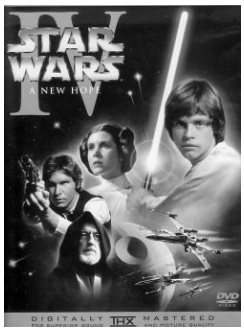
Definitions

- **Malignancies** are uncontrolled growths of tissue
- **Primary tumors** represent *de novo* tumors in their initial site
- **Metastatic tumors** originate from distant primary growths
- Malignancies are generally classified by tissue of origin

Definitions

Four Categories

1. Carcinomas (epithelial origin)
2. Sarcomas (mesenchymal origin)
3. Hematopoietic origin
4. Metastases



Clinical Presentation of Malignant Lesions

- Displaced or mobile teeth
- Ulceration
- Foul odor
- Swelling
- Paresthesia
- Dysesthesia
- Pain
- Dysgeusia (decreased taste)
- Dysphagia (difficulty swallowing)
- Dysphonia (difficulty speaking)
- Dysphasia (impaired speech)
- Exposed bone
- Poorly healing or non-healing surgical or trauma sites
- Sensory or neural deficits
- Weight loss
- Hemorrhage

Clinical Presentation of Malignant Lesions

- Onset of symptoms of malignancies is often rapid
- Prevalence of oral malignancies is low. Due to lack of experience, detection is often delayed. This results in larger tumors, metastases, and poorer prognosis
- Survival rates for oral cancers have <u>not</u> improved over the years. This is thought to be due to late diagnosis

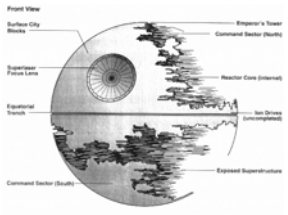
The Role of Radiology

- Initial Diagnosis
- Spread of the lesion
- Size and location of the lesion for surgical planning

Radiographic features of oral malignancies

Location

- Varies depending on the type.
  - Carcinomas: soft tissue locations
  - Sarcomas: mandible and posterior region of jaws
  - Metastatic lesions : common in the posterior mandible and maxilla and within the follicles of developing teeth



Radiographic features of malignancies

Periphery and shape

- Ill defined border with lack of cortication and absence of encapsulation. Associated non-healing soft tissue ulceration and or swelling is highly suggestive
- Shape is generally irregular

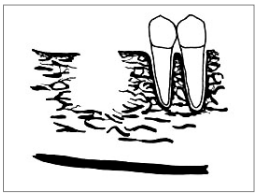
Radiographic features of malignancies

Internal Architecture

- As most malignancies do not produce bone or stimulate the formation of reactive bone, internal aspect is typically radiolucent
- Lesions such as osteosarcomas produce frank sclerosis, whereas some tumors such as prostate and breast metastatic lesions can induce bone formation at distant sites

Radiographic features of malignancies

Effects on adjacent structures

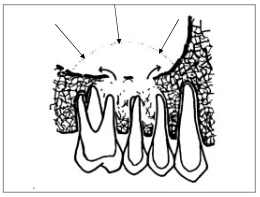


- Ill-defined, invasive borders
- Bone destruction

Adapted from White & Pharoah, fifth edition

Radiographic features of malignancies

Effects on adjacent structures

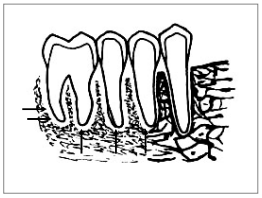


- Destruction of cortical borders
- Soft tissue mass

Adapted from White & Pharoah, fifth edition

Radiographic features of malignancies

Effects on adjacent structures

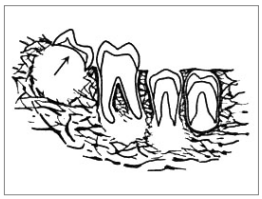


- Invasion of PDL
- Widened PDL space

Adapted from White & Pharoah, fifth edition

Radiographic features of malignancies

Effects on adjacent structures

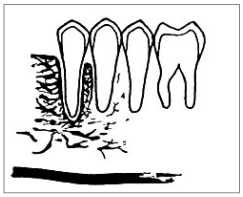


- Destruction of bone at apices
- Displacement of developing tooth

Adapted from White & Pharoah, fifth edition

Radiographic features of malignancies

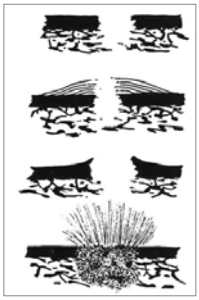
Effects on adjacent structures



- Teeth appear to float due to bone destruction

Adapted from White & Pharoah, fifth edition

Radiographic features of malignancies: Effects on cortical bone



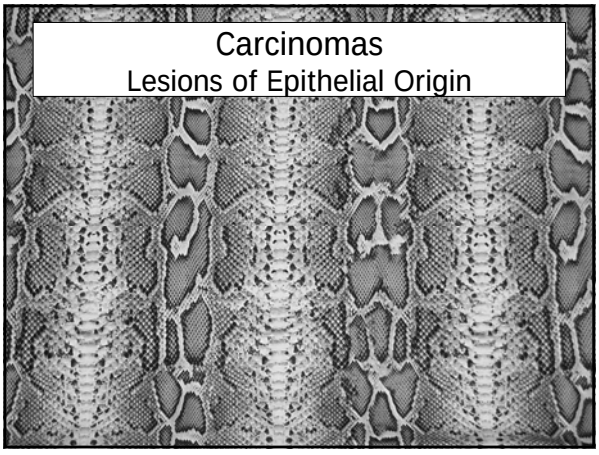
- Cortical bone destruction without periosteal reaction
- Laminated periosteal reaction + cortical bone destruction
- Codman's triangle
- Sunray or sunburst periosteal reaction

Adapted from White & Pharoah, fifth edition

Codman's triangle

- Codman's triangle is the radiographic appearance of the rim of new subperiosteal bone which forms when a lesion such as a tumor lifts the periosteum away from the bone.
- The small triangle of bone is seen at the advancing margin of the lesion.
- The three main causes for a Codman's triangle are:
  - Osteosarcoma
  - Ewing's sarcoma
  - Subperiosteal abscess
- Layering of the new bone may result in an "onion skin" appearance.

Source: http://www.gpnotebook.co.uk



Squamous Cell Carcinoma

Squamous Cell Carcinoma

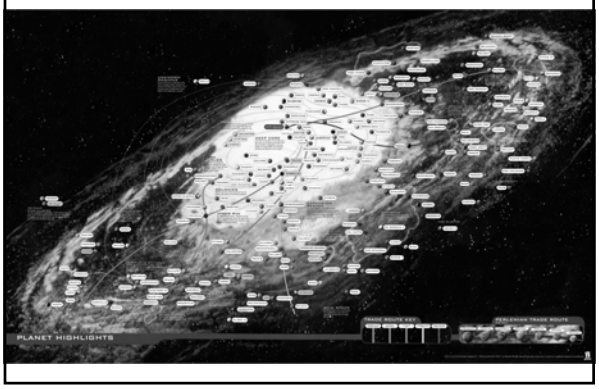
- Malignant tumor from surface epithelium
- Invades
  - Deeper soft tissue
  - Connective tissue
  - Underlying bone
  - Local and regional nodes
  - Metastases to liver, lung, and skeleton

Squamous Cell Carcinoma

Clinical Appearance

- Red, white, or mixed lesion
- Ulcerated
- Indurated or rolled borders
- Can be painful or painless
- Rubbery or hard lymph nodes that are “fixed” to underlying structures.
- Usually occurs in patients >50 years
- More common in males

Location



Squamous Cell Carcinoma

Radiographic features

- Location
  - Often on lateral border of the tongue Therefore, it is seen radiographically in the posterior mandible
  - Lesions in lip and floor of the mouth may invade anterior mandible
  - Ginigival lesions may initially mimic periodontal disease

Squamous Cell Carcinoma

Radiographic features

- Shape and Borders
  - Commonly irregular and ill-defined borders
  - Finger-like projections demonstrating invasion
  - Occasionally, the lesion may have smooth borders, indicating erosion
  - Pathologic fractures may occur. Sharp, thin edges may be evident

Squamous Cell Carcinoma

Radiographic features

- Internal architecture
  - Squamous cell carcinoma tends to be completely radiolucent. There may be trapped pieces of residual bone within the lesion

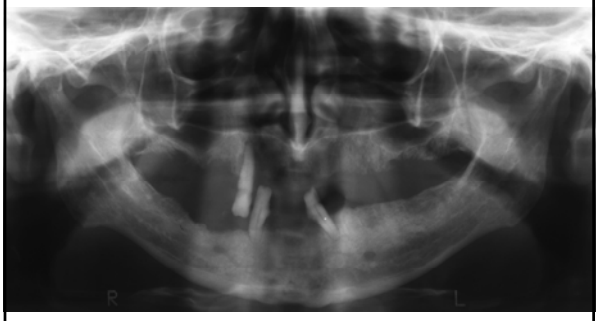
Squamous Cell Carcinoma

Radiographic features

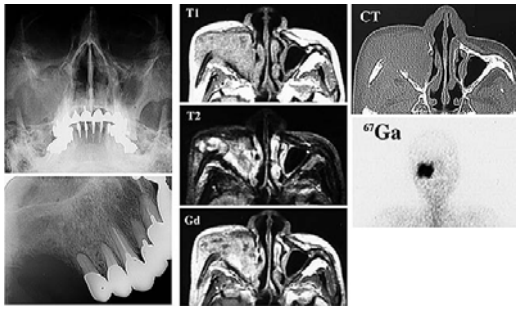
- Effects on adjacent structures
  - Periodontal ligament space will initially appear to widen. Eventually, teeth will appear to "float" in the lesion, and may be displaced as lesion expands
  - Tumor may spread along the mandibular canal, giving a widened appearance
  - Adjacent cortical borders may be effaced (destroyed)

Squamous Cell Carcinoma

Squamous Cell Carcinoma

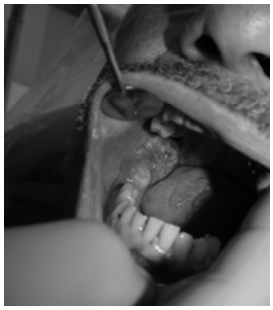


Squamous Cell Carcinoma

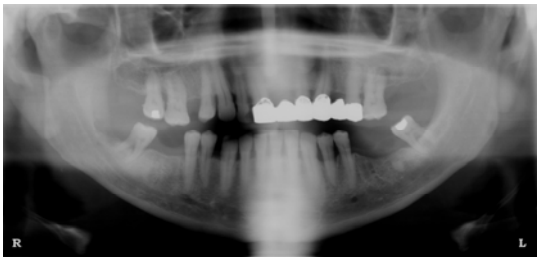


Images courtesy of Ashai University School of Dentistry

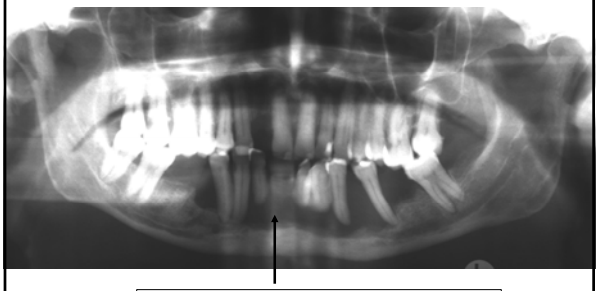
Squamous Cell Carcinoma



Squamous Cell Carcinoma



Squamous Cell Carcinoma

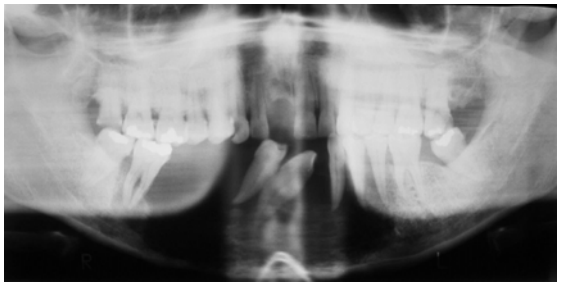


Invasive from the floor of the mouth

Squamous Cell Carcinoma
Soft tissue origin

Case courtesy of Dr. Maano Milles, Dept of Oral and Maxillofacial Surgery UMDNJ

Squamous Cell Carcinoma
Soft tissue origin



Presurgical panoramic radiograph

Squamous Cell Carcinoma
Soft tissue origin

Cropped panoramic radiograph

Squamous Cell Carcinoma
Originating in a cyst

- Uncommon lesion
- May arise from
  - Periapical inflammatory cysts
  - Residual cysts
  - Dentigerous cysts
  - Odontogenic keratocysts (OKC)

Squamous Cell Carcinoma
Originating in a cyst
Clinical Features

- Pain
  - Dull
  - Several months duration
- Swelling
- Pathological fracture
- Regional lymphadenopathy
- Maxillary lesions may invade sinus

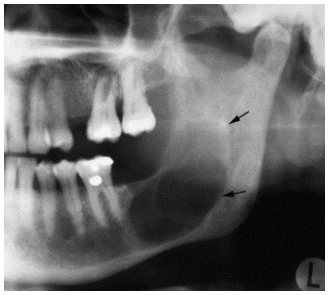
Squamous Cell Carcinoma
Originating in a cyst
Radiographic Features

- Location
  - Tooth-bearing areas
  - Most occur in the mandible
- Shape and Borders
  - Initially indistinguishable from a cyst. Smooth, corticated and hydraulic
  - Advanced lesions are ill-defined, diffuse, and lack cortication

Squamous Cell Carcinoma
Originating in a cyst
Radiographic Features

- Internal Architecture
  - Entirely radiolucent
- Effect on adjacent structures
  - Destroys cortices and adjacent lamina dura of teeth.
  - Capable of destroying alveolar processes

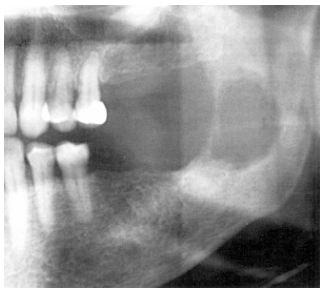
Residual cyst with Squamous Cell Carcinoma



Residual cyst with Squamous Cell Carcinoma

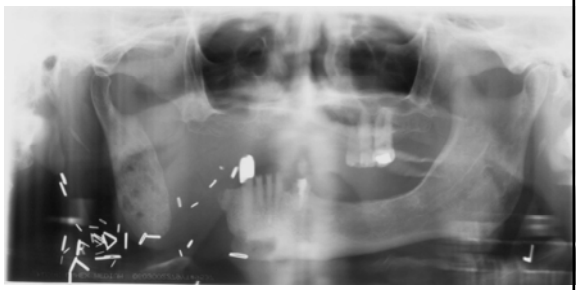
Cropped panoramic radiograph

Squamous Cell Carcinoma
Originating in bone



Adapted from White & Pharoah, fifth edition

Squamous Cell Carcinoma
Originating in base of the tongue



Central Mucoepidermoid Carcinoma

Central Mucoepidermoid Carcinoma

- Epithelial tumor arising in bone
- Possibly originates from pluripotential odontogenic epithelium or from the lining of a cyst
- Leaves cortical plates intact

Central Mucoepidermoid Carcinoma

Clinical Features

- Mimics benign lesions such as a cyst or tumor
- Painless swelling
- May displace teeth or cause asymmetry
- May cause tenderness or paresthesia
- More common in females

Central Mucoepidermoid Carcinoma

Radiographic Features

- Location
  - Twice as common in the mandible than the maxilla
  - Usually in the premolar or molar region
  - Occurs superior to the mandibular canal. This might indicate odontogenic origin

Central Mucoepidermoid Carcinoma

Radiographic Features

- Borders and shape
  - Unilocular or multilocular mass
  - Thick, corticated borders
- Internal architecture
  - Multilocular soap bubble appearance similar to ameloblastoma or odontogenic myxoma
  - Septae are from remodeled residual bone

Central Mucoepidermoid Carcinoma

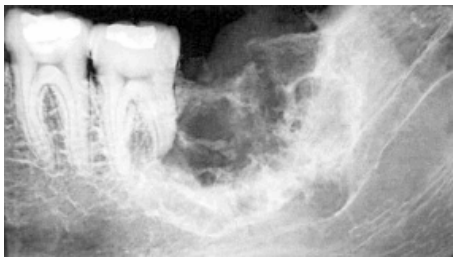
Radiographic Features

- Effects on adjacent structures
  - Expands buccal and lingual cortices
  - Expands inferior border of mandible
  - May thin or scallop cortices
  - Similar effects to benign tumors

Central Mucoepidermoid Carcinoma

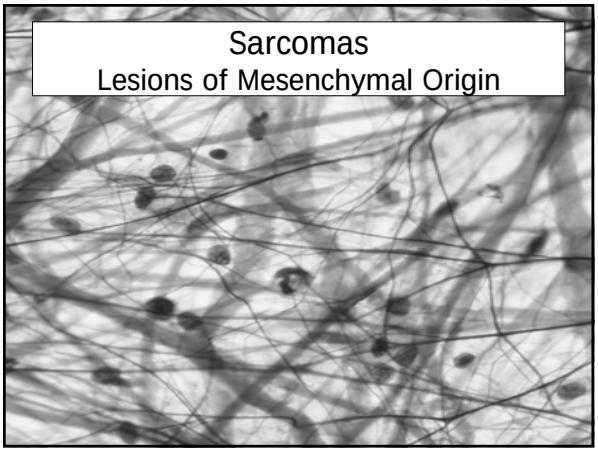
Case courtesy of the Korean Academy of Oral & Maxillofacial Radiology

Central Mucoepidermoid Carcinoma



Cropped panoramic radiograph

Case courtesy of White & Pharoah, fifth edition



Osteosarcoma

Osteosarcoma

- Malignant neoplasm of bone
- New bone is produced by the lesion (not by reactive bone formation of surrounding osteoclasts)
- Three major types
  1. Chondroblastic
  2. Osteoblastic
  3. Fibroblastic

Osteosarcoma

Clinical Features

- Rare. Jaws account for only 7% of all osteosarcomas
- 2:1 Male: Female ratio
- Peak in 4th decade
- Initially reported due to swelling or bleeding

Osteosarcoma

Radiographic Features

- Location
  - More common in the mandible
  - Usually arises in the posterior mandible. The molar areas and ramus are most commonly affected
  - In maxilla, usually arises in the posterior. The ridge, sinus, and palate are most commonly affected

Osteosarcoma

Radiographic Features

- Borders and shape
  - Ill-defined
  - Radiolucent without capsule or surrounding osteosclerosis
  - If the periosteum is involved, sunray spicules (aka: "hair-on-end" trabeculae, or orthoradial striations) may be present

Osteosarcoma

Radiographic Features

- Internal architecture
  - May be radiolucent, mixed density, or completely opaque
  - May have varied osseous appearances, such as granular, cotton wool, wisps, etc. In all cases, normal trabeculation is lost

Osteosarcoma

Radiographic Features

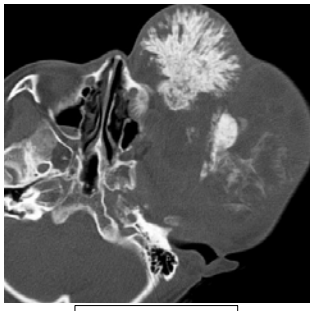
- Effects on adjacent structures
  - Widening of the PDL
  - Destruction of cortices
  - May destroy or widen the cortex of the inferior alveolar canal
  - Codman's triangles are seen

Osteosarcoma

PA View

Images courtesy of Nagasaki University School of Dentistry

Osteosarcoma



Axial CT Bone window

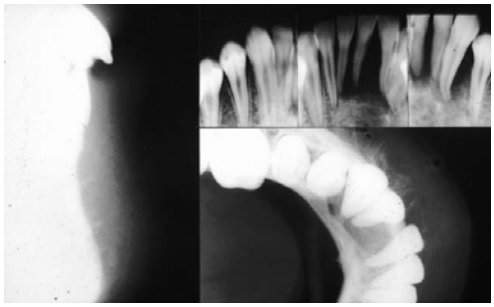
Images courtesy of Nagasaki University School of Dentistry

Osteosarcoma

Axial CT Soft tissue window

Images courtesy of Nagasaki University School of Dentistry

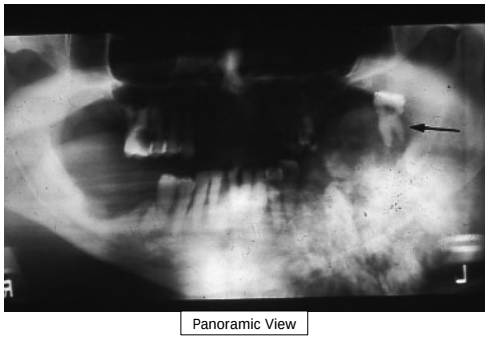
Osteosarcoma



Images courtesy of Ashai University School of Dentistry

Osteosarcoma

Osteosarcoma

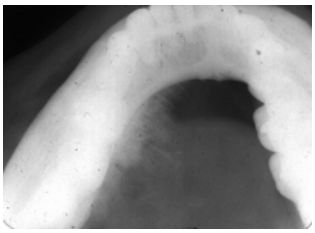


Panoramic View

Osteosarcoma

Cropped Panoramic View

Osteosarcoma



Cropped Occlusal View

Chondrosarcoma

Clinical Features

- Malignancy of cartilaginous origin
- Firm to hard bony mass of long duration
- Four subtypes
  1. Clear cell
  2. Dedifferentiated
  3. Myxoid
  4. Mesenchymal
- Occurs within the bone, peripheral to the bone, or, less commonly, in soft tissue
- Mean age: 47 yrs
- Affects males and females equally

Chondrosarcoma

Radiographic Features

- Location
  - Unusual in the facial bones. Accounts for only 10% of all cases
  - Occurs equally in maxilla and mandible near cartilage
  - Maxillary lesions tend toward the anterior, while mandibular lesions occur in the coronoid process, head of the condyle and neck, and sometimes in the mandibular symphysis

Chondrosarcoma

Radiographic Features

- Borders and Shape
  - Round, ovoid, or lobulated
  - Borders can range from smooth and well corticated to indistinct
  - If the periosteum is involved, sunray spicules (aka: "hair-on-end" trabeculae, or orthoradial striations)

Chondrosarcoma

Radiographic Features

- Internal architecture
  - May appear as multilocular lucencies to highly calcified lesions. Usual appearance is mixed density
  - Radiographic appearance – may be "flocculent" (snow-like)
  - "Moth eaten appearance" may be seen, amid islands of unaffected bone

Chondrosarcoma

Radiographic Features

- Effects on adjacent structures
  - Expand cortical boundaries due to slow growth
  - Can remodel condyle and glenoid fossa
  - Widened PDL and lack of lamina dura of associated teeth

Chondrosarcoma

Radiographic Features

- In general, chondrosarcomas share the general radiographic features of malignant neoplasms

Chondrosarcoma

Differential Diagnosis

- Osteosarcoma
- Benign fibro osseous lesions
- Odontogenic myxoma
- Fibroma
- Osteoma
- Ameloblastoma
- Central bone malignancies

Chondrosarcoma

Chondrosarcoma

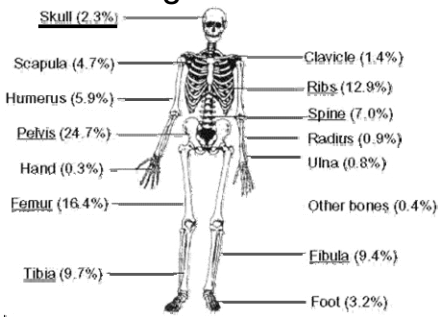
Images courtesy Marquette University School of Dentistry

Ewing's Sarcoma

Clinical Features

- Rare in Jaws
- Generally found in long bones
- Origin is uncertain
- Most common in second decade of life
- 2:1 M:F ratio

Ewing's Sarcoma



Distribution of cases

Ewing's Sarcoma

Radiographic Features

- Location
  - 2:1 mandibular to maxillary cases
  - Found in posterior
  - Lesions start in marrow spaces and expand to involve cortices

Ewing's Sarcoma

Radiographic Features

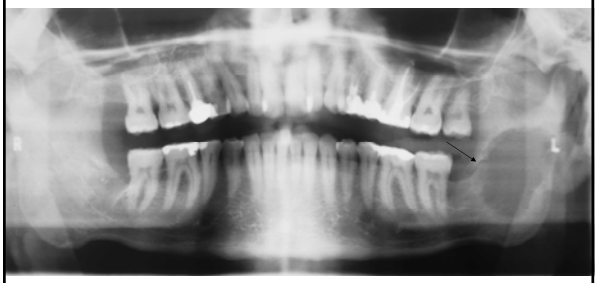
- Shape and Borders
  - Poorly demarcated
  - Non-corticated borders
  - There is no typical shape to lesions of Ewing's sarcoma
- Internal Architecture
  - Radiolucent

Ewing's Sarcoma

Radiographic Features

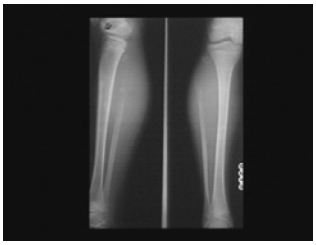
- Effects on adjacent structures
  - May stimulate the periosteum to lay down new bone in sunray pattern or Codman's triangles
  - Will destroy cortices of normal anatomy such as lamina dura of teeth

Ewing's Sarcoma



Ewing's sarcoma of the ramus

Ewing's Sarcoma



Ewing's sarcoma of the fibula

Ewing's Sarcoma

Ewing's sarcoma of the fibula

Ewing's Sarcoma

Ewing's sarcoma

Fibrosarcoma

- Composed of malignant fibroblasts that produce collagen and elastin
- Unknown etiology
- May arise in tissues that have been irradiated

Fibrosarcoma

Clinical Features

- M=F
- Generally occurs in 4th decade of life
- Slowly to rapidly enlarging mass
- If entirely within bone, the lesion is often painful
- May exit bone and invade soft tissue, or may begin peripherally

Fibrosarcoma

Radiographic Features

- Location
  - Mandible
  - Premolar and molar region
- Borders and Shape
  - Ill-defined, ragged borders
  - Poorly demarcated and non-corticated
  - Non-encapsulated

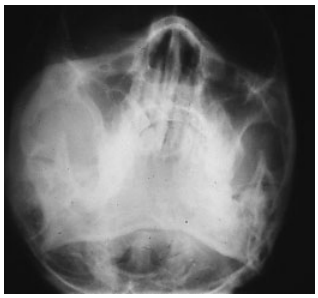
Fibrosarcoma

Radiographic Features

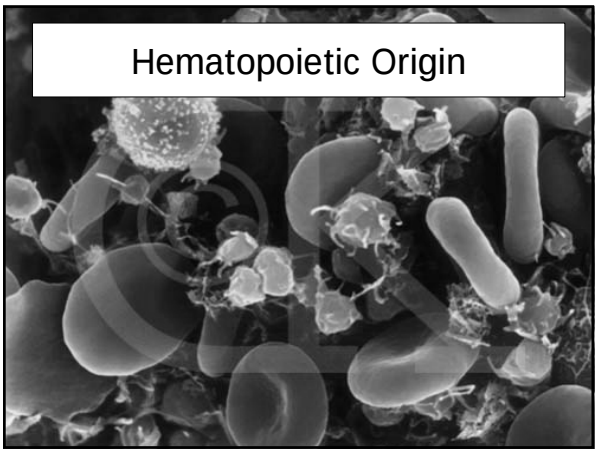
- Internal Architecture
  - Usually radiolucent
  - May include reactive bone formation
- Effects on adjacent structure
  - Destruction
    - Alveolar cortices
    - Inferior cortex of the mandible
    - Follicular cortices
    - Floor of the maxillary sinus
  - Displacement of teeth (rather than resorption)

Fibrosarcoma

Fibrosarcoma



Hematopoietic Origin



Multiple Myeloma

- Malignant neoplasm of plasma cells
- Most common malignancy of bone in adults

Multiple Myeloma

Clinical features

- M+F ratio
- Average age 60 yrs

Multiple Myeloma

Radiographic features

- Location
  - Uncommon in the jaws
  - More frequent in the mandible than the maxilla
  - In the mandible, usually found in the posterior body and ramus
  - In the maxilla, it is usually found in posterior areas

Multiple Myeloma

Radiographic features

- Shape and Borders
  - Well-defined, “punched out” lesions
  - Non-corticated borders
  - No bone reaction seen
  - Some lesions have ragged borders, although most are round or ovoid

Multiple Myeloma

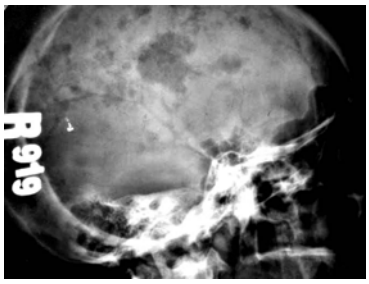
Radiographic features

- Internal architecture
  - No apparent internal architecture
  - Uniformly radiolucent appearance
- Effects on adjacent structures
  - Teeth may appear excessively opaque, due to the radiolucent appearance of demineralized bone
  - Lamina dura may be lost, along with other cortices
  - Cortical borders may be effaced

Multiple Myeloma

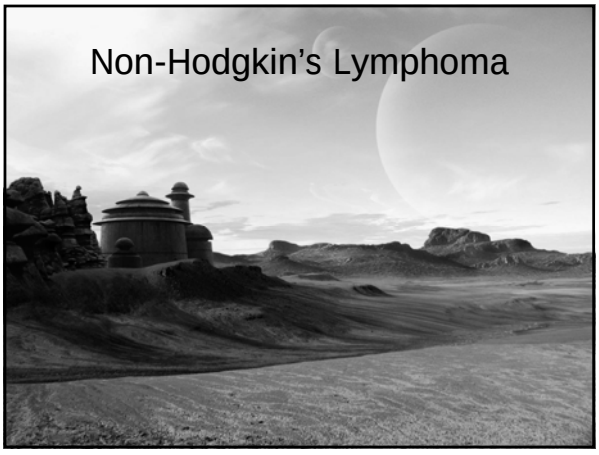
Multiple Myeloma

Multiple Myeloma



Case from AAOMR CRC Session 11/04

Non-Hodgkin's Lymphoma



Non-Hodgkin's Lymphoma

- Refers to a family of tumors
- Composed of malignant cells of the lymphatic system

Non-Hodgkin's Lymphoma

Clinical features

- Occurs in all age groups, but is uncommon in first decade
- Teeth may become mobile as bone is lost
- Patients may feel unwell and lose weight
- Night sweats are a common pathonuemonic feature of lymphoma

Non-Hodgkin's Lymphoma

Radiographic features

- Location
  - Lesions of the head and neck occur in the lymph nodes
  - Extranodal lesions are found in the maxillary sinus, posterior mandible, and maxilla

Non-Hodgkin's Lymphoma

Radiographic features

- Shape and Borders
  - Initial lesions are shaped like the host bone
  - Long standing lesions can destroy the cortices of the bone
  - Borders are poorly-defined and demonstrate invasive processes
  - Lesions in a spaces such as the maxillary sinus may have a smooth border

Non-Hodgkin's Lymphoma

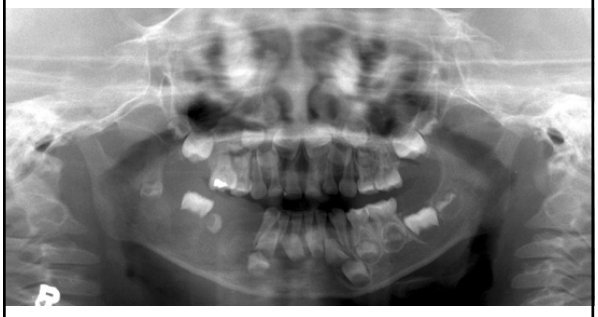
Radiographic features

- Internal architecture
  - Uniformly radiolucent
- Effects on adjacent structures
  - May efface the walls of the maxillary sinus
  - Lymphomas grow in the PDL space of teeth
  - May efface the cortices of the follicles of the developing teeth and displace them superiorly

Lymphoma

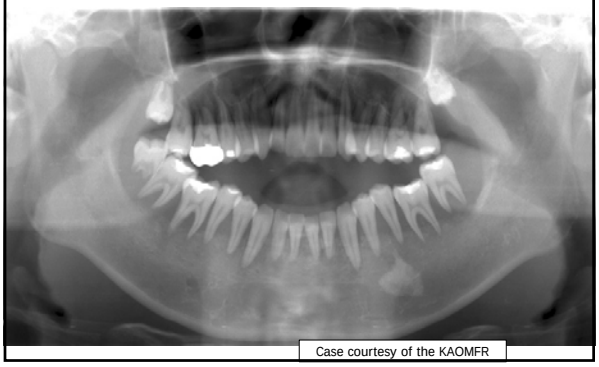
Lymphoma involving the maxillary sinus

Lymphoma v. Leukemia



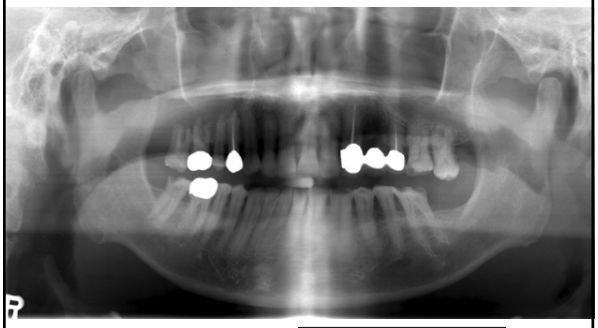
Case courtesy of the KAOMFR

Lymphoma v. Leukemia



Case courtesy of the KAOMFR

Lymphoma v. Leukemia



Case courtesy of the KAOMFR

Metastases

Pet/CT of non-small cell tumor of the lung with metastases

Metastatic Lesions

Metastatic Lesions

- Metastatic tumors are foci of malignant disease that originated in a distant primary tumor
- Usual pathway is through the bloodstream
- Metastases located in the jaws generally arise from primary tumors located <u>below</u> the clavicles
- Usually, the primary has been discovered prior to the discovery of jaw metastases

Metastatic Lesions

- Common type of primary tumor is carcinoma (epithelial origin)
- Common primary sites include:
  - Breast
  - Kidney
  - Lung
  - Colon
  - Rectum
  - Prostate
  - Thyroid stomach
  - Melanoma
  - Testes
  - Bladder
  - Ovary
  - Cervix

Metastatic Lesions

Clinical Features

- Most common in 5th to 7th decade of life
- Complaints may include:
  - Pain
  - Numbness
  - Paresthesia
  - Bleeding
  - Pathologic fracture of the mandible

Metastatic Lesions

Radiographic Features

- Location
  - Posterior regions of the jaws
  - More common in:
    - mandible > maxilla >maxillary sinus > anterior hard palate> mandibular condyle
  - Metastases may be bilateral
  - Lesions may be located in the periodontal ligament space. They may be confused with periodontal or apical inflammatory lesions

Metastatic Lesions

Radiographic Features

- Borders and Shape
  - Moderately well-demarcated
  - Non-corticated borders
  - May also have ill-defined, invasive borders
  - Polymorphous in shape (i.e.: irregular)

Metastatic Lesions

Radiographic Features

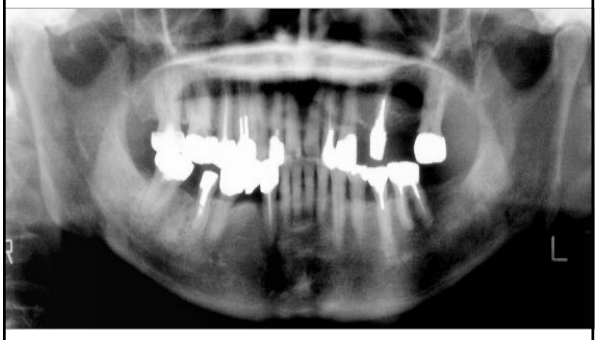
- Internal architecture
  - Lesions are generally lucent
  - Normal trabeculation may be seen, interspersed with radiolucent areas, representing osteolysis. (bone destruction)
  - May be multiple lesions, which may later coalesce

Metastatic Lesions

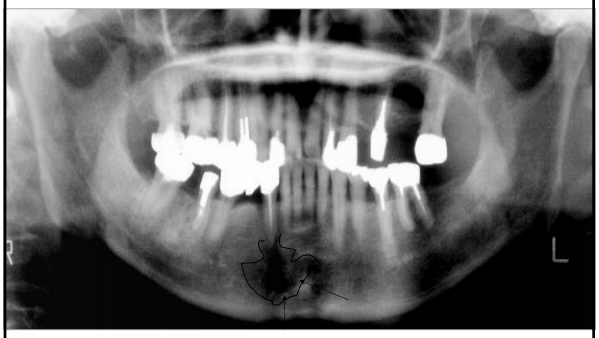
Radiographic Features

- Effects on adjacent structures
  - Effacement of the lamina dura
  - Widening of the PDL space
  - Periosteal reaction. May perforate cortices and form a soft tissue mass extraorally or intraorally
  - Teeth may “float” in a soft tissue mass and may be displaced

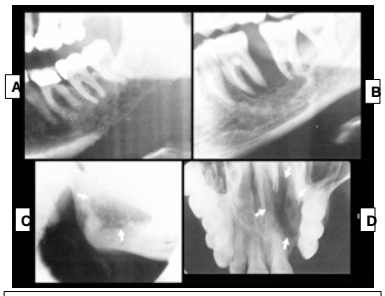
Metastatic bone lesions



Metastatic bone lesions



Metastatic bone lesions



A= from breast ca, B= from renal cell cal
C and D= lesions from gastric ca

Metastatic Lesions

Age Distribution of Common Primary Tumors of Bone

Age group	*Most common benign lesions*	*Most common malignant tumors*
0 - 10	simple bone cyst eosinophilic granuloma	Ewing's sarcoma leukemic involvement metastatic neuroblastoma
10 - 20	non-ossifying fibroma fibrous dysplasia simple bone cyst aneurysmal bone cyst osteochondroma (exostosis) osteoid osteoma osteoblastoma chondroblastoma chondromyxoid fibroma	osteosarcoma, Ewing's sarcoma, adamantinoma
20 - 40	enchondroma giant cell tumor	chondrosarcoma
40 & above	osteoma	metastatic tumors myeloma leukemic involvement chondrosarcoma osteosarcoma (Paget's associated) chordoma

From: http://www.umdnj.edu/tutorweb/introductory.htm

Emily Dickinson

Part Four: Time and Eternity
XXVII

BECAUSE I could not stop for Death,
He kindly stopped for me;
The carriage held but just ourselves
And Immortality.

We slowly drove, he knew no haste,
And I had put away
My labor, and my leisure too,
For his civility.

We passed the school where children played
At wrestling in a ring;
We passed the fields of gazing grain,
We passed the setting sun.

We paused before a house that seemed
A swelling of the ground;
The roof was scarcely visible,
The cornice but a mound.

Since then 't is centuries; but each
Feels shorter than the day
I first surmised the horses' heads
Were toward eternity.