EVALUATION OF JAW OSTEOLYTIC LESIONS AND THEIR COMPLICANCTIONS WITH MSCT AND VR RECONSTRUCTIONS.

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Purpose

Jaw cystic lesions represent a group of inflammatory and neoplastic alterations, deserving both clinical and surgical attention.

The cancellous bone may respond to a pathogen noxa changing the metabolic balance in favour of osteoclastic processes leading to the formation of an area, appearing radiolucent with OPT examination, and as an osteolytic lesion with CT scans.

The main osteolytic lesions of the mandible are represented by radicular cysts, follicular cysts, nasopalatine duct cysts, apical granulomas, ameloblastomas and odontogenic fibromas.

Our purpose is to describe the extension of these lesions in the three spatial planes, their possible complications and involvement of adjacent structures.
Methods and Materials

900 patients, aged 18-75 years, underwent imaging evaluation in our department during the period between January 2008 and January 2010.

In most patients diagnosis was occasional, sequent to an ortopantomographic exam performed because of toothache. These patients sequently underwent CT evaluation with Dentascan and VR reconstruction softwares.

CT scanning was performed using a Light Speed Plus (GE) multislice CT scanner, provided with Dentascan reconstruction software.

The study technique comprised preliminary antero-posterior an lateral scanograms performed with the following acquisition parameters: 120 Kv and 200 mA. The subsequent axial scans were acquired using the sequent scan protocol: thickness 1,25 mm; increment 0,6 mm; feed 3,75 mm/s, rotation time 600 ms; Pitch 0,75:1; SFOV 25 cm; matrix 512x512; reconstruction algorithm with high spatial resolution (for the bone), WW 40, WL 40, gantry inclination of 0°.

CT scans were obtained with the patients in the supine position, using a head holder and modifying the head position according to the considered teeth arc, because of the different angulation of the two arcs in relation to the axial plane, to not modify the FOV angulation during the scan.

The acquired data were transferred to a work-station dedicated to Dentascan reconstructions. We used the following reconstruction parameters: SFOV 12,7 cm; oblique reconstructions thickness 1:0mm; panoramic reconstructions thickness 1:0mm; WL 800; WW 3200.

Using VR softwares, we obtained 3D reconstruction images of the hard tissues to study the physiological and/or pathological anatomy of the examined structures, to obtain a better definition of their borders and to evaluate their relationship with the pathology.
Results

150 patients presented an apical granuloma with a clinical symptomatology characterized by toothache and sometimes fever and lymphoadenomegaly. A small percentage of patients did not present any clinical symptom.

Ortopantomographic (OPT) examination revealed radiolucent areas located adjacent to the root apex of the teeth. CT evaluation revealed osteolytic lesions in the site of the apical root, with different dimensions from few mm to 1 cm.

In 100 patients, mostly asymptomatic, we found one or more radicular cysts presenting as radiolucent areas at the OPT examination and as a low attenuation osteolytic area on the CT images. They had various dimensions from 5mm to 2-3cm and they are located in the maxillary or mandibular bone, mostly located in the incisor-canine area.

60 patients presented a follicular cyst mostly located in the area of inferior third molars, inferior second premolars and superior canines. OPT revealed these cysts as radiolucent areas surrounded by a radiopaque peripheral rim. In the CT images follicular cysts can be observed as osteolytic lesions with an osteosclerotic peripheral rim englobing the involved tooth until the crown. In the biggest cysts we further found thin septa. Most patients had no clinical symptoms, even if in a small percentage we could observe a hard consistency facial tumefaction.

In 15 asymptomatic patients we documented the presence of a nasopalatine duct cyst.

OPT revealed NPDC as radiolucent area in the incisor site. CT images show a low attenuation osteolytic lesions, even if in a patient we observed minute calcifications inside the cyst. Some cyst extended posteriorly, involving the hard palate, or anteriorly, involving central incisors.

In 10 patients with pain, paresthesiae and tooth mobility, we found an ameloblastic heterologous lesion, confirmed by histological examination. OPT revealed a radiolucent uniloculated expansive lesion. It appeared on the CT scans as an osteolytic, uniloculated (8/10) or multiloculated, destructive lesion with thin internal septa and an osteosclerotic peripheral rim. Ameloblastic lesions were mostly located in the molar area of the mandibular bone (7/10). In the remaining 3 patients, the lesion was located in the maxillary bone. One of the seven mandibular lesions was located in the right ramus; other 4 lesions were in the left mandibular emiarch, 2 lesions in the right mandibular emiarch. Two of the 3 ameloblastic lesions of the superior maxillary bone were in the left-side; only one lesion was in the right-side. These lesions had a diameter between 2 and 7 cm.

In 7 patients with pain and fever we found a focal osteomyelitis mostly involving the mandibular bone. OPT revealed a radiolucent area, with destructive character and big
dimensions in the mandibular bone. In the CT scans it appeared as an osteolytic lesion 
with cortical-marrow erosion and edema of the adjacent soft-tissues.

In two patients presenting pain and a facial tumefaction we found an ameloblastic 
fibroma, confirmed by the histological examination. They were both unilocular lesions. 
OPT revealed a radiolucent area with regular and smooth borders. In the CT images we 
could observe an erosive osteolytic lesion, with a smooth and defined border, surrounded 
by an osteosclerotic rim in the molar-premolar region of the mandibular bone.

**FOLLICULAR CYST (Dentigerous Cyst)**

Follicular cyst (dentigerous cyst) is a lesion that includes the crown of a not erupted 
tooth, caused by fluid accumulation between the residues of the enamel epithelium 
and of the crown. This cyst is related to those teeth that most likely remain included 
(third molars, upper canines, lower second premolars). Clinical examination detects one 
or more missing teeth or a hard consistency lump that may cause facial asymmetry. 
Typically, the patient has no pain or discomfort. A dentigerous cyst develops in about 4% 
of individuals with at least one not erupted tooth.

Radiologically it appears as a radiolucent area surrounded by a peripheral rim. In the 
bigger lesions it is possible to appreciate the presence of septa. Histologically it is 
composed of connective tissue covered by not keratinized stratified epithelium with giant 
cells and goblet cells. It constitutes 20% of odontogenic cysts. It is more frequent among 
women, with a peak incidence around age 30-40. The presence of a moving tooth or of a 
relevant expansion of the involved bone should suggest the presence of a cyst. Further, 
if follicular space exceeds 5 mm, lesion is more likely to be a cyst (normal follicular space 
is 2 - 3 mm).

The differential diagnosis (D.D.) is difficult and it must be drawn between small 
odontogenic cysts and hyperplastic follicle; it may also include odontogenic keratocysts, 
ameloblastic fibroma and cystic ameloblastoma.

An odontogenic keratocyst does not expand the bone to the same degree of odontogenic 
cysts and it rarely resorpts the tooth. It may not be possible to differentiate a small 
ameloblastic fibroma or an ameloblastic cyst from a dentigerous cyst if there is not an 
internal structure.

**Nasopalatine Duct Cyst (NPDC)**

The nasopalatine duct cyst (NPDC) occurs in the median of the palate, usually anterior 
to the first molars. It is the most common type of oral non-odontogenic cysts.

It represents the 10% of the jaw lesions. It interests individuals between 40 and 60 years. 
The incidence is higher in males (M:F = 3:1).
Histologically it may show mucous cells and nerve bundles in addition to a lining of stratified squamous or respiratory epithelium. The incisive canal cyst and the cyst of the papilla incisiva are the recognized subtypes.

It is usually asymptomatic, but it may sometimes produce an elevation in the anterior portion of the palate, expanding into the nasal cavity. It is frequently found in edentulous patients. If the cyst involves the hard palate it is shown as median palatine cyst. If the cyst expands between the central incisors, it can be indicated as median anterior maxillary cyst.

This developmental cyst forms in the nasopalatine duct or its remnants, and it appears on panoramic radiograph as a heart-shaped or oval radiolucent lesion, located above or between the roots of the maxillary central incisors. CT scans reveal an osteolytic lesion with a well defined sclerotic border. This cyst has no direct relationship to the teeth, but, in its growth, may encroach upon the incisor apices. It does not interfere with tooth vitality and seldom causes root resorption of the maxillary central incisors.

Differentiation with radicular cysts occurring at this location may be difficult on panoramic radiographs and therefore CT images may be useful for precise characterization and lesion extension. (Fig. 1-6)

**RADICULAR CYST**

Radicular cysts are inflammatory cysts arising at the apex of a necrotic tooth. They are coated by not keratinized squamous epithelium. They are the most common type of odontogenic cysts (70%) with a ratio M: F = 3:2. They affect people of all ages with a peak incidence around 40-50 years. They usually occur in the maxilla (60%), mostly in the incisors area, and only 40% occurs in the jaw. Panoramic radiographs show a classical radiolucent cystic lesion, in the apical area of a necrotic tooth. It can occur in single or multiple pattern and it can reach a considerable size.

Macroscopically the lesion appears as a cystic structure at the apex of tooth, with soft brown-red material inside.

Initially the cyst is formed by an area of granulation tissue (improperly called "apical granuloma" because it isn't a true granulomatous inflammation), and in the apex of the tooth. It mostly consists of fibroblasts, blood vessels, inflammatory tissue rich in lymphocytes, plasma cells and neutrophils; sequently, the central cavity is covered by stratified squamous epithelium that may present chronic inflammatory cells like mature lymphocytes and plasma cells.

The differentiation between a small radicular cyst and an apical granuloma may be difficult and, sometimes, impossible. A round shape, a well-defined cortical rim and a diameter greater than 2 cm are more characteristic of this cyst. (Fig. 7-10)
AMELOBLASTOMA

Ameloblastoma is a slow-growing tumor, locally aggressive, with high relapse frequency. It is the most common type of odontogenic tumor (M:F = 1:1). The peak incidence has a 30-40 years range and its elective localization is the posterior mandible (>70%).

It is often an incidental finding on routine radiographs and OPT. The small ameloblastoma appears on CT as a destructive osteolytic lesion, mostly located in the mandible, especially in the molar branch.

The large ameloblastoma usually appears multiloculated with bony septa giving to the lesion an "honeycomb" or "bubble" appearance. It can be uni- or multi-cystic; in the first case it is similar to a benign non-neoplastic cystic lesion or it may contain an included tooth simulating an odontogenic cyst.

Its main histological patterns are: 1) follicular with cells forming a fence around a cystic area; 2) plexiform with nests of ameloblastic epithelium crossing each other.

Other patterns are: acanthomatous and granulous cells.

Ameloblastic cells are positive for calretinin. (Fig. 11-12-13)

AMELOBLASTIC FIBROMA

Ameloblastic fibroma is a benign odontogenic tumor characterized by the neoplastic proliferation of mature ameloblasts and primitive dental pulp mesenchymal components.

It usually occurs between 5 and 20 years with a mean age of 15 years. There is an equal prevalence between the sexes. Mandibular premolar-molar region is its elective localization.

There are two types: unilocular and multilocular. Ameloblastic fibroma appears as an erosive osteolytic lesion on CT images, located in the mandibular premolar-molar region and surrounded by a rim of sclerotic bone.

Unilocular or multilocular appearance makes fibroma similar to ameloblastoma, although the last one occurs in the older age. Other differential diagnosis are: giant cell central granuloma, odontogenic myxoma, hemangioma and odontogenic keratocyst.

APICAL GRANULOMA

Dental granuloma is characterized by inflammation of the tissues next to the teeth root-apex, caused by dental pulp infection and necrosis sequent to the spread of bacteria and toxins across the root foramen.
The clinical presentation of periapical inflammatory lesions may vary from the absence of symptoms to occasional toothache, to severe pain with or without facial swelling, fever and lymphadenopathy.

The radiographic aspects of periapical flogistic lesions are different, according to the lesion age.

Panoramic radiograph reveals only old granulomas which appear as radiolucent lesions; CT images show an osteolytic lesion at the root apex.

The two lesions, most frequently involved in the differential diagnosis of apical inflammatory lesions, are the cement periapical dysplasia (CPD) and tooth apex enostosis. (Fig. 14-15)

MAXILLARY OSTEOMYELITIS

Osteomyelitis is an acute or chronic inflammatory process that can involve cortical and trabecular aspects of bone or bone marrow. Cranial bones are infrequently involved, but spreading of inflammation with involvement of surrounding structures represent important risk, as are cerebral abscess, encephalitis, or meningitis.

Osteomyelitis of the maxilla is a rare condition. In the pre-antibiotic era patients died of meningitis, brain abscess, cavernous-sinus thrombosis or septicaemia; or they survived with gross deformities and bony sequestra. We can classify them according to their origin in:

Traumatic: following injury or surgery. The primary site of infection may be the antrum, teeth or mouth, or lacrimal sac.

Rhinogenic: spontaneous spread of infection from the antrum is rare.

Odontogenic: at any age dental-root sepsis may progress to osteomyelitis.

Infection is more likely to occur in the spongy bone of the alveolar arch than in the relatively hard, compact bony walls of the antrum.

Osteomyelitis of the mandible may present radiographically as suppurative osteomyelitis, sclerosing (chronic) osteomyelitis, or osteomyelitis with periostitis, and as osteoradionecrosis.

Acute suppurative osteomyelitis runs a very acute course, associated with fever and other constitutional reactions. In the first 8-10 days, plain radiographs may be negative for abnormal findings. Later, radiolucent areas will appear. Bone scintigraphy, MR and CT imaging may detect the early stage of the disease.
Sclerosing osteomyelitis of the mandible is a predominantly proliferative reaction of bone to low grade infection. The process may be focal or diffuse. The focal type may be known as periapical osteitis resulting in a periapical scleroting bone. The chronic diffuse type causes thickening of the cortical outline and sclerosis of the marrow spaces.

Osteomyelitis with periostitis is a variant of osteomyelitis in which a periosteal reaction predominates, leading to subperiosteal deposition of new bone.

Osteoradionecrosis, which occurs following high-dose irradiation of the bone, is characterized by a chronic, painful necrosis accompanied by late sequestration and permanent bone deformity. The OPT or CT scans may show multiple radiolucent areas or a moth-eaten appearance of involved bone. (Fig. 16-17-18)
Fig. 0: Nasopalatine duct cyst in a 54 year old man. Axial CT image shows a large boneless area in the left maxillary incisor-canine region (diameters: 15 mm x 12,5 mm).

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**Fig. 0:** Dentascan reconstructions reveal that the lesion causes an interruption of the palatal cortex, reducing the thickness of the vestibular cortex. The cyst englobes the nasopalatine duct and the roots of the contiguous teeth.

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Fig. 0: VR reconstructions reveal that the lesion causes an interruption of the palatal cortex, reducing the thickness of the vestibular cortex. The cyst englobes the nasopalatine duct and the roots of the contiguous teeth.

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**Fig. 0:** Radicular cyst in a 15 year old boy. CT scan axial image reveals a boneless area surrounding the root apices of the superior right incisors, contiguous with the nasopalatine foramen. This cystic lesion, with a maximum diameter of 11 mm, reduces the thickness interrupting the vestibular cortical bone.

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**Fig. 0:** Radicular cyst in a 15 year old boy. 3D VR reconstruction reveals a boneless area surrounding the root apices of the superior right incisors, contiguous with the nasopalatine foramen.

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**Fig. 0:** Dentascan reconstruction image reveals a boneless area surrounding the root apices of the superior right incisors, contiguous with the nasopalatine foramen.

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Fig. 0: Dentascan parasagittal reconstructions reveal a boneless area surrounding the root apices of the superior right incisors, contiguous with the nasopalatine foramen. This cystic lesion, reduces the thickness interrupting the vestibular cortical bone.

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Fig. 0: Ameloblastoma in a 10-year old boy. CT axial image shows an asymmetry in the right mandibular side with the involvement of adjacent soft tissues.

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Fig. 0: 3D VR reconstruction shows in the molar-ramus region a large multilocular boneless area. This disomogeneous lesion (maximum diameter 40 mm) alterates the internal bone structure which appears rarefacted and with "bubble-soap" septa.

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**Fig. 0**: In Dentascan parasagittal reconstructions we can observe that the lesion reduces the cortical thickness, swallowing the bone on both vestibular and lingual side, englobing the mandibular canal.

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**Fig. 0:** Apical granuloma in a 20 year old man with palatoschisis. Dentascan reconstructions show a large boneless periapical area (maximum diameter 15.5 mm) in the left median incisor region, above the nasopalatine duct, interrupting the cortical bone of the contiguous nasal cavity.

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**Fig. 0:** VR reconstructions show a large boneless periapical area in the left median incisor region, above the nasopalatine duct, interrupting the cortical bone of the contiguous nasal cavity.

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**Fig. 0:** Mandibular osteomyelitis in a 75 year old woman. Axial CT image shows a large osteolytic area in the left mandibular ramus (maximum diameter 23 mm), interrupting the lingual cortex.

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Fig. 0: VR reconstruction reveals intralesional bone sequestration with interruption of the occlusal, vestibular and lingual bone cortex.

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**Fig. 0:** Dentascan reconstructions reveal intralesional bone sequestration with interruption of the occlusal, vestibular and lingual bone cortex.

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Conclusion

Osteolytic lesions of the jaw represent a spectrum of frequent alterations, deserving clinical ad surgical attention. MSCT gives important informations to the maxillofacial surgeon in the choice of a conservative or a surgical treatment, of the operative planning and of the rightest access way depending on the lesions typology and on the presence of complicantions.
References


