Benign lesions of mandible—imaging findings using MDCT with histopathological correlation

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Abstract
Mandibular lesions have a very wide spectrum but overlapping imaging features which pose a great diagnostic challenge. This essay aims to describe the imaging features of the histologically proven benign lesions of the mandible.

Introduction
Mandibular lesions have odontogenic and non-odontogenic origins. Teeth develop both from ectoderm and mesoderm. Enamel develops from ectoderm of the oral cavity and all other tissues from associated mesenchyme [1]. Odontogenic tumors demonstrate interactions between the odontogenic epithelium and odontogenic ectomesenchyme and are typically sub classified by their tissue of origin. Odontogenic tumors usually involve one tooth or specific part of tooth while non-odontogenic lesions have no specific relationship to dentition, hence can involve the bone around two or more teeth.

WHO histological classification of benign odontogenic tumors

| Type | Description |
|------|-------------|
| 1. | Ameloblastoma, solid/multicystic type |
| 2. | Ameloblastoma, extraosseous/peripheral type |
| 3. | Ameloblastoma, desmoplastic type |
| 4. | Ameloblastoma, unicystic type |
| 5. | Squamous odontogenic tumor |
| 6. | Calculifying epithelial odontogenic tumors |
| 7. | Adenomatoid odontogenic tumor |
| 8. | Keratocystic odontogenic tumor |

Mesenchyme and/or odontogenic ectomesenchyme, with or without hard tissue formation

| Type | Description |
|------|-------------|
| 1. | Ameloblastic fibroma |
| 2. | Ameloblastic fibrodentinoma |
| 3. | Ameloblastic fibro-odontoma |
| 4. | Odontoma, complex type |
| 5. | Odontoma, compound type |
| 6. | Odontoameloblastoma |
| 7. | Calcifying cystic odontogenic tumor |
| 8. | Dentinegenic ghost cell tumor |

Subjects and methods
All suspected patients of Mandibular lesions underwent Computed tomography (CT) FACE on 256 Slice Dual Source SEIMENS CT Scanner. All radiologically diagnosed focal or diffuse suspicious lesions underwent biopsy. All biopsy proven benign Mandibular lesions were included in this article.

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Discussion

Cystic lesions of jaw

Majority of cysts are odontogenic in origin and are epithelium lined [2].

Radicular cyst (periapical cyst)

They are the most common odontogenic cyst resulting due to inflammation secondary to caries. The cyst arises from epithelial remnants called rest of Malassez that are located in the periodontal ligament [1]. Infection spreads to the root of tooth resulting in periapical periodontitis, granulomas, abscess and finally a cyst formation. Peak incidence is between 30 and 50 years of age [2]. On radiography, occur as well circumscribed radiolucent lesions at the apex of tooth, usually measuring less than 1 cm, may lead to root resorption in long standing lesions (Figure 1). The term residual cyst should be used when the lesion persists even after tooth extraction.

Dentigerous (follicular) cyst

It is the second most common odontogenic cyst that develops around the crown of an unerupted tooth, usually the third molar tooth. The enamel epithelium lining the crown of tooth proliferates and secretes fluid. Fluid collects between the layers of epithelium or between epithelium and enamel. The wall of the cyst tends to converge to cement-enamel junction. Hence, presence of cystic cavity with crown inside the cavity is virtually diagnostic [1,2]. Displacement of the teeth is seen and resorption is not a feature of follicular cyst. Ameloblastoma, mucoepidermoid tumor and carcinomas may develop in the wall of the cyst [1] (Figures 2 and 3).

Lateral periodontal cyst

It is a developmental cyst that arises from epithelial remnants in periodontal ligament along lateral aspect of the tooth root.

Lateral radicular cyst

It is analogous to Periapical cyst but occur along lateral aspect of the root.

Non-odontogenic cysts

Simple/Hemorrhagic/Traumatic bone cyst is a pseudocyst without an epithelial lining that usually is seen in young people in second decade of life. These are usually asymptomatic, discovered incidentally and most commonly located in premolar region rather in incisor area of mandible [1]. On imaging, they are slightly irregular in shape, poorly defined borders; give scalloped appearance between the roots of the teeth. On CT, high density may confirm blood products, but density is variable.

Aneurysmal bone cyst (ABC) is often expansile, multilocular lesion show cortical thinning or destruction and contains blood filled spaces separated by fibrous septa. The appearance is similar as in long bones. On CT/MRI, Presence of fluid levels may be present, strongly suggestive of ABC. In our case, Fluid levels were not seen, however expansile fluid density lesion causing marked bone remodeling and thinning was seen (Figure 4).

Stafne cyst (static bone cavity) is a radiolucency usually located on the medial surface of the posterior mandible near the angle of mandible below the mylohyoid line and mandibular canal. These are more common in males with age range 20-70years. The bone defect usually contains submandibular salivary gland or fatty tissue (Figure 5).

Odontogenic tumors

Ameloblastoma is a benign odontogenic tumor that arises from ameloblasts (enamel forming cells), has peak incidence in 3rd to 4th
incidence of life with majority of lesions occur in mandible and in posterior region.

Multiloculated/solid type give honeycombing like appearance, may invade cortex to extend into adjacent tissues, may lead to scalloping and bony expansion. On MRI, mixed solid and cystic components, thick walls, papillary projections with enhancing solid component and septae may be seen. Loss of lamina dura, erosion of tooth apex and displacement of teeth may also be seen. Presence of enhancing soft tissue component and papillary projections differentiates it from other cystic lesions [1] (Figure 6).

The Extra osseous/Peripheral type leads to superficial erosion of the bone due to pressure resorption with rare significant involvement of bone.

Desmoplastic type occurs mainly in anterior mandibular region, has mixed lucent-opaque appearance with ill-defined borders, hence difficult to distinguish from bone related lesions. Unicystic type usually present at a younger age in second decade of life with predilection for posterior mandible [3]. Up to 80% are associated with an unerupted tooth usually the mandibular third molar. Radiographically, present as well corticated unilocular lesion with other features similar to other classical ameloblastoma (Figures 7 and 8).

Calcifying epithelial odontogenic tumor (Pindborg tumor) is a locally invasive epithelial odontogenic neoplasm made of epithelial cells in fibrous stroma containing acidiphilic homogenous structures that often calcify [1]. They most commonly occur between 20 and 60 years of age (mean 40 years) [4]. Many of the lesions are seen in molar and premolar region and half of the cases are associated with crown of an impacted or unerupted tooth [4]. Radiographically, mixed lucent-

Figure 4. Aneurysmal bone cyst: 26-year-old male (a) Axial (b) Coronal bone window images show well circumscribed expansile cystic lesion in left ramus of mandible extending into the coronoid process and sigmoid notch. Surrounding bone is thinned, remodelled and eroded, however capsule of the lesion appear intact. Post contrast (c) Axial (d) Coronal images show no enhancement on the post contrast study.

Figure 5. Stafne cyst: 39-year-old male presented with clicking sound in right TMJ, the cyst was an incidental finding. (a) VRT image shows the smooth cortical defect in mandible at the level of angle of mandible (blue arrow) below the myelohyoid line (red arrow). (b, c) Coronal and Axial bone window image shows the cortical defect is in the posterio-medial cortex with inferior alveolar nerve superior and anterior to the lesion (blue arrow). (d) Coronal soft tissue image shows a portion of the submandibular gland is within the cystic lumen (light blue arrow).

Figure 6. Ameloblastoma: 30-year-old male (a, b) VRT images showing markedly expansile lytic lesion in the body, angle and adjacent ramus of the mandible with multiple site perforated cortices more on lingual than the buccal side. (c) Coronal plain soft tissue (d) Post contrast image shows heterogeneous enhancement of the matrix. Peripheral septa are also seen. (e) Axial bone window image shows thinning and expansion of cortex with septa within.

Figure 7. Unicystic ameloblastoma: 10-year-old female, swelling in left side of the face for 8 months with intraoral pus discharge (a, b) VRT images (c) Oblique sagittal bone window image showing expansile lytic lesion in the left body, angle and ramus mandible with perforated cortex at many sites. The impacted tooth was seen at the floor of the lesion (black arrow). (d) Axial plain soft tissue (e) Post contrast image shows mild peripheral enhancement, mild hyperdense contents in the matrix and air foci s/o fistulous connection with oral cavity and superimposed infection.
Odontoma are the most common benign odontogenic tumors of epithelial and mesenchymal origin considered as hamartomas. They are developmental lesions as dentin and enamel are laid down in an abnormal pattern. They are made up of various components of teeth (enamel, dentin, cementum or pulp) [5]. They are of two types: Complex and compound. Complex odontomas consist of radio-opaque masses usually associated with an unerupted tooth, most commonly seen in molar and premolar region in mandible, also seen in maxilla. Occasionally, surrounding lucent rim is seen. Compound odontomas contain variable amount of tooth like elements, most commonly seen in incisor- canine region of maxilla (Figure 10).

Adenomatoid odontogenic tumor is an uncommon odontogenic neoplasm more common in young females in second decade of life and maxilla is more commonly involved than mandible often associated with unerupted permanent tooth mimicking dentigerous cyst [6]. The lesions have well demarcated radiolucent centers with punctuate calcifications. If attached to tooth, lesions are found more apically on root, than dentigerous cyst [2] (Figure 11).

Ameloblastic fibroma is a rare odontogenic tumor that resembles the dental papillae and small islands of odontogenic epithelium that resembles the dental lamina. More commonly seen in children with mandible more often affected than maxilla. Radiographically, lesions appear as well-defined to poorly-defined unilocular or multilocular radiolucency [7].

Keratocyst odontogenic tumor is a benign odontogenic tumor with a characteristic parakeratinized stratified squamous epithelium. The lesion is more commonly seen in posterior mandible and occurs in 2nd and 3rd decades of life. The lesions can be multiple in Basal cell nevus syndrome. The lesion can be unilocular or multilocular with smooth scalloped margins, bulging of bony cortex, occur commonly in body and ramus of mandible and may be associated with impacted tooth. The lesion grows along the length of mandible and does not usually resorb teeth roots. On MRI, lesion has cystic appearance with thin wall, heterogeneous intensity of fluid contents and weak contrast enhancement of the cyst wall [1] (Figures 12 and 13).

Odontogenic myxoma is an odontogenic tumor of mesenchymal in origin, seen in 2nd and 3rd decade of life. Mandible and maxilla are both equally involved, and body and ramus are most commonly involved in mandible. The lesion contains stellate and spindle shaped cells with an abundant myxoid or mucoid extracellular matrix. The lesion appears multilocular or unilocular, may give honeycombing like appearance mimicking ameloblastoma and other tumors and may cause extensive destruction of bone with marked cortical expansion [1,8].

Cementoblastoma is a rare odontogenic tumor characterised by cementum like mass connected at the tooth root. More commonly seen in males younger than 20 years of age with predilection for mandibular first molar followed by premolar teeth. Radiographically, they appear as radiopaque mass confluent with the tooth root surrounded by a thin radiolucent periphery fused with roots of a vital teeth.(9)

Bone related lesions

Ossifying fibroma

Fibro osseous lesions constitute a spectrum of diseases in which normal bone tissue is replaced by fibroblasts and fibrous tissue with...
that blends with the bone. The disease can also cause bone remodeling, expansion and thinning of the cortex [12]. Upward displacement of the inferior alveolar nerve was considered as a unique feature of fibrous dysplasia [13], however in our case postero-inferior displacement of the canal was noted (Figures 17 and 18). MDCT is useful to know the full extent of the lesion and relation with neurovascular structures.

Other benign non-odontogenic tumors

Osteochondroma (Exostosis) are the bony outgrowth of normal cancellous and compact (Figure 19).

Torus mandibularis is a type of exostosis on lingual surface of mandible.

Osteoma contains is a benign neoplasm of cortical or cancellous bone with most common site is in paranasal sinuses followed by jaw.

Figure 11. Adenomatoid odontogenic tumor: 18-year-old male with swelling in lower alveolar region for 2 months (a) OPG shows well circumscribed expansile lytic lesion with sclerotic margins in body of mandible in midline with impacted teeth in left lateral wall. (b) VRT image shows both lingual and buccal cortex perforations with displaced and impacted teeth. (c) Axial plain (d) Post contrast image showing specks of calcification within the lesion and mild enhancement of the matrix. (e) Axial bone window image shows remodelled cortex with crown of impacted tooth within the left lateral wall of cyst.

Figure 12. Keratocyst odontogenic tumor: 25-year-old female (a) Coronal Plain bone window and (b) Soft tissue image- An expansile lytic lesion involving left body, ramus of mandible extending up to coronoid process. (c) Post contrast Coronal image- Peripheral subtle enhancement is seen with central fluid contents and air pockets. (d, e) VRT images- The lesion is causing cortical thinning with perforations of the buccal and lingual cortex. Medially there is cortical breach with extension of air from the oral cavity into the lesion to suggest fistula formation.

Presence of mineralized matrix. Fibrous dysplasia, bony dysplasia and ossifying fibroma constitute fibro osseous lesions. First two are reactive lesions while ossifying fibroma is a true neoplasm [10]. They are more common in women in 3rd to 4th decade of life with premolar and molar area more commonly affected [11]. Radiographically, lesion has distinct boundary with normal bone in contrast to fibrous dysplasia. Lesion is lucent in early stages, becomes radiopaque as lesion grows surrounded by a halo of less ossified tissue [1] (Figures 14-16).

Fibrous dysplasia

Fibrous dysplasia may occur as single or multiple lesions or may be associated with McCune Albright Syndrome. Radiographically, lesion has varied appearance, may show well defined margin with sclerotic rim or ill-defined with non-sclerotic margin, the matrix may vary from mixture of dense to radiolucent areas of fibrosis, homogenously dense, homogenously ground glass or cystic appearance. Most commonly lesion appears as asymmetric homogenous ground glass attenuation.

Figure 13. Keratocyst odontogenic tumor (KOT): 22-year-old female (a) Coronal Plain Soft tissue window and (b) Bone window- Hypo dense intramedullary lytic expansile lesion seen involving the right ramus of mandible superiorly reaching up to sigmoid notch and inferiorly up to the 2nd molar tooth. (c) Post contrast axial image- Thin peripheral rim of enhancement is seen. (d, e) Volume rendered images showing breach of cortex both involving lingual and buccal cortex. No periosteal reaction or internal calcification seen presence of mineralized matrix. Fibrous dysplasia, bony dysplasia and ossifying fibroma constitute fibro osseous lesions. First two are reactive lesions while ossifying fibroma is a true neoplasm [10]. They are more common in women in 3rd to 4th decade of life with premolar and molar area more commonly affected [11]. Radiographically, lesion has distinct boundary with normal bone in contrast to fibrous dysplasia. Lesion is lucent in early stages, becomes radiopaque as lesion grows surrounded by a halo of less ossified tissue [1] (Figures 14-16).

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Figure 14. Ossifying Fibroma: 15-year-old female with swelling over left side of face for 1 year (a) Oblique sagittal bone window, (b) Axial Plain soft tissue image- An expansile lytic lesion involving left half of body and angle of mandible, roots of adjacent molars and premolars lie within the lesion. Inferior alveolar nerve is seen adjacent to the lesion (red arrow). (c) Axial post-contrast image- Minimally enhancing hyperdense soft tissue component seen within the lesion.
Figure 15. Ossifying fibroma: 14-year-old female (a) Orthopentogram shows well circumscribed lytic lesion in body of mandible on right side causing mildly displaced roots of 1st molar and premolar teeth. (b) Axial Plain CT image shows mildly hyperdense matrix of lesion. (c) Sagittal Bone window CT image shows thinning of surrounding bone and roots of adjacent teeth in peripheral portion of lytic lesion. (d) Post contrast Coronal image shows mild heterogeneous enhancement of the lesion. (e, f) VRT images show smooth cortical defect in both buccal and lingual cortex.

Figure 16. Ossifying fibroma: 36-year-old female with left facial swelling for 1-year (a) VRT image shows well defined expansile lytic lesion in left body region of mandible with adjacent teeth appearing normal. (b) Axial soft tissue (c) Bone window images show lytic expansile lesion with peripheral calcified matrix and thinned out cortex. (d) CT cropped Panorex image shows hyperdense matrix of lesion. Root of adjacent teeth appear mildly displaced but not resorbed.

Figure 17. Fibrous dysplasia in a 10-year-old girl. (a) Volume rendered image shows expansile lesion involving posterior body of mandible. Small perforation in buccal cortex seen superiorly (red thin arrow). (b, c) Reformatted Coronal and Sagittal bone window images show mixed lucent and dense matrix giving ground glass appearance with expansile and thinned out cortex. Root of 1st molar and 2 premolars are within the matrix of lesion (red arrow) with displacement of unerupted 2nd and 3rd molar tooth (black arrow). No e/o resorption of root seen. (d) Axial bone window image shows posterior-inferiorly displaced Inferior alveolar nerve on right side (yellow arrow) while normal nerve on left side (blue arrow).
Central giant cell granuloma is most commonly seen in females in 2nd and 3rd decade of life, more common in anterior mandible between 2nd molar and 2nd premolar and tend to cross midline. Radiographically, lesion is often multilocular lucent with honeycombing appearance, thin bony septae but may have unilocular appearance. Lesions often are expansile, can cause tooth displacement and resorption and may produce ground glass opacities and occasional calcification [1].

**Paget’s disease**

Radiographically, depending upon the stage of progression, there can be punched out radiolucent lesions, mixed areas and more sclerotic areas. In the mandible, both rarefaction and sclerosis are common. In our case, mixed lytic and ground glass opacity is seen with multiple areas of perforated cortex and air foci within to suggest secondary infection [1] (Figure 20).

Hemangioma is a benign neoplasm of proliferating endothelial cells. They are more common in females and rarely involve jaw. Radiographically, appear as radiolucent lesions and may appear multilocular in shape. Doppler may be useful, and angiography shows prolonged parenchymal staining and tissue blush. In our case, hyperdense soft tissue component was seen within the lytic component of the lesion which may suggest locule of blood (Figure 21).
always provide confirmatory diagnosis but narrow down the differential diagnosis and provide a definite road map to the surgeon.

References

1. Som PM, Curtin HD (2011) Cysts, Tumors, and Nontumorous Lesions of the Jaw. (5th edn), Head and neck imaging. St. Louis: Mosby Inc: 1476-1546.
2. Dunfee BL, Sakai O, Pistey R, Gohel A (2006) Radiologic and pathologic characteristics of benign and malignant lesions of the mandible. Radiographics 26: 1751-1768. [Crossref]
3. Hsu MH, Chiang ML, Chen JK (2014) Unicystic ameloblastoma. J Dent Sci 9: 407-411.
4. Singh N, Sahai S, Singh S, Singh S (2011) Calcifying epithelial odontogenic tumor (Pindborg tumor). Nat J Maxillofac Surg 2: 225-227.
5. Salish V, Prabhadevi MC, Sharma R (2012) Odontome: A Brief Overview. Int J Clin Pediatr Dent 4: 177-185. [Crossref]
6. Handschel JG, Depprich RA, Zimmermann AC, Braunstein S, Kühler NR (2005) Adenomatoid odontogenic tumor of the mandible: review of the literature and report of a rare case. Head Face Med 1: 3. [Crossref]
7. Lalitha C, Goyal S, Perka L, Kodangal S (2016) Ameloblastic fibroma. J Indian Acad Oral Med Radiol 28: 199-202.
8. Manne RK, Kumar VS, Venkata Sarath P, Anumula L, Mandalapudi S, et al. (2012) Odontogenic myxoma of the mandible. Case Rep Dent 2012: 214704. [Crossref]
9. Sankari LS, Ramakrishnan K (2011) Benign cementoblastoma. J Oral Maxillofac Pathol 15: 358-360. [Crossref]
10. de Andrade M, Silva-Sousa YT, Marques MF, Pontual ML, Ramos-Perez FM, et al. (2013) Ossifying fibroma of the jaws: a clinicopathological case series study. Braz Dent J 24: 662-666. [Crossref]
11. Curé JK, Vattoth S, Shah R (2012) Radiopaque jaw lesions: an approach to the differential diagnosis. Radiographics 32: 1909-1925. [Crossref]
12. Nityasri V, Haris PS, Bose T, Balan A (2011) Fibrous dysplasia-a 13-year retrospective radiographic analysis in a south Indian population. Dentomaxillofac Radiol 40: 282-289. [Crossref]
13. Petrikowski CG, Pharoah MJ, Lee L, Grace MG (1995) Radiographic differentiation of osteogenic sarcoma, osteomyelitis, and fibrous dysplasia of the jaws. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 80: 744-750. [Crossref]

Neurogenic tumors

Radiographically, schwannoma arising from inferior alveolar nerve lesions may present as radiolucency which can lead to widening and expansion of inferior alveolar canal. Neurofibroma adjacent to bone may produce pressure defect on the surface of bone.

Inflammatory conditions

Osteoradionecrosis may occur as a sequel to heavy irradiation which leads to painful necrosis followed by sequestration of bone. Radiographically, in late stages, ill-defined radiolucent areas giving moth eaten appearance with areas of sequestra and variable areas of cortical breach may develop.

Osteomyelitis may develop in jaw secondary to odontogenic infection. The presentation and radiographic findings are similar as in other parts of body.

Conclusion

History, clinical presentation and imaging play a key role in diagnosis of benign lesions of Mandible. Although CT findings may not

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