1

Application of CT for the Study of Pathology of the Jaws

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1. Introduction

Computed tomography (CT) scanning is very useful in identifying and evaluating the location, size, and suspected pathological diagnosis of lesions such as cysts, tumors, and infections. At the same time, it aids in the elucidation of bone and surrounding soft tissue invasion of lesions with high resolution.[1, 2] In the maxilla and mandible, teeth are included and the CT capacity there can distinguished a foreign body of only 30 µm. Precise size and location are needed in the evaluation of lesions in the maxilla and mandible based on a high resolution in addition to the suspected pathological diagnosis based on CT findings.
Therefore, multi-detector CT (MDCT) scanning is commonly applied for various kinds of lesions in the maxilla and mandible because of its precision and diagnostic accuracy. Multi-detector CT scanning provides rapid acquisition of numerous thin axial images and more accurate reconstruction images. Multi-detector CT scanning provides accurate information about the height, width, and three-dimensional (3D) evaluation of the maxilla and mandible, as well as detailed information about the location of normal anatomical structures, such as the mandibular canal, mental foramen, mandibular foramen, incisive foramen, and maxillary sinus. In addition, the relationship between lesions and anatomical landmarks, including cortical margins and roots of teeth, can be established. These images are also excellent because MDCT eliminates streak artifacts from dental restorations that degrade direct coronal CT scans. With MDCT, axial images are used to reformat the cross-sectional images, projecting the artifact along the crowns of the teeth rather than over the bone that is the region of interest.[3] At the same time, CT readings of lesions in the maxilla and mandible measured by MDCT can reflect the nature and inclusion within lesions, from which

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suspected pathological diagnosis can be estimated. Multi-detector CT scanning could improve the performance of CT angiograms and dynamic contrast and maneuver imaging.[4, 5] Multi-detector CT angiography is used to delineate the blood vessels **(Fig. 1)** and to provide information about the exact location of neoplasms, lymphadenopathy, and their vascular infiltration or spread.

Fig. 1. CT angiography image in the oral and maxillofacial regions of a patient with oral cancer.

In the case of dental lesions such as dental caries **(Fig. 2A)**, marginal and/or periapical periodontitis **(Fig. 2B)**, or an impacted tooth **(Fig. 2C)**, cone-beam CT (CBCT), with its better resolution, may also be applied, but without CT readings. In addition, this modality has endodontic and orthodontic applications.[6, 7] For orthodontic tooth movements, CBCT offers a 3D image that can be used to visualize all three planes of space.[7] Cone-beam CT is especially useful for the evaluation of 3D alveolar bone volumes and the relationship between anatomical landmarks before dental implant surgery **(Fig. 2D)**.[8, 9] However, the disadvantage of CBCT is that soft tissues with different densities cannot be visualized on the images, which explains why there is no whole-body CBCT. This modality is best applied for identifying the calcification of hard tissues.

2. CT findings for various kinds of lesions in jaws

Characteristic CT findings of lesions commonly encountered in our clinical practice, such as cysts, tumors including fibro-osseous lesions, and infections in the maxilla and mandible, are described.

2.1 Cysts in jaws

Most cyst-like lesions occurring in the maxilla and mandible are odontogenic cysts, such as radicular cysts, and some are non-odontogenic cysts, such as nasopalatine duct cysts.[10] Also found are pseudo-cysts without cystic epithelium, such as simple bone cysts. In this report, CT images of odontogenic cysts, non-odontogenic cysts, and pseudo-cysts in jaws are shown and interpreted.

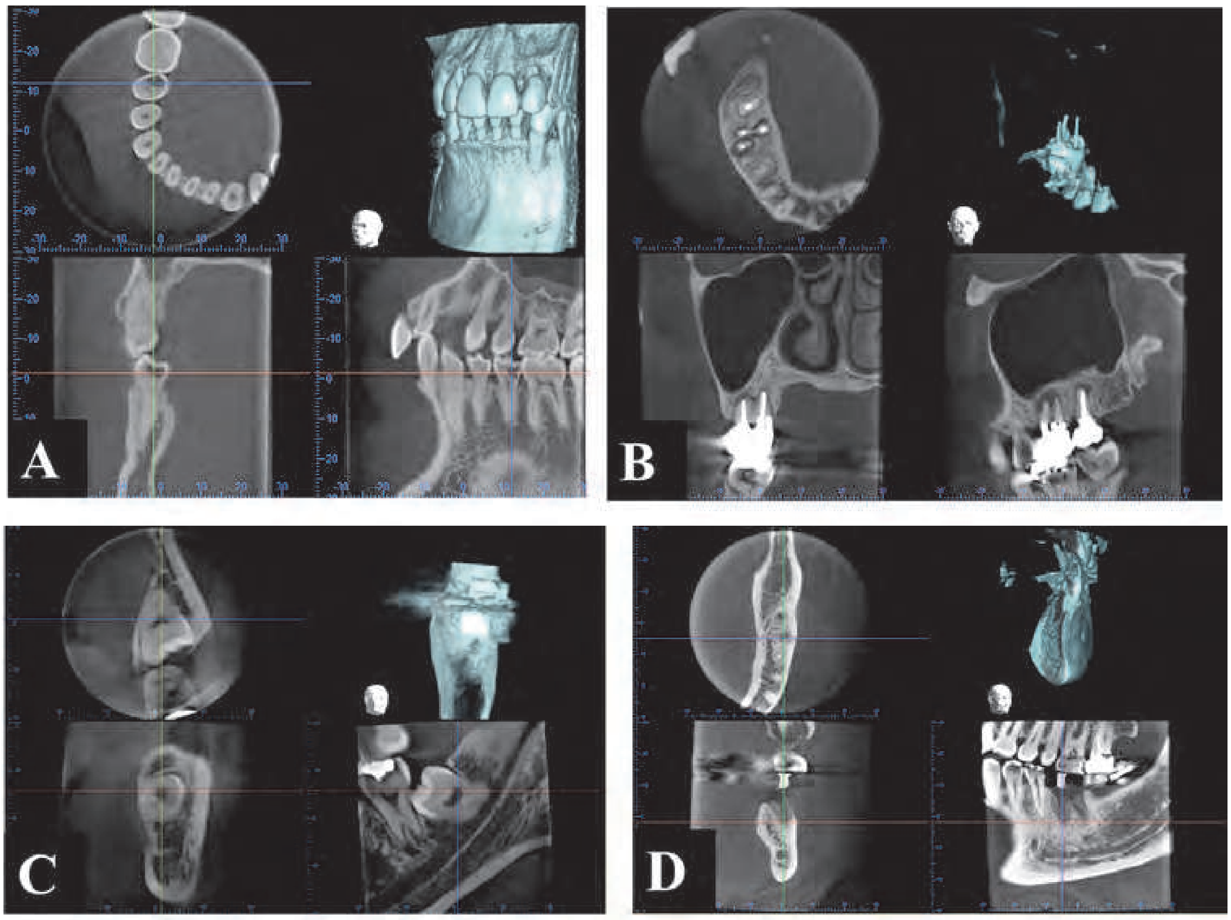


Fig. 2. CBCT images of dental caries in the right second premolar (A). CBCT images of marginal and/or periapical periodontitis in the maxillary molar region (B). CBCT images of an impacted tooth in the mandibular third molar region (C). CBCT images of the evaluation before dental implant surgery in the mandibular molar region (D).

2.2 Odontogenic cysts in jaws

Representative odontogenic cysts in the maxilla and mandible are radicular cysts and dentigerous cysts. Therefore, CT images of both types of cysts are demonstrated.

2.3 Radicular cysts, including residual cysts and periapical granulomas

Radicular cysts are the most common odontogenic cyst, which is a post-inflammatory lesion related to the apex of a non-vital tooth root.[11] The characteristic clinical locations of the cysts are adjacent to the apex of a carious or heavily restored non-vital tooth. The cyst is a cavity in the bone that contains fluid. Radiographically, the radicular cyst is a well-circumscribed radiolucency arising from the apex of the tooth and bounded by a thin rim of cortical bone **(Fig. 3A)**. On CT imaging, the cyst is shown as a water-dense mass with a well-defined margin **(Fig. 3B)**. In addition, the cyst is located around the apex of a causative tooth, including it. If the cyst occurs in the maxilla, extension into the maxillary sinus from the maxillary sinus floor may be observed **(Fig. 3C)**. At the upper border of the lesion, the bone line may be observed **(Fig. 3C)**. A periapical granuloma and radicular cyst may have identical radiographic appearances, but a radicular cyst sometimes may be differentiated from the granuloma by its size. An apical granuloma is usually smaller than 1 cm in diameter, whereas a radicular cyst may become as large as 10 cm.[12] One type of radicular cyst is a residual cyst that remains after or develops subsequence to extraction of an infected tooth. Therefore, its radiological findings including CT images are similar to those of radicular cysts without the causative teeth **(Fig. 3D, E)**.

Fig. 3. Panoramic radiograph image (A), axial CT image (B) of a radicular cyst in the maxilla (arrows). Oblique coronal CT image (C) of a radicular cyst extension into the maxillary sinus from the maxillary sinus floor (arrows). Axial (D) and oblique coronal (E) CT images of the residual cyst in the left mandible (arrows).

2.4 Dentigerous cysts (follicular cysts)

The dentigerous cyst is the second most common type of odontogenic cyst; its pericoronal position around the crown of an unerupted tooth is its characteristic clinical finding. Therefore, the dentigerous cyst is the most common pathologic pericornal radiolucency in the jaws according to Ackermann et al.[13] Radiologically, the dentigerous cyst consists of an well-corticated pericoronal radiolucency exceeding about 2.5 mm on CT images, which is a criterion between cystic change and a normal dental follicular sac **(Fig. 4)**. The common teeth related to dentigerous cysts are the mandibular third molars, maxillary canines, and supernumerary teeth. Among supernumerary teeth, mesio-dens are most commonly associated with dentigerous cysts. Radiographically, the dentigerous cyst is a well-circumscribed radiolucency bounded by a thin rim of cortical bone including the crown of an unerupted tooth **(Fig. 4A)**. On CT images, this cyst is shown as a water-density mass with a well-defined margin including the crown of an unerupted tooth **(Fig. 4B)**. It is often difficult to differentiate between dentigerous cysts and odontognic benign tumors such as ameloblastomas. Dentigerous cysts cannot strongly absorb the contiguous teeth roots by knife-edge resorption **(Fig. 4C)**, but odontogenic tumors can. In addition, dentigerous cysts do not tend to expand the buccolingual cortical bone, but odontogenic tumors do.

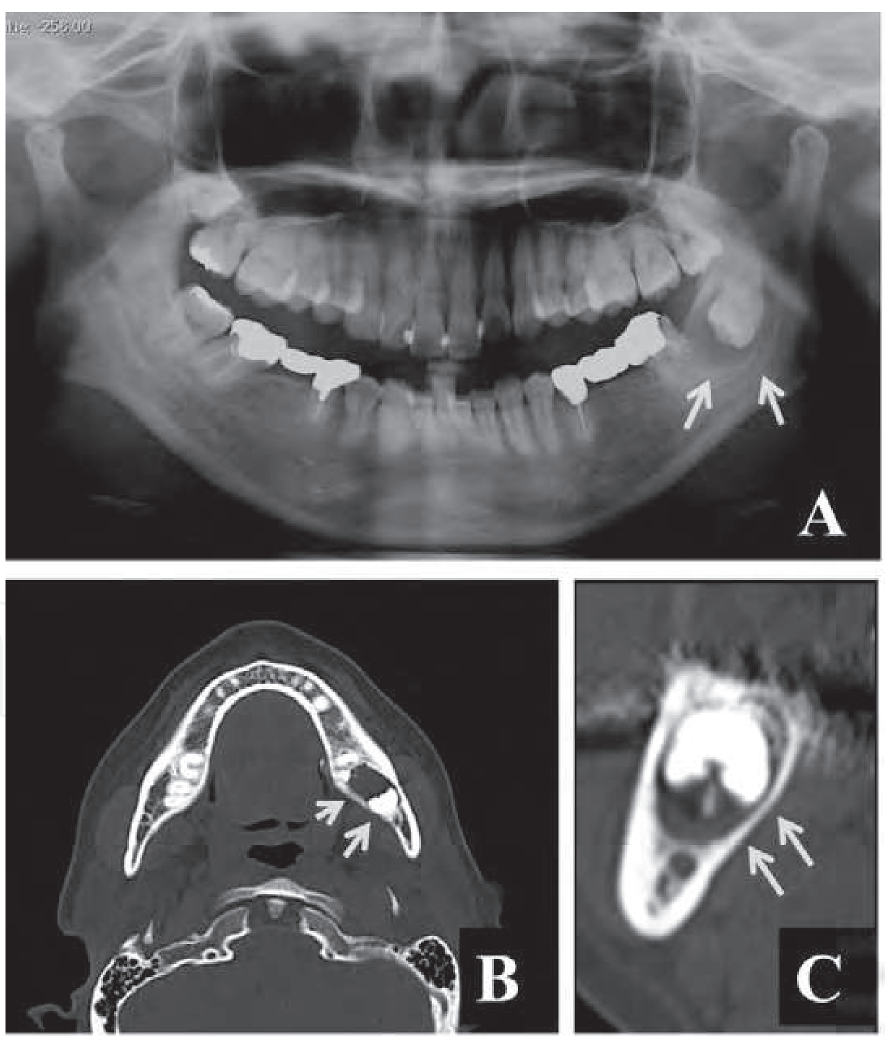


Fig. 4. Panoramic radiograph image (A), axial (B) and oblique coronal (C) CT images of a dentigerous cyst in the left mandibular third molar region (arrows).

3. Non-odontogenic cysts in jaws

3.1 Nasopalatine duct cysts (incisive canal cysts)

A nasopalatine duct cyst is a representative non-odontogenic developmental cyst (one of the fissural cysts).[10] The cyst occurs in the incisive canal near the anterior palatine papilla. Pathologically, the epithelium of the cyst may originate from remnants in the incisive canals. The nasopalatine cyst has a unique heart-shaped appearance **(Fig. 5)**. In addition, the cyst is a well-circumscribed radiolucency bounded by a thin rim of cortical bone including the incisive canals **(Fig. 5A)**. On CT images, this cyst is indicated as a water-dense mass with a well-defined margin including the incisive canals **(Fig. 5B, C)**. This cyst has intra-osseous and extra-osseous variants. It sometimes is difficult to differentiate between radicular cysts and nasopalatine duct cysts if contiguous teeth are non-vital. We base the diagnosis on whether the lesions have expanded over the median palatine suture and whether the lesions are relatively asymmetric.

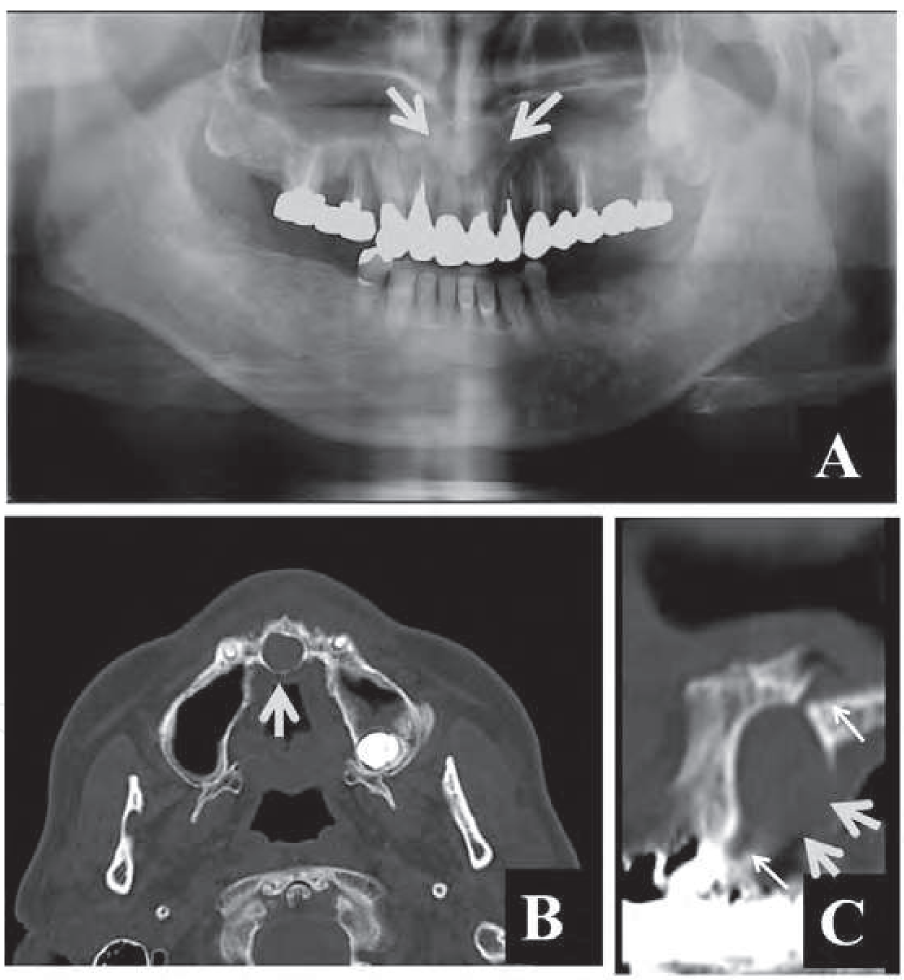


Fig. 5. Panoramic radiograph image (A), axial (B) and oblique sagittal (C) CT image of an incisive canal cyst (arrows) and incisive canals (narrow arrows).

3.2 Postoperative maxillary cysts

The postoperative maxillary cyst occurs 20 to 30 years after Caldwell-Luc surgery and is one of the non-odontogenic cysts.[14] Pathologically, the cystic lining originates from the epithelium of the maxillary sinus, based on its histologic similarity. The characteristic features of the post-Caldwell-Luc maxillary sinus are a right-angle triangular shape and an ill-defined panoramic innominate line on panoramic radiographs **(Fig. 6A)** and the contracted sinus and a thickened posterior wall on CT scans **(Fig. 6B)**. In addition, this cyst is indicated as a well-circumscribed radiolucency bounded by a thin rim of cortical bone **(Fig. 6C)** and as a water-dense mass with a well-defined margin on CT images **(Fig. 6D, E).**

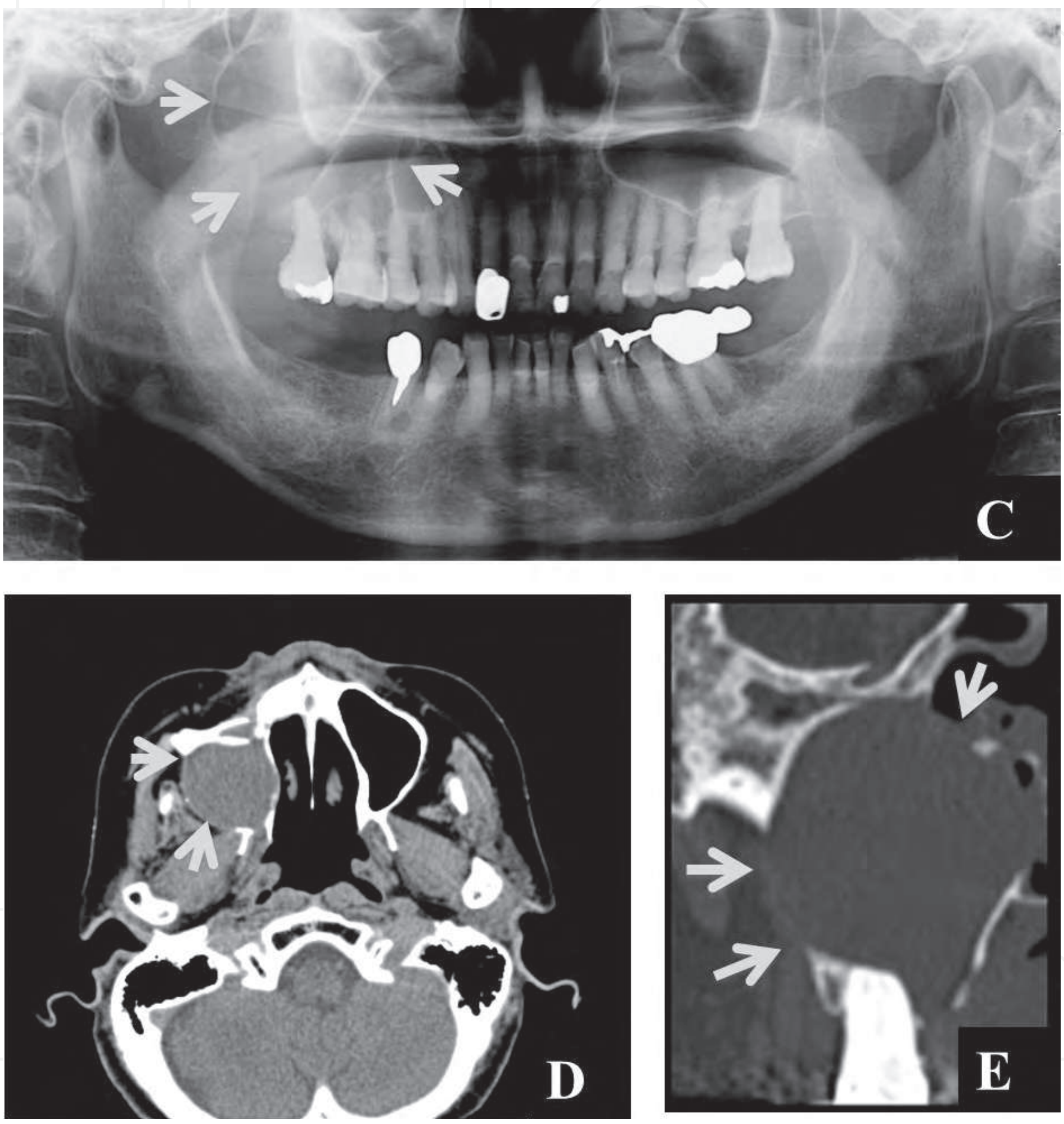


Fig. 6. Panoramic radiograph images (A, C), axial CT images (B, D), oblique coronal CT image (E) of a postoperative maxillary cyst in the right sinus region (arrows).

4. Pseudo-cysts in jaws

4.1 Simple bone cysts

A simple bone cyst is a representative pseudo-cyst, which does not have epithelium. The cyst lining consists of loose vascular connective tissue that may have areas of recent or old hemorrhage.[15] The cyst tends to occur in the mandible of young men. These cysts often are asymptomatic and most are discovered incidentally during examination of the teeth for other purposes.[16] Radiologically, the cyst is a well-circumscribed radiolucency bounded by a thin rim of cortical bone **(Fig. 7A)**. On CT images, this cyst is indicated as a water-dense mass with a well-defined margin **(Fig. 7B)**. As radiological characteristic features, the outline of the cyst between the roots of teeth has a scalloped appearance **(Fig. 7C)**.

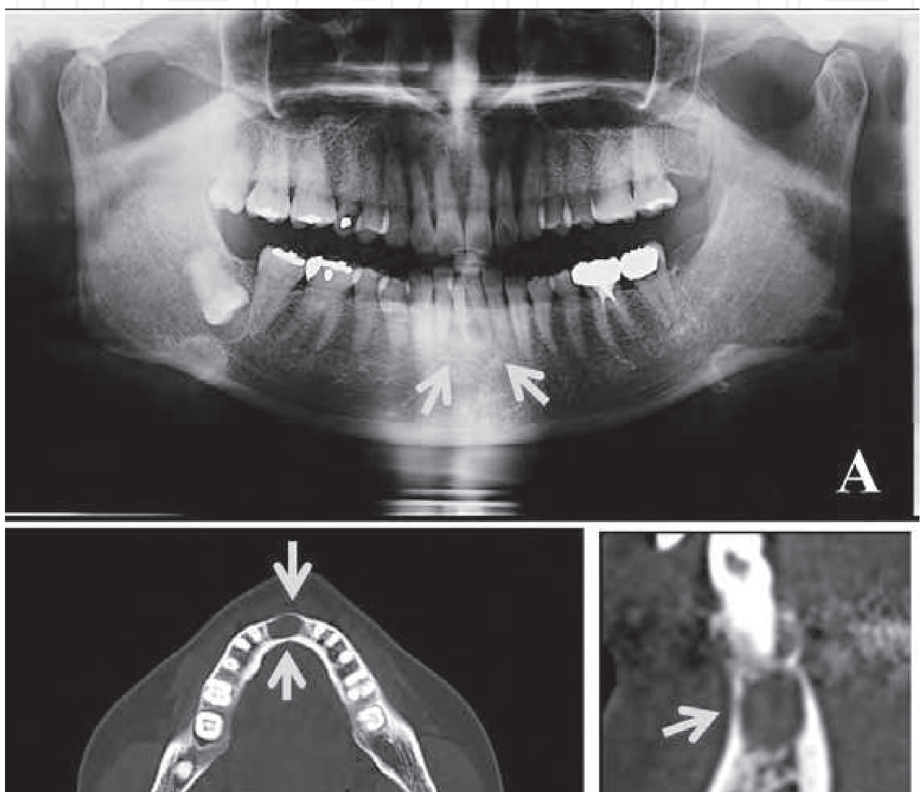


Fig. 7. Panoramic radiograph image (A), axial (B) and sagittal (C) CT image of a simple bone cyst in the mandible (arrows).

4.2 Static bone cavity

A static bone cavity incidentally appears as an ovoid or round radiolucency in the posterior mandible on X-ray radiographs completely like cysts in jaws **(Fig. 8A)**, but it is not a cyst. It is simply a bony defect on the lingual surface of the mandible that is demonstrated on CT images **(Fig. 8B)**, but not X-ray radiographs. The static bone cavity usually includes salivary gland tissues, fatty tissues, and air.[17]

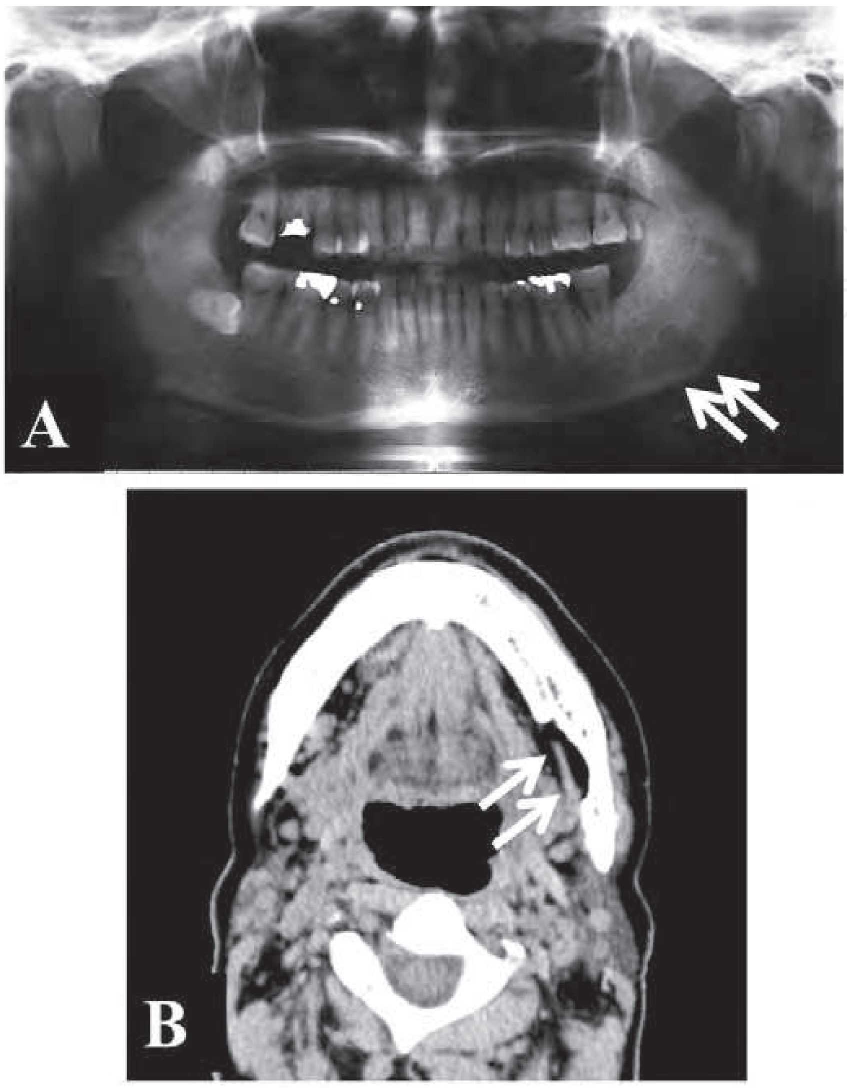


Fig. 8. Panoramic radiograph image (A) and axial CT image (B) of a static bone cavity in the left angle of the mandible (arrows).

5. Tumors in jaws

Tumors occurring in the maxilla and mandible are divided into benign and malignant types and most tumors are benign. At the same time, tumors occurring in the jaws are odontogenic, such as keratocystic odontogenic tumors (KCOT) and ameloblastomas, and some are non-odontogenic such as osteomas. Moreover, odontogenic tumors are subdivided into four categories by the World Health Organization (WHO) based on the tissue origin.[10] In addition, fibrous-osseous lesions also occur as tumor-like lesions in the jaws. In this report, the CT image findings of tumors and tumor-like lesions are shown and interpreted.

6. Benign odontogenic tumors in jaws

6.1 Keratocystic odontogenic tumors

Keratocystic odontogenic tumors (KCOT) are odontogenic tumors as classified by the WHO in 2005.[10] It is a cystic neoplasm of Category 1 (originating from odontogenic epithelium) of the WHO classification and often affects the posterior mandible. Keratocystic odontogenic tumors are thought to arise from the dental lamina and have a similar keratinized squamous epithelium without rete ridges.[10, 18] Radiologically, the cystic mass is a well-circumscribed multi-loculated radiolucency bounded by a thin rim of cortical bone with smooth or scalloped margins **(Fig. 9A)**. On CT images, the cystic mass is indicated as a water-dense mass with well-defined smooth or scalloped margins **(Fig. 9B)**. The contents of KCOT are thick due to desquamated keratinizing squamous cells. These contents can occasionally increase the radiographic attenuation of the lesion on CT scans, but this is not appreciable on panoramic radiographs.[19] In the case of multiple KCOT in the maxilla and mandible, basal cell nevus syndrome (Gorlin-Goltz syndrome), which is a genetic disorder inherited as an autosomal dominant trait with variable penetrance and expressivity, should be suspected **(Fig. 9C)**.

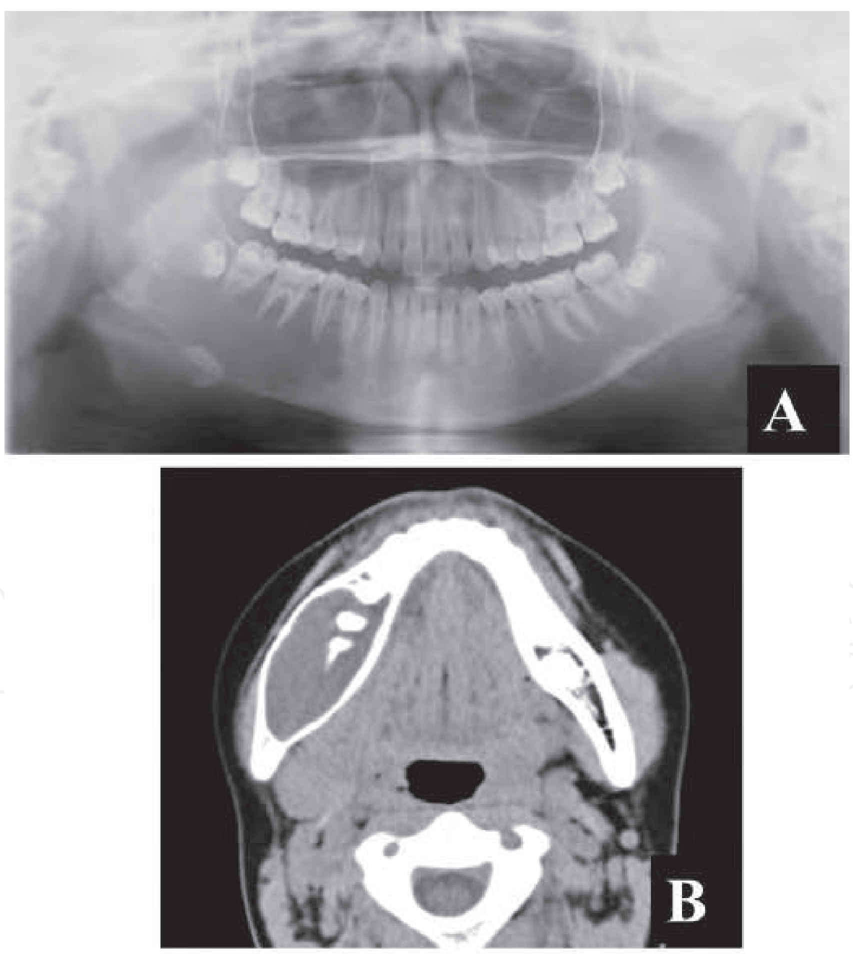
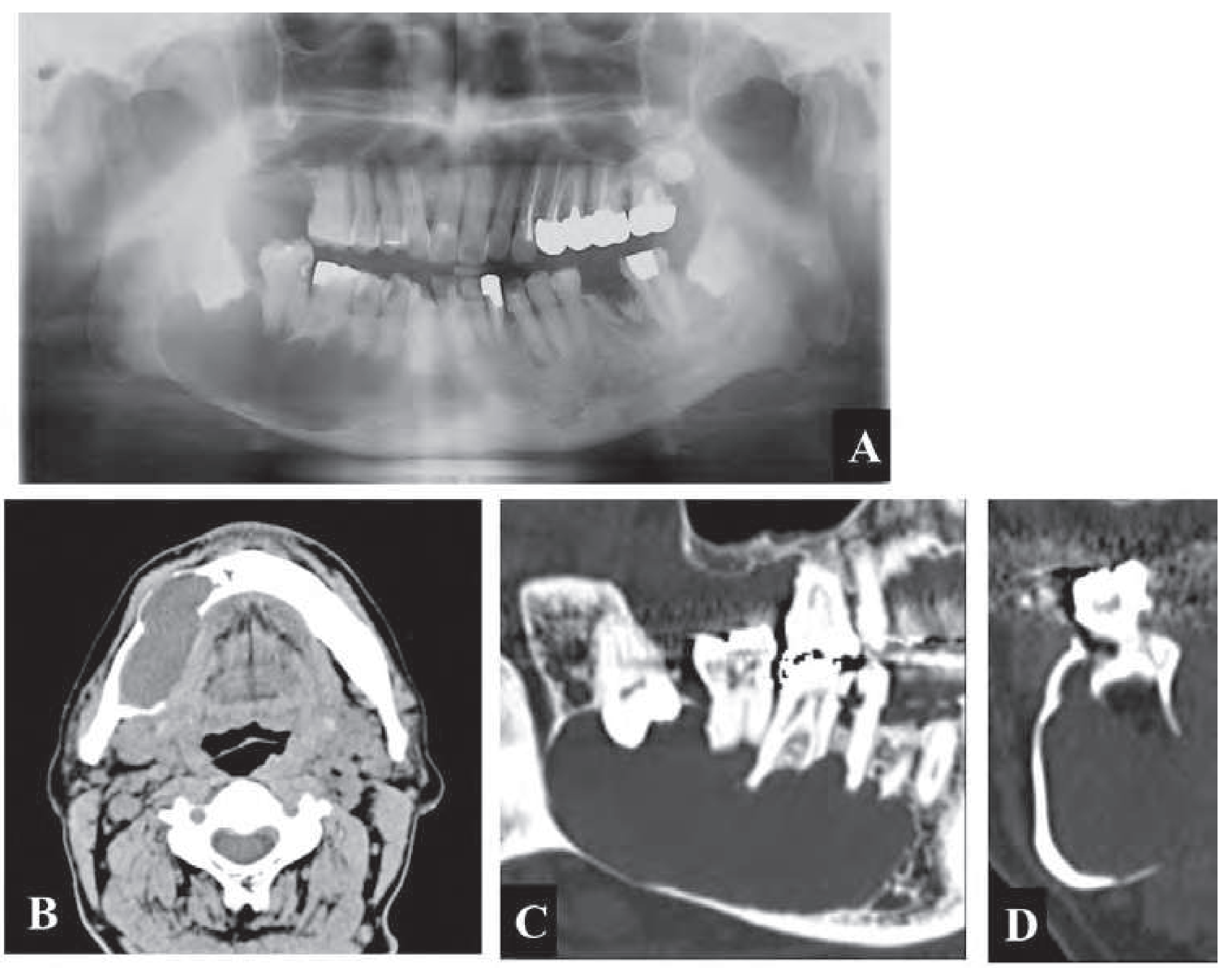


Fig. 9. Panoramic radiograph image (A), and axial CT images (B) of a keratocystic odontogenic tumor in the mandible. Axial CT image **(C)** of the keratocystic odontogenic tumor with basal cell nevus syndrome.

6.2 Ameloblastomas

An ameloblastoma is also a representative tumor of Category 1 by the WHO classification and is thought to arise from ameloblasts.[20-22] The common clinical findings of ameloblastomas are painless swelling in the posterior mandible of adults less than 40 years old. Radiologically, the tumor is a well-circumscribed multi-loculated radiolucency bounded by a thin rim of cortical bone with smooth or scalloped margins **(Fig. 10A)**. On CT images, the tumor is indicated as a soft tissue or water-dense mass with well-defined smooth or scalloped margins **(Fig. 10B)**. Therefore, it is sometimes very difficult to differentiate between ameloblastomas and KCOT by characteristic radiographic findings. However, ameloblastomas tend to replace the roots of teeth with knife-edge resorption **(Fig. 10C)**, but KCOT have relatively less resorption if the lesions are contiguous with teeth. In addition, ameloblastomas tend to expand the marked buccolingual cortical bone **(Fig. 10D)**, but KCOT do not if the lesions are contiguous with cortical bone in the maxilla and mandible. In addition, about 5% of ameloblastomas can transform into malignancy **(Fig. 10E)** and the mass should be excised appropriately.



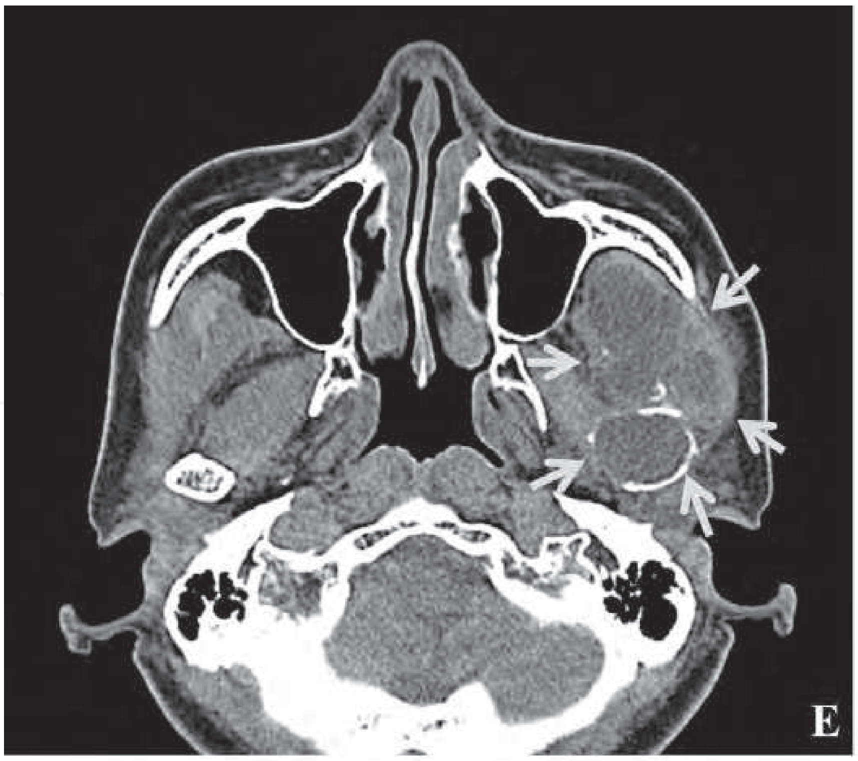


Fig. 10. Panoramic radiograph image (A) and axial (B), oblique sagittal (C), oblique coronal (D) CT images of an ameloblastoma in the right mandible. Axial CT image (E) of a malignant ameloblastoma (arrows).

6.3 Odontomas

Odontoma is a representative Category 2 tumor (originating from odontogenic epithelium and mesenchyme with hard tissue formation). By the WHO classification, odontomas are divided into two types, complex and compound.[18] Pathologically, the compound odontoma gathers and arranges in an orderly pattern such that the lesion resembles multiple normal tooth-like structures. The complex odontoma is arranged in a disorderly pattern such that the lesion does not resemble tooth-like structures. Therefore, radiologically, odontomas usually are not difficult to differentially diagnose. Both compound and complex odontomas are surrounded by a thin radiolucent area consisting of a connective tissue capsule. Compound odontomas are radiopaque masses composed of many tooth-like structures on X-ray radiographs **(Fig. 11A)** and on CT images **(Fig. 11B)**. The areas of inter tooth-like structures are radiolucent and soft tissue density areas on the respective modalities **(Figs. 11A, B)**. The compound odontomas are well-demarcated, radiopaque masses surrounded by narrow radiolucent zones **(Figs. 11C, D)**.

6.4 Benign cementoblastomas

Benign cementoblasoma is a representative Category 3 tumor (originating from mesenchyme and/or ectomesenchyme with/without odontogenic epithelium), and is called a true cementoma.[25] Pathologically, a benign cementoblastoma is characterized by the formation of cementum or a cementum-like mass connected with a tooth root.[23, 24] Radiologically, a benign cementoblastoma has intimate involvement with the whole tooth root and has three stages: radiolucent, radiopaque, and mature radiopaque with an

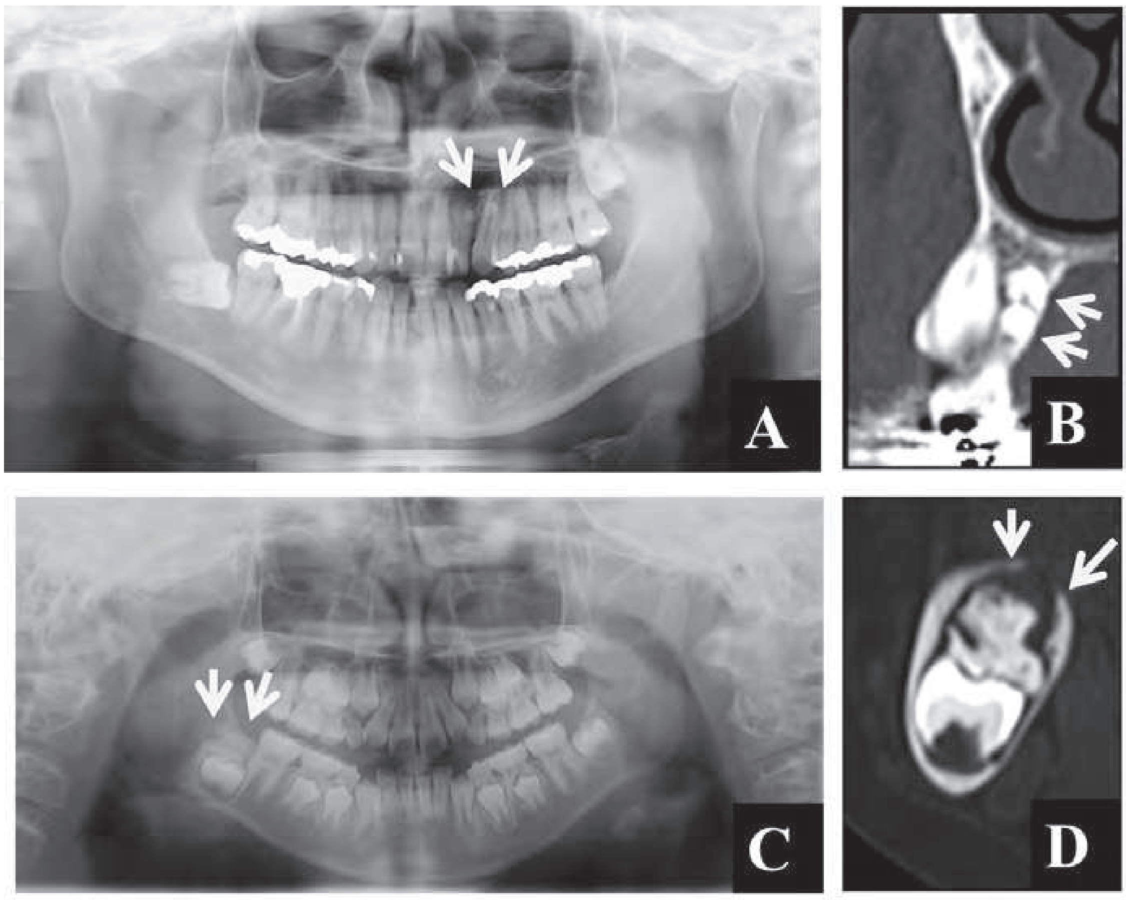


Fig. 11. Panoramic radiograph image (A) and oblique sagittal CT image (B) of compound odontoma (arrows). Panoramic radiograph image (C) and oblique coronal CT image (D) of complex odontoma (arrows).

obscured root outline within the lesion. The benign cementoblastoma is a central high-density mass attached to the tooth root surrounded by a well-defined low-density area **(Fig. 12A, B)**. Periapical cemental dysplasia involves cementomas and is a reactive disorder rather than a neoplastic process. Periapical cemental dysplasia also has three phases: ostolytic, cementoblastic, and a mature stage likely to be benign cementoblastomas. Most cases of periapical cemental dysplasia appear as radiopaque masses with well-defined radiolucent areas at multiple periapical regions **(Fig. 12C, D)**.

6.5 Fibrous dysplasia

Fibrous dysplasia is a representative tumor-like lesion classified as a Category 4 condition (bone-related lesions) by the WHO. In this category, simple bone cysts are also included.[12] Fibrous dysplasia is divided into two types.[12] Monostotic fibrous dysplasia affects only one bone and polystotic fibrous dysplasia affects multiple bones. In polystotic dysplasia, McCune-Albright's syndrome is induced by point-mutations of the GNAS1 gene[25, 26] and Lichtenstein-Jaffe syndrome is a milder form.[25, 26] Radiological changes as a result of fibrous dysplasia are sometimes related to multiple bones such as the skull, facial bones, and femur,

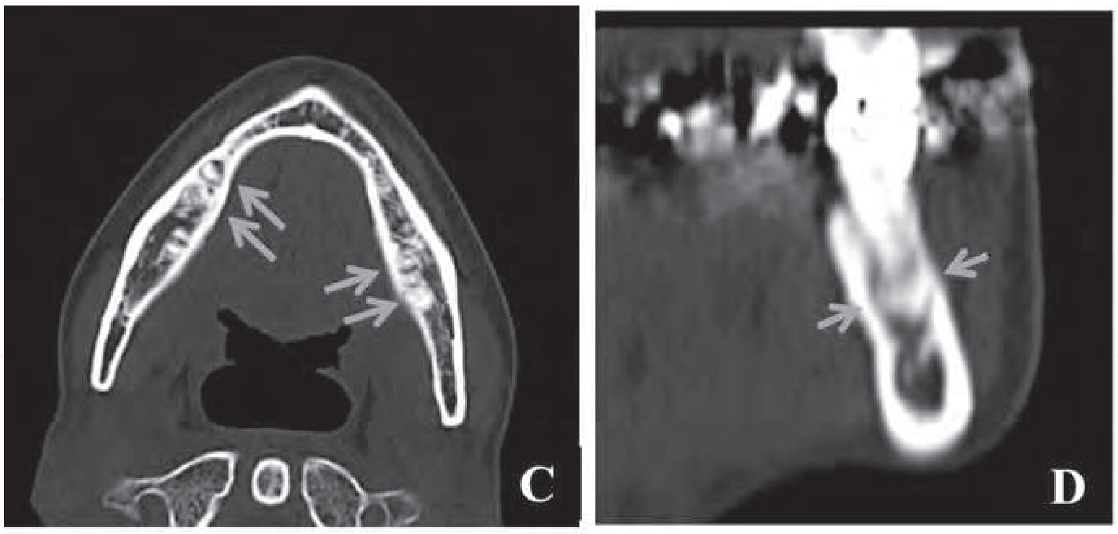


Fig. 12. CT images (A, B) of a benign cementoblastoma in the mandible (arrows). CT images (C, D) of periapical cemental dysplasia in the mandible (arrows).

in addition to the jaws. Various areas should be examined whenever one area of fibrous dysplasia is suspected. Pathologically, fibrous dysplasia is characterized by fibrous tissue alternating with trabeculae, woven bone, and less organized lamellar bone. Radiological characteristic features also vary and may be radiolucent, radiopaque, or mixed-density according to the degree of bone present within the lesion. One representative case is seen as mass-like unilocular mixed-density changes with a poorly defined margin and the other representative case is seen as radiopaque change with a poorly defined margin accompanied by bone deformity, such as the expansion of cortical bone, on X-ray radiographs **(Fig. 13A)** and on CT **(Fig. 13B, C)**.

7. Benign non-odontogenic tumors in jaws

7.1 Osteomas

An osteoma is a representative benign non-odontogenic tumor composed of compact and/or spongy bone.[27] Radiologically, an osteoma is a radiopaque mass with a well-circumscribed margin attached to the bone surface **(Fig. 14A)**. The degree of radiopacity is related to the composition within the osteoma such as compact or spongy bone.

In cases of multiple osteomas in the jaw, Gardner's syndrome should be suspected. Exostoses in the jaws are outgrowths of the bone and are similar to osteomas. A representative exostosis is a torus mandibularis, which is bilateral bone growth of the lingual surface of the mandible in the premolar regions **(Fig. 14B)**.

7.2 Osteochondromas

An osteochondroma is the most common benign tumor and occurs at the condyles of the mandible in the temporomandibular joints. Pathologically, the surface of the tumor is covered with cartilage and the inner part is composed of spongy bone. Therefore, radiopaque masses with well-defined margin are indicated as radiological features **(Fig. 15)**.

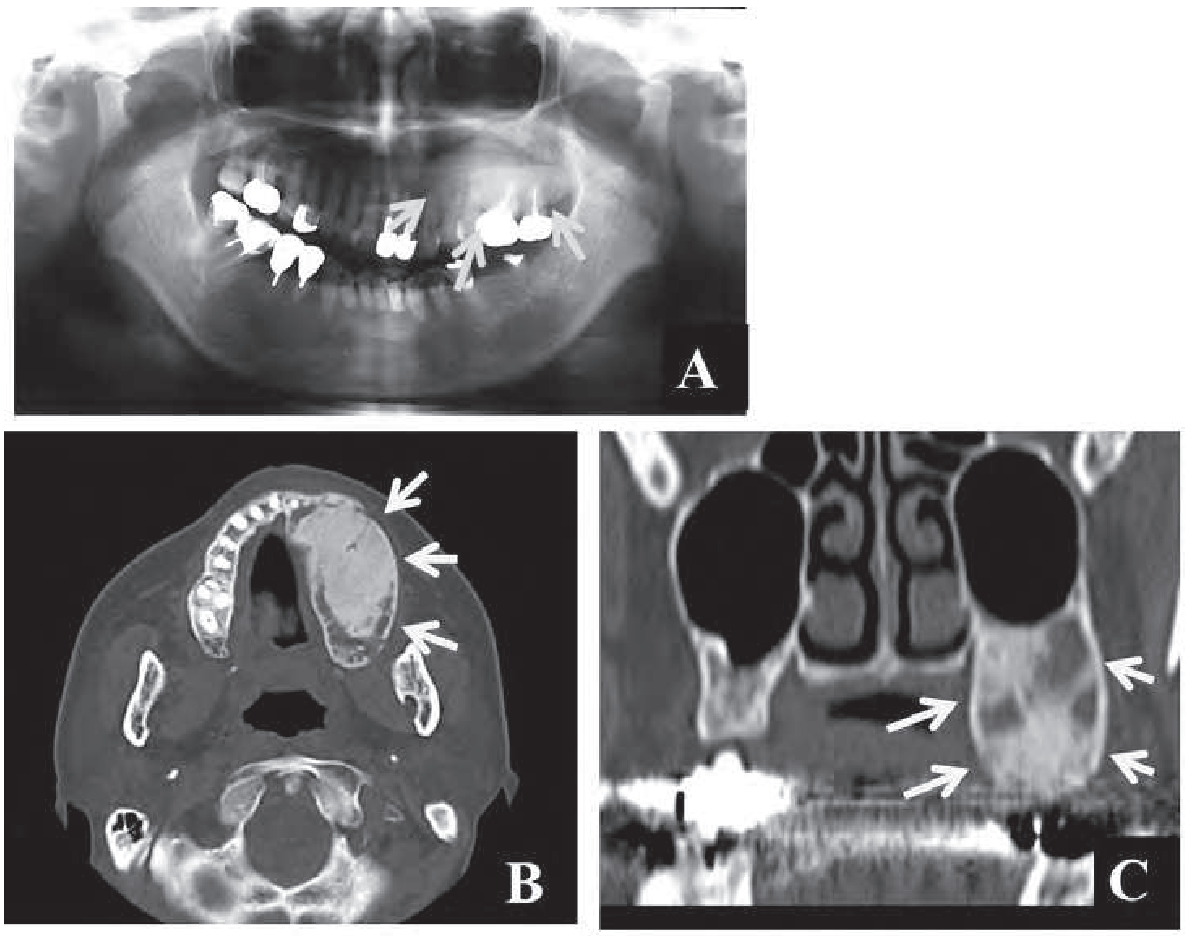


Fig. 13. Panoramic radiograph image **(A)** and axial **(B)**, coronal **(C)** CT images of fibrous dysplasia in left maxilla (arrows).

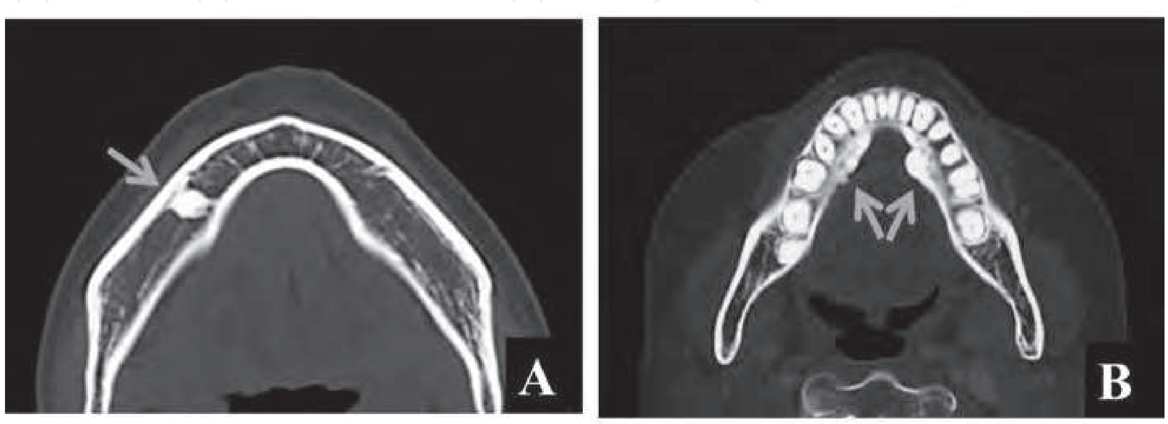


Fig. 14. Axial CT images of an osteoma in the mandible (A) and the torus mandibularis (B) (arrows).

Fig. 15. Oblique sagittal CT image of an osteochondroma in the temporomandibular joint (arrows).

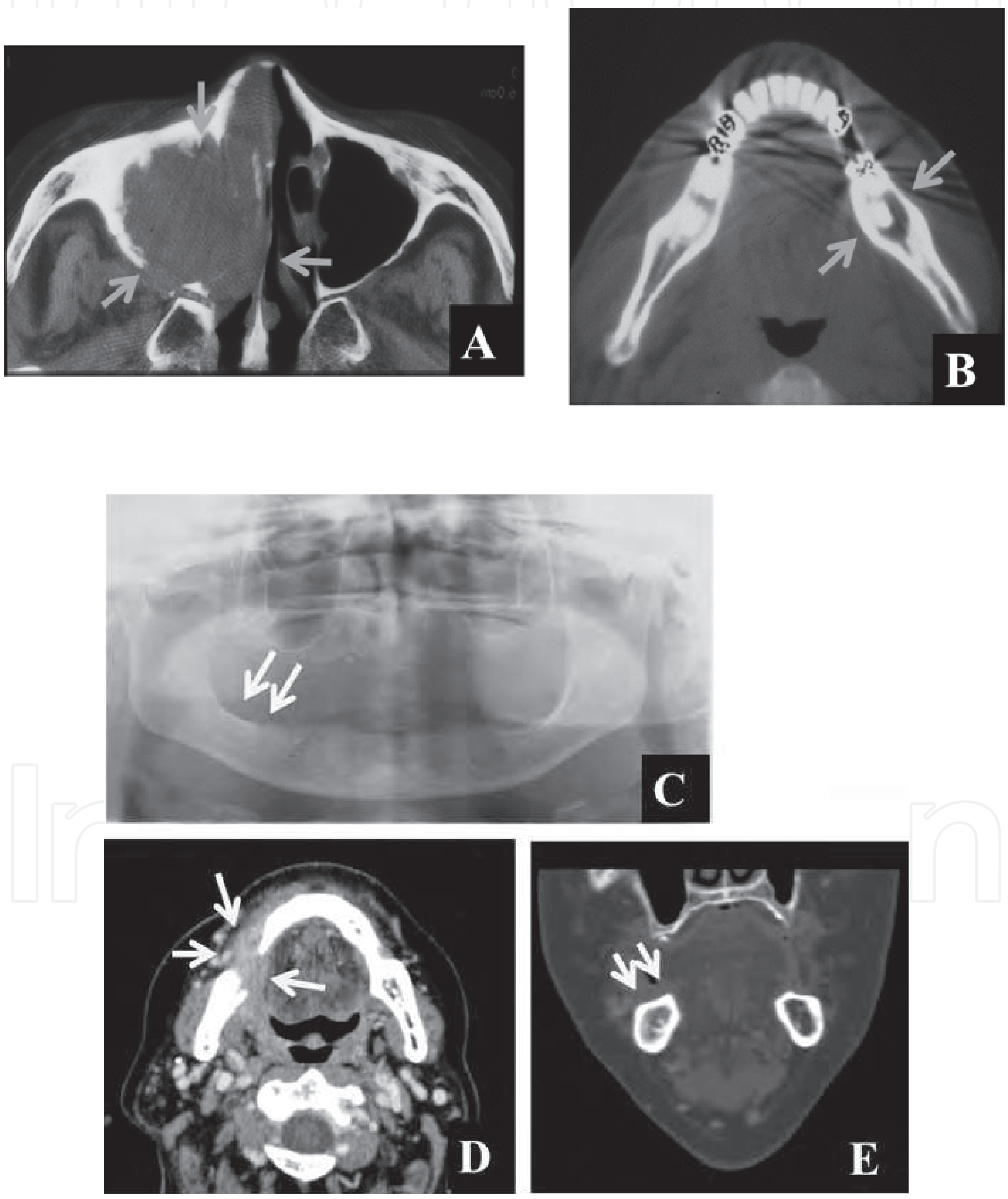
8. Malignant tumors in jaws

Malignant tumors occurring in the jaws are various kinds of lesions such as primary intraosseous carcinomas, lymphomas, malignant ameloblastomas, and metastatic tumors to the jaws. In particular, the lesions that attention should be paid to are oral cancers with erosive changes to the mandible and maxilla, such as gingival carcinomas and metastatic cancers to the jaws.

8.1 Oral cancers with erosive changes to the jaws

Most of the lesions encountered routinely in malignant tumors of jaws are gingival or tongue carcinomas of the mandible or maxilla. Tumors occurring in soft tissues should not be included in non-odontogenic tumors of the jaws. However, because oral and maxillofacial surgeons including dentists often have an opportunity to deal with these lesions, they should be described in this section. Their pathological cause is transformation of the epithelium and the carcinomas are derived from odontogenic cysts **(Fig. 16A)** and remnants in primary intra-osseous regions **(Fig. 16B)** in rare cases. These lesions are included in non-odontogenic malignant tumors of the jaws.

In cases where an exact evaluation of erosive changes to the mandible and maxilla is required, coronal plane views should be produced using multi-planar reconstruction techniques after the acquisition of axial planes with very thin (0.5-1 mm) slices.[28, 29] In those cases, metal dental artifacts should be minimized. Furthermore, a CT scan can encompass the area from the cavernous sinuses to the thoracic inlet to examine the primary cancer and possible lymph node metastases in the neck. Radiologically, the crestal portion of the alveolar ridge attached to lesions indicates saucerization and beneath this area, there may be a wide transition zone and a relative lack of sclerosis at the margin **(Fig. 16C, D, E)**. In addition, there may be motheaten and permeative patterns of bone destruction and floating teeth from bone loss **(Fig. 16F)**. CT images commonly include soft tissue density masses with mild contrast enhancement associated with bone destruction **(Fig. 16G, H)**. However, masses affected by dental metal streak artifacts are often undetectable on CT images. It has been reported that particular radiological findings and parameters using dynamic CT could also be useful.[30-32] Wakasa *et al*. reported that the peak height, which is the relative CT value measured from the base CT value to the point where the curve reaches its peak, is useful for distinguishing between inflammation and tumors.[31] Transit time, which is the time between two transit points on the time-density curve, has been reported to be significantly longer in benign tumors than in malignant tumors.[31]



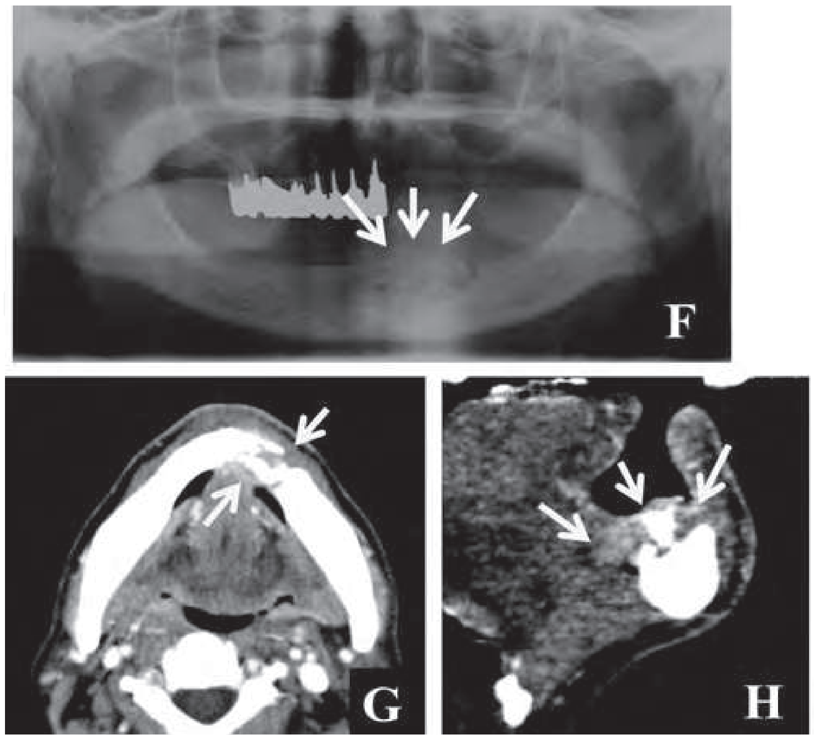


Fig. 16. Axial CT image (A) of the carcinomas derived from odontogenic cysts (arrows). Axial CT image (B) of the carcinoma in the primary intra-osseous region (arrows). Panoramic radiograph image (C), axial contrast-enhanced CT image (D) and coronal CT image (E) of the gingiva carcinoma in the molar region (arrows). Panoramic radiograph image (F), axial (G) and coronal (H) contrast-enhanced CT images of the gingiva carcinoma in the mandibular canine region (arrows).

8.2 Metastatic cancers to jaws

Metastatic cancers to the jaws are relative rare, but we should pay attention to them. In particular, if patients had primary cancers in the lung, breast, liver, prostate, or kidney, and if patients with the clinical manifestations of numb chin syndrome have known cancers, it would be important to be aware of the criteria used to judge whether the known cancers had worsened.[33] Radiologically, in most patterns, the metastatic masses with ill-defined margins destroy the bone diffusely **(Fig. 17A)**.[33] In rare case, the metastatic mass with diffuse calcification destroys the mandible and replaces it with muscle **(Fig. 17B)** .[33] The inner nature of the masses tends to be determined according to that of the primary lesions. To prevent the misdiagnosis of numb chin syndrome, dentists need to be aware of the clinical manifestations of numb chin syndrome, the need for CT imaging, and the shortcomings of panoramic radiographs.[33]

9. Infections in jaws

9.1 Osteomyelitis including bisphosphonate-related osteonecrosis of the jaws

Infections caused by dental caries, periodontitis, and pericoronitis, tend to spread into and around the jaws. When infections produce intra-osseous expansion, osteomyelitis occurs in the jaws. Osteomyelitis is divided into acute and chronic types by the period from the onset of infection. In addition, there are other kinds of osteomyelitis such as common suppuration osteomyelitis without particular infection, radiotherapy-related, and bisphosphonate-related

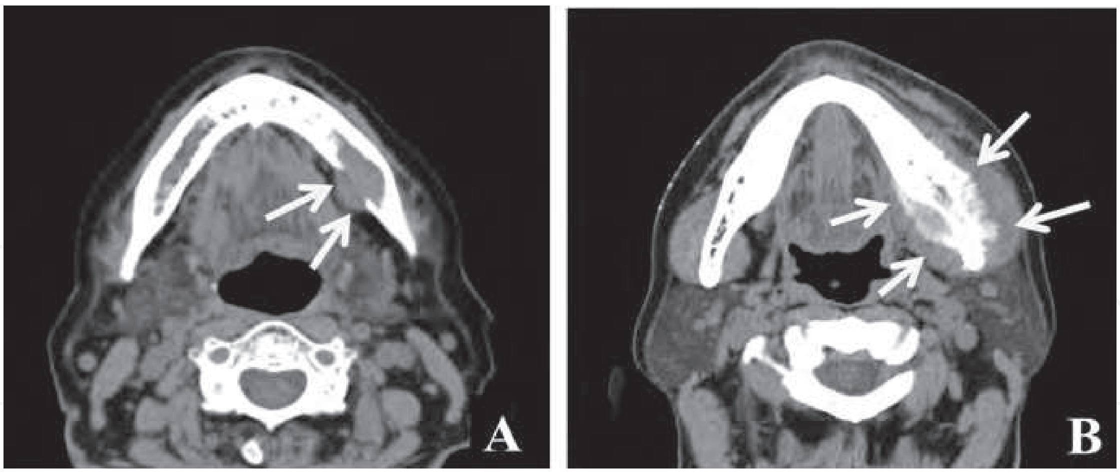
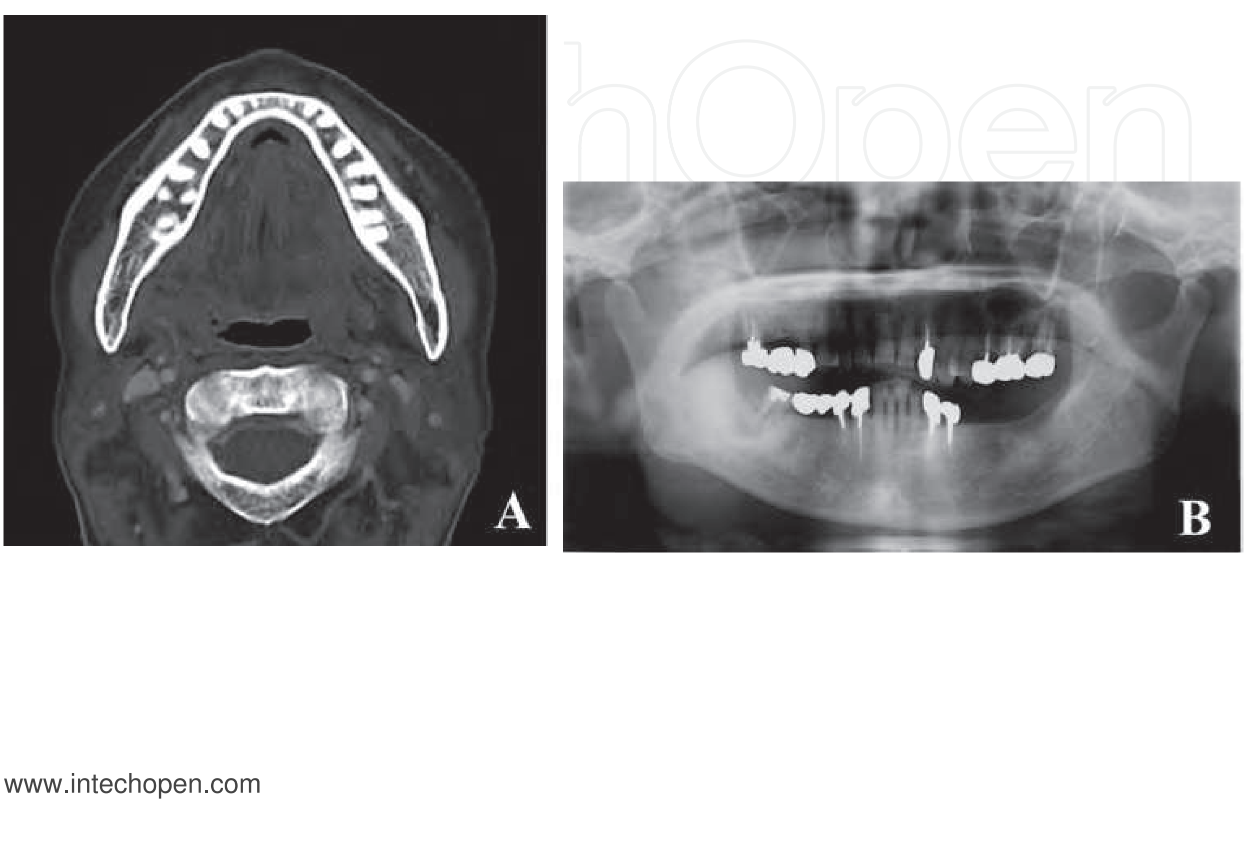


Fig. 17. Axial CT images (A, B) of a metastatic mass (arrows) in the mandible.

osteomyelitis. Basic radiological features are the same and there is little radiological change in the jaws in acute osteomyelitis **(Fig. 18A)**. In chronic osteomyelitis, osteolytic and/or osteogenic changes with ill-defined margins are demonstrated in the jaws. In osteogenic osteomyelitis, diffuse sclerosing jaws are shown and the clarity of the mandibular canal can be visualized **(Figs. 18B, C)**. In addition, in some cases, periosteal reactions are also visualized on CT images **(Fig. 18D)**. In some cases of chronic osteomyelitis, a sequestrum can be visualized **(Fig. 18E)**. Recently, bisphosphonate-related osteonecrosis of the jaws (BRONJ) has become recognized as a potentially serious complication in patients, including those with cancer and osteoporosis, who are treated with long-term administration of bisphosphonates.[34] Once BRONJ has occurred in a patient, it is difficult to completely cure the disease. Therefore, its prevention is especially important. However, the radiological findings in BRONJ are the same as those in chronic osteomyelitis, except for the prominent bone destruction **(Figs. 18F, G, H)**. If chronic multifocal recurrent osteomyelitis occurs in the jaw, we should suspect SAHPO (synovitis, acne, pustulosis, hyperostosis, osteitis) syndrome, and additional examinations should be performed.[35]



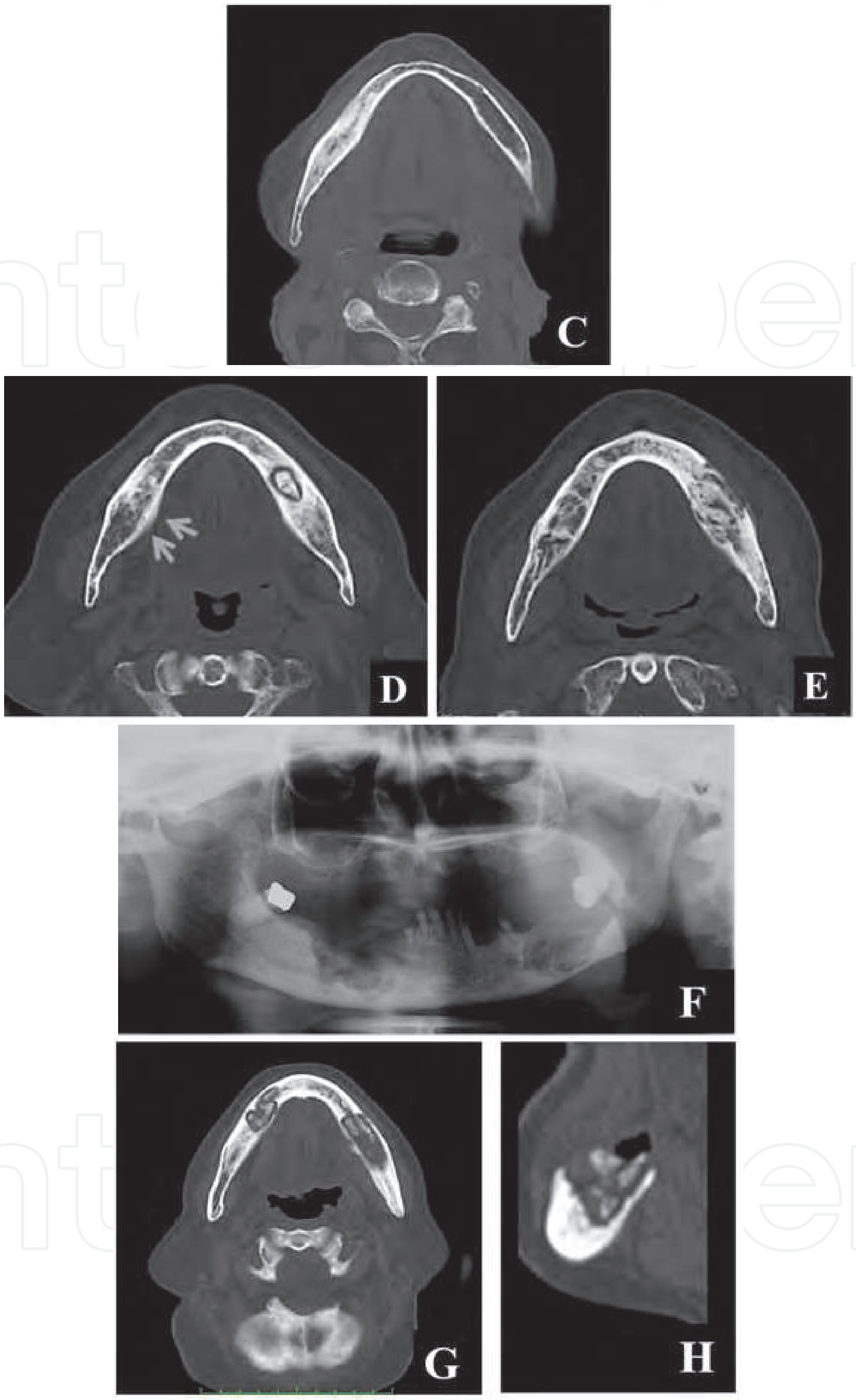


Fig. 18. Axial CT image of acute osteomyelitis in the left mandibular molar region (A). Panoramic radiograph image (B) and axial CT image (C) of chronic osteomyelitis in the right mandibular molar region. Axial CT image of periosteal reactions (arrows) in a case of chronic osteomyelitis (E). Axial CT image of a sequestrum in a case of chronic osteomyelitis (E). Panoramic radiograph image (F), axial (G) and oblique coronal (H) CT images of a sequestrum in a case of bisphosphonate-related osteonecrosis of the jaws.

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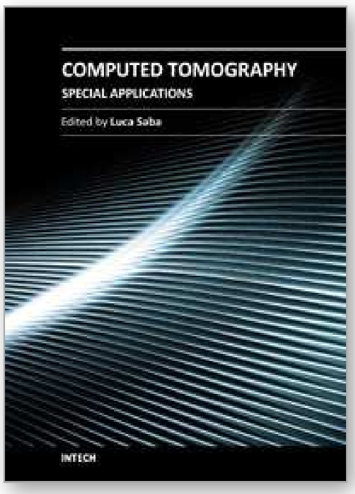

Computed Tomography - Special Applications

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