Benign Jaw Tumors and Tumor-like Conditions

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Purpose

The purpose of this educational exhibit is to illustrate imaging findings of benign tumors of the maxilla and mandible on CT and MRI.

Introduction

Odontogenic tumors are neoplasms that originate from tooth-forming epithelium, mesenchymal tissue, or both. Benign odontogenic tumors are characterized by imaging findings of expanding growth and well-defined margins with smooth borders.

CT is highly useful for demonstrating the extent of bone resorption, osteosclerosis, cortical bone swelling, destruction, and calcification.

MR imaging is effective for differentiating between cysts and tumors, evaluating the infiltration of malignant tumors in the jawbone and surrounding soft tissue, and detecting bone marrow changes of the jaw.

Bone-destructive

Ameloblastoma (Figure 1)

- Most common and most clinically significant odontogenic tumor (10% of all tumors in maxillomandibular region)
- Slowly growing, locally invasive epithelial odontogenic tumor of jaw
- High rate of recurrence, but with virtually no tendency to metastasize
- Most ameloblastomas occur in the ramus and posterior body of mandible (80% cases)
- Usually painless swelling (80%). Typically manifest in 3rd to 5th decade of life
- Typically expansile with an osseous shell that represents involved bone
- Can perforate lingual cortex and extend to adjacent soft tissues
- May appear as well-corticated, unilocular lucent lesion; others are multilocular with internal septa and honey comb or soap bubble appearance
- Absorption of the apices of adjacent teeth (seen in about 40% of cases)
- **MR imaging:** Characteristic findings: multilocularity, mixed solid and cystic components, irregularly thickened walls, papillary projections, and marked enhancement of the walls and septa
- **Treatment:** For unilocular cystic lesions in young patients, curettage or enucleation is effective treatment. Solid lesions show high recurrence rates (50%–90%), necessitating tumor excision or partial resection of the jawbone
- Although malignant transformation is rare, repeated recurrences increase the likelihood of malignancy

Ameloblastoma

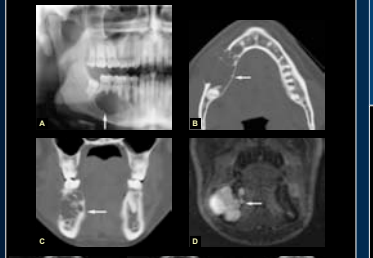

Figure 1A-G: Ameloblastoma, unicystic, mandible; 22-year-old male with painless perimandibular swelling. A) Panoramic view shows radiolucency and root resorption (*arrow*). B) Axial CT image shows destroyed bone with expansion of buccal cortical bone, which is very thin and partially absent (arrow). C) Coronal CT image shows multilocular appearance in anterior part without cortical outline buccally (*arrow*). D) Coronal STIR MRI shows multilocular appearance and heterogeneous intermediate to high signal (*arrow*). E) Axial T2-weighted MRI shows high signal in posterior part (arrow) and intermediate signal in anterior part (*arrowhead*). F) Axial T1-weighted pre-Gd MRI shows intermediate signal in posterior part (arrow) and intermediate to low signal in anterior part. G) Axial T1-weighted post-Gd MRI shows no contrast enhancement in posterior part (*arrow*) except partially in periphery, and septal enhancement in anterior part (*arrowhead*).

Keratocystic Odontogenic Tumor (Figures 2 & 3)

Synonyms: Odontogenic keratocyst, Primordial cyst

- Benign uni-or multi-cystic, intraosseus tumor of odontogenic origin with a characteristic lining of parakeratinized stratified squamous epithelium
- Potential aggressive, infiltrative behavior with tendency to **recur**
- **Multiple** lesions are associated with inherited nevoid basal cell carcinoma syndrome (Gorlin Goltz syndrome)
- Grow in multilocular bosselated fashion with daughter cysts extending into surrounding bone
- Frequently occur in **third molar** region and ascending ramus of mandible
- **On CT:** increased attenuation areas in cystic cavity
- **On MRI:** heterogeneous intermediate signal on T1 and high signal on T2 WI
- Bone expansion is not prominent with tooth resorption being rare (in contradistinction to ameloblastomas)

Keratocystic Odontogenic Tumor

Figure 2A-E: Keratocystic odontogenic tumor, mandible; 33-year-old male, painless perimandibular swelling 12 years after first surgery. A) Panoramic view shows multilocular radiolucency (arrow). B) Panoramic view 9 months postoperatively shows nearly complete regeneration. C) Panoramic view 12 years after surgery shows recurrence of tumor; now crossing midline, being more extensive than initially (arrow). D) Axial CT image shows expansive radiolucency with intact cortical bone (arrow). E) Axial T2-weighted MRI shows heterogeneous high to intermediate signal (*arrow*).

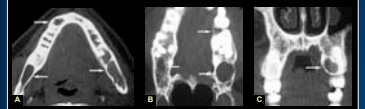

Figure 3A-C: Keratocystic odontogenic tumor, maxilla and mandible; Gorlin-Goltz syndrome. A) Axial CT image shows three cystic tumors in mandible (arrows). B) Axial CT image shows three cystic tumors in maxilla (arrows). C) Coronal CT image shows better cystic tumor in anterior part of maxilla (*arrow*).

Odontogenic Myxoma (Figure 4)

- Uncommon, benign neoplasm arising from mesenchymal odontogenic tissue
- Locally invasive neoplasm consisting of rounded, angular cells lying in abundant myxoid stroma
- 3rd decade of life
- Higher prevalence among women, and occurs mainly in the mandibular molar area
- Painless swelling or incidental finding
- Often multilocular with internal osseous trabeculae
- **MRI:** Prolongation of T1 and T2, reflecting rich myxoid stroma. Gradual contrast enhancement is typically seen on contrast-enhanced images
- **Treatment**: excision or partial resection of the jawbone
- High rate of local recurrence due to infiltrative growth pattern

Odontogenic Myxoma

Figure 4A-G: Odontogenic myxoma, mandible; 45-year-old female with painless swelling which the patient did not notice because tumor was "Filling out" mandibular torus on right side. A) Clinical photograph shows buccal and lingual jaw expansion (arrows). B) Panoramic view shows scalloped radiolucency without sclerotic outline (arrow). C) Axial CT image shows expanded but intact buccal and lingual cortical bone.Note tumor occupies mandibular torus on right side (arrow). D) Axial T2-weighted MRI shows homogeneous high signal (arrow). E) Axial STIR MRI shows homogeneous high signal (arrow). F) Axial T1-weighted pre-Gd MRI shows intermediate (to low) signal (arrow). G) Axial T1-weighted post-Gd MRI shows homogeneous contrast enhancement (*arrow*).

Odontogenic Fibroma

- Fibroblastic neoplasm containing variable amounts of apparently inactive odontogenic epithelium
- Relatively uncommon tumor of young people (aged 5-20 years)
- Benign, expansile, unilocular, radiolucent lesion most often in posterior mandible
- **Treatment:** Block excision with a border of normal bone

Bone-destructive & Bone-productive Tumors

Osteoblastoma (Figure 5)

- Active production of osteoid or primitive woven bone occurs
- Osteoid osteoma - similar tumor but of much smaller size
- Usually present as painful swelling in second decade
- Coarse trabecular pattern - ground glass appearance
- 15% recurrence rate for mandibular osteoblastomas

Osteoblastoma

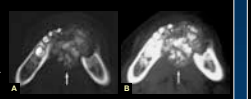

Figure 5A-B: Osteoblastoma, mandible; 3-yr-old male, painless swelling of anterior part of mandible. A) Axial CT image shows extensive bone production (arrow). B) Axial CT image, soft tissue window, shows rather well-defined process (arrow).

Ossifying Fibroma (Figure 6)

Synonyms: Cemento-ossifying fibroma, juvenile (aggressive) ossifying fibroma

- Painless swelling mostly in posterior mandible
- Typically encapsulated, well demarcated lesion composed of varying amounts of fibrocellular tissue and mineralized matrix
- Grow slowly and symmetrically
- Juvenile (active, aggressive) - occurs in younger patients and has greater tendency to recur

Ossifying Fibroma

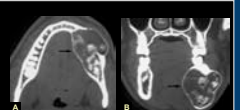

Figure 6A-B: Ossifying fibroma, mandible; 22-yr old male with painless swelling of left mandible. A) Axial CT shows expansion with intact cortical border and central mineralization (arrow). B) Coronal CT shows expanded, intact cortical bone and central mineralization (*arrow*).

Adenomatoid Odontogenic Tumor

- Rare neoplasm characterized by duct formation by its epithelial component.
- Slowly increasing painless swelling in second decade
- Anterior maxilla, especially canine region
- Unilocular, expansile, well-demarcated cyst like radiolucent lesion with impacted teeth (canine) and foci of calcifications
- **Treatment:** Simple excision

Calcifying Epithelial Odontogenic Tumor

Synonym: Pindborg tumor

- Benign, locally infiltrating epithelial tumor
- Occurs between the third and seventh decades of life
- Well-defined, expansile, unilocular radiolucency, containing varying amounts of radiopaque material. It is associated with unerupted or impacted teeth in 50% cases
- **Treatment:** Enucleation

Desmoplastic Variant of Ameloblastoma (Figure 7)

- Scattered calcifications in an expansile osteolytic lesion with ill-defined margins
- Tends to recur locally due to infiltrative growth pattern

Desmoplastic Ameloblastoma

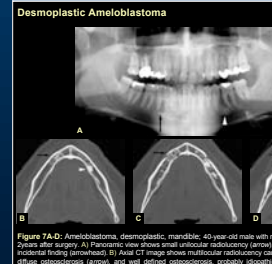

Figure 7A-D: Ameloblastoma, desmoplastic, mandible; 40-year-old male with recurrence of ameloblastoma 2years after surgery. A) Panoramic view shows small unilocular radiolucency (arrow), and small radiopacity as an incidental finding (arrowhead). B) Axial CT image shows multilocular radiolucency caudad to mental foramina with diffuse osteosclerosis (arrow), and well defined osteosclerosis, probably idiopathic (arrowhead). C) Axial CT image shows two radiolucencies with some sclerosis at level of mental foramina (*arrow*). D) Axial CT image shows destroyed cortical bone buccally in tooth-bearing area (arrow).

Hard Tissue-producing Tumors & Malformations

Osteoma (Figure 8)

- Benign, slowly growing lesion composed of well-differentiated mature bone with a predominant lamellar structure
- Incidental finding or painless hard swelling

Osteoma

Figure 8: Osteoma,mandible; 23-year-old male with incidental finding at routine dental radiography. A) Coronal CT image shows exostotic tumor predominantly of cortical bone (arrow) at lingual aspect of mandibular ramus.

Exostoses (Figure 9)

- **Mandible:** Torus Mandibularis in premolar regions lingually and bilaterally
- **Maxilla:** Torus palatinus in midline

Exostoses

Figure 9: Torus mandibularis; painless hard lingual swellings. Axial CT image shows bilateral exostoses (*arrow*)

Odontoma (Compound and Complex) (Figure 10)

- **Most common** odontogenic tumors
- Tumor-like malformation (hamartoma) in which enamel and dentin, and sometimes cementum is present.
- WHO classifies into 2 categories - may appear as multiple, miniature, or rudimentary teeth (compound odontoma) or it may appear as amorphous conglomerations of hard tissue (complex odontoma)
- **Compound** odontoma: younger individuals- most commonly seen in maxillary anterior alveolar bone.
- **Complex** odontoma: mainly in the second and third decades of life-mandibular molar and premolar portions
- **Treatment**: Radiographic observation or simple excision. Do not recur

Odontoma

Figure 10A-B: Odontoma, maxilla; 15-year-old female with incidental finding at orthodontic consultation. A) Panoramic view shows large radiopaque mass in right maxillary sinus (arrow). B) Coronal CT image shows large mass of cortex or enamel density in right maxillary sinus (*arrow*), surrounded by fibrous capsule,with destroyed lateral sinus wall and root resorption.

Tumor-like Conditions

Giant cell granuloma (Figure 11)

- Localized benign but sometimes aggressive osteolytic proliferation of fibrous tissue with hemorrhage and hemosiderin deposits
- Most frequently in posterior mandible in females from first to third decades
- Uni-or multi-locular, may expand bone.
- MRI- Heterogeneous intermediate signal on T1 and T2 WI with contrast enhancement

Giant Cell Granuloma

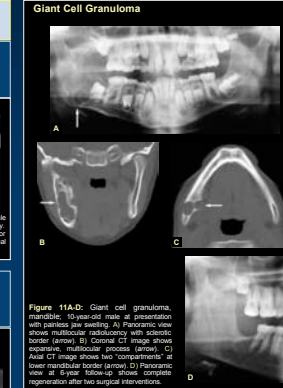

Figure 11A-D: Giant cell granuloma, mandible; 10-year-old male at presentation with painless jaw swelling. A) Panoramic view shows multilocular radiolucency with sclerotic border (arrow). B) Coronal CT image shows expansive, multilocular process (arrow). C) Axial CT image shows two "compartments" at lower mandibular border (arrow). D) Panoramic view at 6-year follow-up shows complete regeneration after two surgical interventions.

Langerhans Cell Histiocytosis (Figure 12)

Synonym: Eosinophilic granuloma

- Localized proliferation of Langerhans cells (histiocytes)
- Male predilection, 1-10 years of age
- May have further lesions in skull, spine, ribs, long bones
- Punched out, sharply demarcated bone destruction, not corticated. May have associated soft tissue mass

Langerhans' Cell Histiocytosis

Figure 12A-F: Eosinophilic granuloma, mandible; 4-year-old male with pain and swelling in the right cheek and jaw (ramus). A) Panoramic view shows rather well-defined radiolucency (arrow). B) Axial CT image shows punched-out bone destruction at level of mandibular foramina (arrow). C) Axial CT image shows onion-skin periosteal reaction lingually (arrow) and buccally (*arrowhead*). D) Axial CT image,soft-tissue window,shows well-defined soft-tissue mass lingually (arrow) and inflammatory infiltrate in connective tissue space laterally (*arrowhead*). E) Axial CT image 1 year after treatment (surgery, cortisone medication) shows somewhat thickened right ramus and remnant of original buccal cortex at level of mandibular foramina, but otherwise normalized bone (*arrow*). F) Axial CT image shows normalized bone also at another level (*arrow*).

Fibrous Dysplasia (Figure 13)

- Monostotic or polyostotic (may be part of McCune-Albright Syndrome)
- Craniofacial bones form up to 25 % of monostotic forms
- Non-neoplastic, self limiting but nonencapsulated lesion
- **Maxilla**, lateral region in particular
- Painless swelling, jaw asymmetry
- 2nd and 3rd decades
- Ground glass appearance with bone expansion
- **MRI:** intermediate signal on T1 and heterogeneous low signal on T2 WI with contrast enhancement

Fibrous Dysplasia

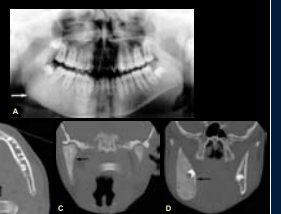

Figure 13A-D: Fibrous dysplasia, mandible; 14-year-old male with painless facial asymmetry. A) Panoramic view shows enlarged mandible with ground-glass appearance (arrow). B) Axial CT image shows expanded mandible with ground-glass appearance (arrow). C) Coronal CT image shows process involving mandibular collum and condyle (arrow). D) Coronal CT image shows process involving coronoid process (arrow).

Cherubism (Figure 14)

- Inherited-autosomal dominant
- **Histology**: indistinguishable from giant cell granuloma
- **Mandible**, posterior regions, in early childhood
- Symmetric painless swellings
- Well-delineated, bilateral multiloculated radiolucencies; soap bubble appearance

Cherubism

Figure 14: Cherubism (familiar fibrous jaw dysplasia); 13-year-old male with incidental finding at orthodontic consultation. Panoramic view shows bilateral multilocular radiolucencies with sclerotic border in mandible (*arrows*).

Conclusion

Benign odontogenic tumors are characterized by imaging findings of expansile growth and well-defined margins with smooth borders, and their appearance is very similar to that of odontogenic and nonodontogenic cysts.

Combining plain radiography with advanced imaging techniques, including CT and MR imaging, can improve the accuracy of diagnosing odontogenic tumors.

This exhibit illustrates the imaging characteristics of benign jaw tumors and will give the practicing radiologists an opportunity to become familiar with appearances of jaw tumors.

Acknowledgments

All images used in this poster are from Larheim TA and Westesson PL, Maxillofacial Imaging, Springer Germany, 2006.

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References

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