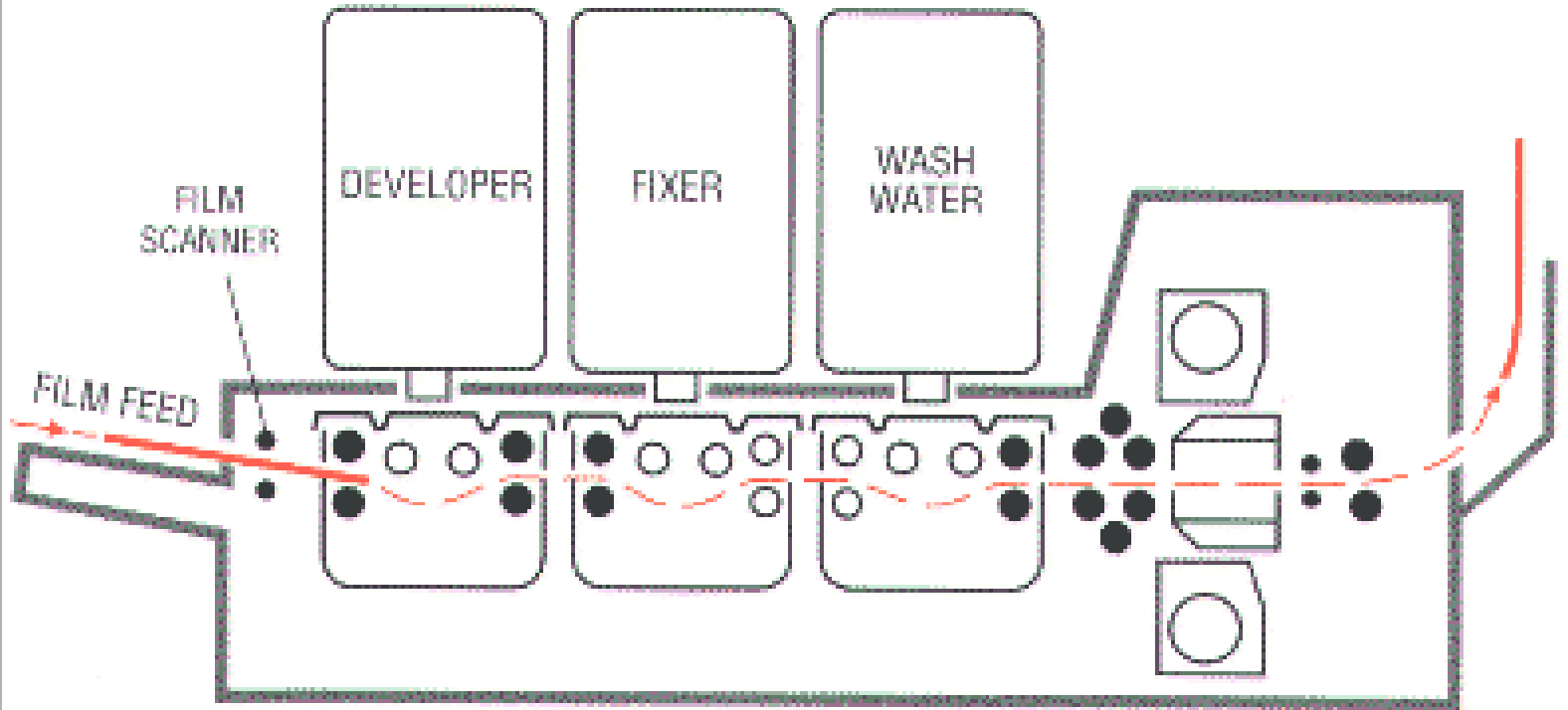
- dental films



# SIZES

- Various sizes available, although only three are usually used routinely:
- For periapical & bitewings
  - 31 X 41 mm
  - 22 X 35 mm
- For occlusal
  - 57 X 76 mm

# Film processing:



- RUBBER ROLLERS
- PVC ROLLERS

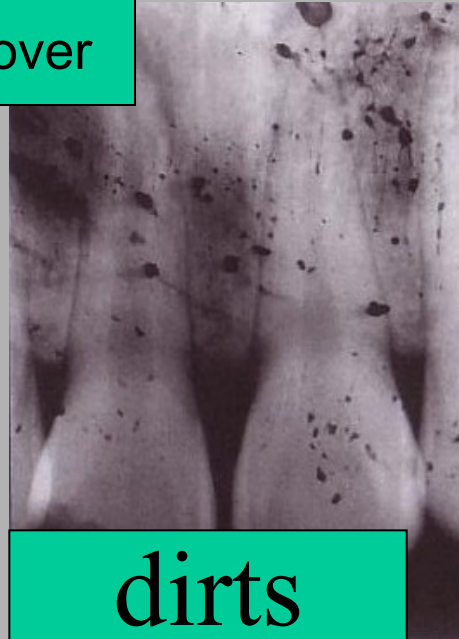
Automatic processing machine





# Conventional film processing - artifacts

too fast taking film out of the cover



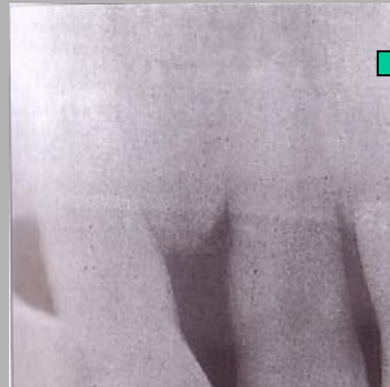
dirts



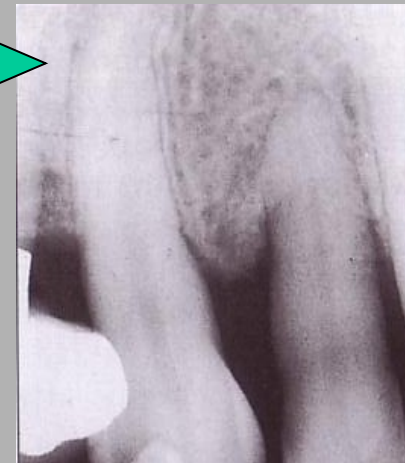
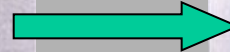
neil



drop of water



cold chemicals  
film is grainy

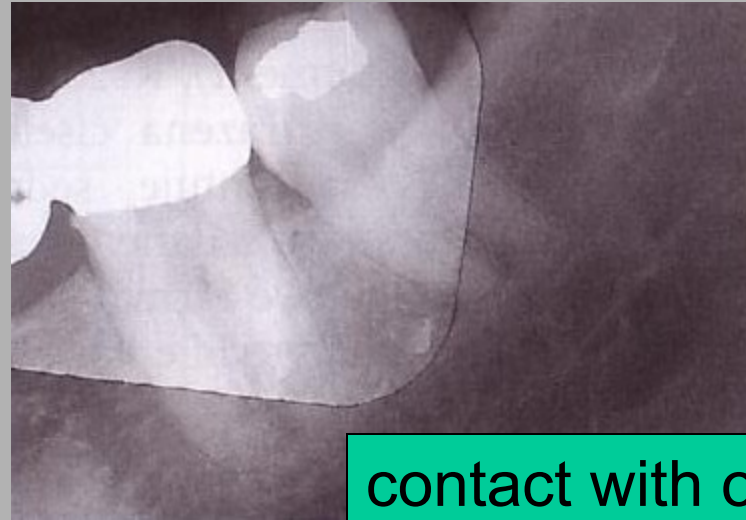


correct temperature

# Conventional film processing - artefacts



fingerprint

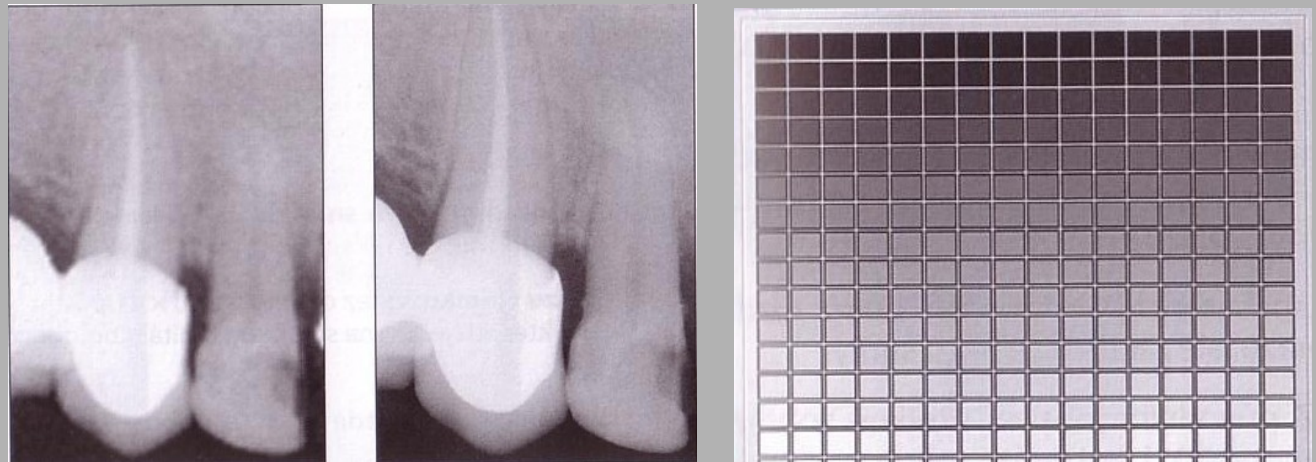
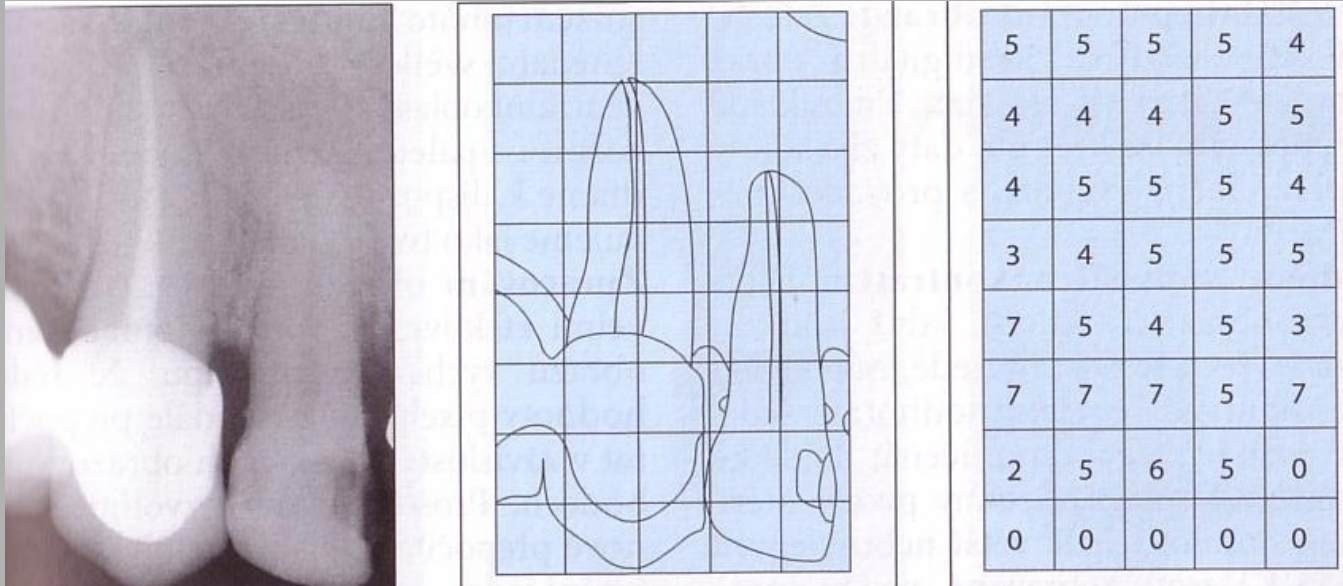


contact with other film



too high temperature during developing

# Digital technique

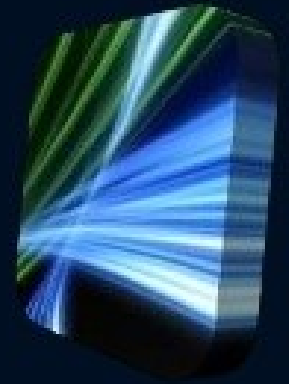


amount of radiation incident on the detector at any spot is coded by gray shade – with 256 different gray shades

# Digital technique - advantages

- filmless performance
- friendly inspecting and storage of pictures
- repeated exposure without medium changing

# Indirect digital imaging



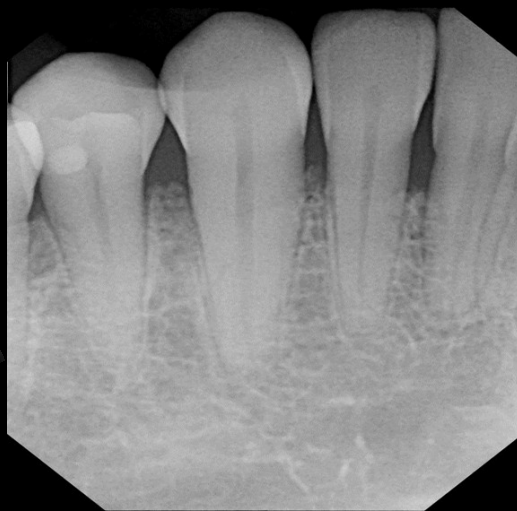
Existing X-ray film digitized using CCD camera

Scans the image

Digitizes displays on computer monitor

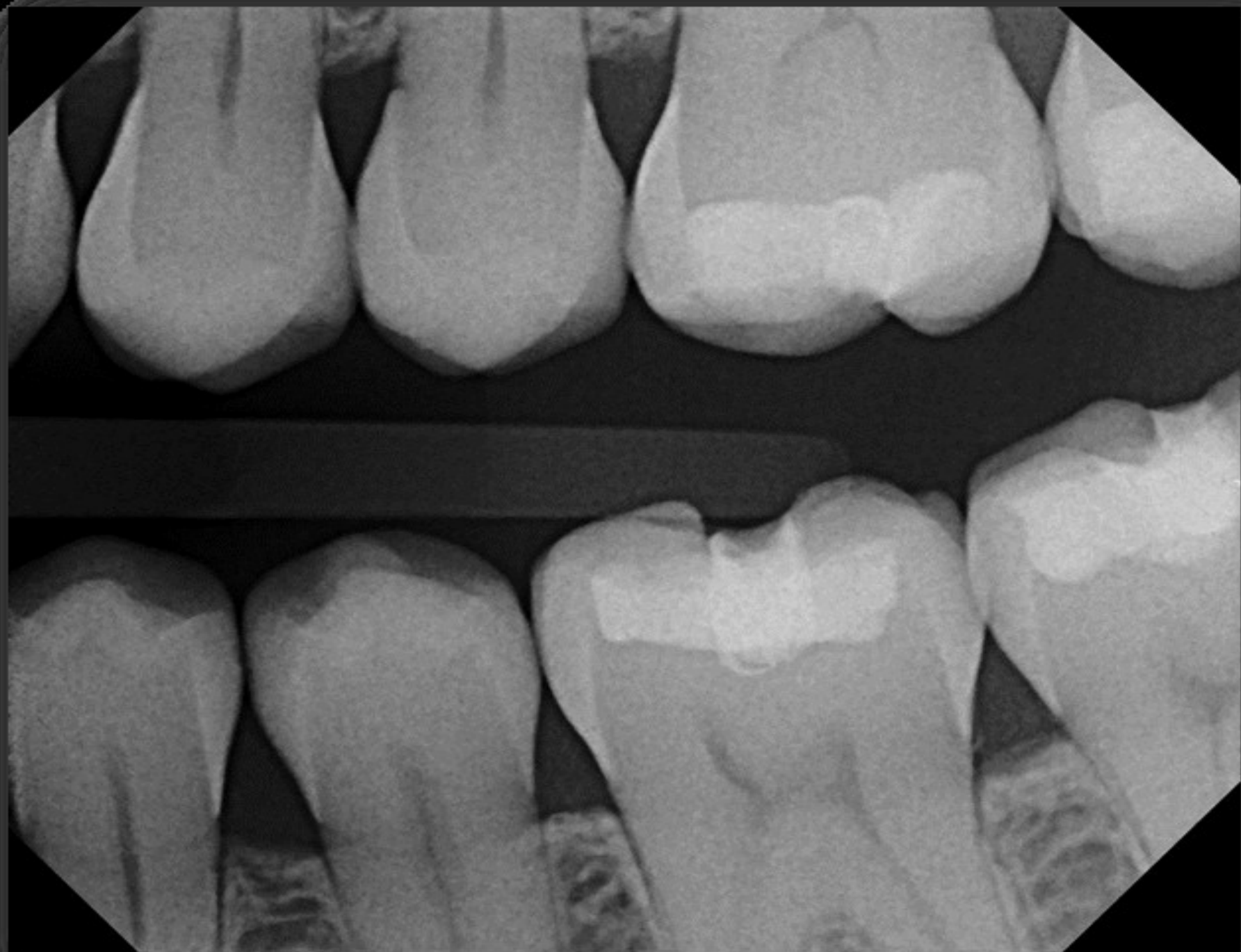
# INTRA ORAL RADIOGRAPHS

- Bitewing
- Occlusal
- Peri apical



# **BITEWING**

- **So called because patient closes the teeth together biting on a wing of card projecting from the tube side of the film**
- **Demonstrates occlusal surfaces, interproximal surfaces of enamel, enamel-dentine junction & the bone levels surrounding the tooth**
- **Used for pre-molars, molars**
- **indications: dental caries, assessment of fillings & crown, periodontology**

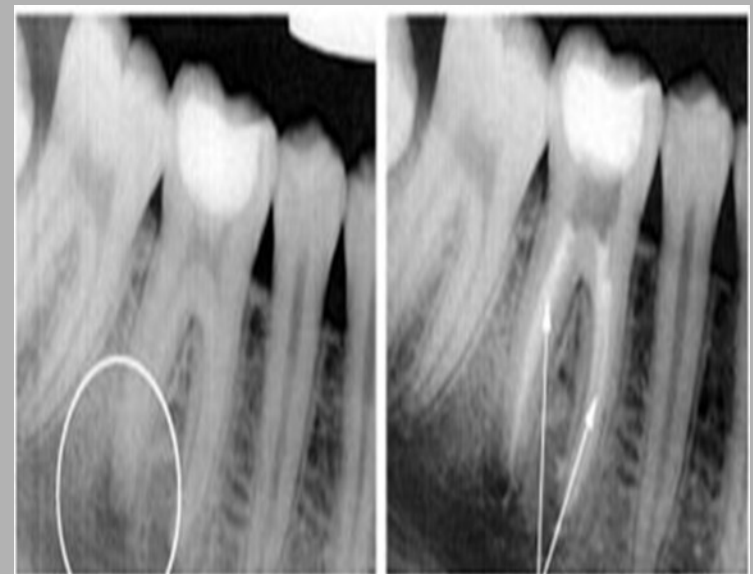
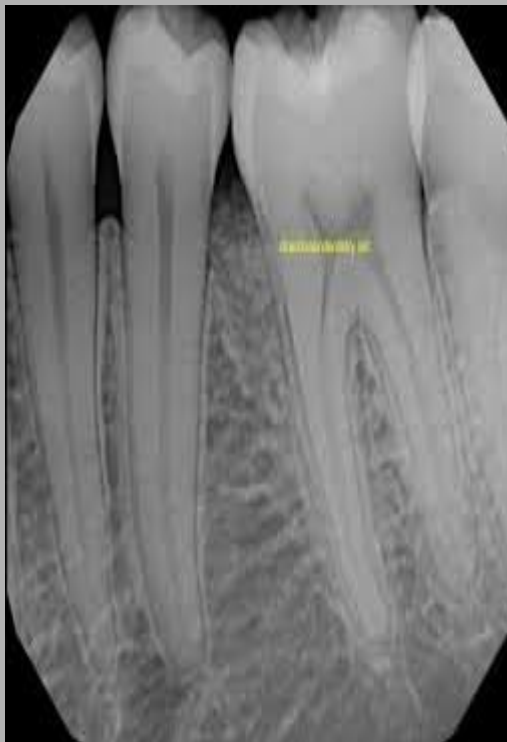






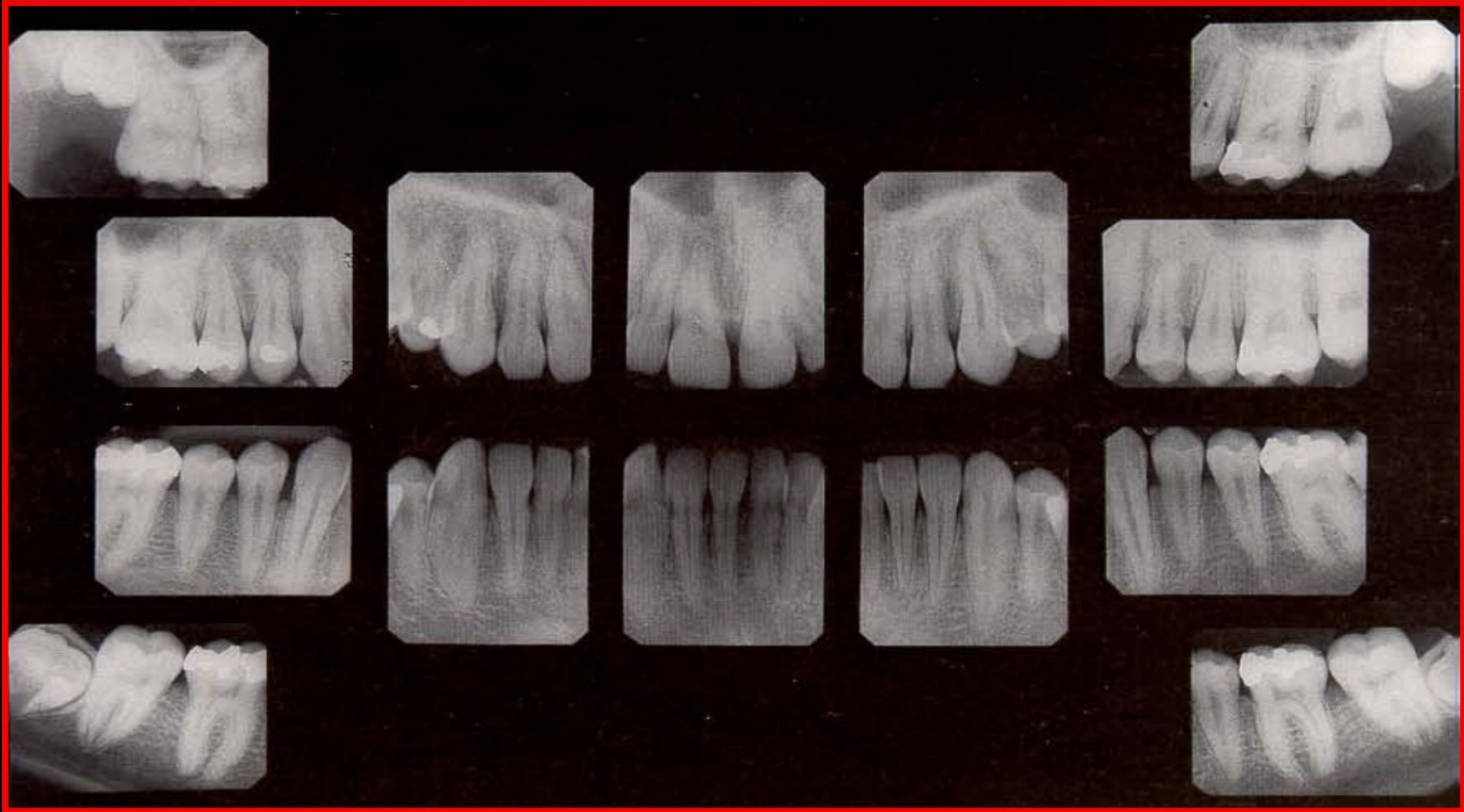
# PERIAPICAL

- Shows usually 2-4 teeth, individual teeth & tissues around apices



Infection, tooth in need of  
Root Canal Treatment

After Root Canal Treatment



## Typical 14 film survey for adults

The central rays is targeted onto the apex; depiction of the alveolar crest is of only secondary importance.

# INDICATIONS

- Detection of **apical infection**
- Assessment of **periodontal** status
- After **trauma to teeth** & **associated alveolar bone**
- Assessment of root morphology **before extraction**
- During **endodontics**
- Detailed evaluation of **apical cyst** & other lesion within the bone
- Evaluation of **implants postoperatively**

# Techniques for Periapical radiography

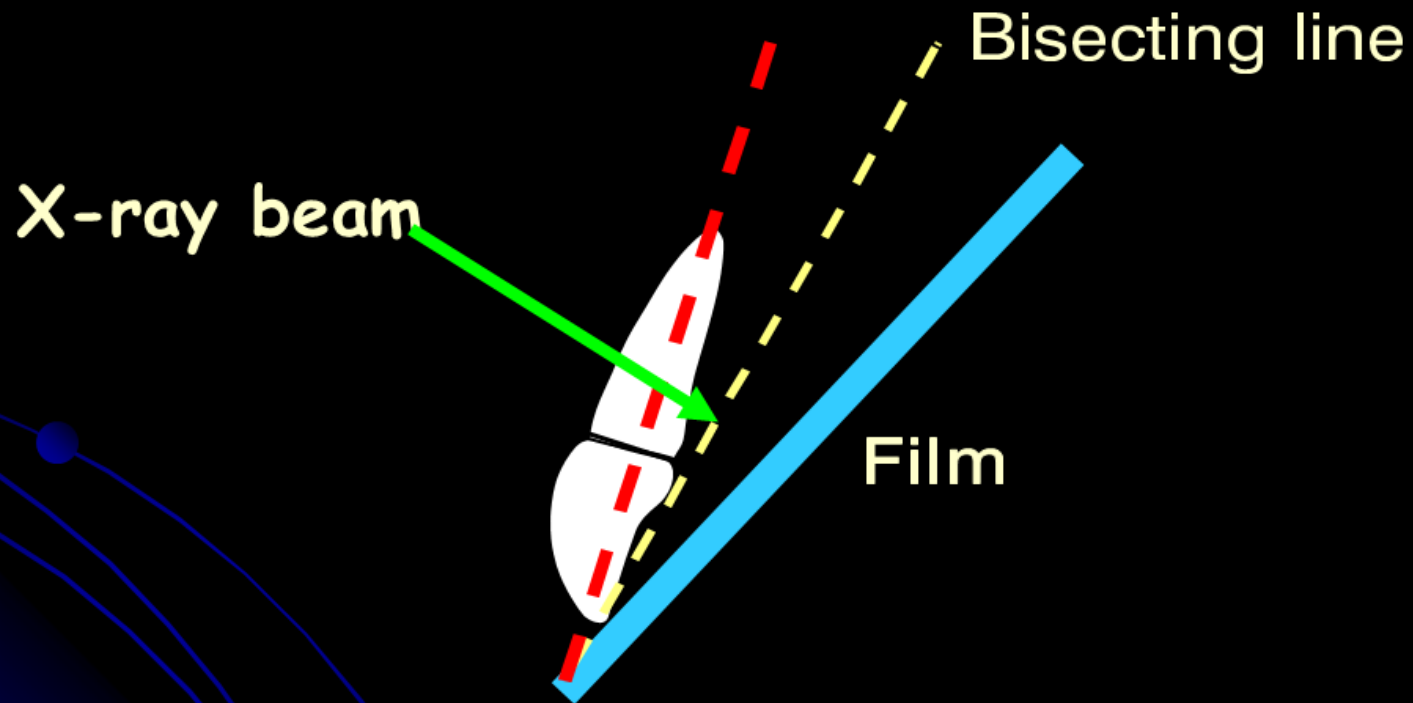
**Paralleling technique**

**Bisecting angel technique.**



# Bisecting angel technique.

---



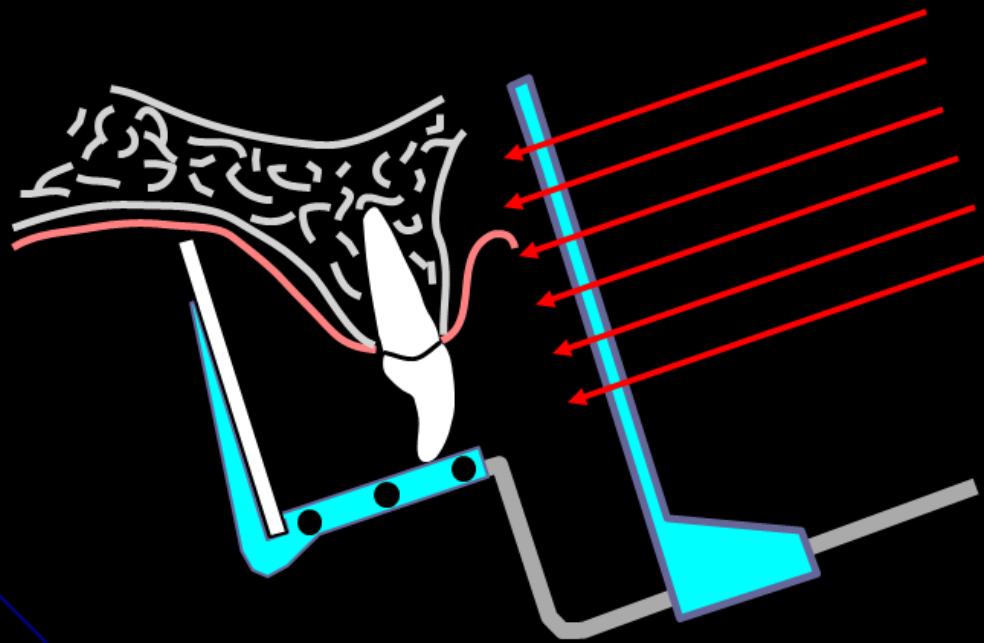
X-ray beam perpendicular to bisecting line

# Paralleling technique

---

Right angle technique

Long cone technique



# Advantages of Bisecting Angle Technique

- **More comfortable:** because the film is placed in the mouth at an angle to the long axis of the teeth, the film doesn't impinge on the tissues as much.
- **A film holder,** although available, is not needed. Patients can hold the film in position using a finger.
- **No anatomical restrictions:** the film can be angled to accommodate different anatomical situations using this technique



## Disadvantages of Bisecting Angle Technique

- **More distortion:** because the film and teeth **are at an angle to each other** (not parallel) the images will be distorted.
- **Difficult to position x-ray beam:** because a film holder is often not used it is difficult to visualize where the x-ray beam should be directed.
- **Film less stable:** using finger retention, the film has more chance of moving during placement

# OCCLUSAL

- **Utilize the largest intra oral film (6 X 8cm)**
- **Various projections**
- **Maxillary occlusal projections**
  - Upper standard
  - Upper oblique standard
- **Mandibular occlusal projections**
  - lower 90 degree occlusal
  - lower 45 degree occlusal
  - lower oblique occlusal

# Indications

- Identify large lesions
- Determine bucco-lingual location
- View developing anterior dentition
- Image patients with trismus (if panorama not available)



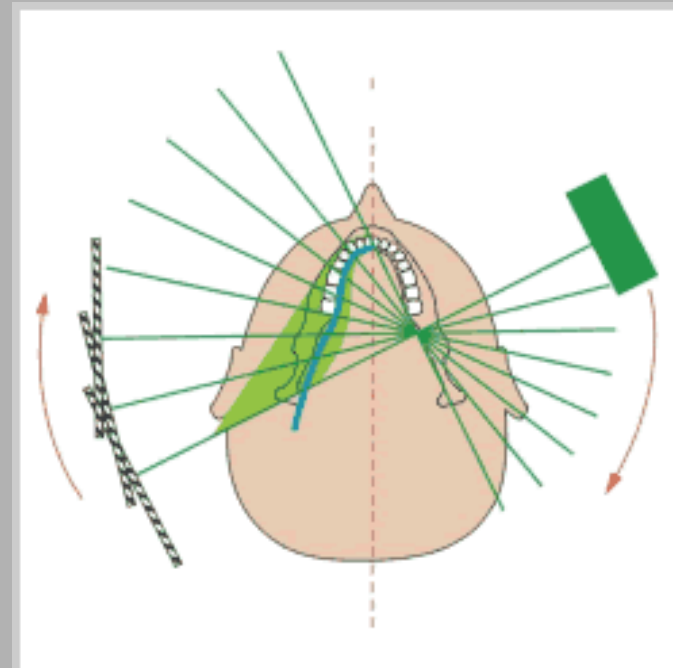
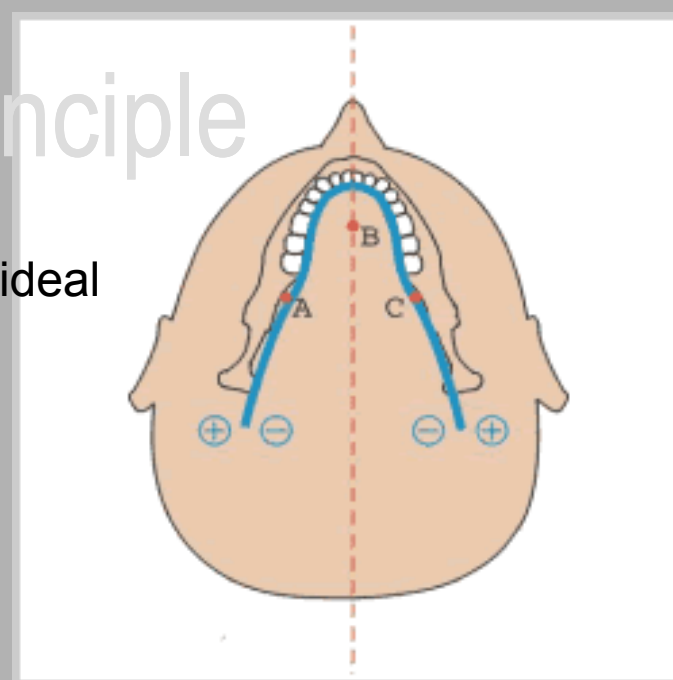


# OPG - Orthopantomography

Single image of facial structures that  
includes maxillary  
and mandibular arches  
and their supporting  
structures.

# Ortopanthomography - principle

- X-ray tube goes around the head on the track of ideal teeth occlusion - parabola
- There are 3 rotatory centra very next to the teeth occlusion



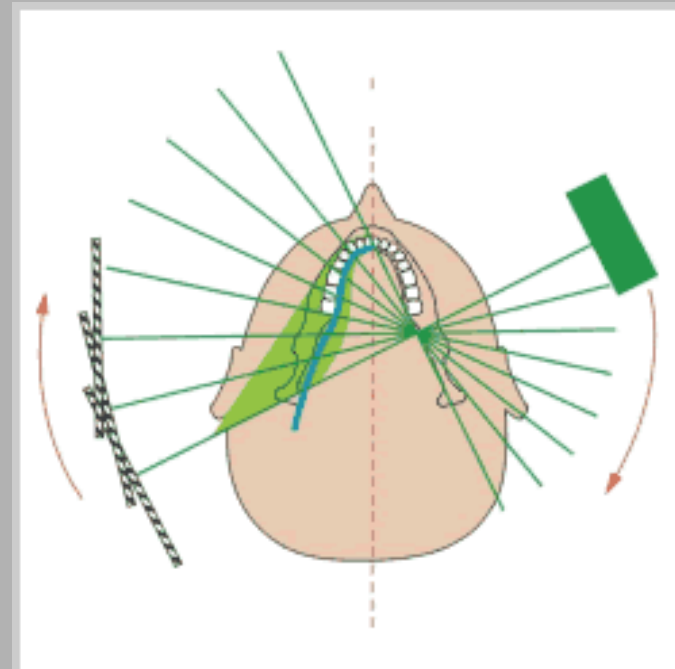
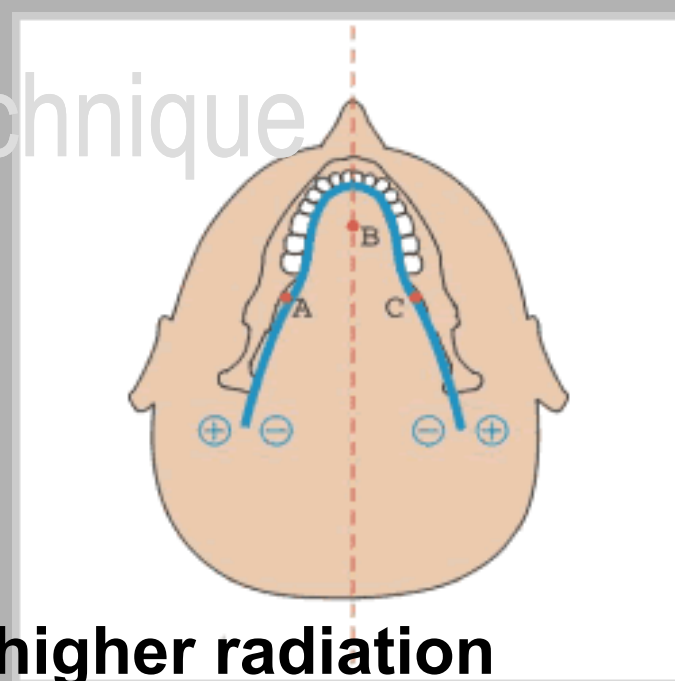
# Ortopanthomography - technique

- **leyer thickness**

- ✓ from 9 mm (frontal part)
- ✓ till 20 mm (in the area of TMJ)

– **thinner leyer = less artefacts, higher radiation dose**

- defocus
- zoom
- possibility of mesuring





# Indications

- Evaluation of trauma
- Third molars
- Large lesions
- Tooth development
- Developmental anomalies
- Intolerant to intraoral procedures

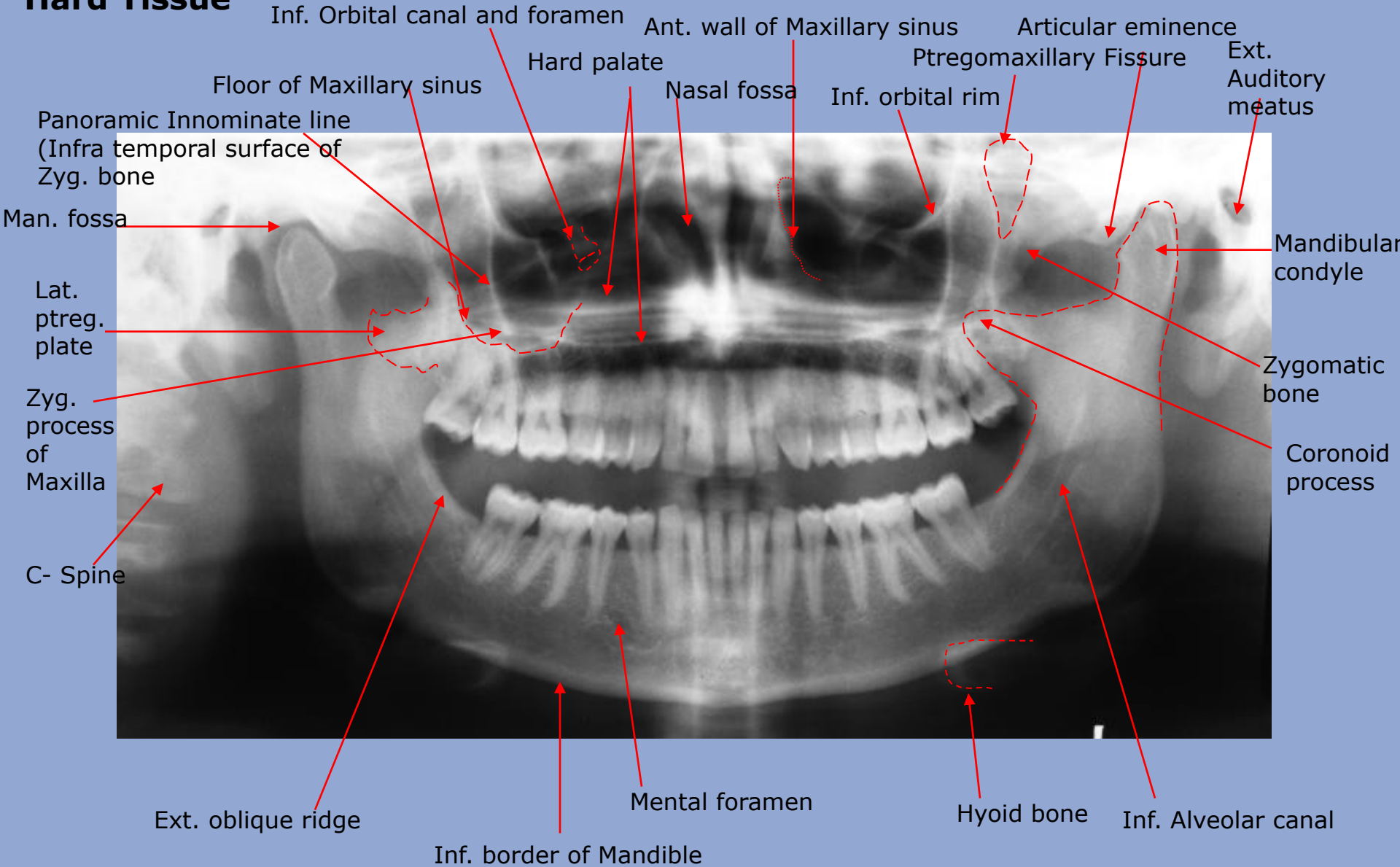
# Advantages...

- Broad anatomic coverage
- Low patient radiation dose
- Convenience of examination
- Used in patients unable to open mouth

# Disadvantages

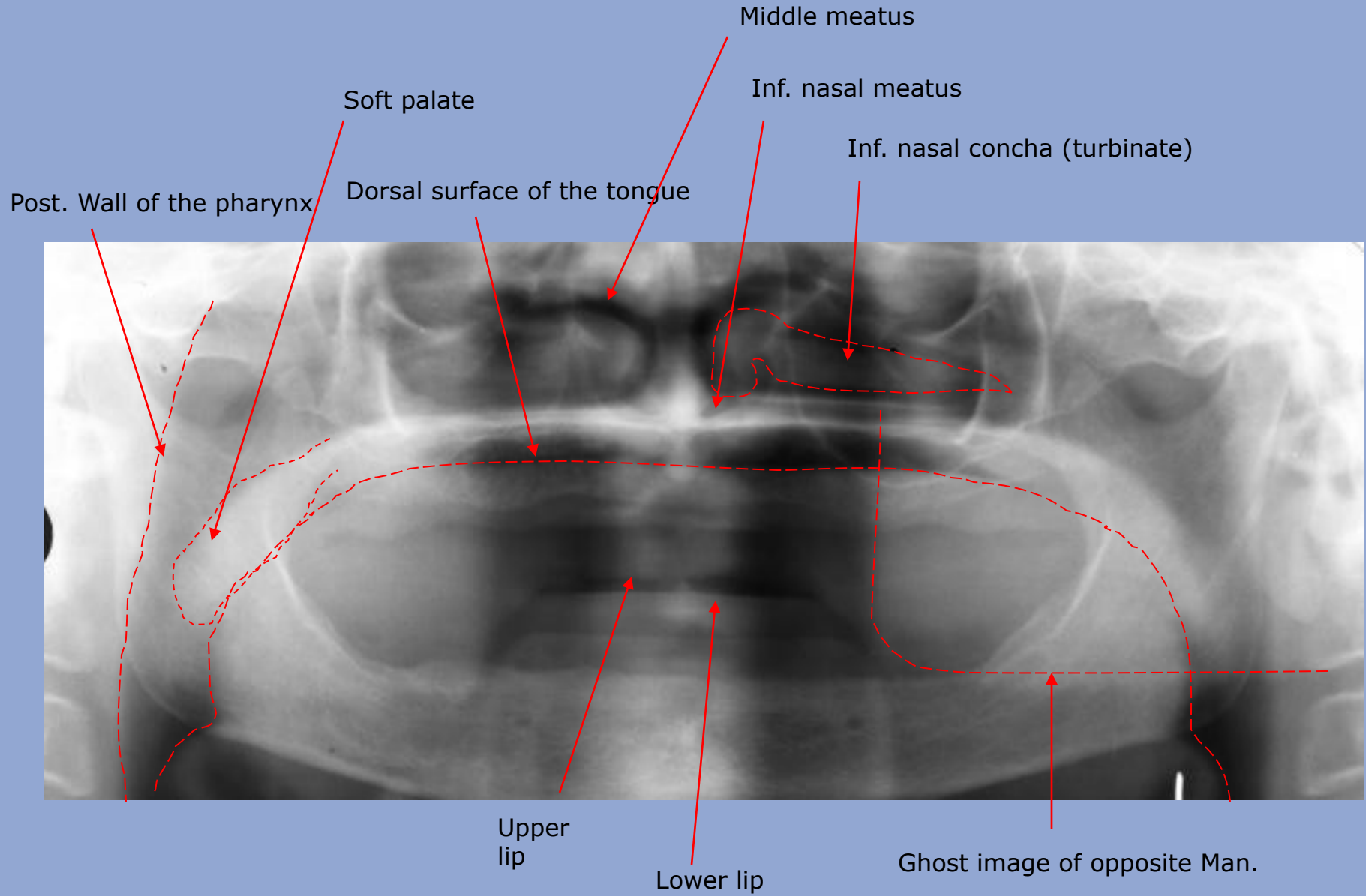
- Does not show fine anatomic details
- Magnification
- Distortion
- Overlapped image of teeth
- Expensive

# Hard Tissue



**All this diagnostic information is missed in intraoral X-rays**

# Soft tissue (edentulous)



**All this diagnostic information is missed in intraoral X-rays**

Other imaging modalities:

# **Contrast studies**

# SIALOGRAPHY



# Basic pathologies on plain Xray images



# Basic pathologies on plain Xray images

- 1) Dental Retention
- 2) Calcifications, salivary stones
- 3) Parodontopathies, inflammations, caries
- 4) Temporomandibular joint diseases
- 5) Jaw cysts
- 6) Tumors
- 7) Fractures

# 1 ) Retentio dentes



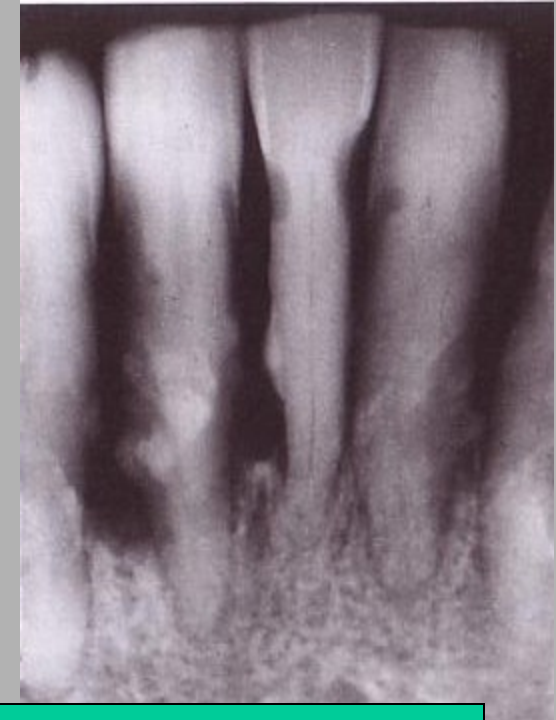
## 2) Calcifications, salivary stones

### Tartar

tartar is composed of mineralized tooth plaque + generalized bone reduction as a consequence of parodont pathology



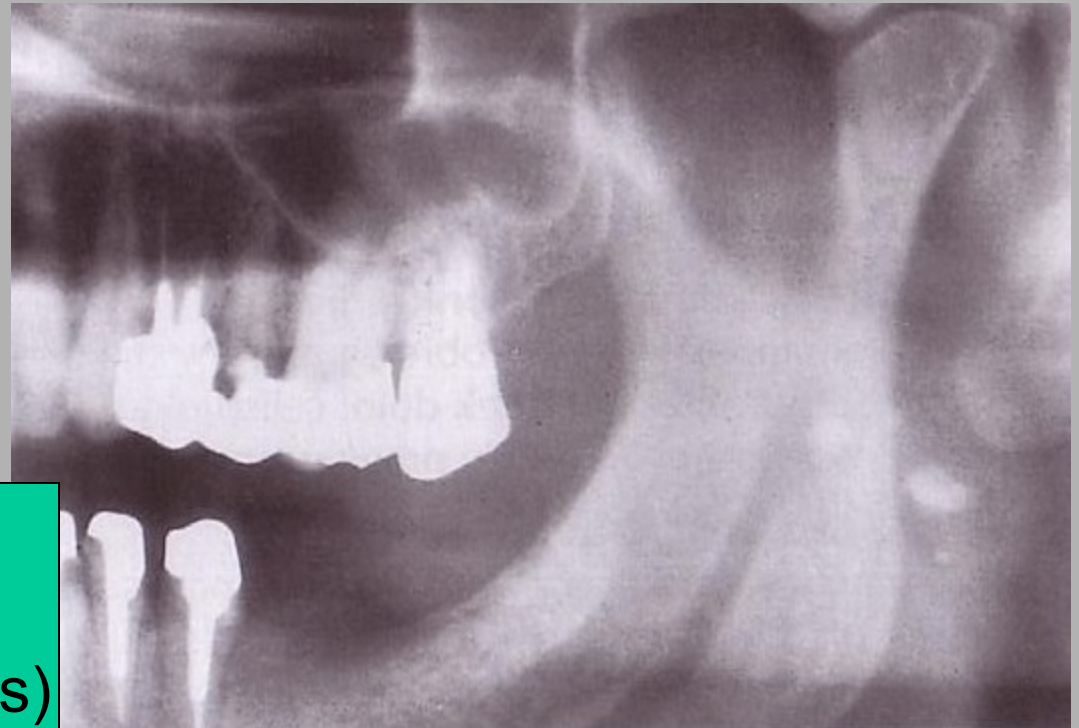
- origins in area of outfall of main salivary glands
- calcium phosphate
  - x-ray opacity



parodontitis marg. profunda  
sublingual tartar

## 2) Calcifications, salivary stones Concrements

calcified cervical lymph nodes

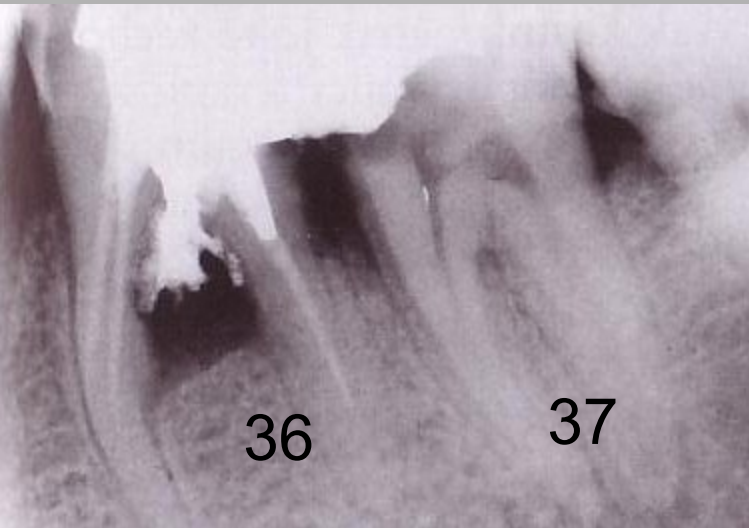


calcification of gl. parotis  
as a consequence of  
parotitis epidemica (mumps)

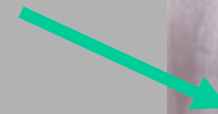


# Marginal periodontopathy

bone reduction between 35,37  
as a consequence of amalgam overhang  
caries 34,37,38



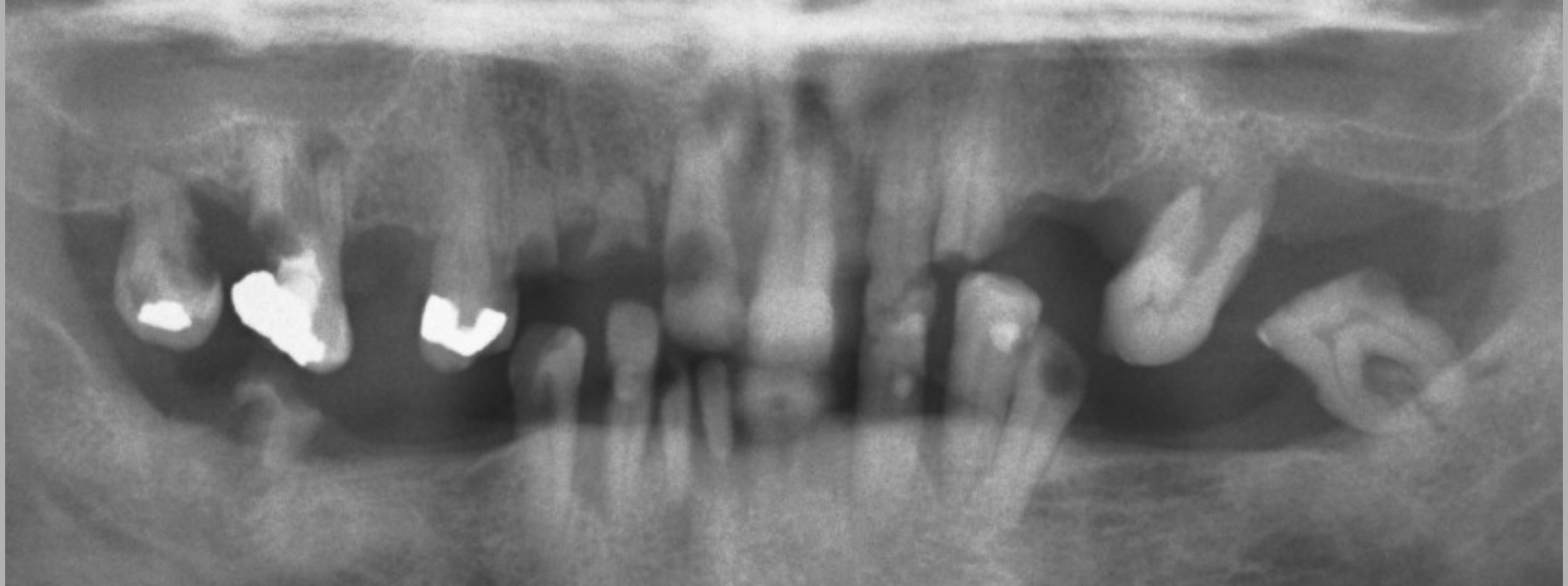
mezial posttraumatic  
central granuloma



oversupply of root filling  
injury to the desmodont and mesodont of tooth root  
etiology: via falsa  
= interradicullar bone loss

11

apical periodontitis, caries acuta



# Marginal periodontopathy

traumatic occlusion

etiology: fixed bridgework

massive bone reduction

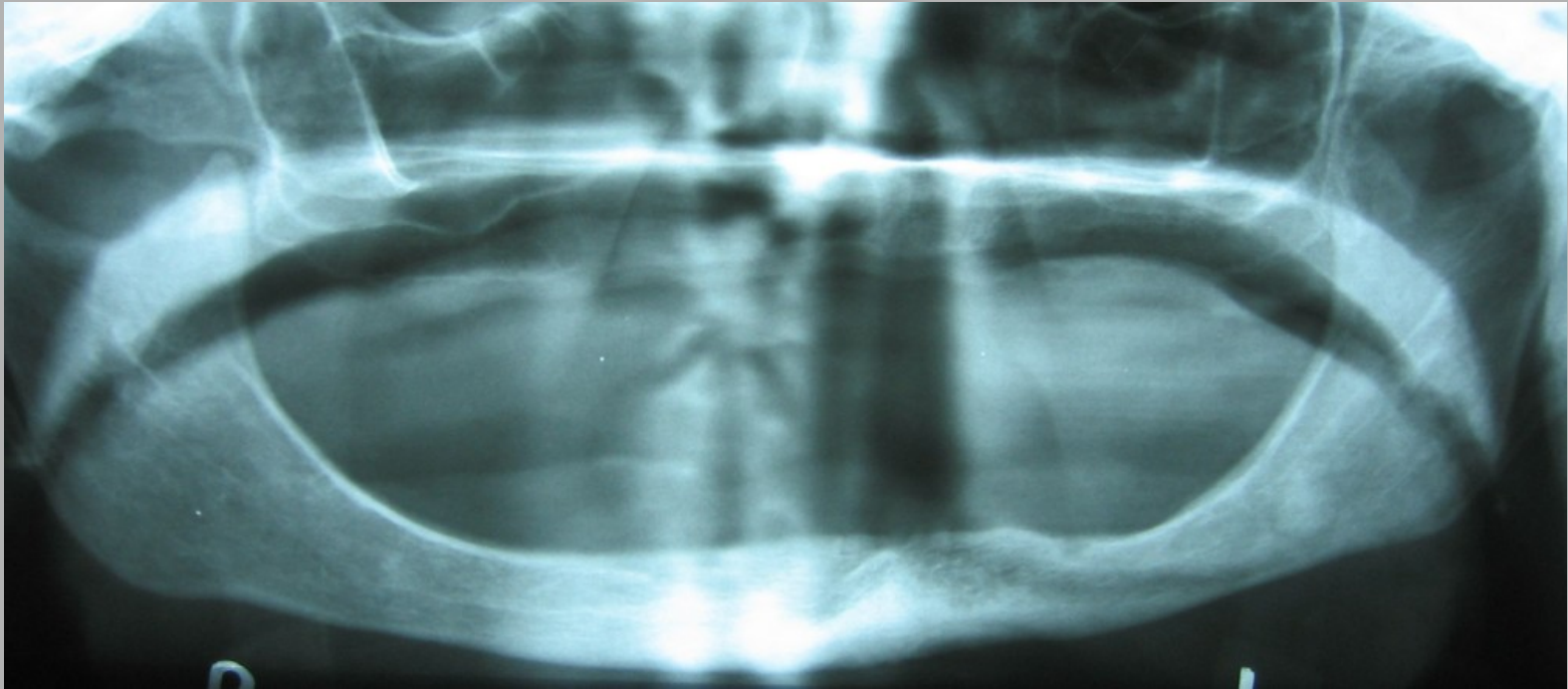
sclerotic reactive zone - apically (36,37)





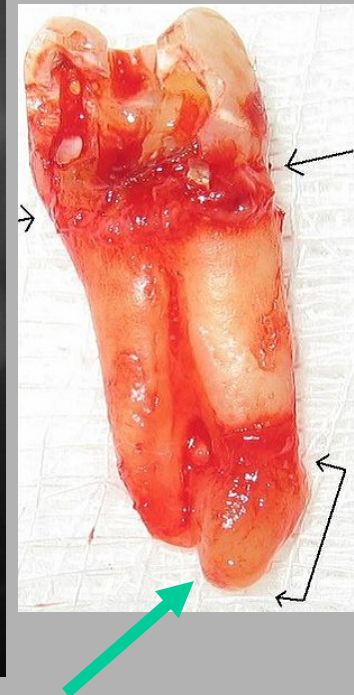
# Marginal periodontopathy

alveolar and mandible bone reduction  
old age



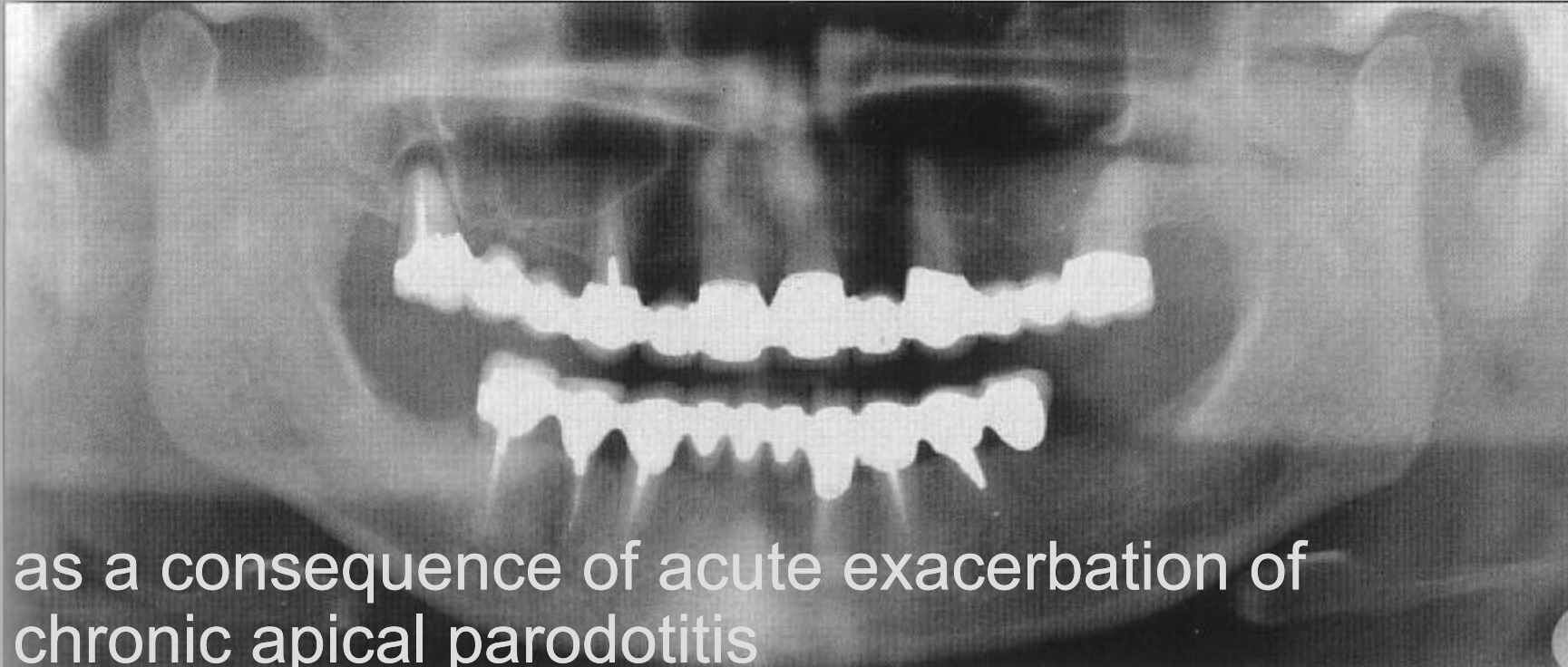
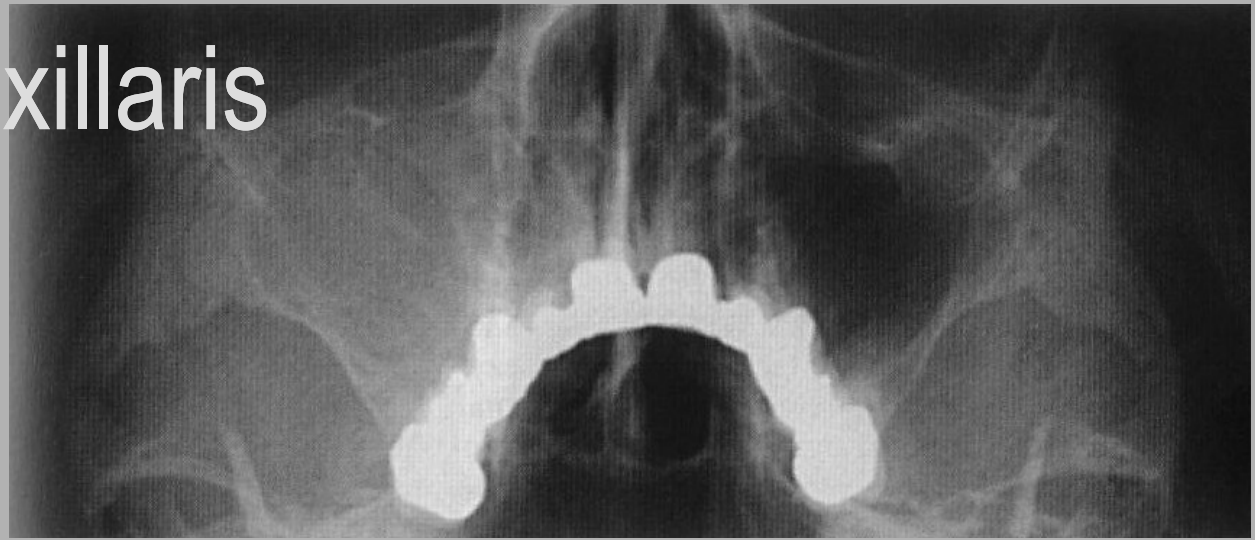
# Periapical abscess

A **periapical abscess** is the result of a chronic, localized infection located at the tip, or apex, of the root of a tooth.



# Sinusitis maxillaris

w, 57 y



- as a consequence of acute exacerbation of chronic apical parodontitis

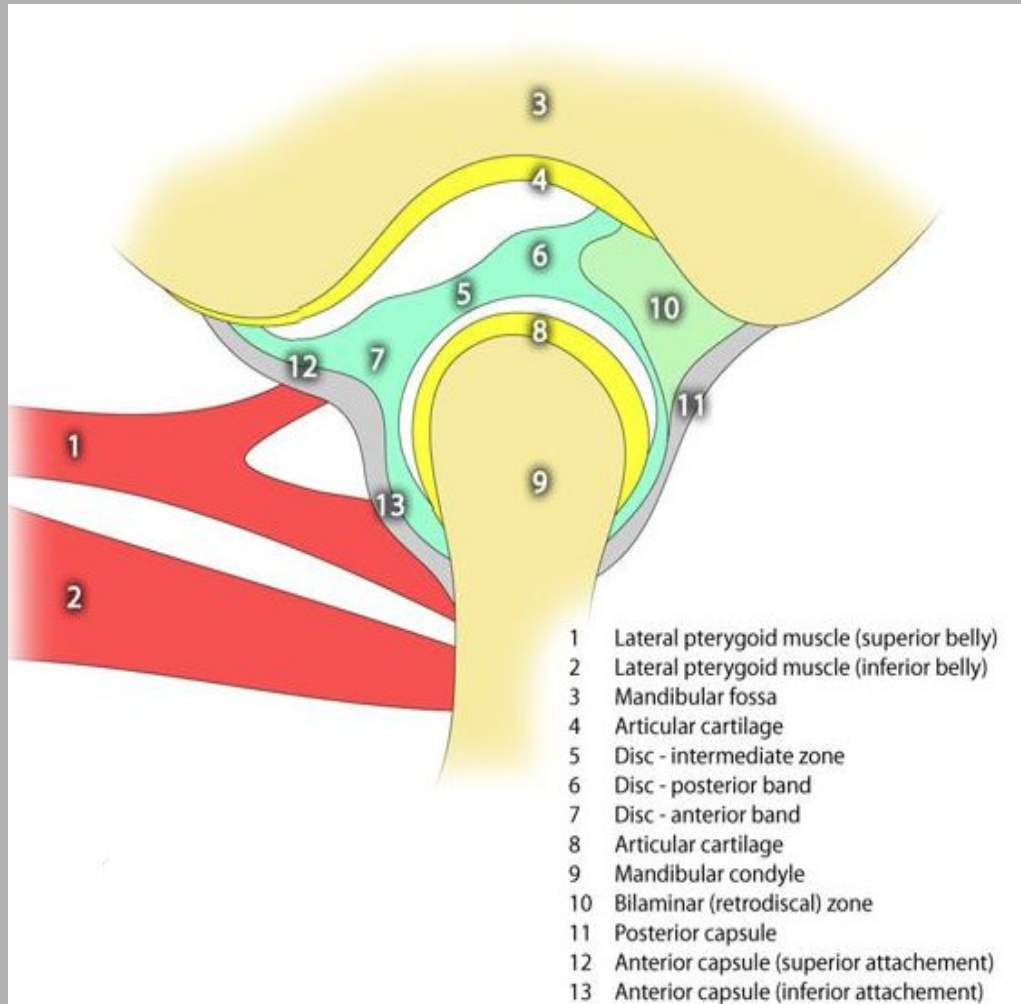
# Sinusitis maxillaris

- w, 17 y
- acute catarrhal etiology

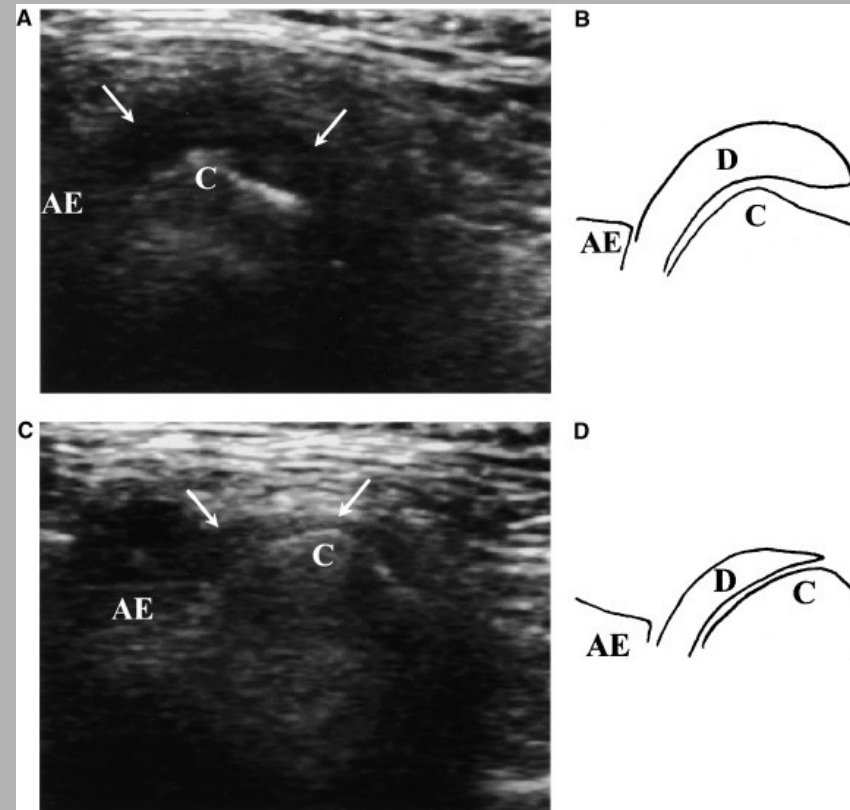


# 4) Temporomandibular joint diseases

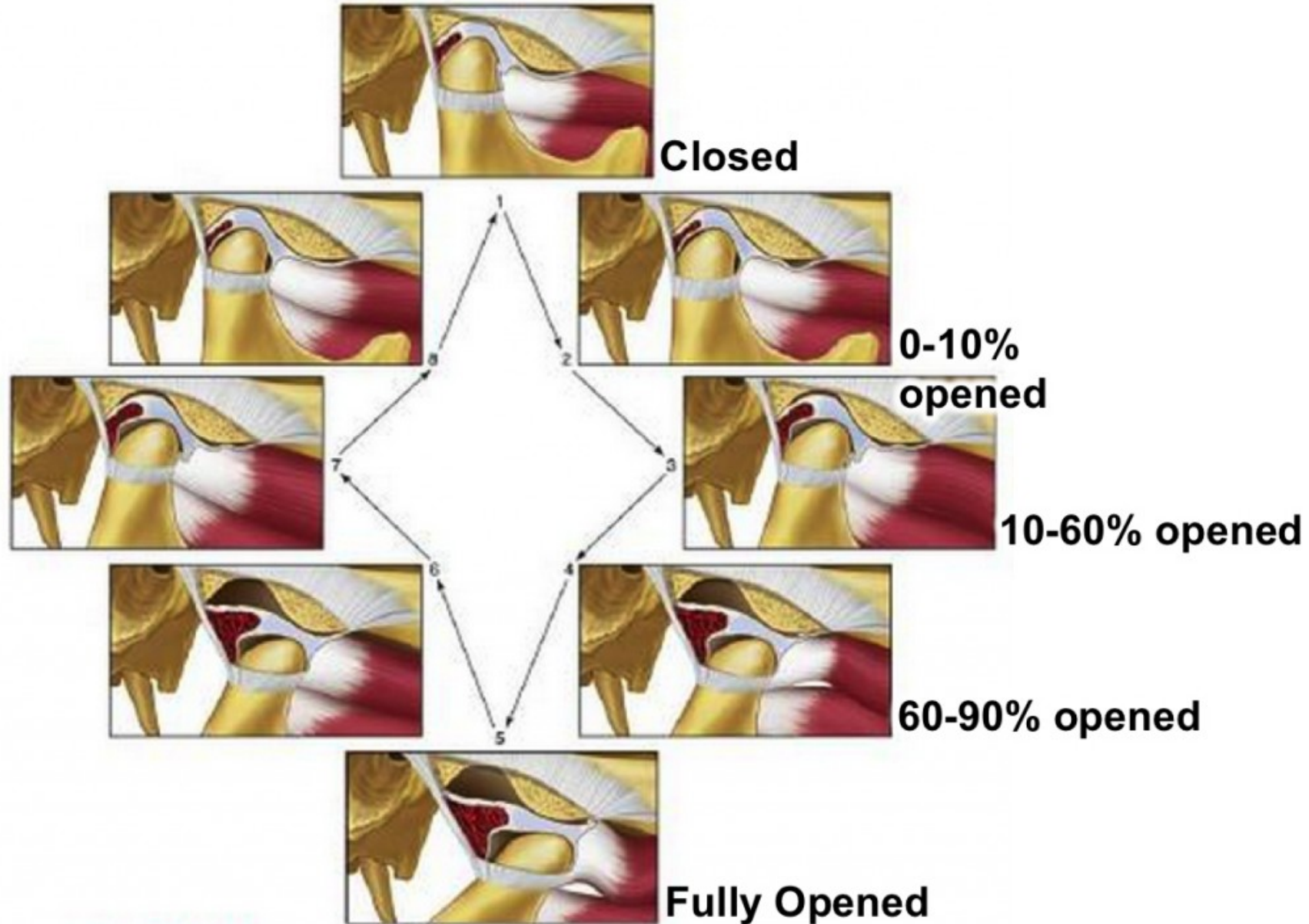
## • Anatomy



## Ultrasound

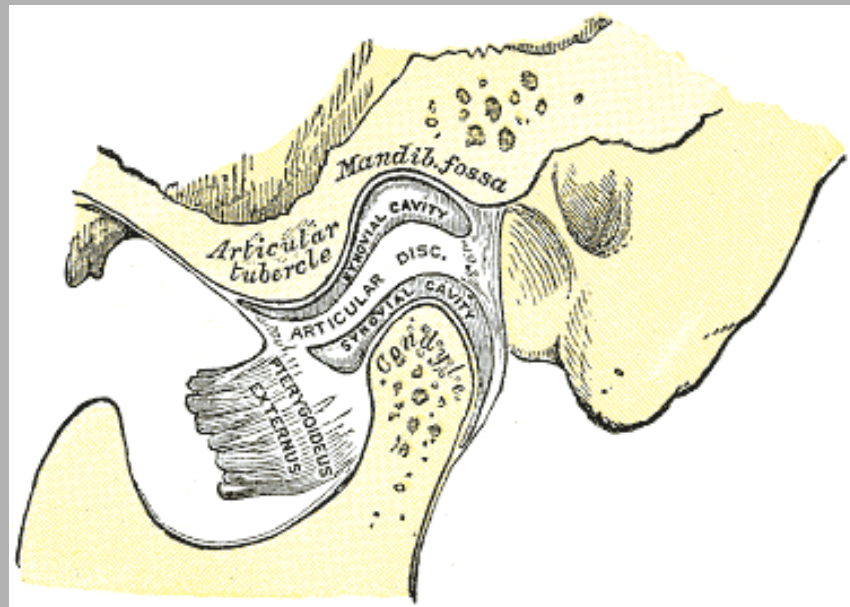


# Joint movement



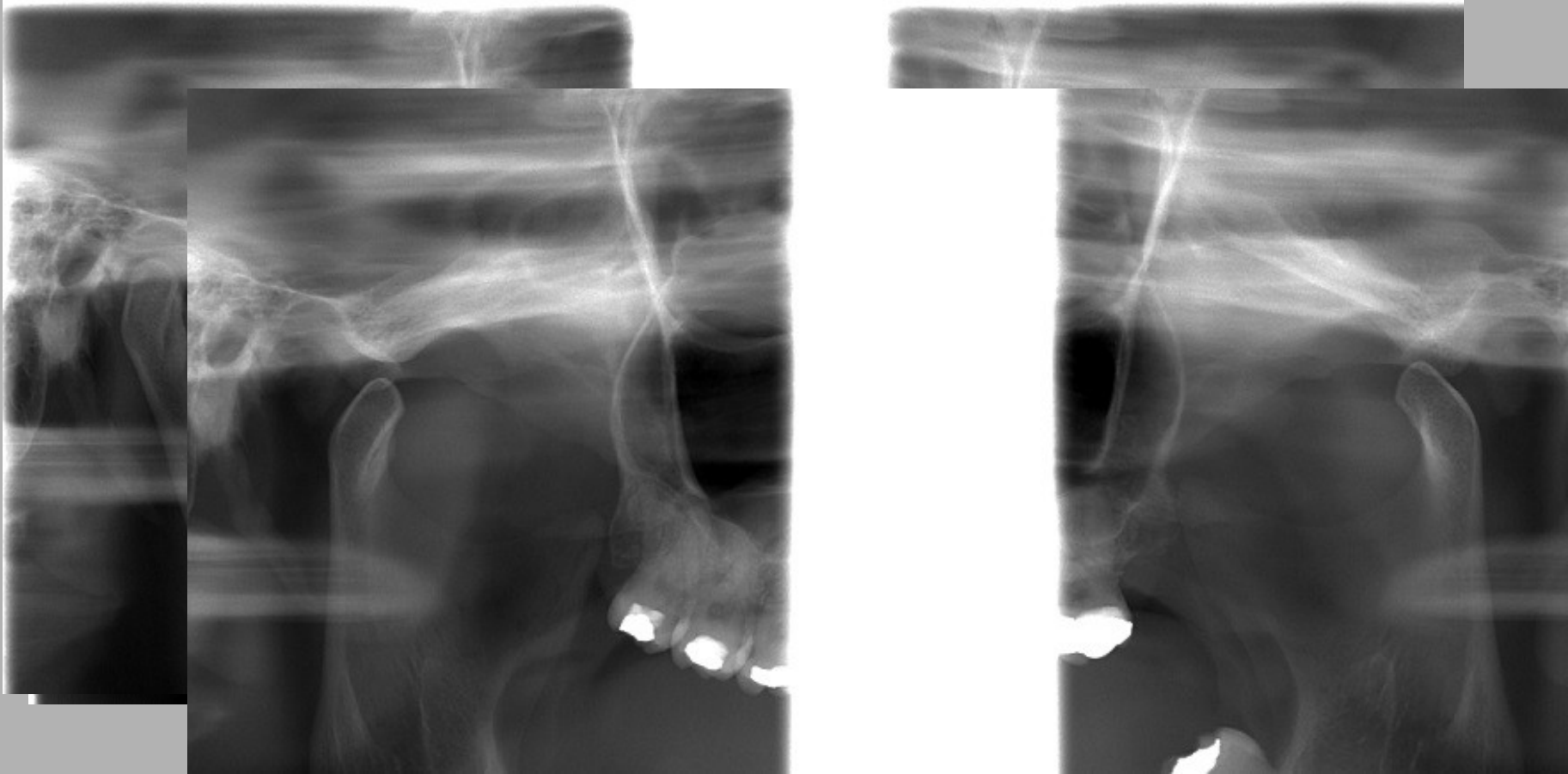
# Imaging modalities

- Xray
- Ultrasound
- MRI



# RTG

- OPG and plain Xray with open and closed mouth

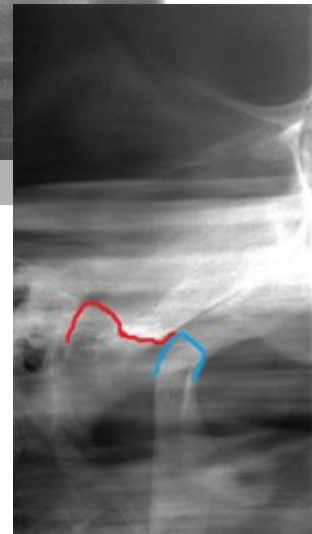
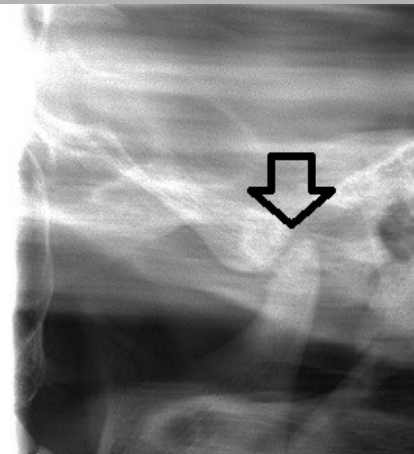
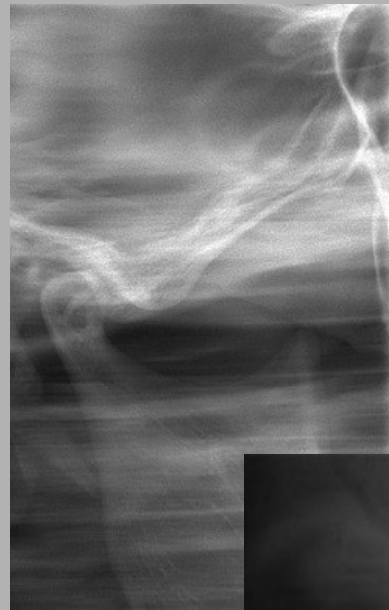




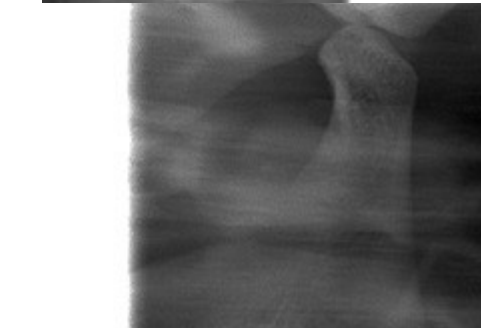
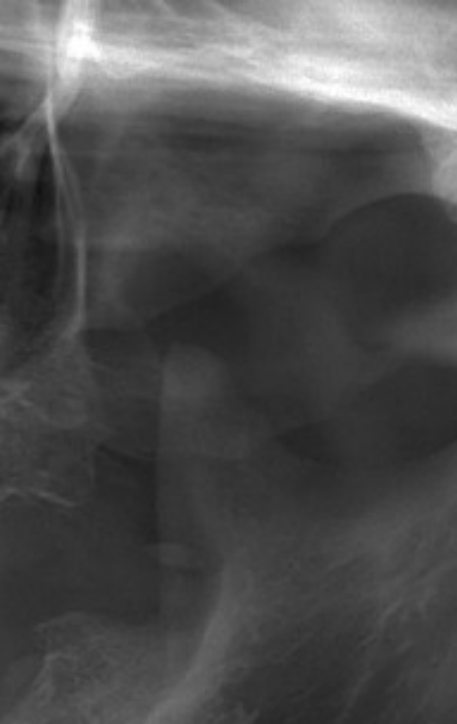
# Plain X-ray:

- 1) Shape of joint
- 2) Position of the head relative to joint fossa
- 3) Maximal mobility of condyle

OPG – Odontogenic cause of joint pain



Ha Luxation

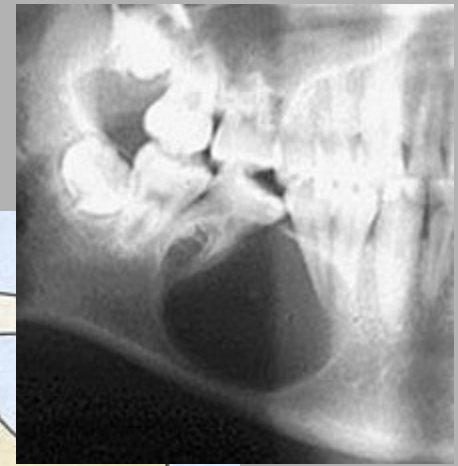
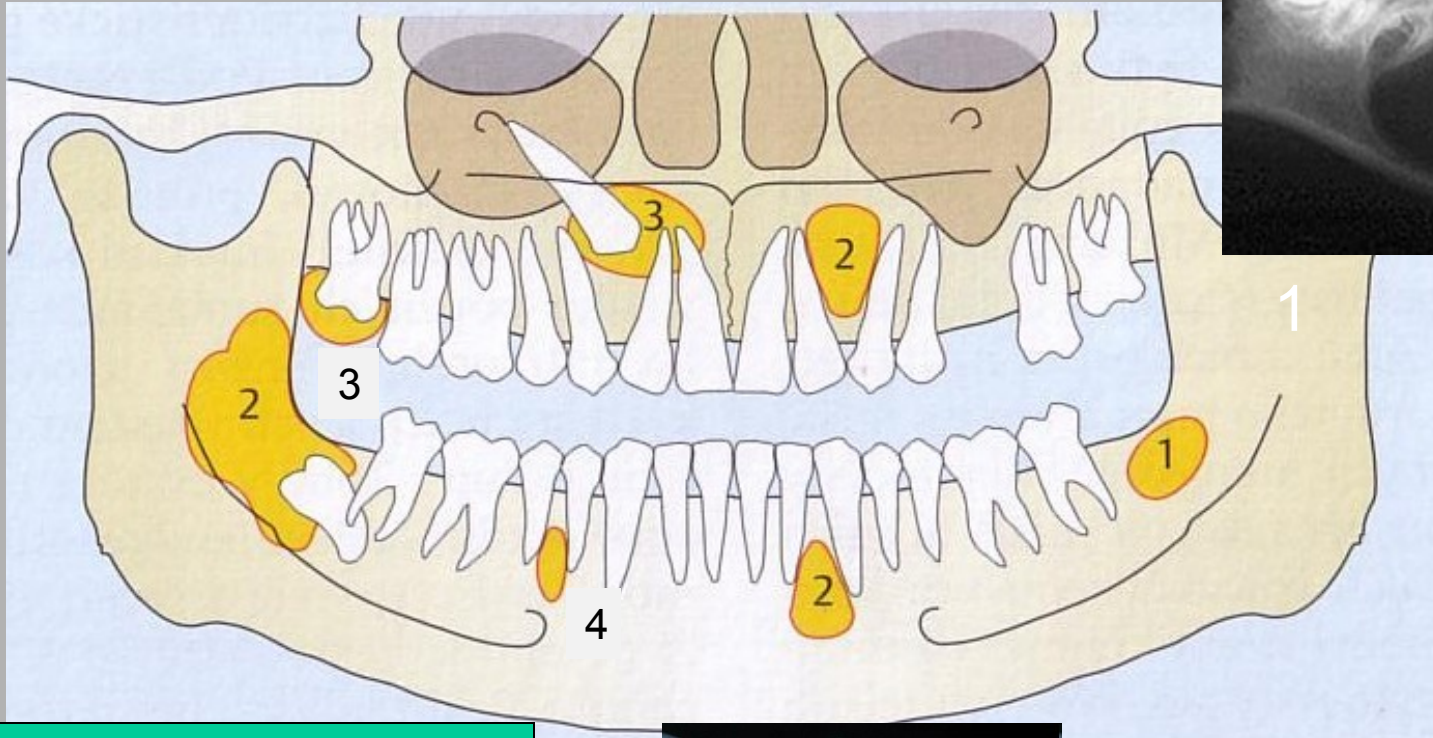


Hypomobility

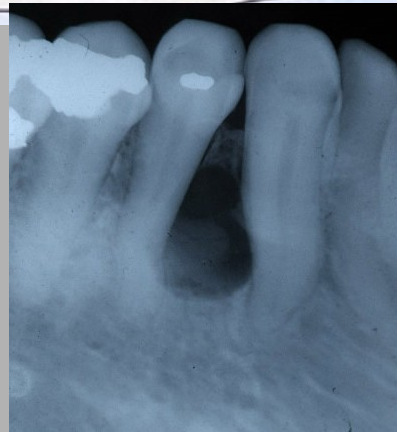
## 5) Cysts

- A) odontogenic
- B) non-odontogenic
- C) inflammatory

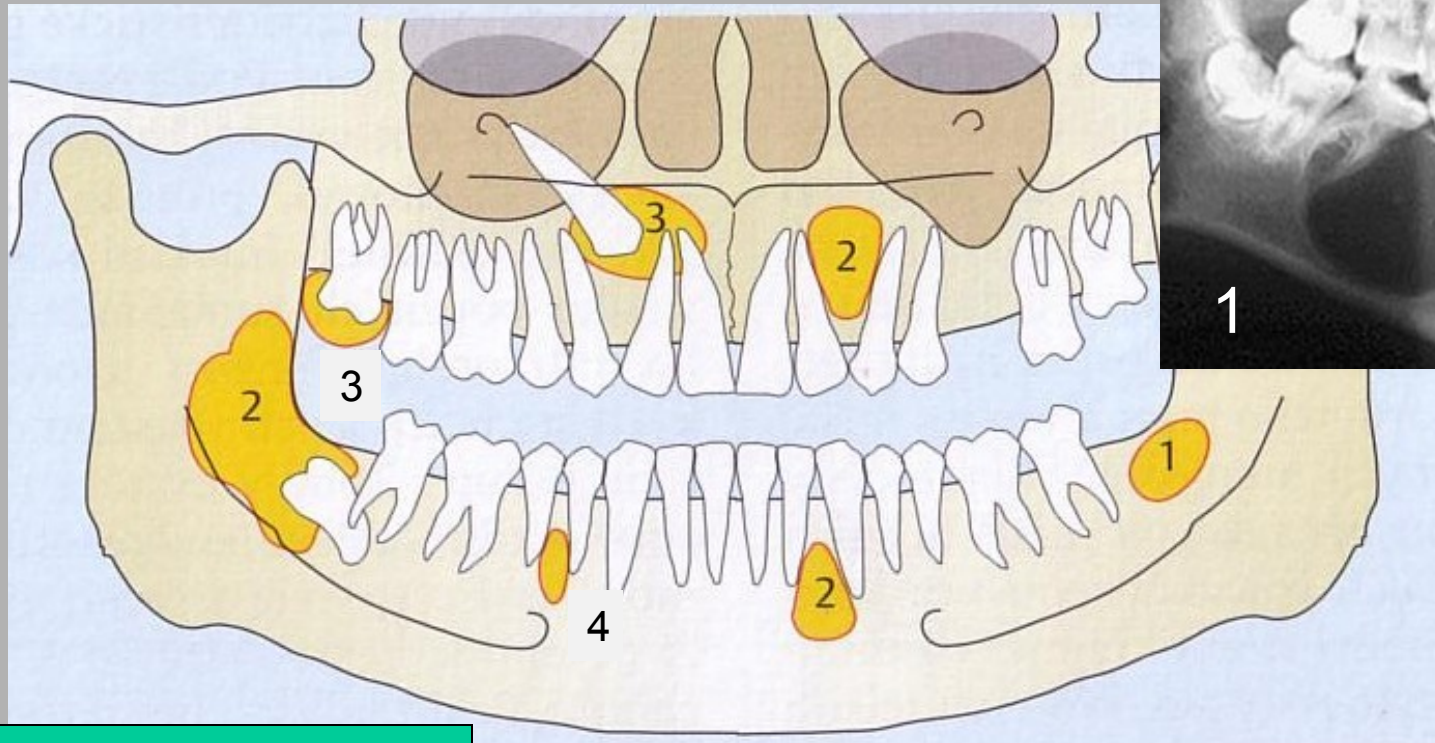
# Cysts – odontogenic



1. primordial c.
2. keratocyst
3. folikular c.
4. lateral parodontal c.



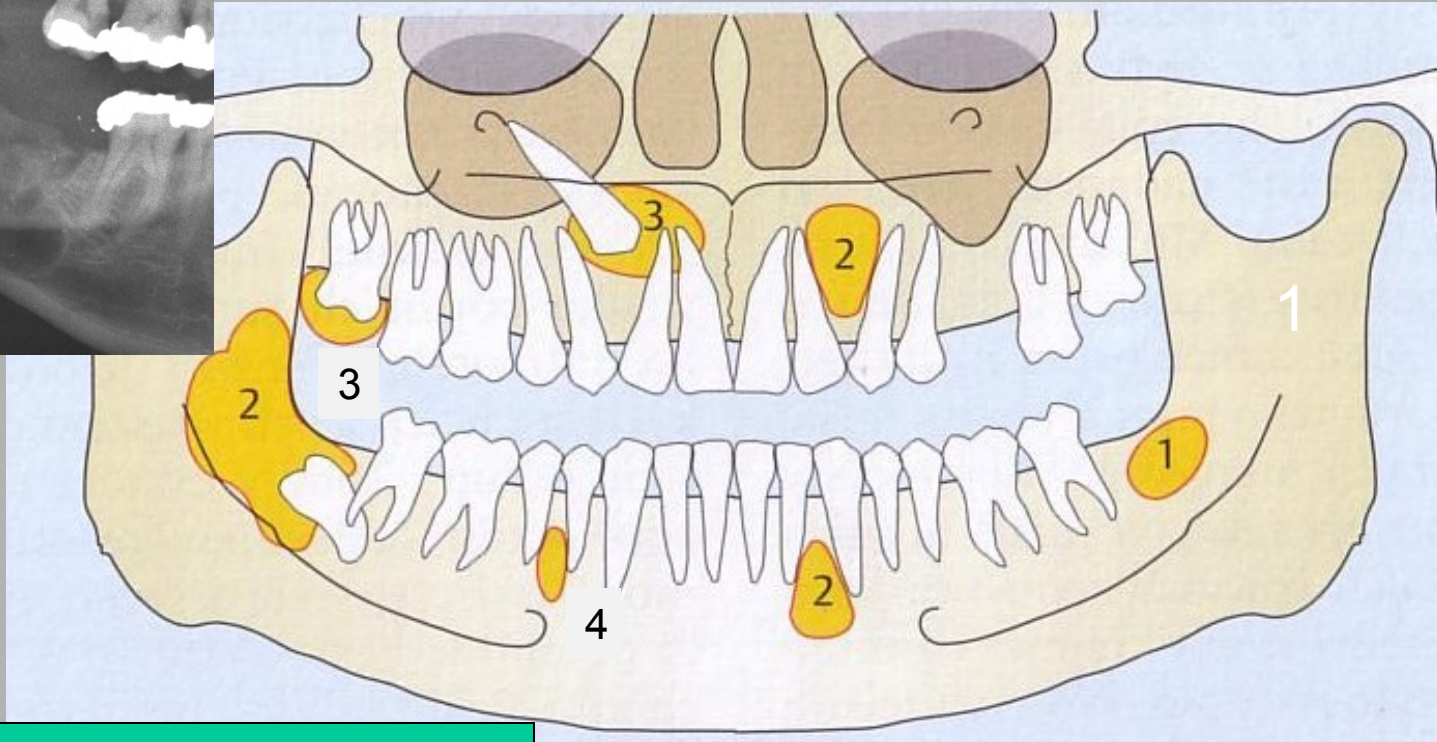
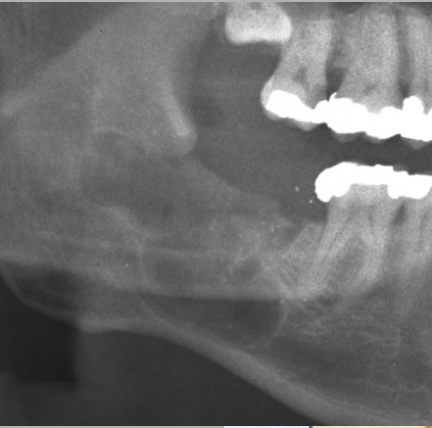
# Cysts – odontogenic



- 1. primordial c.
- 2. keratocyst
- 3. follicular c.
- 4. lateral periodontal c.

**A primordial cyst** is a developmental odontogenic cyst. It is found in an area where a tooth should have formed but is missing. Primordial cysts most commonly arise in the area of mandibular third molars.

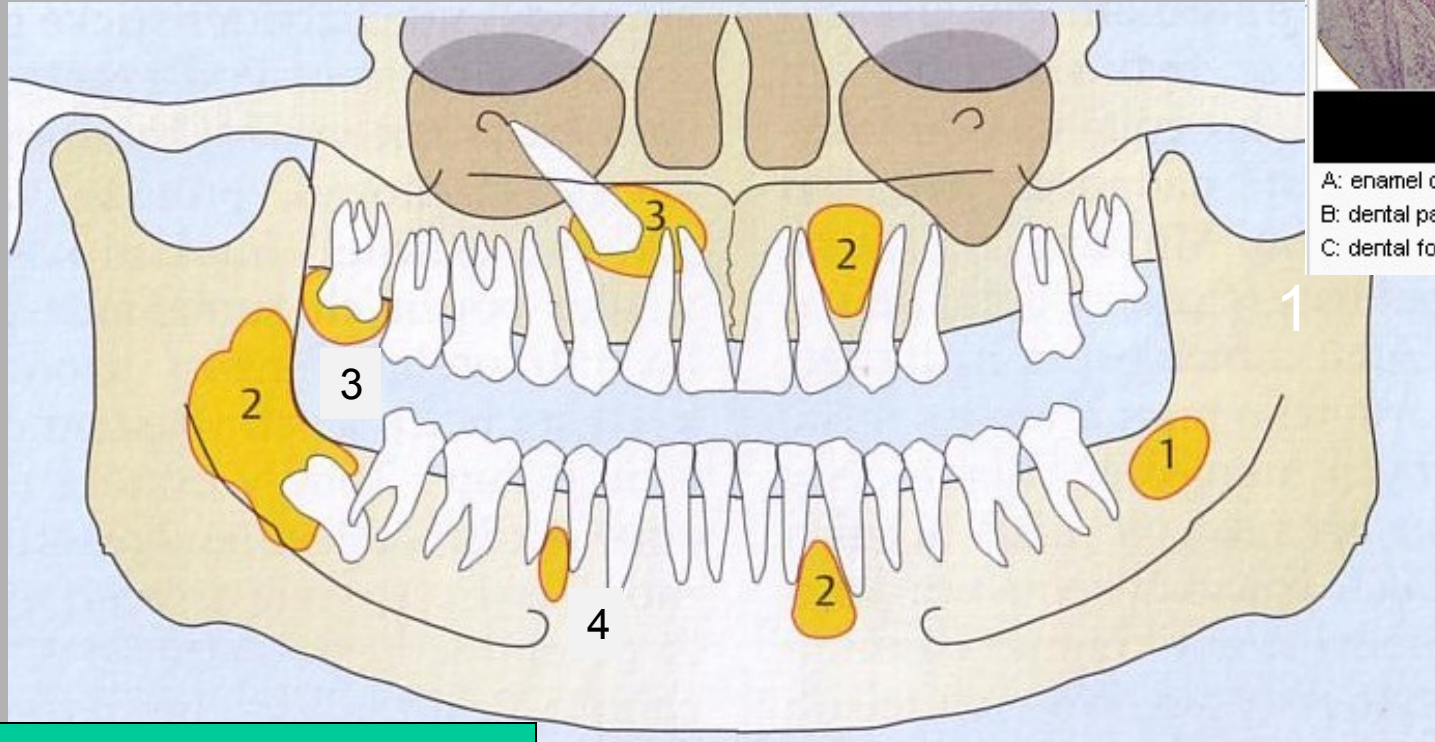
# Cysts – odontogenic



1. primordial c.
2. keratocyst
3. follicular c.
4. lateral periodontal c.

**Keratocyst** is a benign but locally aggressive developmental cystic neoplasm. It most often affects the posterior mandible.

# Cysts – odontogenic



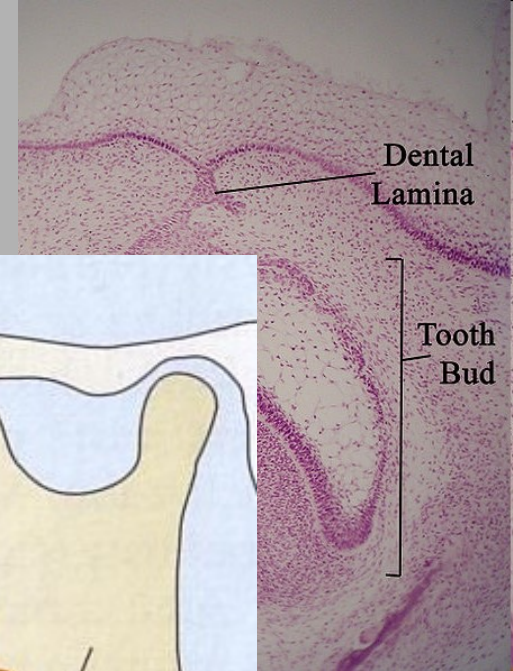
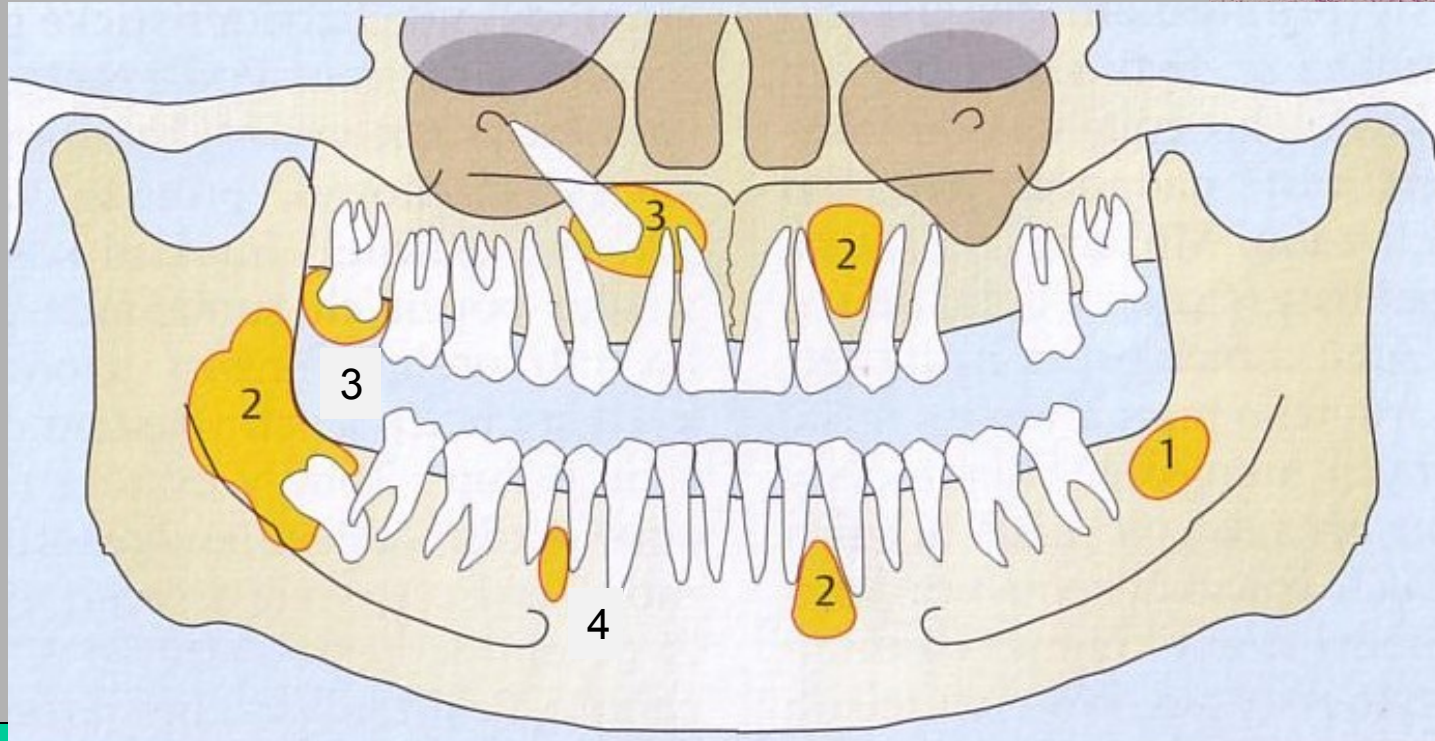
A: enamel organ  
B: dental papilla  
C: dental follicle

1. primordial c.
2. keratocyst
3. follicular c.
4. lateral periodontal c.

**A follicular cyst** is a cyst of dental follicle

The **dental follicle** is a sac containing the developing tooth and arise from cemento enamel border and contains crown of tooth.

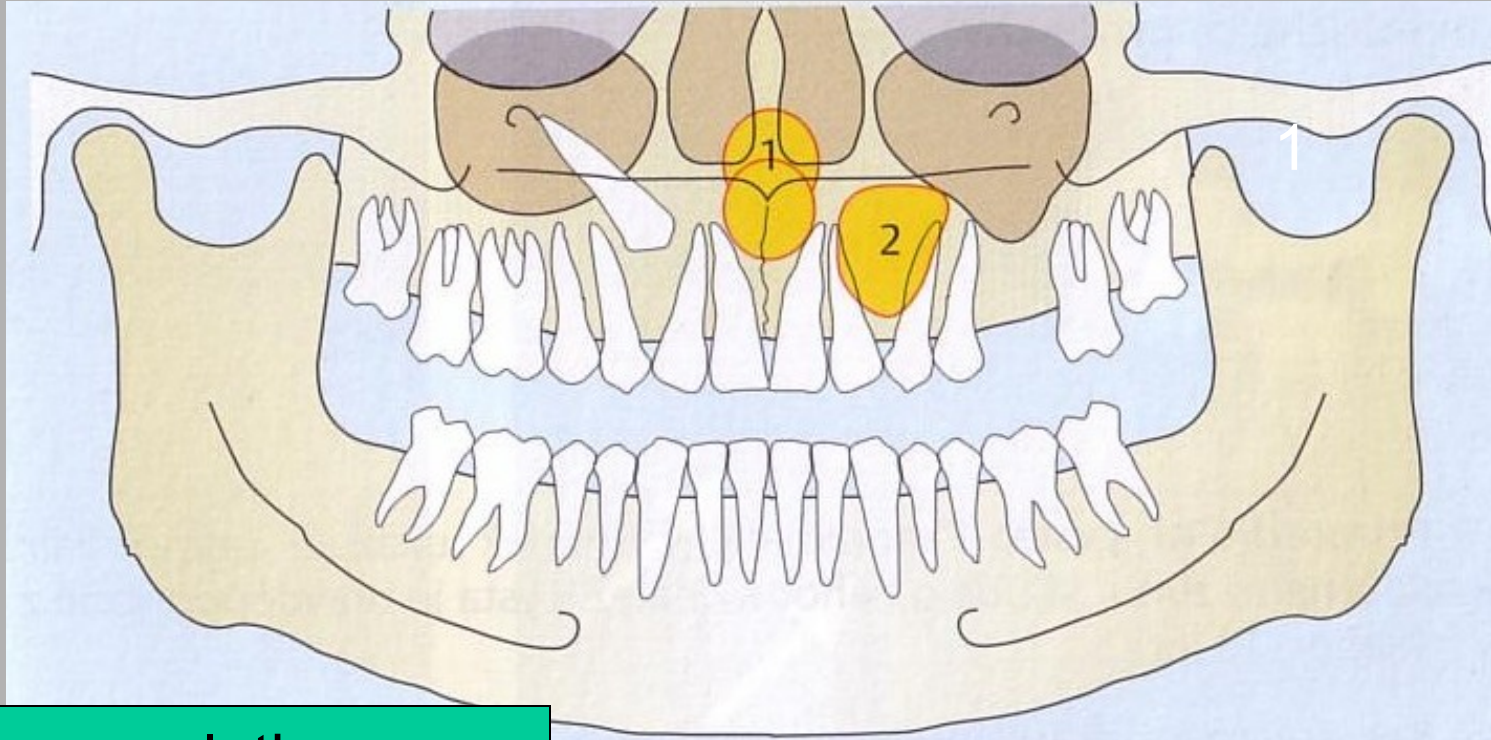
# Cysts – odontogenic



1. primordial c.
2. keratocyst
3. folikular c.
4. lateral parodontal c.

The **lateral periodontal cyst** is a cyst that arises from the rest cells of the dental lamina. It is more common in middle-aged adult males. Usually, there is no pain associated with it, and it usually appears as a unilocular radiolucency (dark area) on the side of a canine or premolar root. Microscopically, the lateral periodontal cyst appears the same as the gingival cyst of the adult.

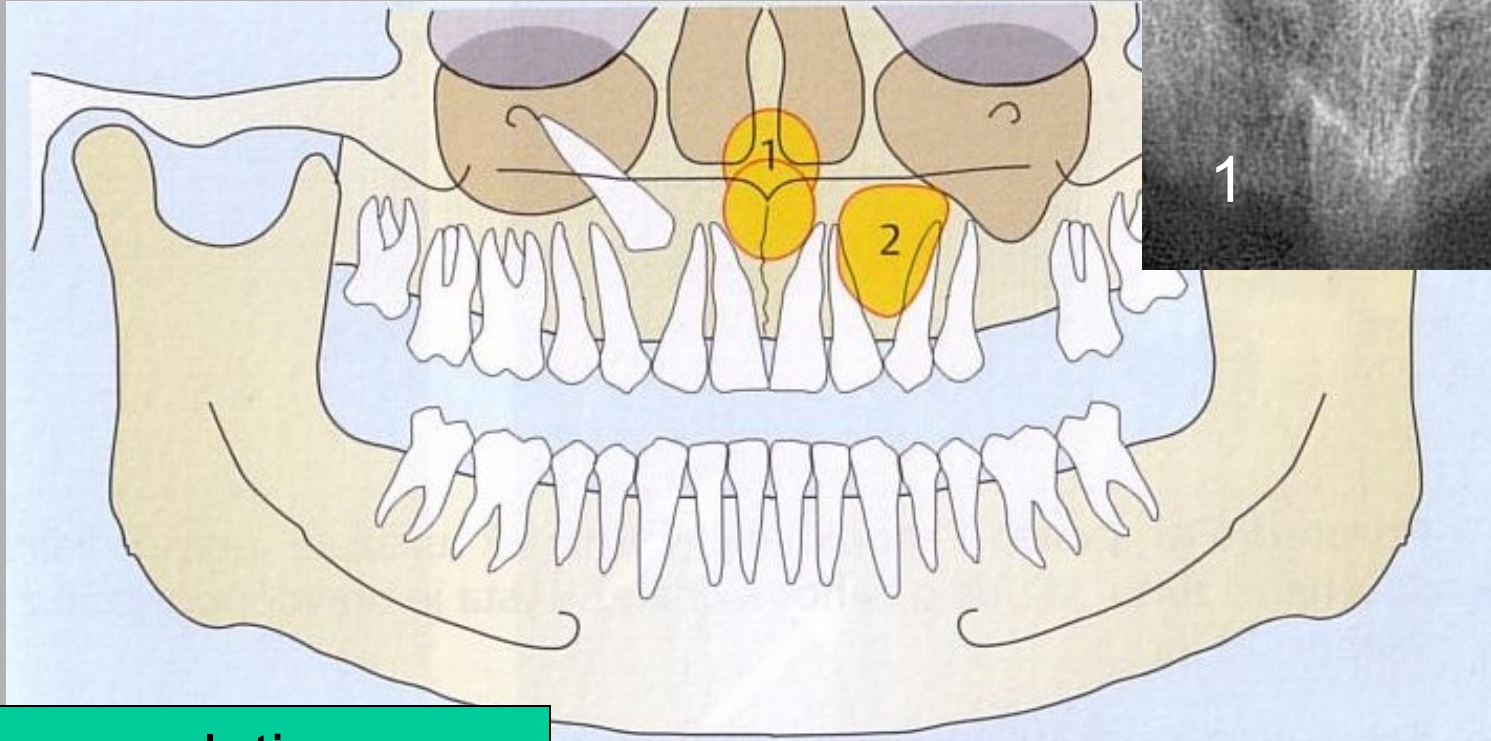
# Cysts – non-odontogenic



1. nasopalatine c.
2. nasolabial c.



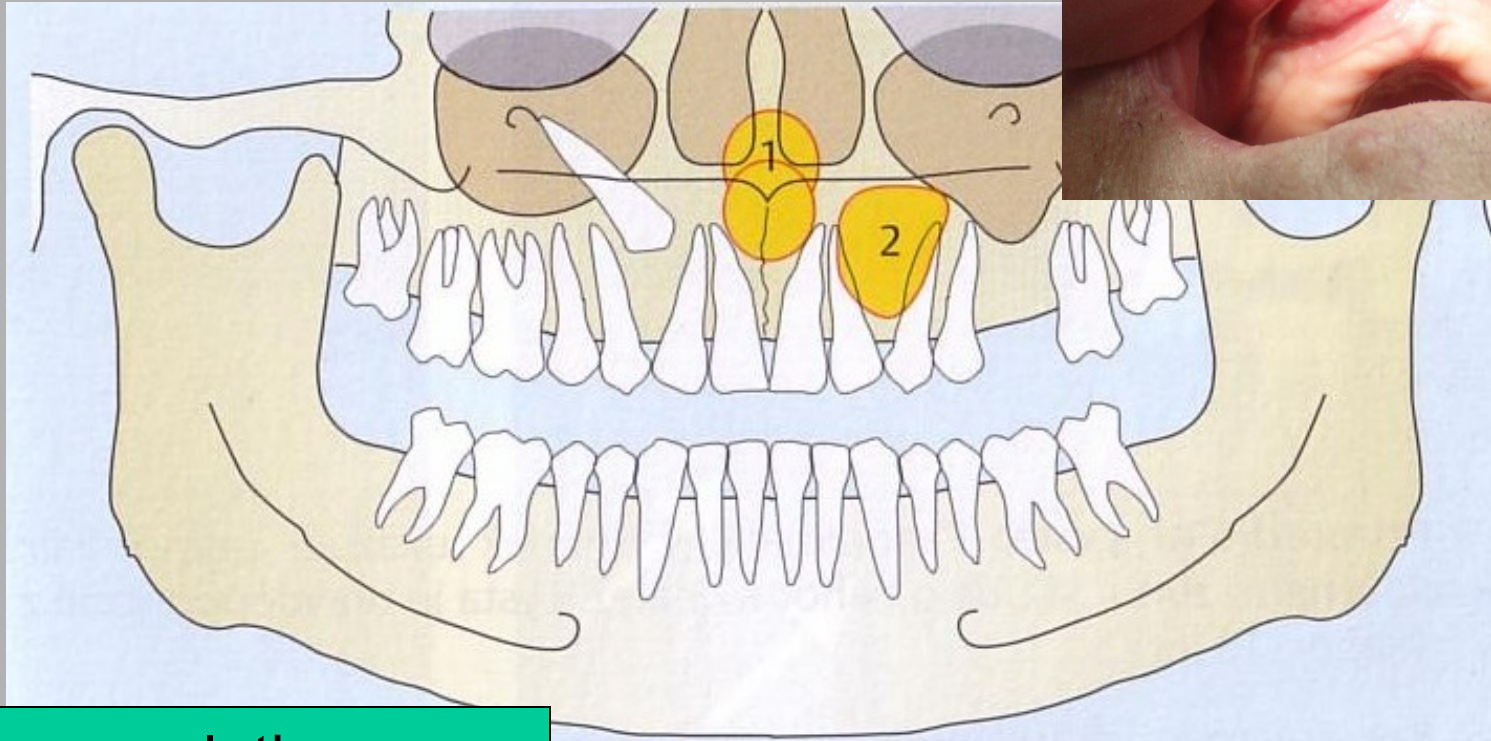
# Cysts – non-odontogenic



1. nasopalatine c.
2. nasolabial c.

**Nasopalatine cyst** occurs in the median of the palate.

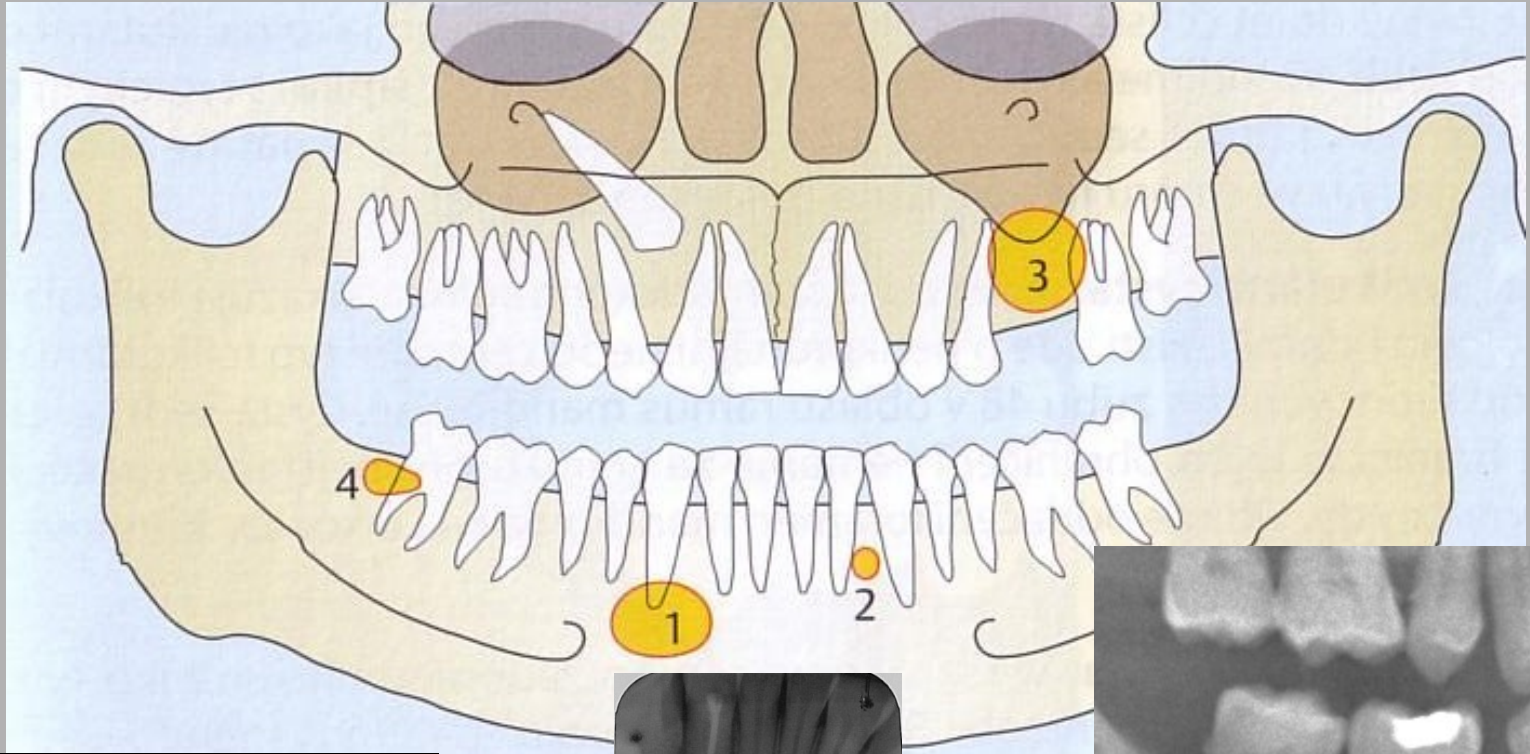
# Cysts – non-odontogenic



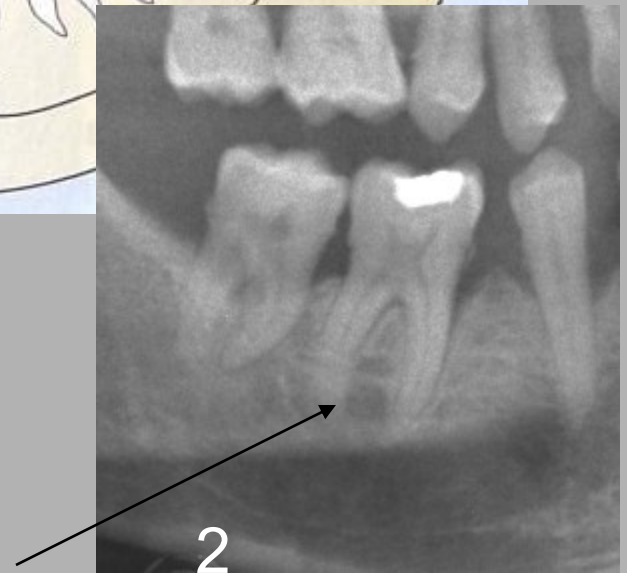
1. nasopalatine c.
2. nasolabial c.

**Nasolabial cyst** is located superficially in the soft tissues of the upper lip. Unlike most of the other developmental cysts, the nasolabial cyst is an example of an extraosseous cyst.

# Cysts - inflammatory

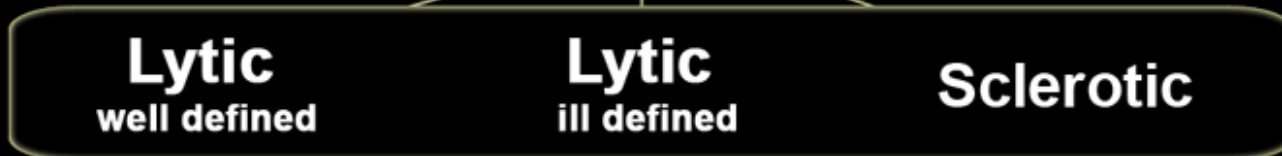


1. apical radicular
2. lateral radicular
3. residual lateral
4. paradontal (Craig's) - wisdom tooth



# 6) Tumors

## Plain Radiograph



< 30y

**Age**

> 30y

long bone - axial  
body or arch of spine

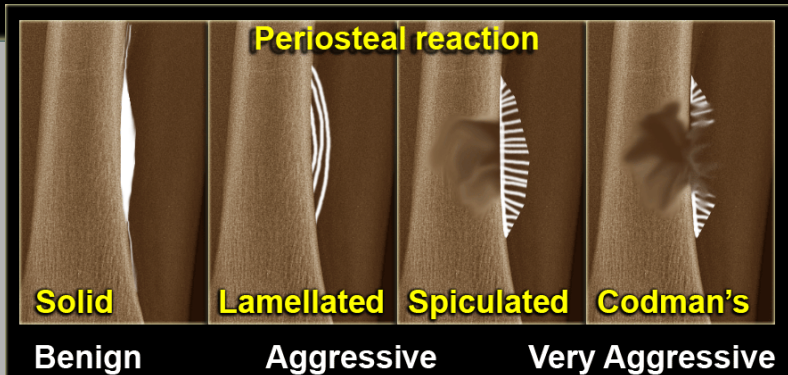
**Location**

dia - meta - epiphysis  
centric - eccentric

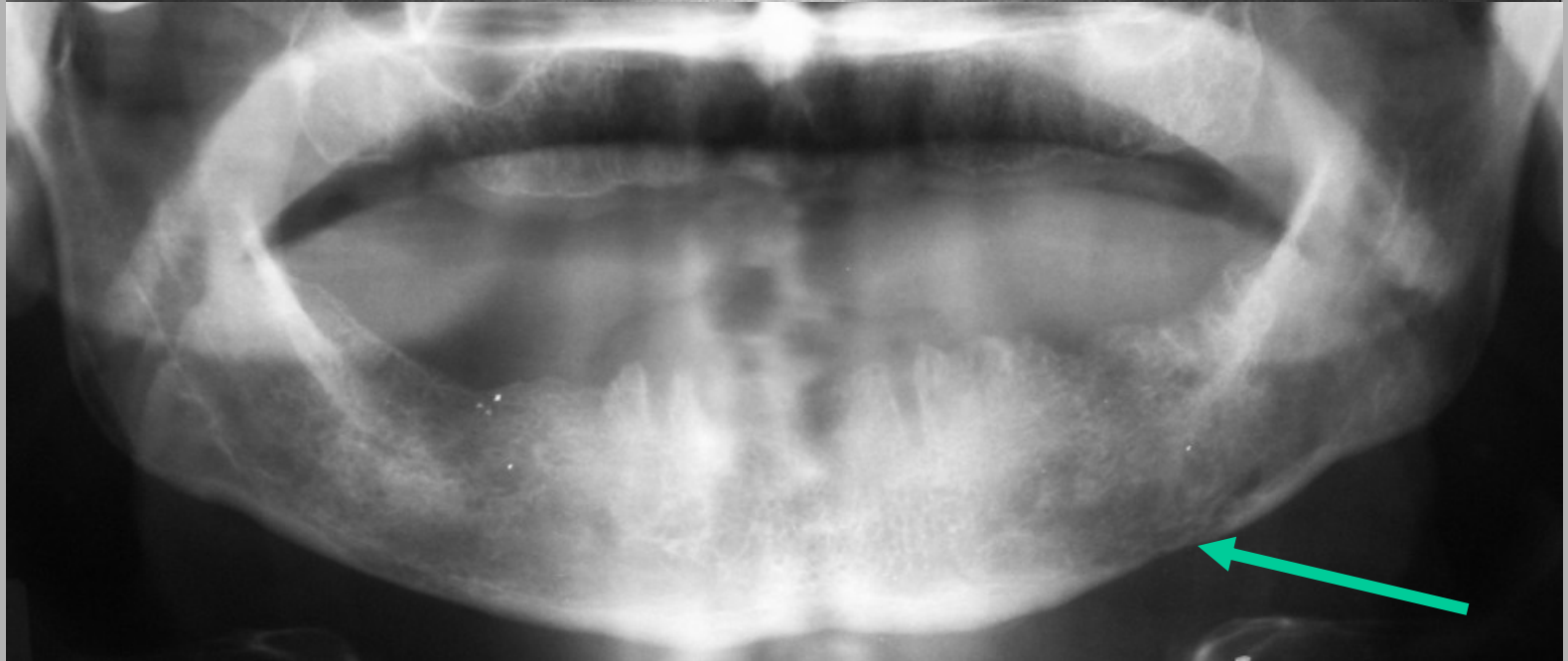
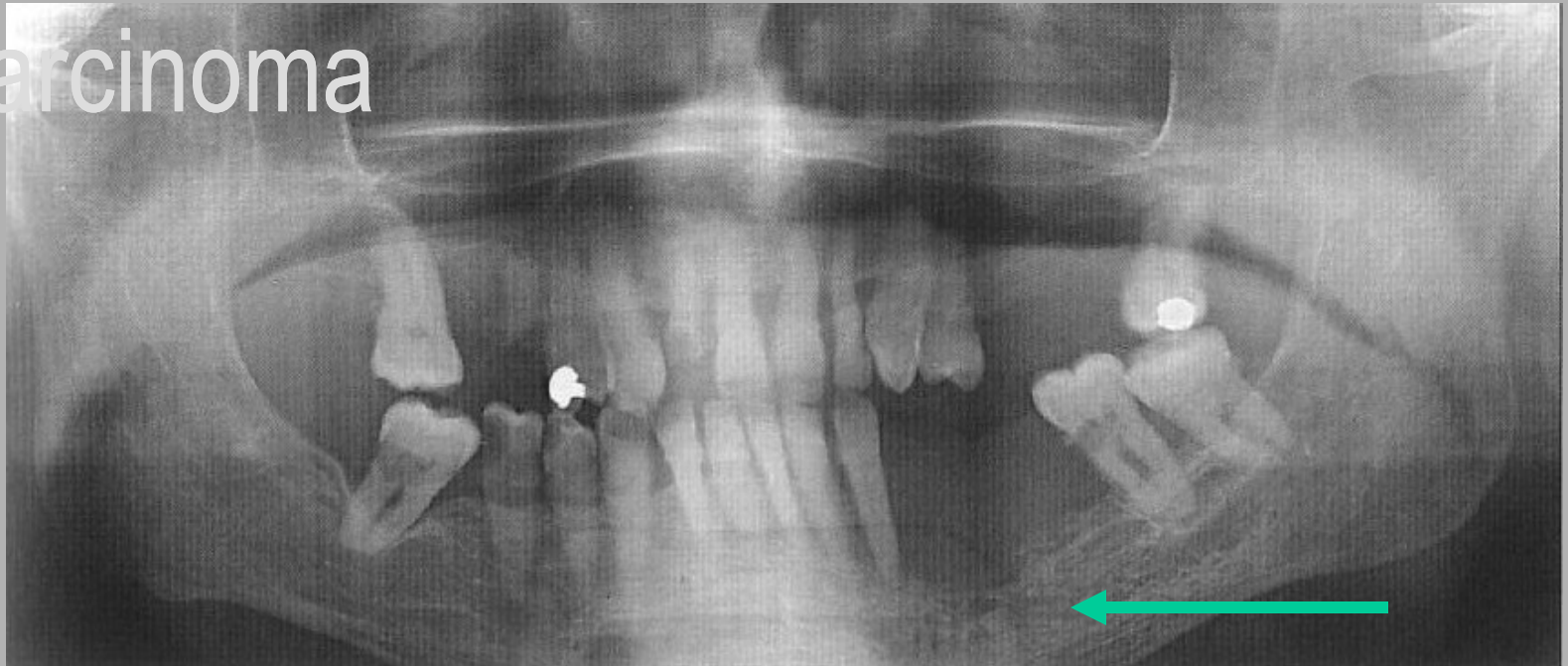
solitary - multiple

**Miscellaneous**

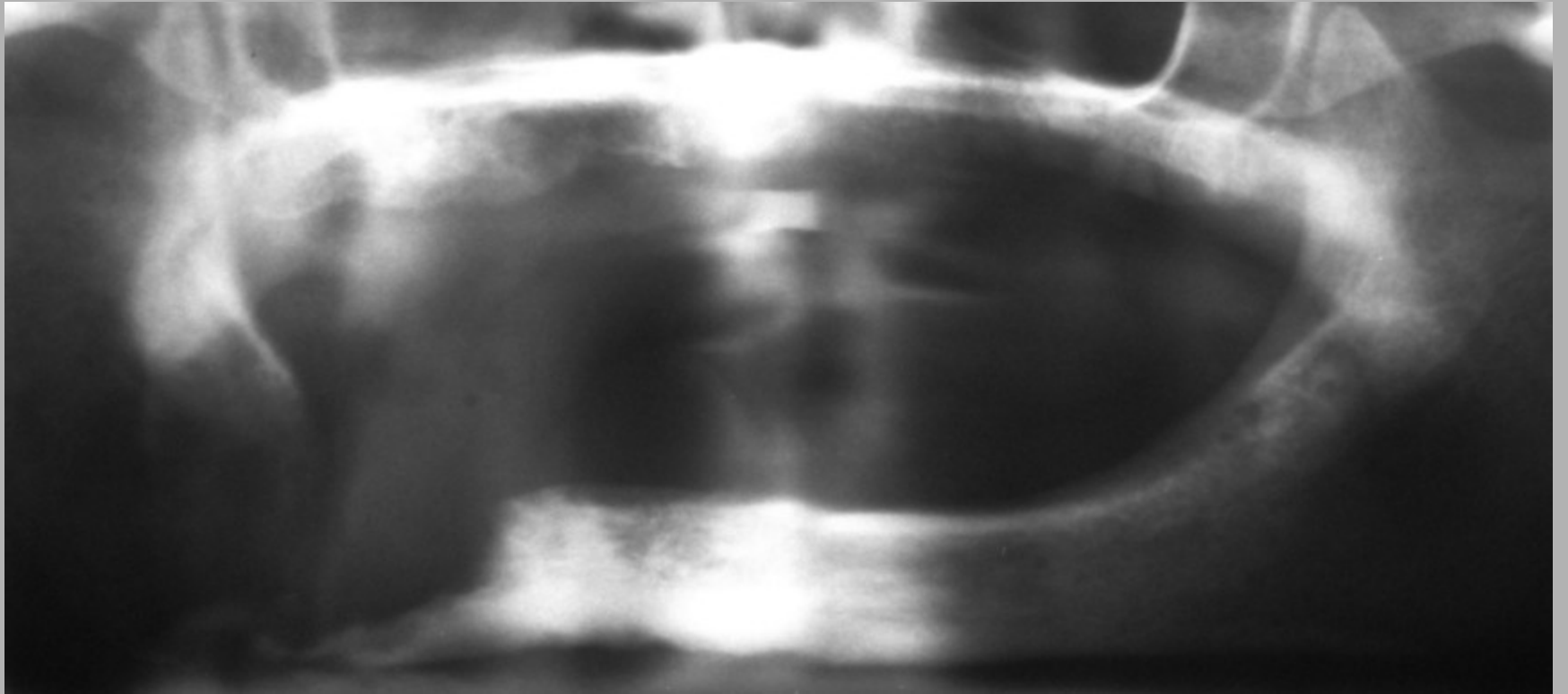
periosteal reaction  
cortical destruction



# Carcinoma



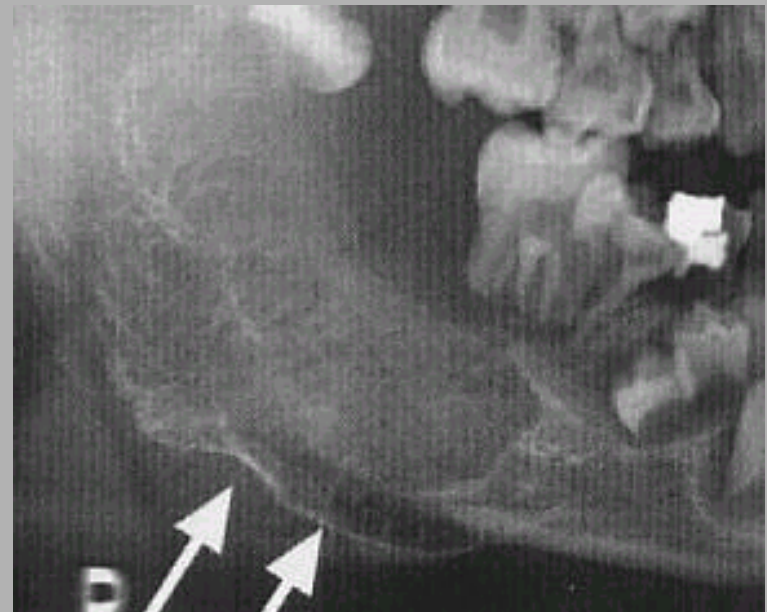
# Carcinoma



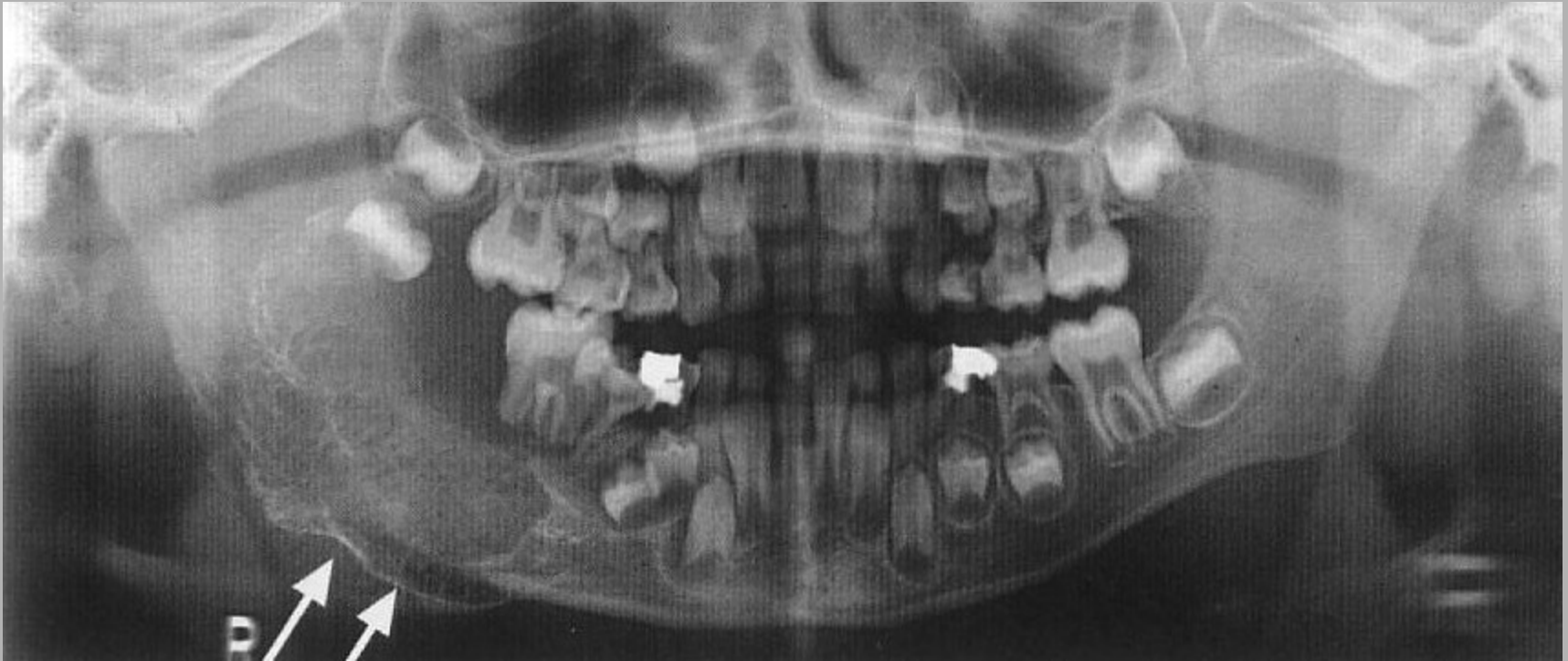
# Ewing sarcoma

- children 10-20 y
- high grade malignant
- fast grow
- soon metastatis
- angle of mandible
- painfull
- X-ray: „slices of onion“
- Dif.dg.
  - osteosarcoma
  - endosteal hemangioma

gold diagnostic standard  
MRI



# Ewing sarcoma

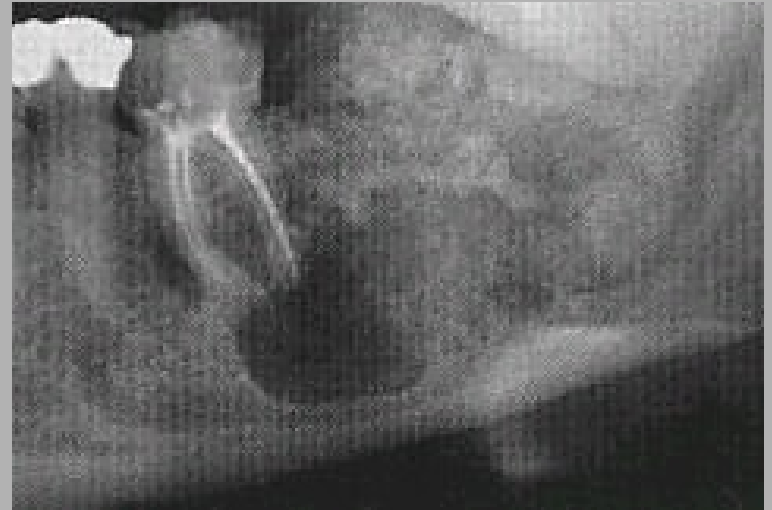


boy, 7 y  
difficulty clinics  
oedema of low jaw  
movement of teeth  
periost reaction



# Osteosarcoma

- 2. and 3. decennium
- mesenchymal tumor
- histologic
  - osteoblasts
  - chondroblasts
  - fibroblasts

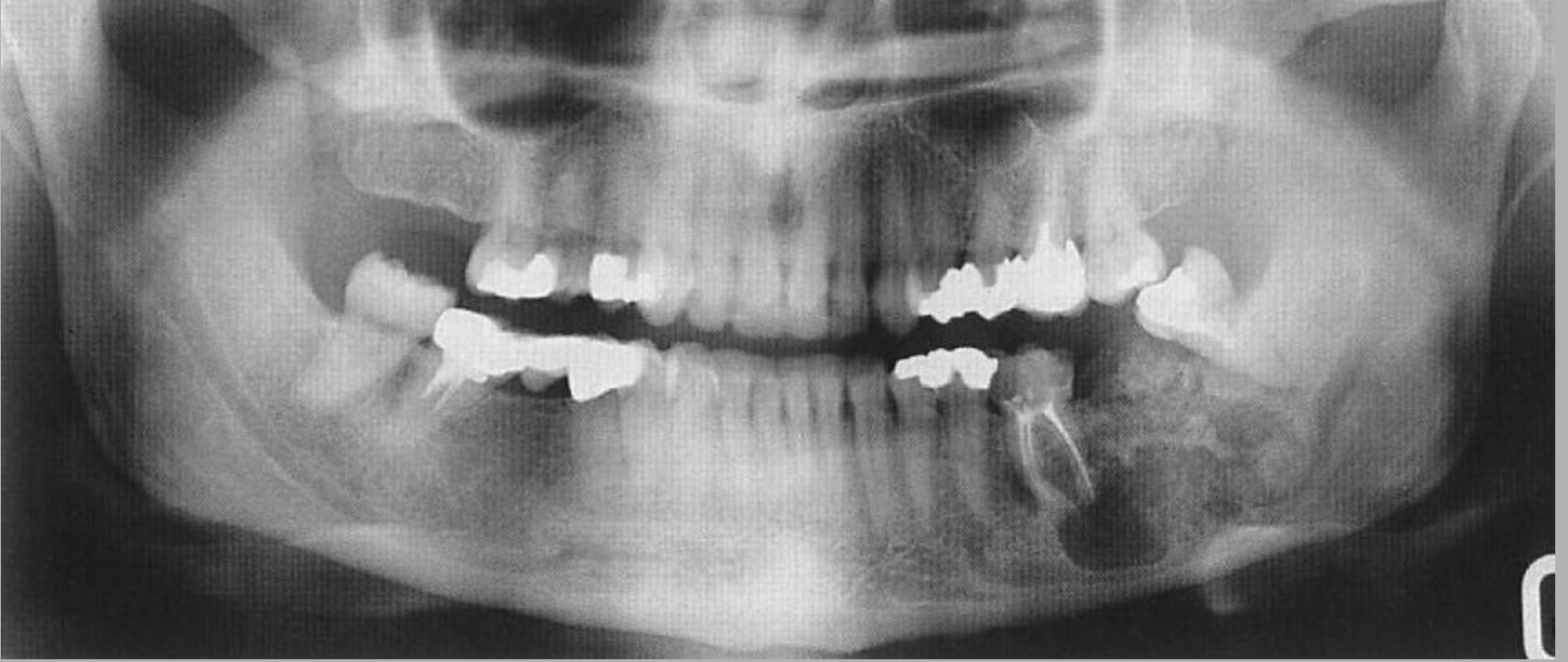


## RTG

- osteoblastic + osteolytic
- various image

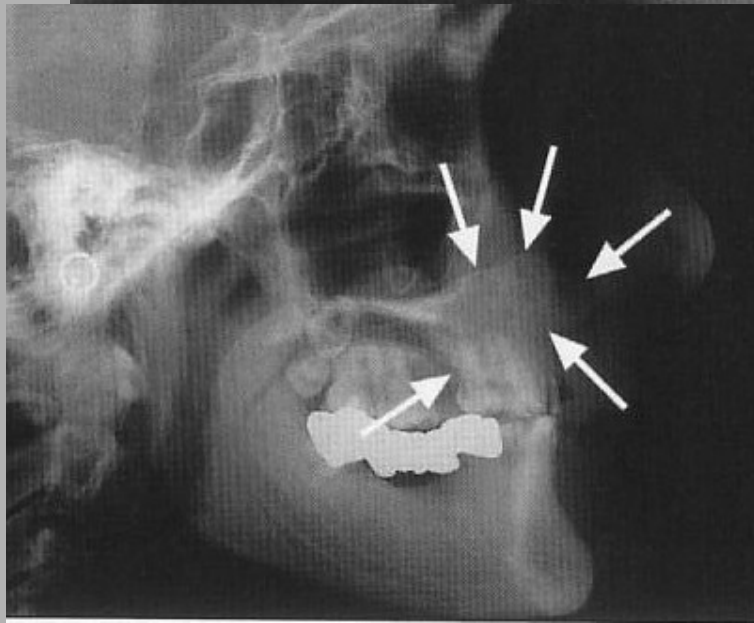
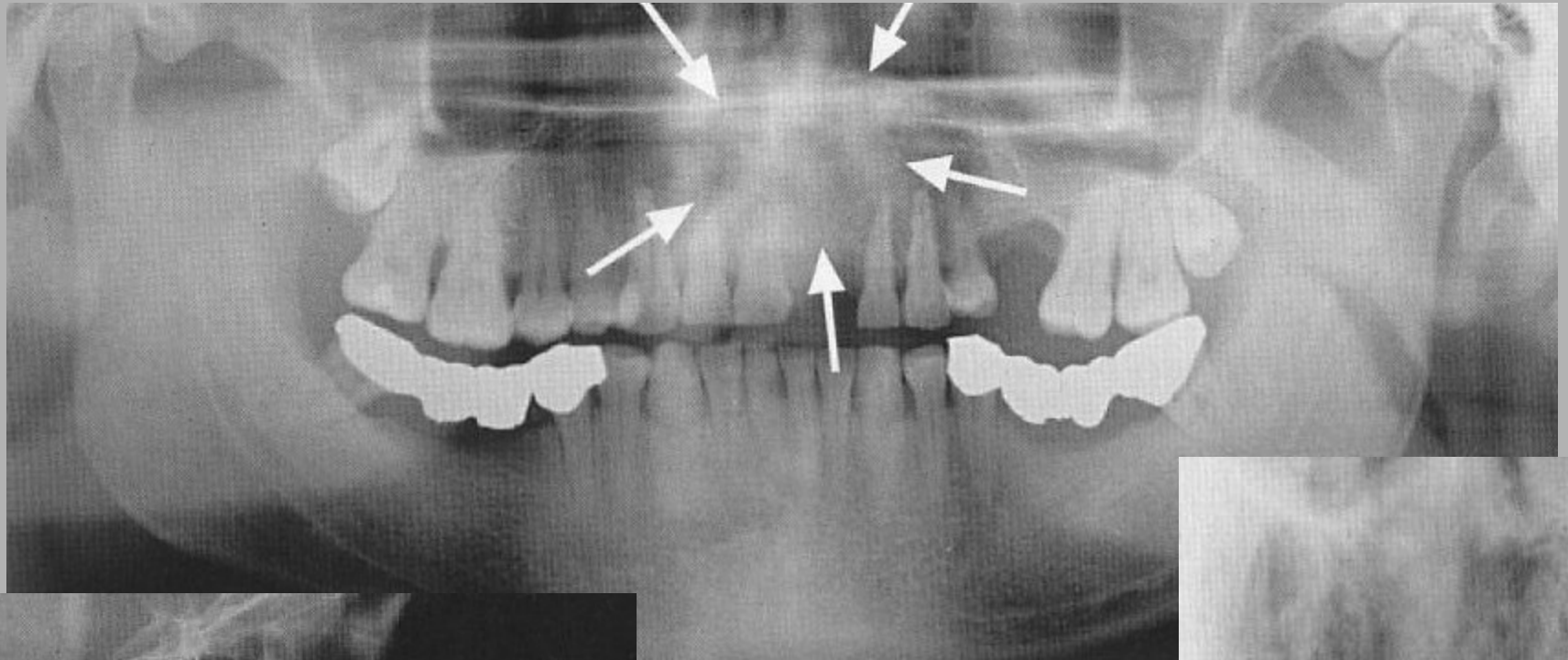


# Osteosarcoma



w, 29 y

# Osteosarcoma

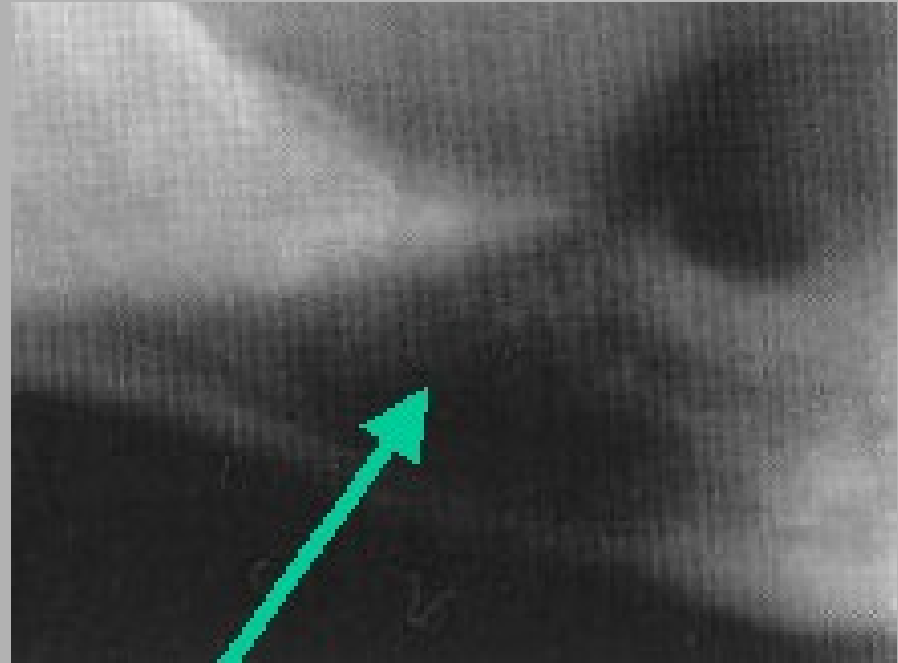


m, 40 y

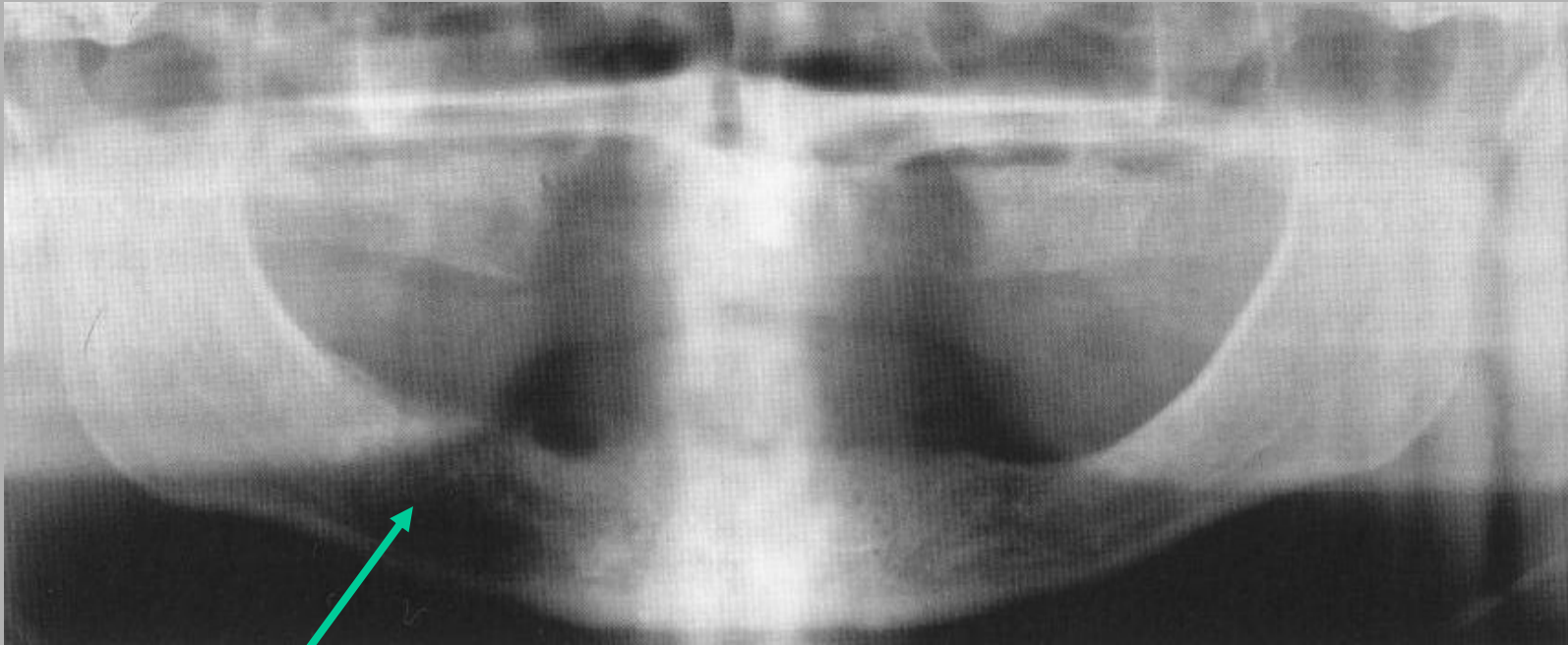


# Metastasis

- carcinomas of:
  - mamma
  - lung
  - gl. thyreoidea
  - prostate
- blood spread
- clinics:
  - pain in the bones
  - „reasonless“ teeth release
  - paresthesis of lower lip
  - pathological fracture
- suspicion = scintigraphy



# Metastasis



- m, 69 y
- prostate carcinoma
- transparency

# Metastasis



- bowel carcinoma
- spotted, blurred

# Odont. myxoma

- age 10-50 y
- w/m 1:1
- jaws (only)
- most often in lower jaw - caput of mandible
- growth
  - fast
  - endosteal
  - muscle infiltration (occasionally)
- good bounded, irregular translucency
- often relaps



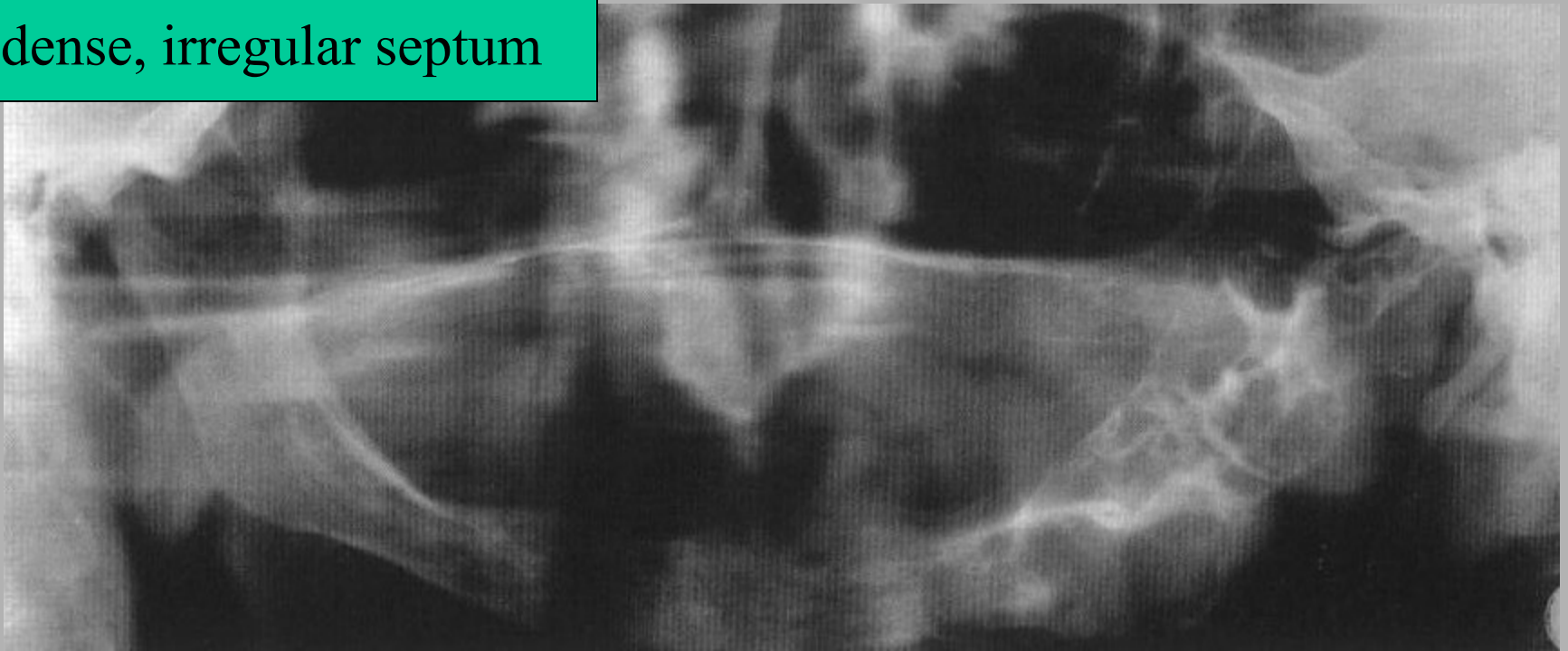
# Odont. myxoma

w, 34 y

structure - net



dense, irregular septum





# Odont. myxoma

boy, 13 y



# Odontoma

- similar to the hamartomas
- conglomerate of various teeth tissues
  - composite odontoma
    - ✓ contains several developed teeth
  - complex odontoma
    - ✓ contains basic teeth tissues in amorphous mass



composite



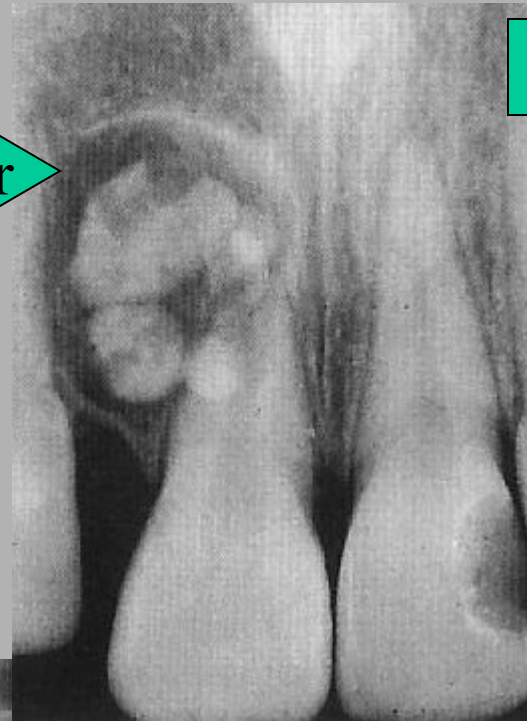
complex

# Odontoma

incidental findings—  
susp. calc. odontogen. cyst

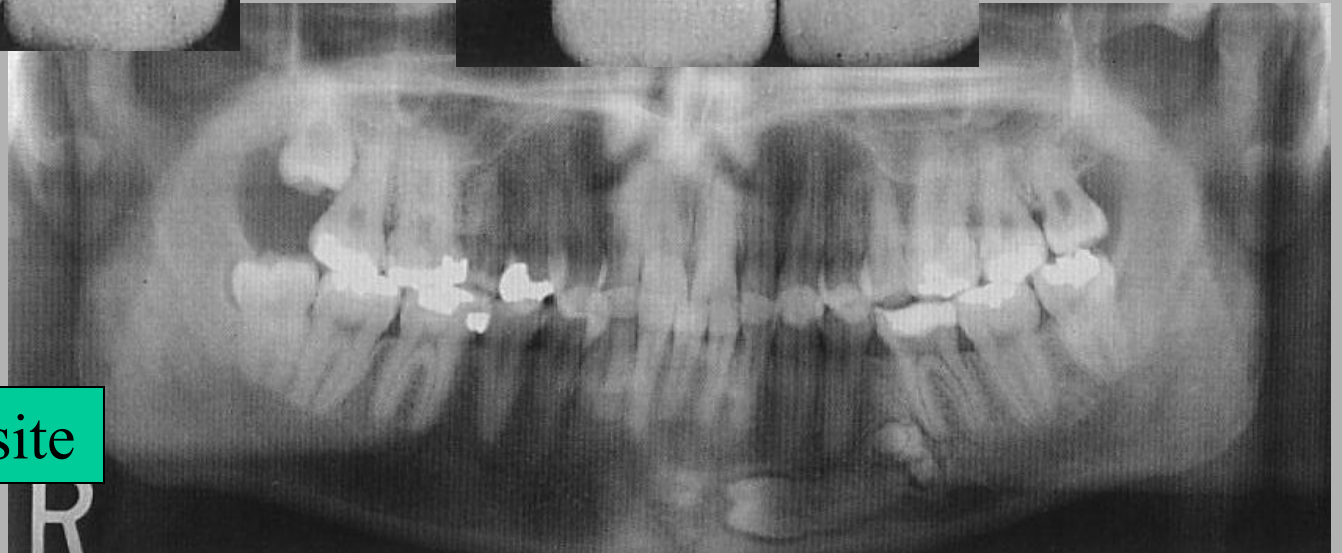


after 2,5 year



composite

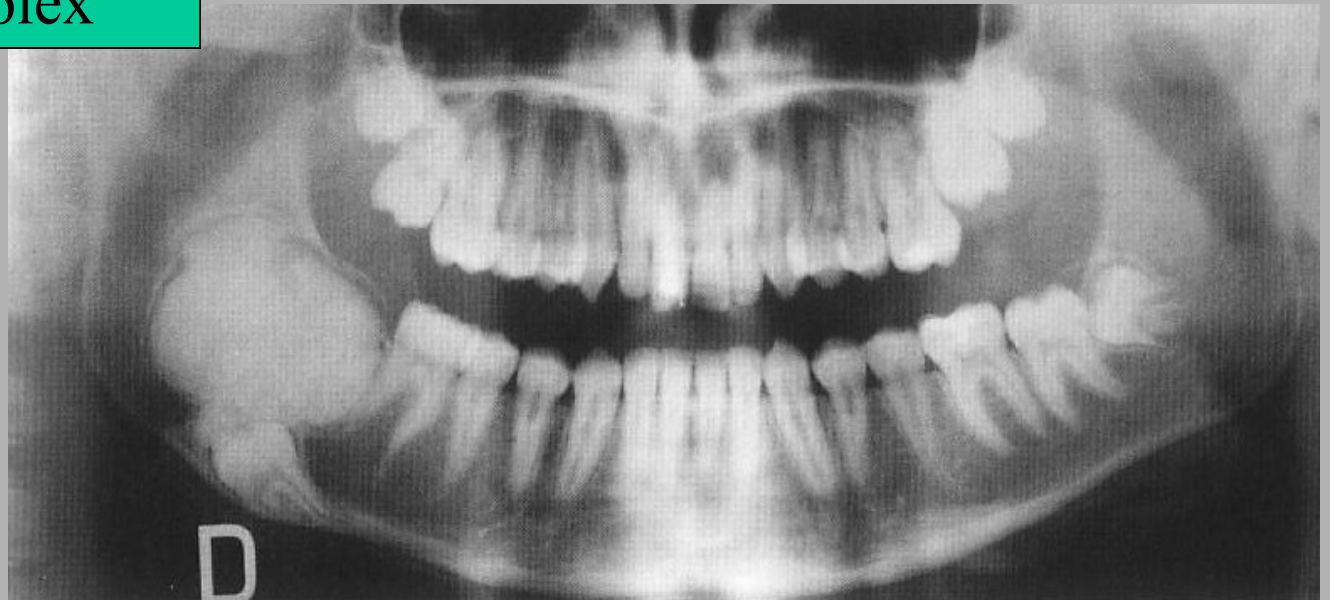
composite



# Odontoma

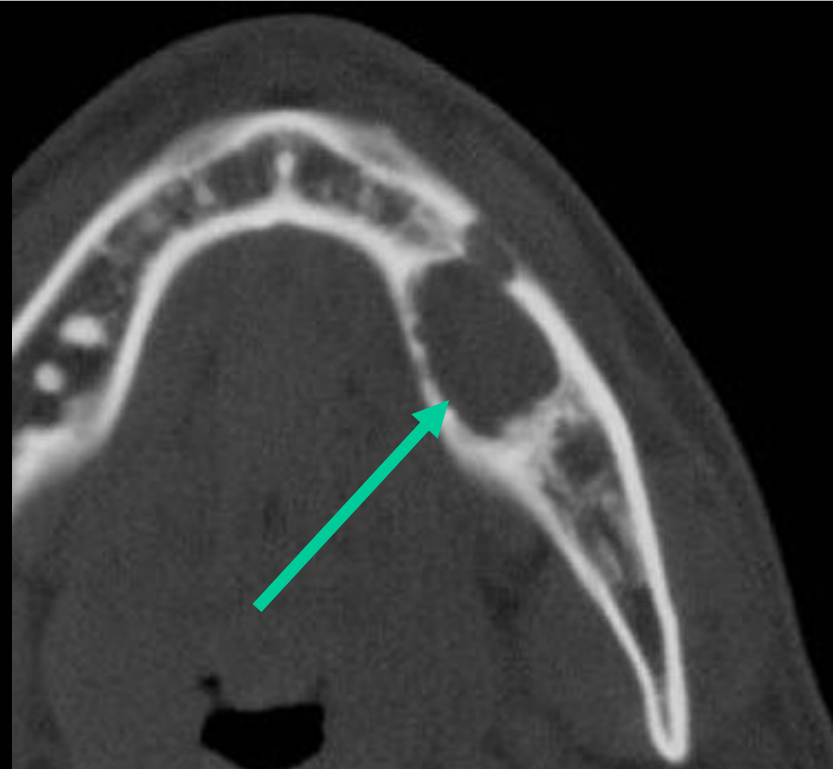
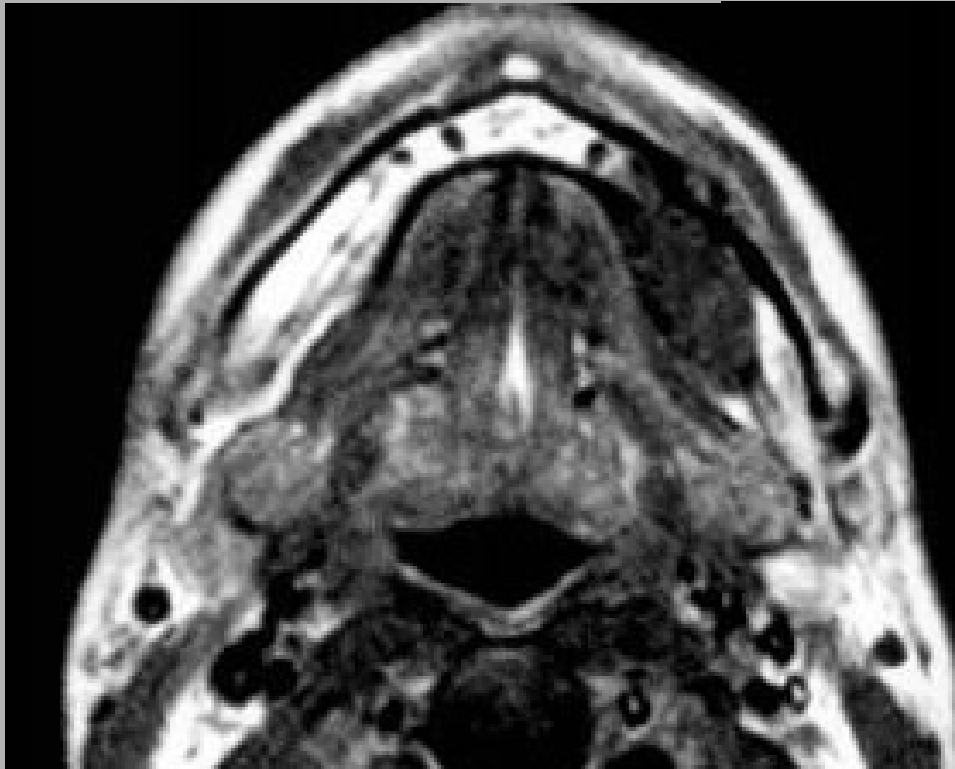


complex



# Fibroma

- **Fibromas** (or **fibroid tumors** or **fibroids**) are benign tumors that are composed of fibrous or connective tissue.



# Ameloblastic fibroma

- The **ameloblastic fibroma** is an odontogenic tumor arising from the enamel organ or dental lamina
- tumor with odontogennal epithelium and ectomesenchyma
- benign
- 10-20 y, boys
- in molar mandible region
- dif.dg.
  - follicular cyst
  - ameloblastoma
- don't recidivate

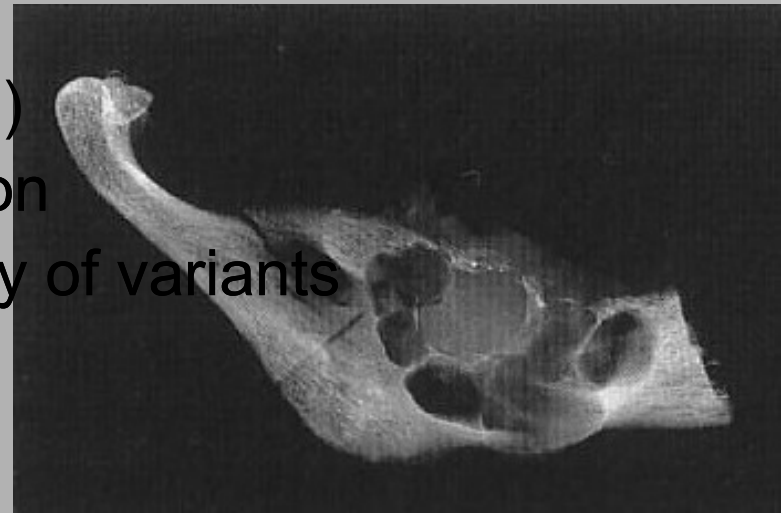


# Ameloblastic fibroma

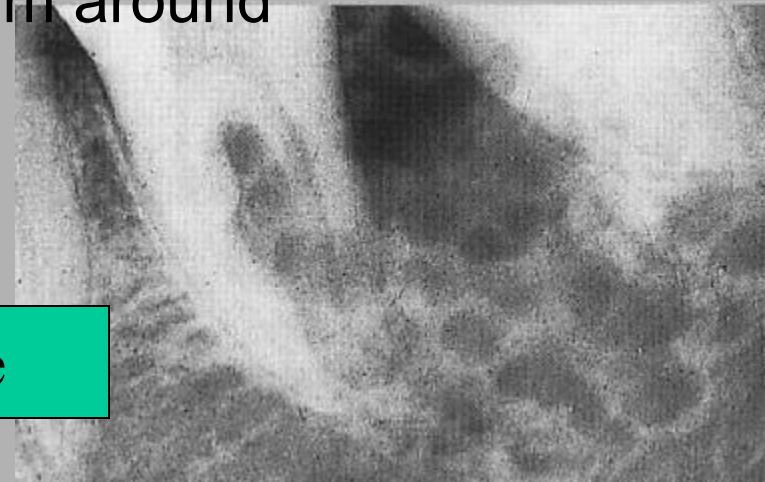


# Ameloblastoma

- is a rare, benign tumor of odontogenic epithelium
- m/w 1:1
- in a region of caudal molars (80%)
- long-term relaps = radical resection
- variable histological image – many of variants
- RTG
  - multilocular
  - multicystic
  - bubble transparency with septum around
  - compacta thin out
- slow growth, painless
- oedema, facial asymetry



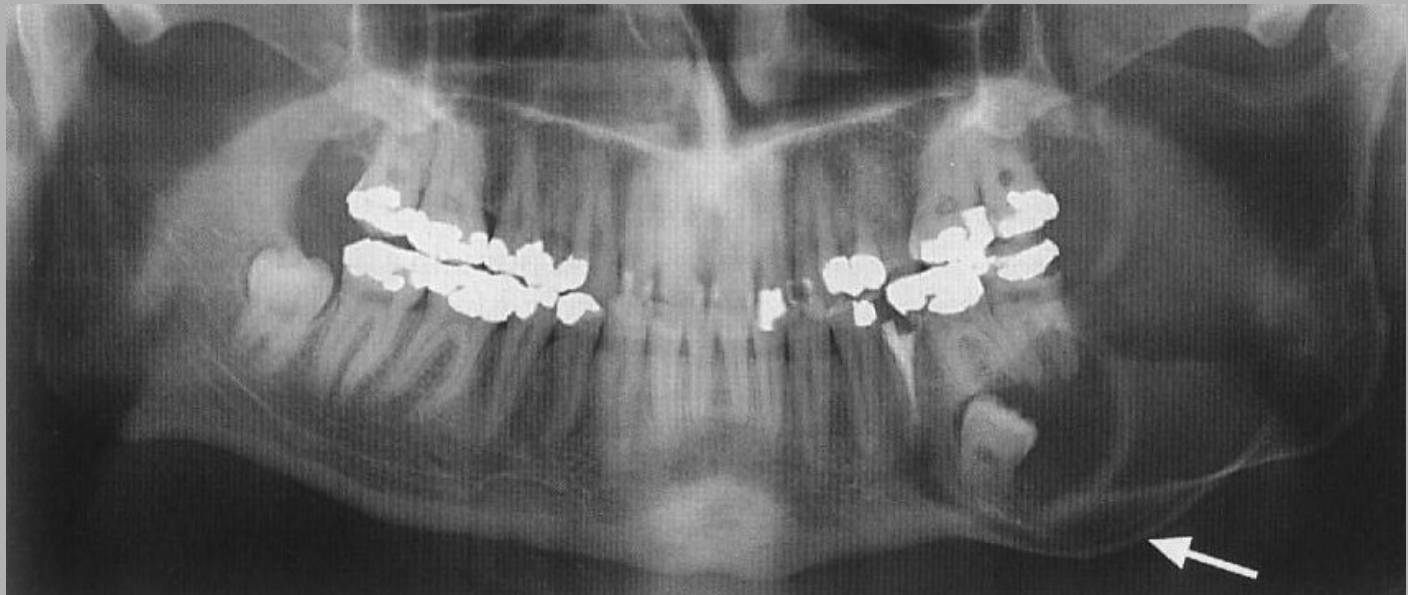
„honeycomb“ structure





# Ameloblastoma

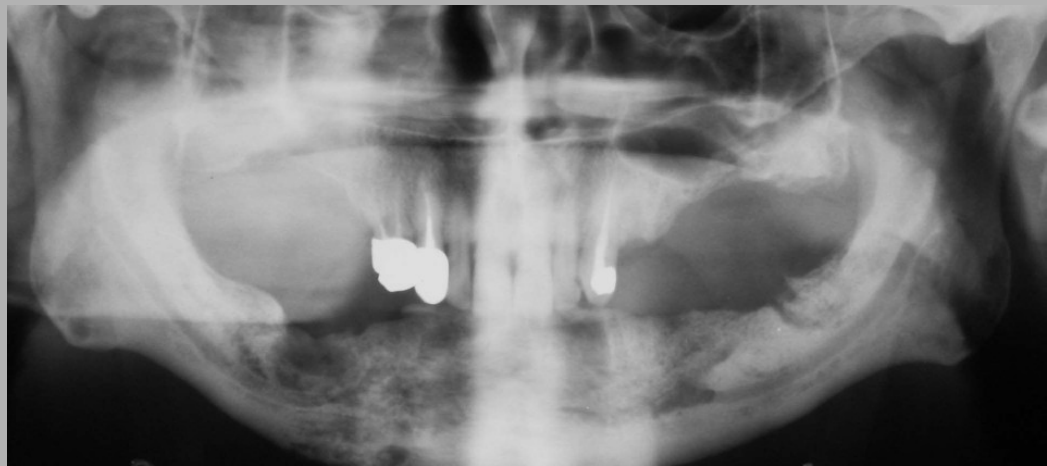
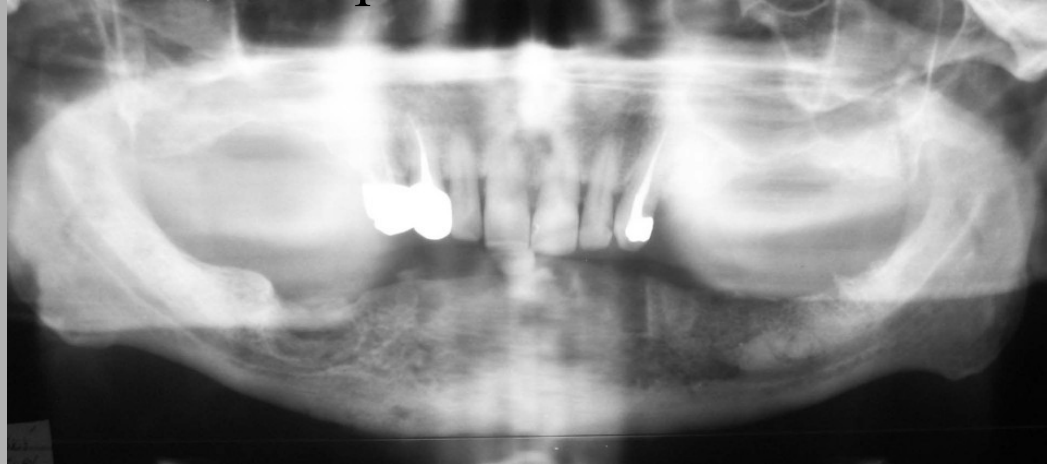
- dif.dg.
  - follicular cysts
  - keratocysts
  - ameloblastic fibroma
  - odontogennal myxoma
  - central eosinofil granuloma



# Myeloma

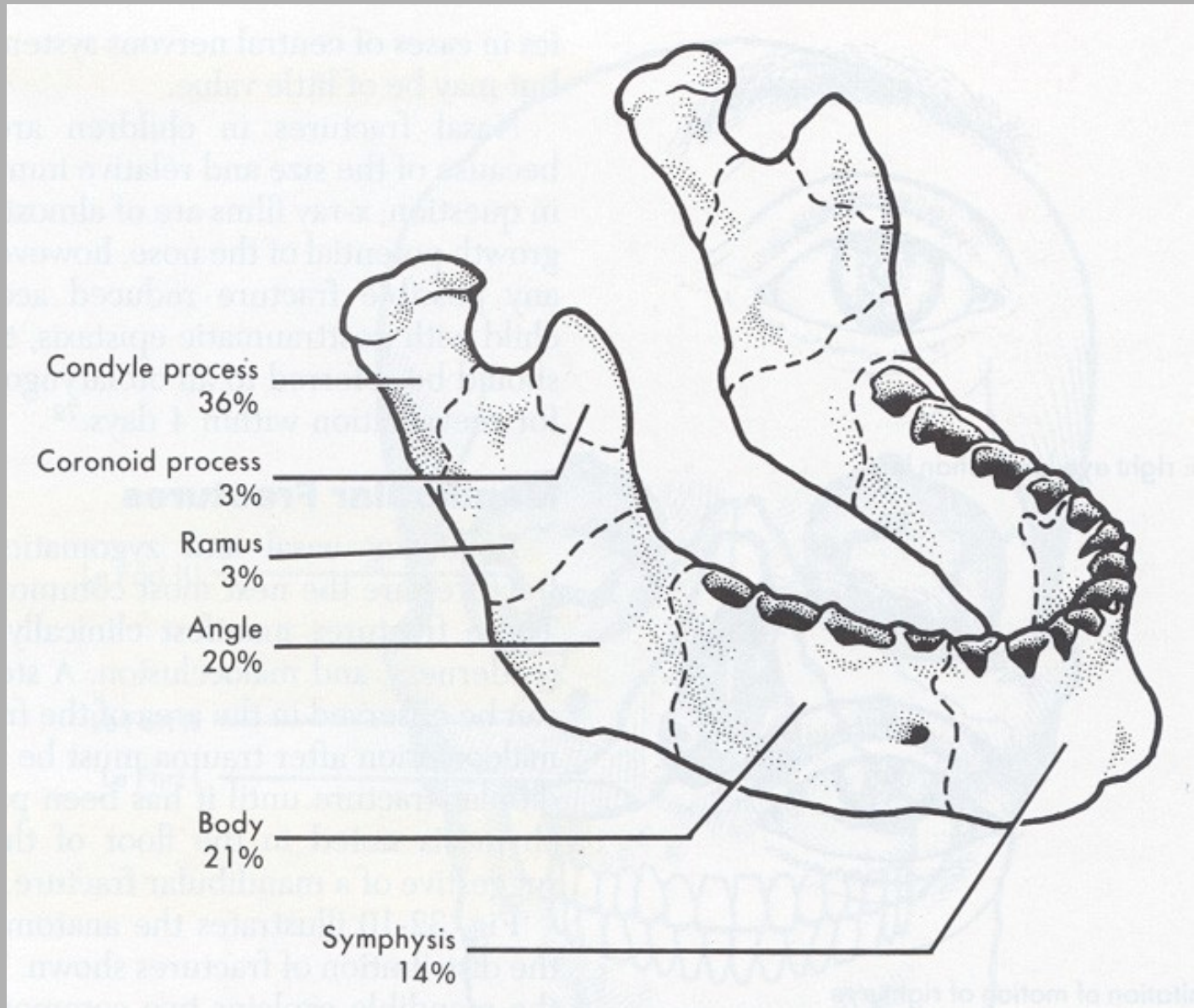
is a cancer of the white blood cells known as plasma cells.

- Hypercalcemia (corrected calcium  $>2.75$  mmol/L)
- Renal insufficiency attributable to myeloma
- Anemia (hemoglobin  $<10$  g/dL)
- Bone lesions (lytic lesions or osteoporosis with compression fractures)
- Frequent severe infections ( $>2$  a year)
- Amyloidosis of other organs
- Hyperviscosity syndrome

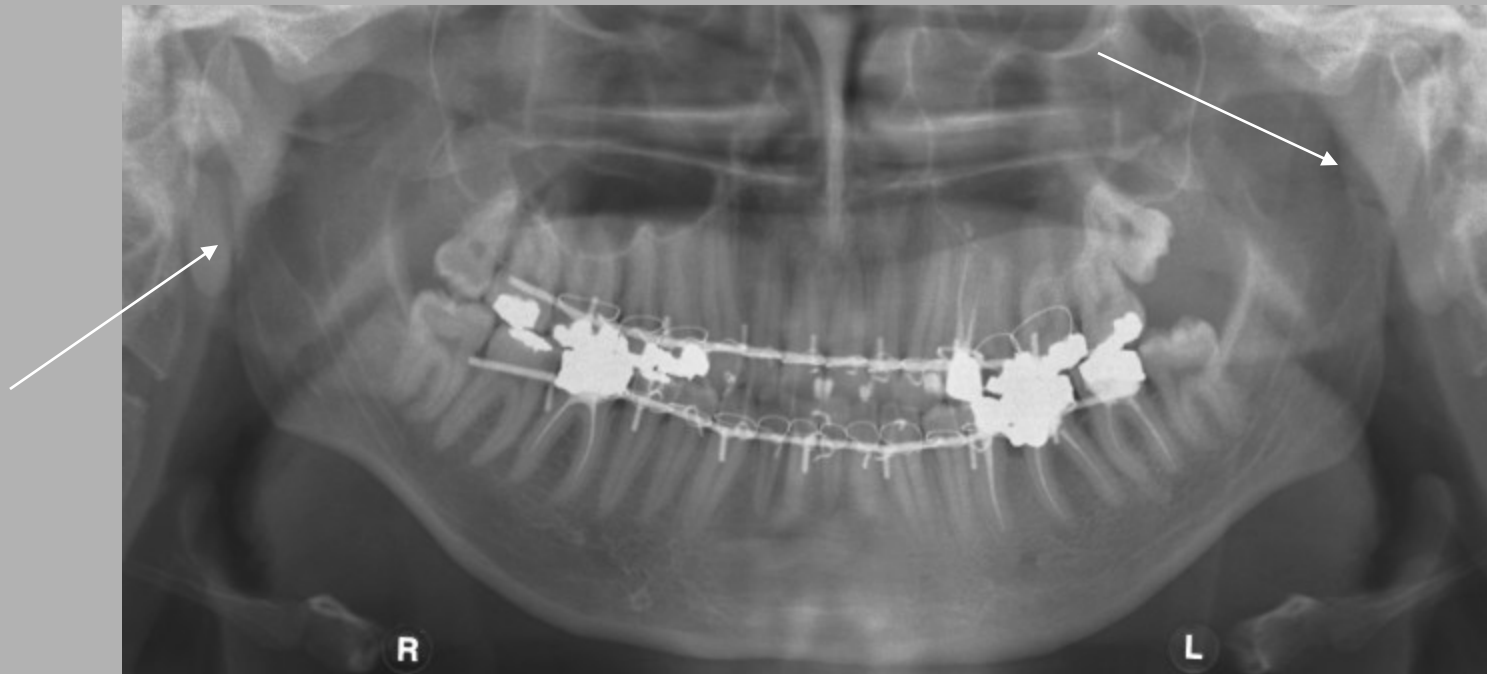




# Mandible fractures



Fract. processus articul. mandibulae bilat.



mandible angle - sutura



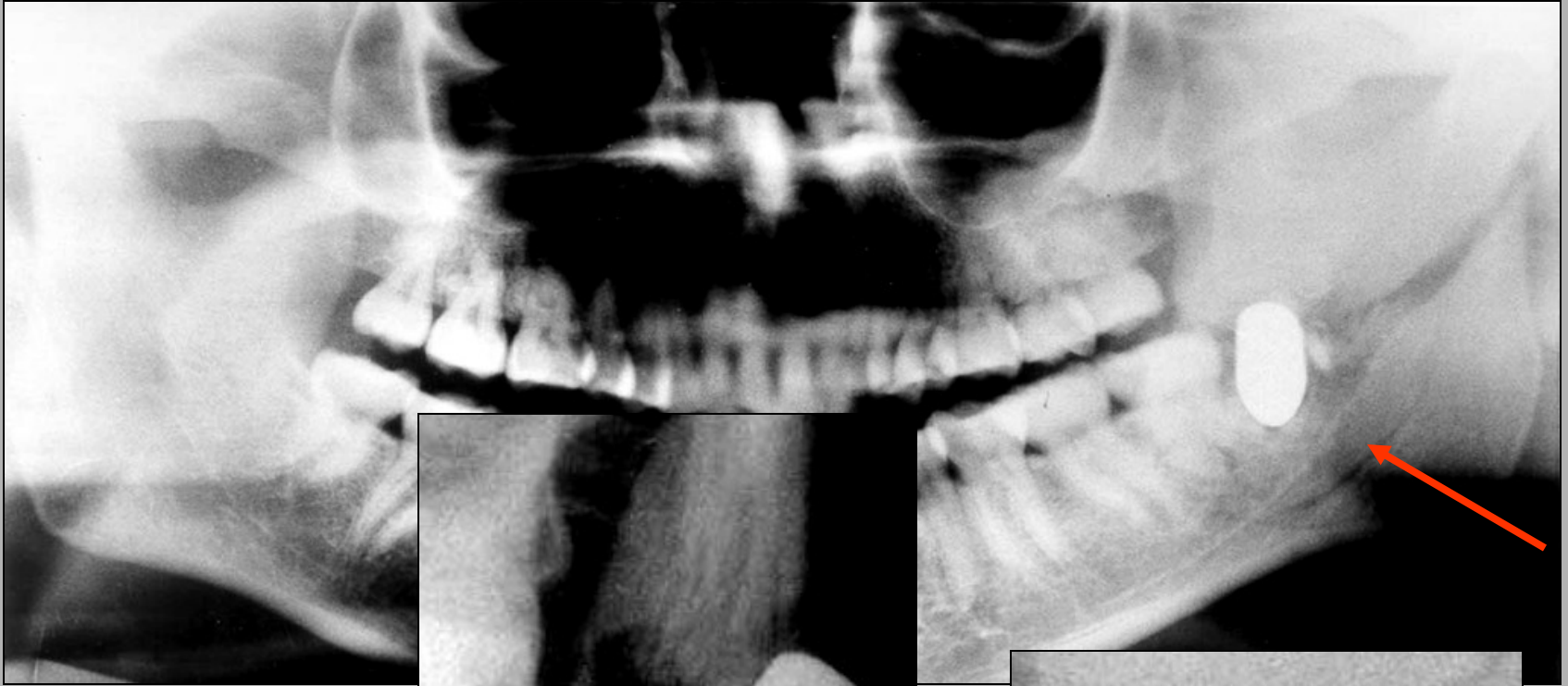
# Body



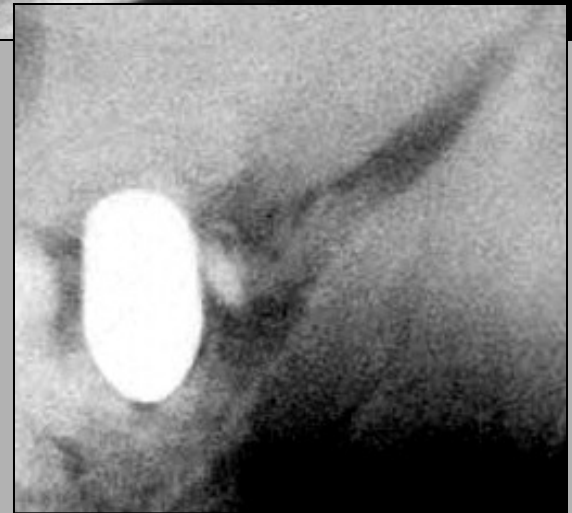
symphysis



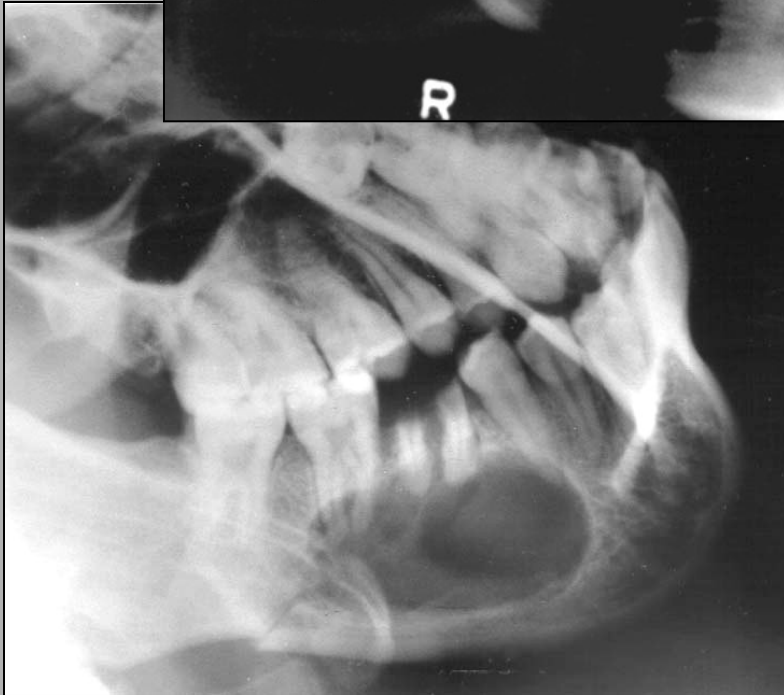
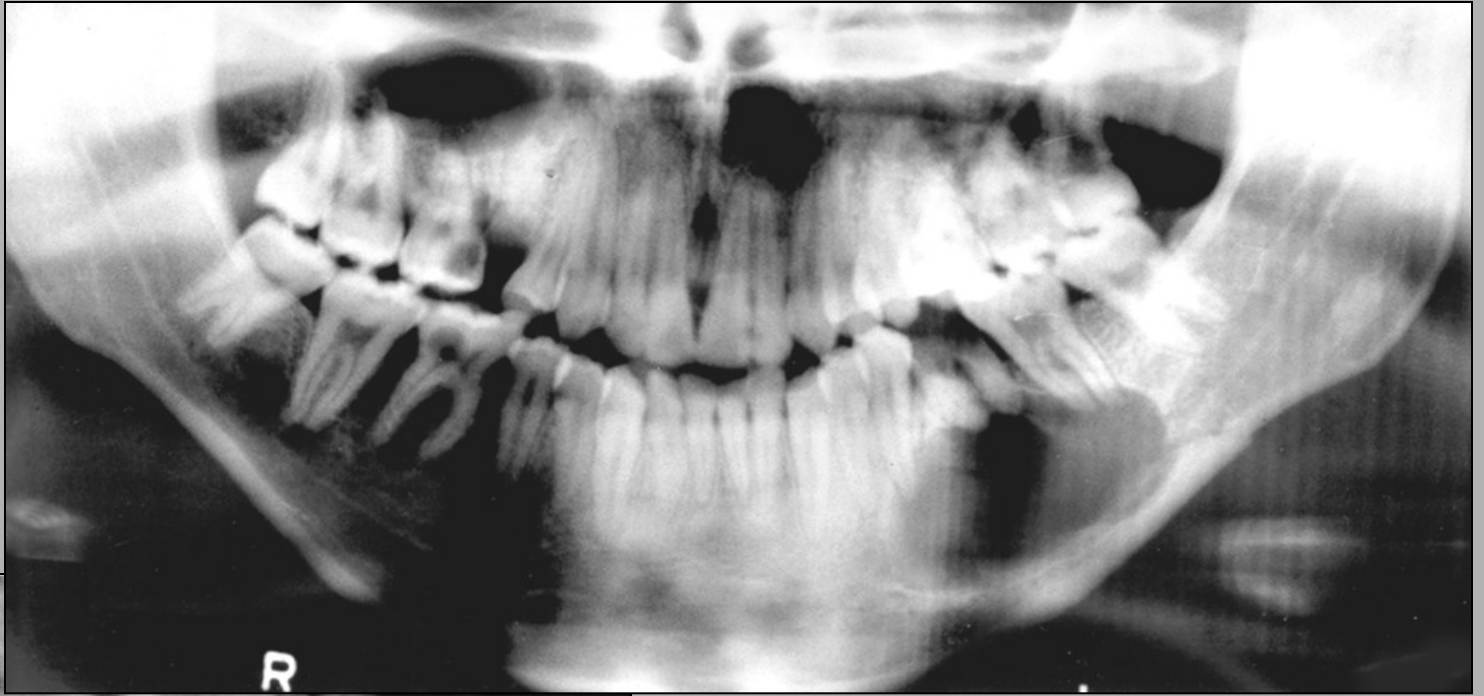




bullet



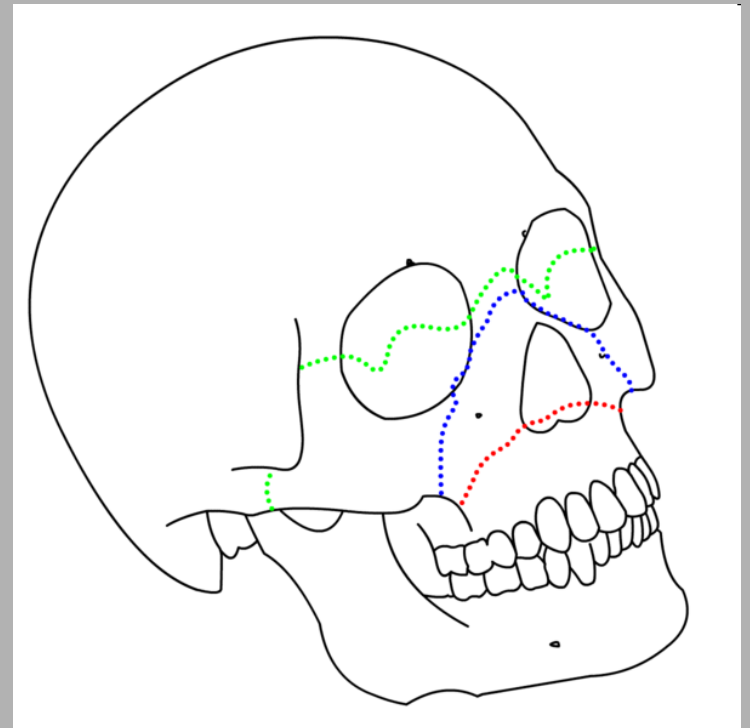
# Pathological fracture apical cyst





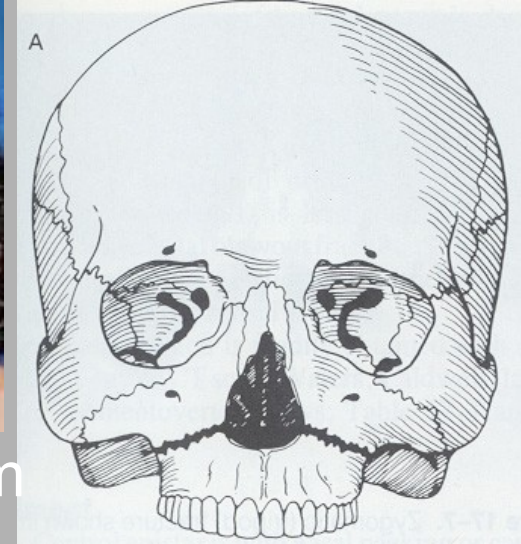
# Le Forte

- high energy trauma
- Classification: **Le-Forte I-III**
- all types Le Forte involve processus pterygoideus



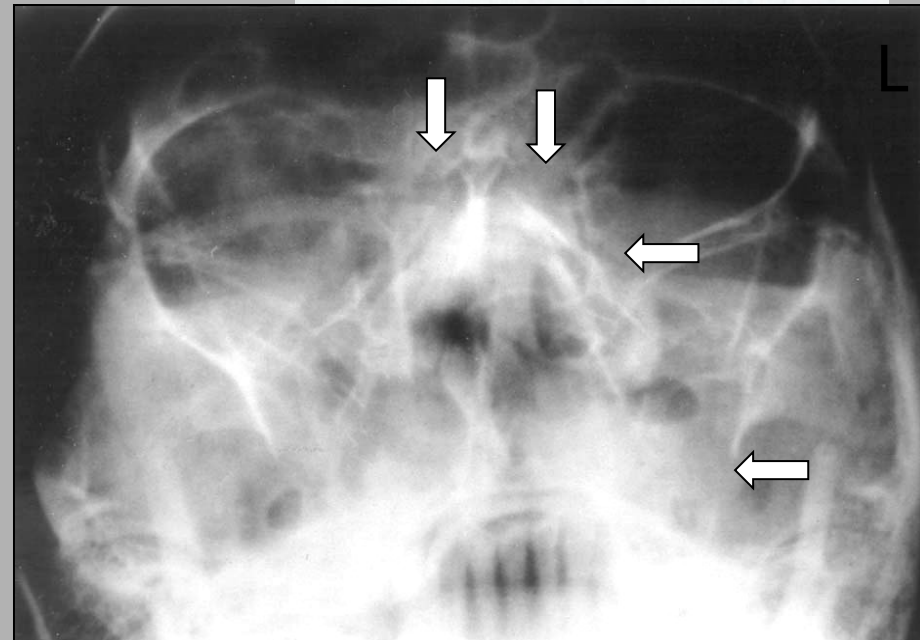
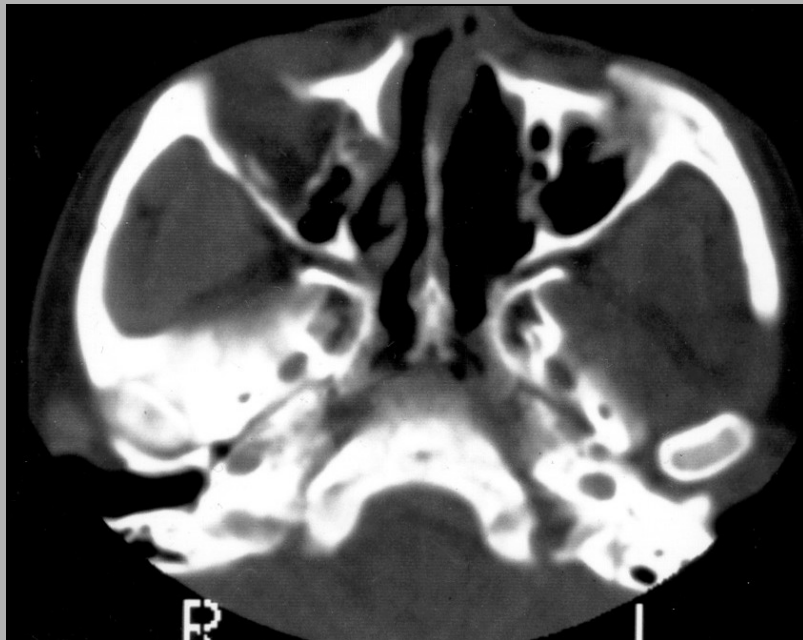
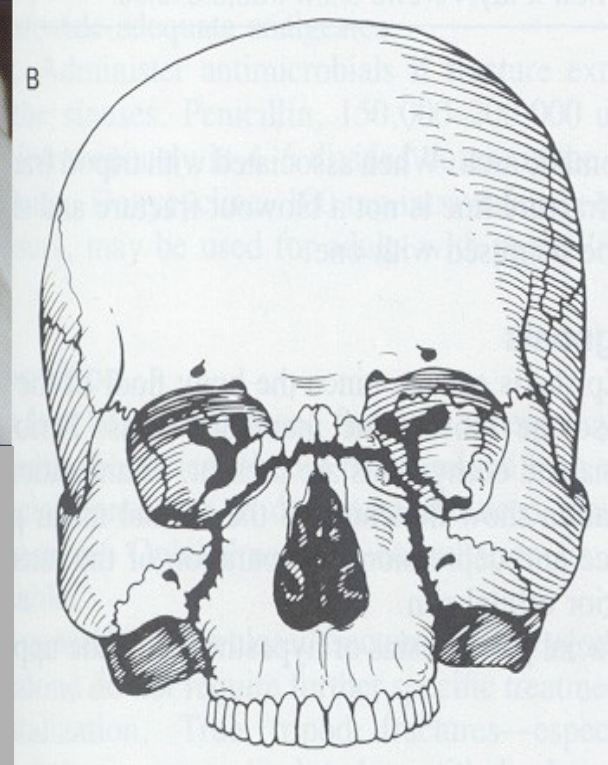
# LeFort I

- horizontal fracture
- 'floating palate'
- The fracture extends from the nasal septum, travels horizontally above the teeth apices
- crosses below the zygomaticomaxillary junction, and traverses the pterygomaxillary junction to interrupt the pterygoid plates.

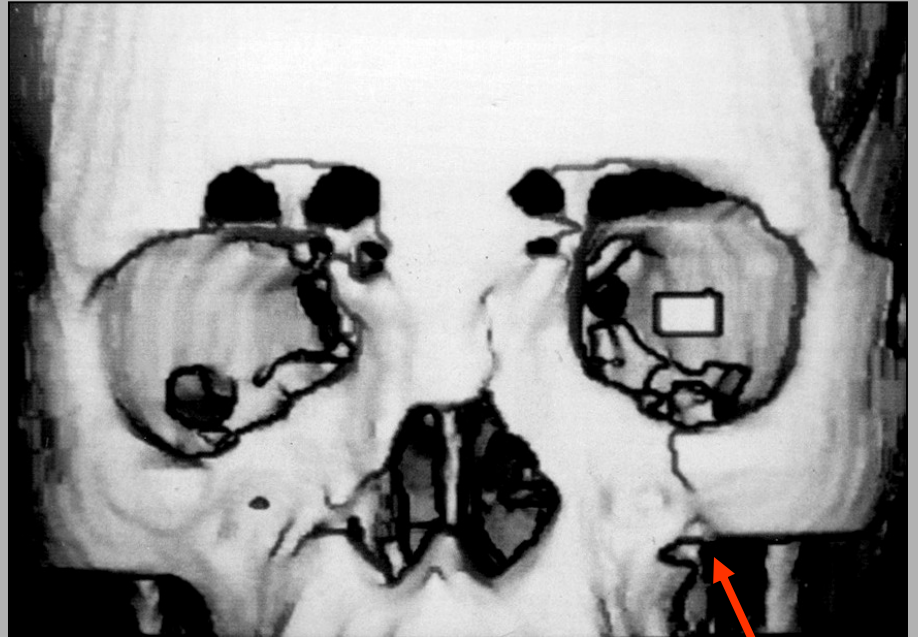
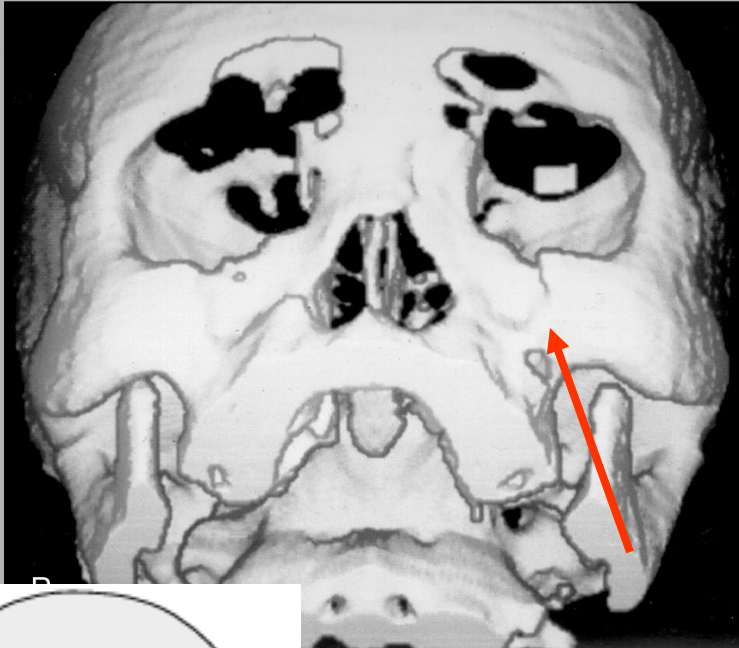


# LeFort II

- ✓ Maxilla
- ✓ Medial portion of orbits
- ✓ nasal bones



# LeFort II



CT 3-D reconstruction



# LeFort II



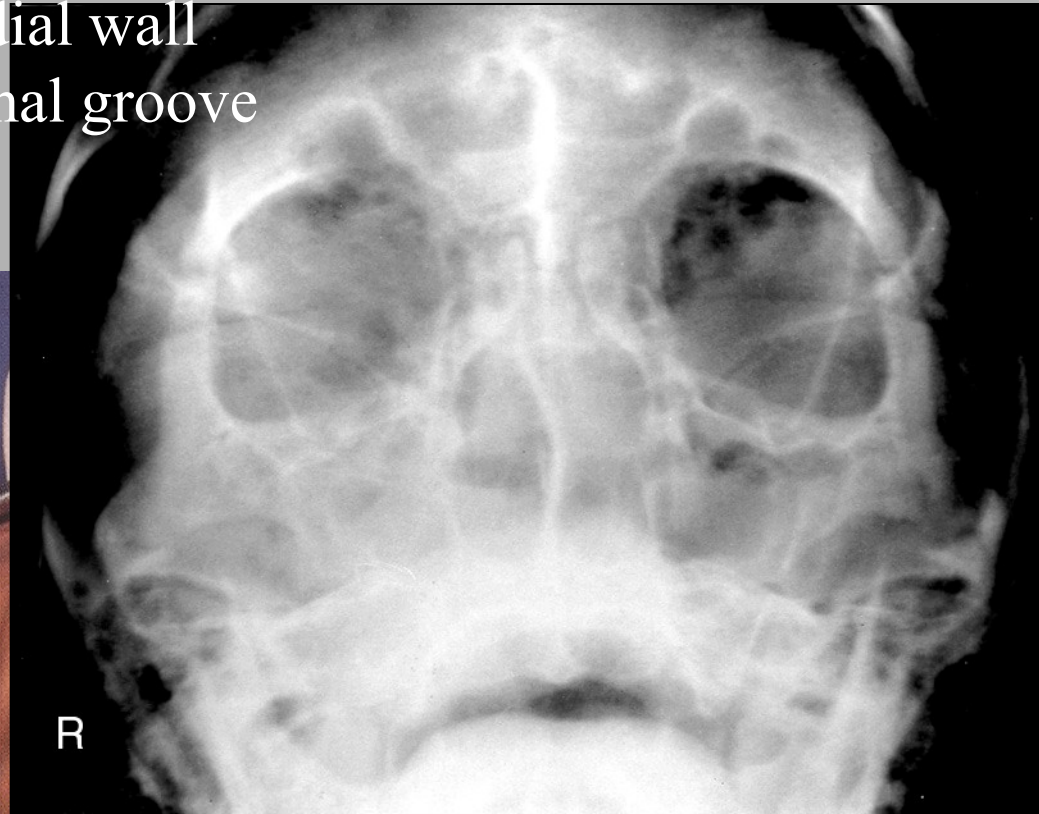
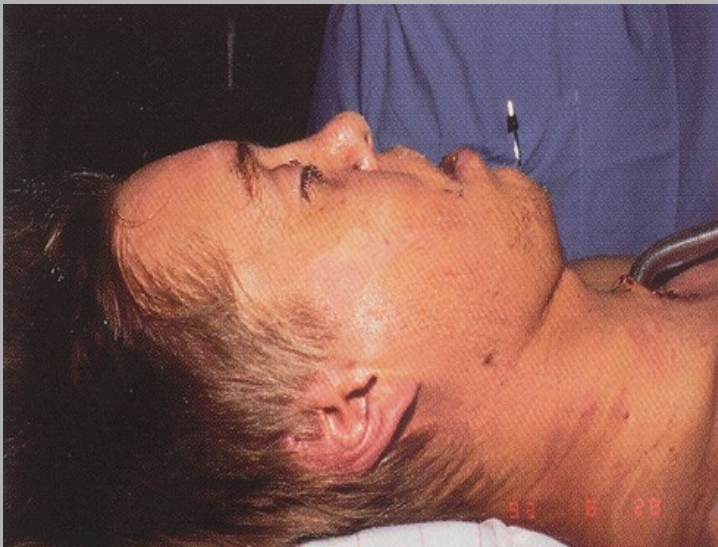
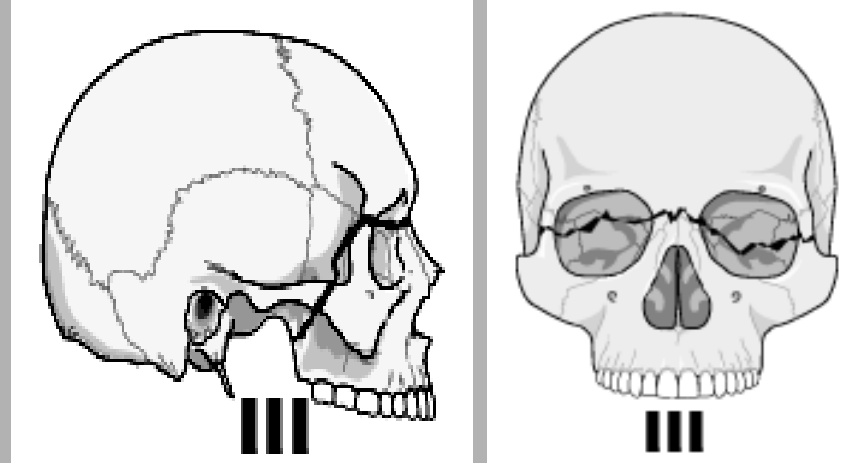
F  
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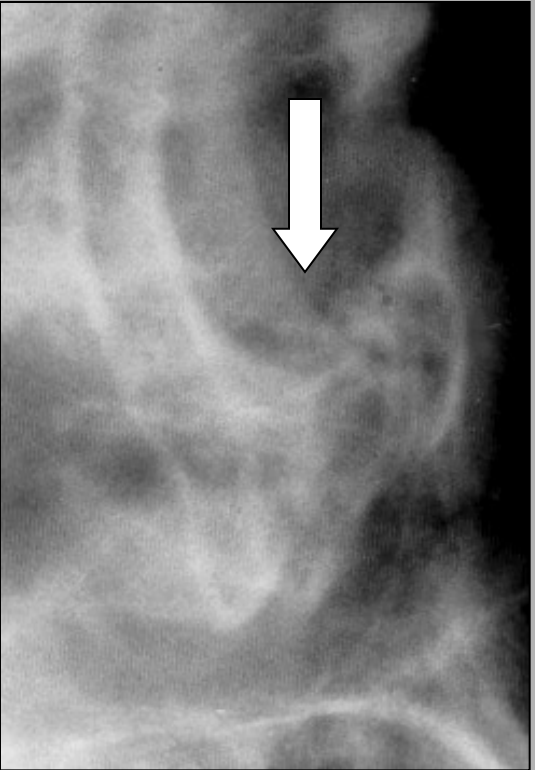
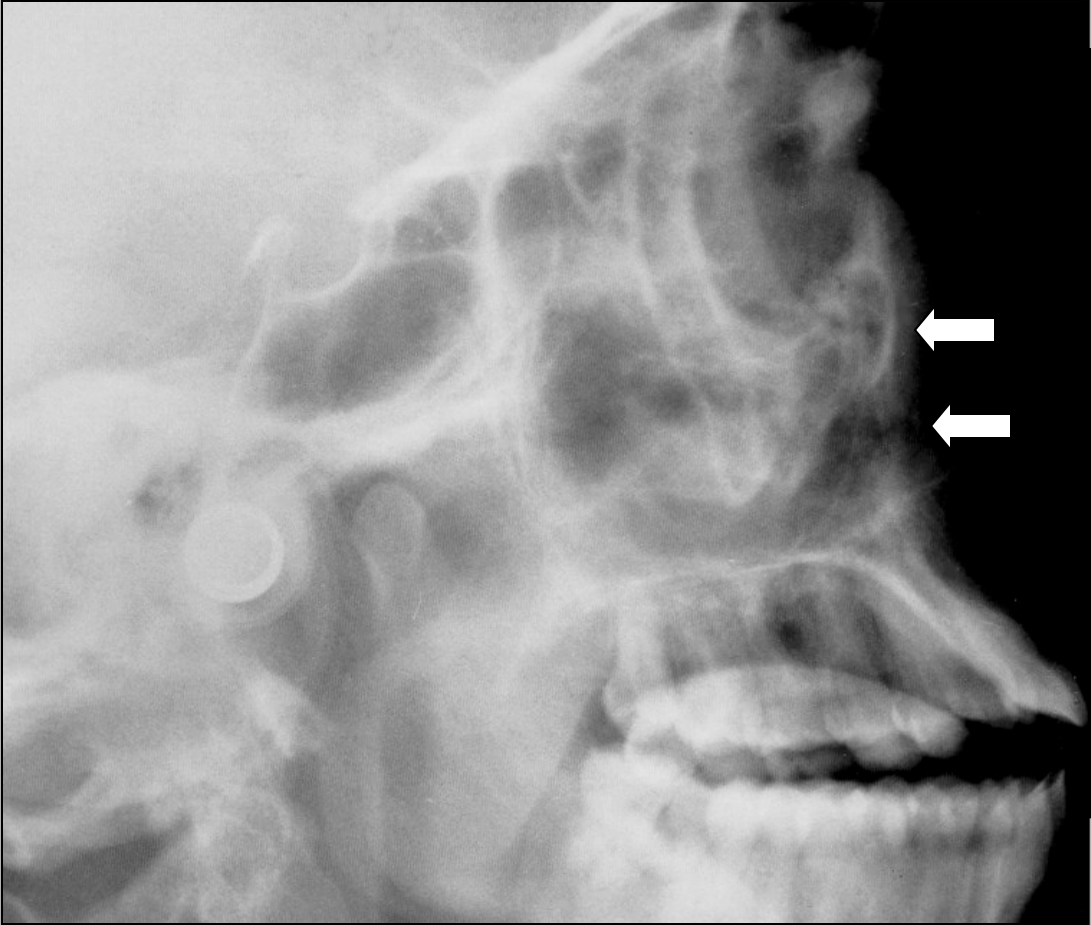




# LeFort III

- fractures (transverse)
- known as craniofacial dissociation
- involve the zygomatic arch
- start at the nasofrontal and frontomaxillary sutures
- extend posteriorly along the medial wall of the orbit through the nasolacrimal groove and ethmoid bones.

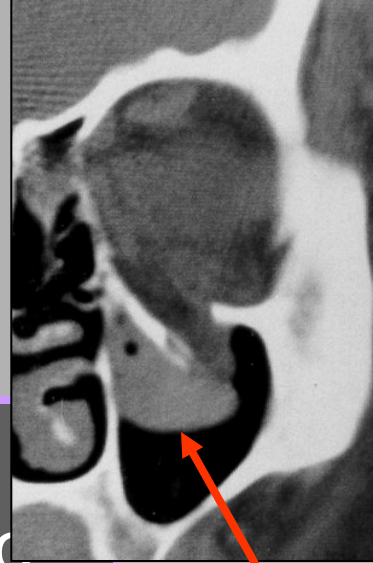






# „Blow-out“ fraktura

- Síla se přenáší přes tenké dno orbity, kde dochází k fraktuře v blízkosti infraorbitálního kanálu.
- Měkké tkáně přesahují okraj orbity.
- Afekce maxilárního sinu.
- Dislokace dna orbity.
- Polypoidní denzita při horním okraji maxil. sinu při herniaci obsahu orbity.
- Parestezie tváře.

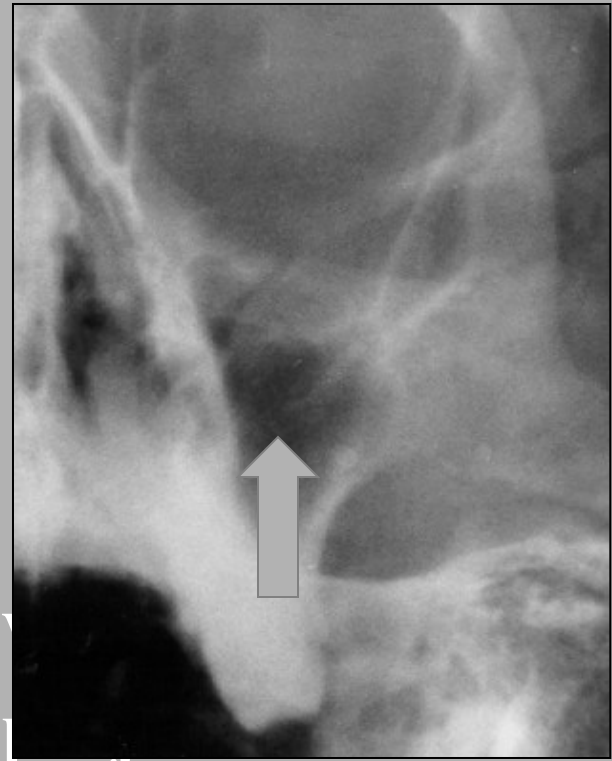


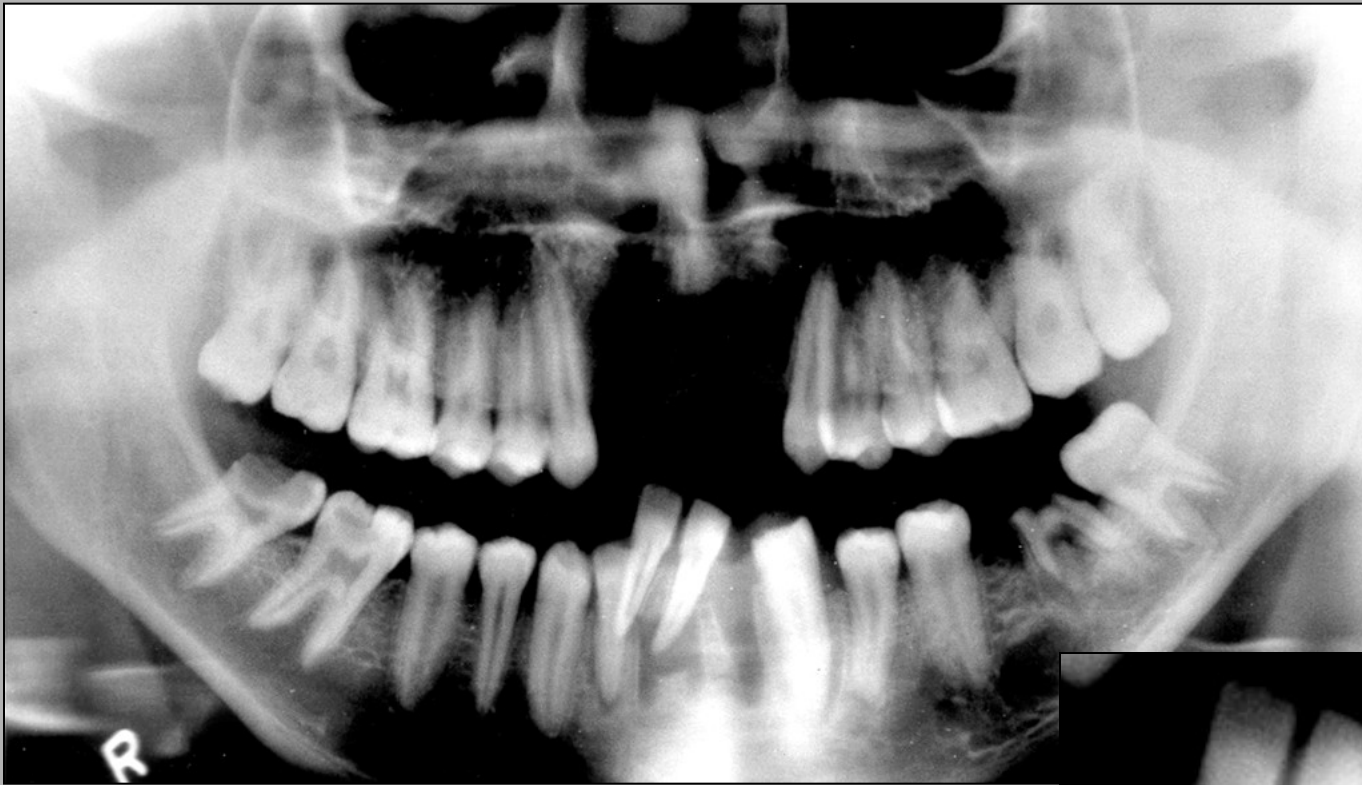


# Orbita



„Blow-out“ fract.

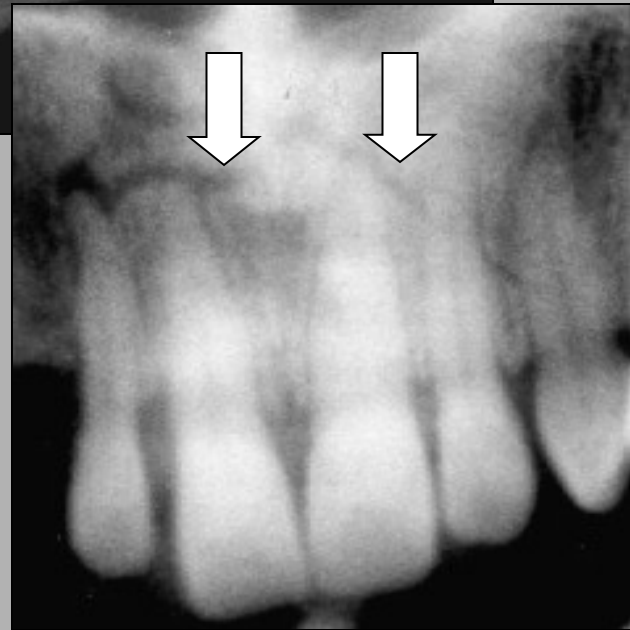




**Subluxation.**







Alveolar fract.