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# Radiologic Evaluation, Principles of Management, Treatment Modalities and Complications of Orofacial Infections

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## 1. Introduction

### 1.1 Radiological evaluation of orofacial infection

- Intraoral x-rays

Periapical view is useful to show the affected tooth/teeth crown, root apex in cases of caries, fracture, impaction and periodontitis

Occlusal view is useful to show any stone in the submandibular salivary gland which may cause an ascending infection in the gland and later spread to the soft tissue space

- Plain soft tissue x-rays of the skull, jaws and neck are useful to see expansions in the soft tissue spaces in the head and neck region.

Also plain hard tissue x-rays such as the tangential Posterior-anterior view can show calculi in the parotid duct

Conventional posterior-anterior, oblique laterals are useful to show mixed osteolytic changes (radiolucencies) and new bone formation (radioopacities) in chronic osteomyelitis of the mandible; which is the classical moth eaten appearance.

For the maxilla, occipitomental and true lateral views are useful.

However, a single view of orthopantomogram (panorex) is useful for both mandible and maxilla

- Chest x-rays
- Computerized tomographic scan is mainly useful for bone lesions as in osteomyelitis giving reduced CT no. in areas of bone destruction and close to normal CT no. in areas of bone formation. Fluids, abscesses and exudates gives varying opacities and lucencies with CT no. more than that of water (0) and cerebrospinal fluid (7) but less than fat (100) and bone (1000).

## 1.2 Types of CT scans

1. Traditional or single slice CT scan- produces single slice of images from the data obtained from detectors in the gantry. The patient's table must be turned to allow another 360 degrees revolution for a second slice of 3mm or less to be made.
  2. Spiral CT scan- Allows simultaneous movement of table and x-ray tube; has a single row of detectors which produces volumetric data set and allows reconstruction of multiple slices of images obtained in a single revolution. The images can also be reformatted and viewed in multiple planes with the Pictural archival communication system. Also has the advantage of less artifact due to swallowing because a single breathe hold is utilized, gives better vascular opacification and small contrast bolus is needed to enhance lesions.
  3. Multi-detector CT scan- has a matrix of detectors which sends volumetric data sets to produce multiple slices of images in more than the three planes at one revolution thereby increasing the speed of imaging.
  4. New Tom CT scan (Schick, NIM, S.r.l., Verona, Italy) produces axial panoramic images and 3D data set for multiplanar images. It is a cone-beam CT scan which apart from the 3D dimensional imaging produced, also exposes patients to less radiations, but not useful for inflammatory swellings.
  5. Contrast enhanced CT. scan- Contrast is introduced to enhance imaging of soft tissue space infections.
- Magnetic resonance imaging clearly demarcates the exudates accumulation and expansions within the soft tissue compartments. In the T2 weighted sequence image, soft tissue space swellings appear more opaque than the soft tissues while the bones appear dark.



Fig. 1. Shows CT scan demonstrating a retropharyngeal abscess; excerpt from [anaerobicinfections.blogspot.com](http://anaerobicinfections.blogspot.com)

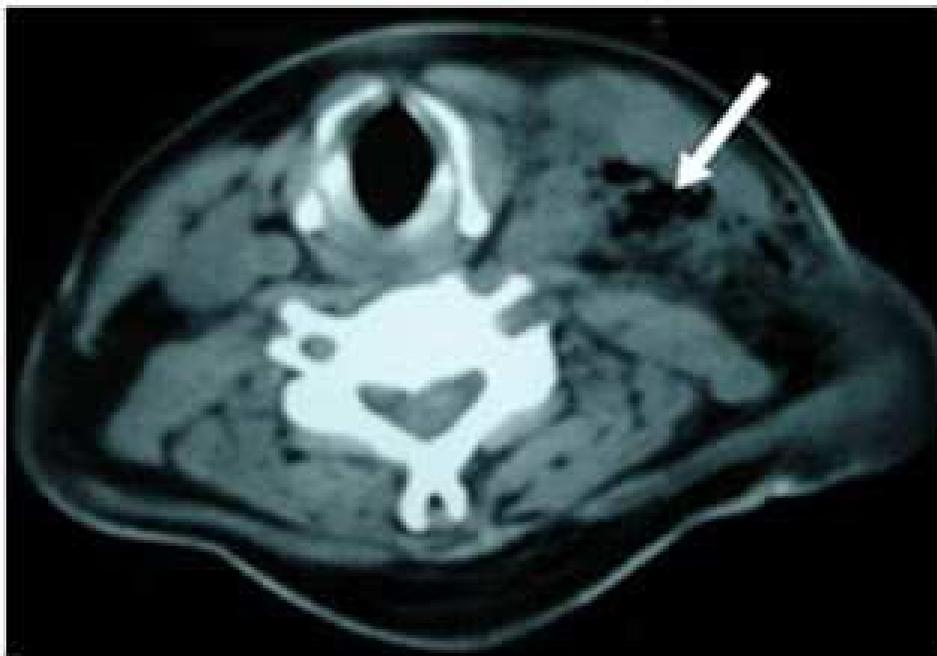


Fig. 2. Shows CT scan demonstrating a collection of gas filled abscess in the neck; excerpt from anaerobicinfections.blogspot.com



Fig. 3. Shows Contrast enhanced CT scan demonstrating a sublingual space abscess

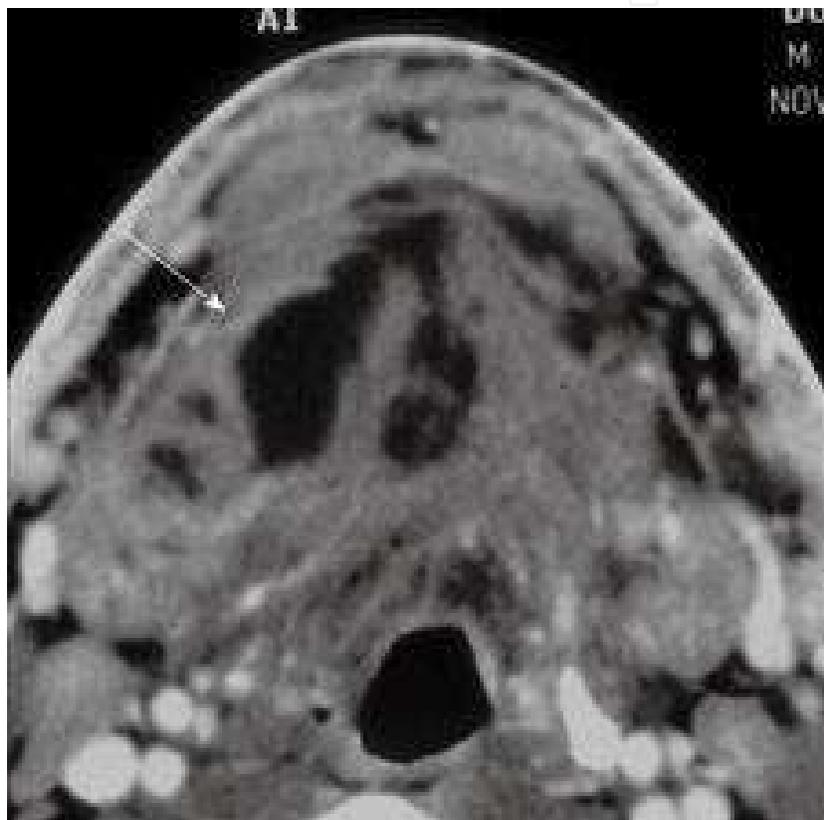


Fig. 4. Shows Contrast enhanced CT scan demonstrating left parapharyngeal space abscess excerpt from [abcradiology.blogspot.com](http://abcradiology.blogspot.com)



Fig. 5. Shows Contrast enhanced CT scan demonstrating a left buccal space abscess

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Fig. 6. Shows Contrast enhanced CT scan demonstrating multiple abscess in Ludwig's angina; excerpt from [abcradiology.blogspot.com](http://abcradiology.blogspot.com)

- Ultrasound scan is also useful for superficial soft tissue imaging with probes of high frequencies of 7.5Mhz and above
- Scintiscanning is very useful to ascertain the presence of exudates within bone especially in the early phase as well as in the established phase of acute osteomyelitis, producing high signals in the spectrum of that of inflammations. X-rays and CT scans may not be very useful in acute osteomyelitis to demonstrate early bone changes.

Soft tissues and exudates are best evaluated using contrast medium, therefore the best imaging technique is contrast CT-scan. The soft tissues, spaces and exudates appear radioopaque on contrast CT scans. Moreover, CT scan is cheaper, readily available and has no electromagnetic effects on patients with metallic implants compared to MRI and most patients do not react to the contrast medium (Gadolinium) which is injected into the body via intravenous route before the scan. Pre-operative and post-operative evaluation of the lesions/swellings by these imaging modalities not only assist in the diagnosis but also serve as a guide in the treatment and monitoring of progress. Incision and decompression, sequestrectomies are now being done under ultrasonic and CT guidance.

## 2. Principles of treatment and treatment modalities of orofacial infection

Thorough evaluation of the patients with these infections, elimination of local factors and control of systemic diseases contribute to the successful management and good outcome. Effective decompression, choice and dosages of antibiotics, compliance of patients are measures necessary to combat these problems with a view to reducing the morbidity and mortality.

The spread of the infections in patients with periapical periodontitis and dentoalveolar abscess who present early to the hospital is better curtailed with empirical broad spectrum oral antibiotics within five days to 1 week.

- Capsule amoxicillin 500mg or amoxicillin/clavulanate and
- Tablet metronidazole 400mg 8hrly
- Analgesic tablet paracetamol or ibuprofen

For infections that have spread to the potential spaces;

- It is better to admit;
- Commence empirical intravenous antibiotics,

No gold standard for antibiotic regime, based on the polymicrobial etiologic nature of odontogenic infections, patients can be given

- intravenous metronidazole 500mg/100ml 8hrly for 72hrs
- with intravenous broad spectrum antibiotic amoxicillin/clavulanate or ceftriaxone commenced before the outcome of the m/c/s results.

Parenteral Analgesics;

- either paracetamol or
- selective cyclo-oxygenase enzyme inhibitor, non-steroidal anti-inflammatory drugs; celecoxib or
- non-selective, diclofenac with misoprostol to protect the gastric/duodenal wall.

Rehydrate with intravenous fluids, Dextrose saline 5% alternate with Normal saline 0.9% 1 liter 8hrly for 72hrs, fluid control however should be depend on degree of dehydration, renal status, input/output chart. An average output of 1-2mls per minute per kg body weight must be maintained.

### 3. Principles of drainage

Drain abscesses both intraorally or extraorally depending on the site.

Drainage may be done under conscious sedation or general anaesthesia depending on the extent of spread, airway obstruction, patients' cooperation and availability of facilities and necessary skills

For cases to be done under G.A, orotracheal or fiberoptic intubation without muscle relaxants is preferred to prevent further compromise of the airway. Both forms of intubation can enhance quicker access or visibility into the airway than nasotracheal.

If there is airway obstruction, cricothyrostomy or tracheostomy may be necessary.

#### 3.1 Procedure

1. Make about 1.5 – 2cm skin incision in the most dependent fluctuant site/sites on the swelling to aid drainage under gravity where possible.
  2. Blunt dissection into the swelling, the swelling is entered with the sinus forceps closed and then opened and moved in different directions to break multiple loci of pus, drainage is aided with digital pressure, suction and can be guided by radiologic or endoscopic imaging
  3. After satisfactory decompression of exudates, sinus forceps should be removed with the beaks wide open to avoid gripping of any vital tissue.
- For submandibular and Ludwig's abscesses, the first layer is skin followed by the subcutaneous tissue and platysma muscle within it, then the outer part of the investing layer of deep cervical fascia before entering into the submandibular space which is below the inner part of the investing layer. Further dissection through the inner part and mylo-hyoid muscle which forms the floor of the mouth allows access into the sublingual space which is below the oral mucosa. Dissections should be along same line and at least 3cm away from the lower border of the mandible to avoid the salivary glands. At least 3 interrupted incisions are made for ludwig's angina.
  - For submasseteric abscesses, approach can be transoral (intraoral) or via the neck (extraoral) or both. Extraoral can be retromandibular- this also allow drainage of intermuscular planes easily without going through masseter muscle but continuous drainage is not aided by gravity and extra care must be taken to protect the retromandibular vein, external carotid artery, and facial nerve. The submandibular offers access below the angle of the mandible avoiding those structures and drainage under gravity is better but dissection is through the muscle. Intraoral dissection may be added to facilitate drainage and incision is made on mucosa along the anterior border of the ramus of mandible, sinus forceps is inserted into the space lateral to the ramus and medial to masseter
  - For pterygomandibular space, same intraoral incision at same site allows penetration into the space, which is medial to the ramus and lateral to the medial pterygoid.

- For lateral pharyngeal space, same incision, also allow forceps into the space lateral to the superior constrictor and medial to the medial pterygoid.
- For infratemporal space, the incision is extended higher to the coronoid process, the forceps penetrates medial to the attachment of the temporalis muscle and below the lateral pterygoid muscle. Care must be taken to avoid the internal maxillary vessels, mandibular nerve/branches and pterygoid plexus.
- For peritonsillar space abscess (Quinsy), incision is made into the mucosa in the tonsillar bed anterior to the tonsils, quick suctioning of the exudates must be done to avoid aspirations.

By the second day of admission, when the patient is fairly stable,

- Extractions of the causal tooth/teeth should be done and
- Commence jaw exercises with mouth gag to continue daily with wooden spatula- this will improve the mouth opening and aid the drainage of exudate.

By the end of the third day or beginning of fourth day, Empirical antibiotic given needed to be changed after the arrival of the m/c/s result if response is not satisfactory. Patients with spreading soft tissue space infections and bone infections have to be admitted for about two to three weeks.

#### 4. Treatment modalities of osteomyelitis

All cases of suppurative osteomyelitis must be admitted.

Those with acute suppurative osteomyelitis are to commence on fluids and intramuscular analgesics and empirical antibiotics while waiting for M/C/S result.

Intravenous Sparxfloxacin 200mg 12 hrly for 72hrs with lincomycin 500mg 8hrly or clindamycin 300mg 12hrly for 4 weeks. If symptoms of necrotizing colitis start, the macrolides should be stopped.

Those with chronic suppurative osteomyelitis must wait for M/C/S result before given antibiotic-no need for empirical antibiotics

Also indicated for chronic osteomyelitis is

1. sequestrectomy and
2. excision of the sinus tracts.

##### 4.1 Focal sclerosing osteomyelitis

May not need any intervention but if there is persistent pain or superimposed infection,

- Extraction of tooth/teeth
- Excision of sclerotic bone, place autograft or allograft bone material if necessary
- Antibiotic coverage

##### 4.2 Chronic sclerosing osteomyelitis

There have been controversies over the origin and aetiology of diffuse sclerosing osteomyelitis. Some authors believe that it is due to organisms like *propionibacterium acne* and

*peptostreptococcus intermedius* found in the deep pockets associated with generalized periodontitis. Others believe that it may be part of a bone, joint and skin {SAPHO; synovitis, acne, pustulosis, hyperostosis and osteitis} syndrome probably due to allergic or autoimmune reaction in the periosteum<sup>7</sup>.

Based on this fact, it has been found that

- Corticosteroids or high doses of potent NSAIDs and biphosphonates have been useful in its management;
- With or without prolonged antibiotic therapy and
- Decortications as well as thorough
- Periodontal tissue management with
- Oral hygiene instructions.

#### 4.3 Refractory osteomyelitis

In refractory cases, not responsive to the above treatment, resection of that part of bone involved and reconstruction with bone grafts with or without alloplastic bone substitutes and reconstruction plates will be indicated

- Occasionally, hyperbaric oxygen daily for 1 month may also be required.

The average period of antibiotic coverage for the patients with soft tissue space infections and dentoalveolar abscess ranged between 5 to 14 days while that for osteomyelitis was between 4 to 6 weeks. The latest broad spectrum antibiotics now used in the treatment of orofacial infections are the fourth generation cephalosporins (Cefepime) and the Imipenems/ cilastin derivatives (Bacure). Both are exceptional in the treatment of beta lactamase producing organisms.

### 5. Complications of orofacial infections

#### 5.1 Early complications

1. Regional and distant spread (abscess in any part of the body)-

Spread of odontogenic infections accounts for up to 57 % of deep neck abscesses (Mihos et al., 2004). With the potential for infection spreading to the interpleural space and mediastinal tissue, the mortality rate of mediastinitis continues to be 17-50 % despite aggressive use of antibiotics and advances in intensive care facilities (Marty-Ane et al., 1999).

- Additional incisions below the swellings have to be made for patients whose infection had spread to the neck and chest wall, to allow for drainage
  - For spread into the thorax, a chest tube will be needed at the seventh intercostal space mid-axillary line or a thoracotomy when there is organisation and consolidation
  - Paracentesis/laparotomy for abdominal/pelvic abscesses
  - Orbital decompression will be needed for spreading retrobulbar abscess
  - Cranial burr holes/craniotomy for intracranial abscess
2. **Septicemia and Toxic shock syndrome**- recognized by high temperature, pallor, jaundice, increasing respiratory and pulse rate with reducing blood pressure. Massive

and aggressive intravenous antibiotics, intravenous fluids and diet (hyperalimentation), hyperbaric oxygen and ozone therapy application may be useful but with the risk of pulmonary toxicity.

3. Necrotizing fasciitis marked by erythema, blistering and denudation/loss of skin, subcutaneous tissue, deep fascia and muscle due to devitalization- Excision of devitalized tissue and repetitive debridement must be done combined with intravenous antibiotics and antiseptic dressings. High protein diet and fluid intake as well as control of systemic factors are vital. Biotherapy with honey and larvatherapy are also applicable.
4. **Disseminated intravascular coagulopathy** marked by blood coming out from all orifices in the body; Blood, fresh frozen plasma, cryoprecipitate and factor VIII and platelet concentrate must be given.
5. **Cavernose sinus thrombosis** marked by severe headache, vomiting, high temperature, redness, proptosis and painful swelling of the eyeball/lid and prominent conjunctival and sclera vessels- Massive and aggressive intravenous antibiotics with anti-inflammatory analgesics must be given, subcutaneous low dose heparin, intravenous fluids and diet
6. Chronic suppurative otitis media and mastoiditis
7. **Stroke (embolic)**- Appropriate consult.
8. **Death** - Death usually occurs due to sepsis and multi-organ failure although airway occlusion is also a significant complication and requires early management by tracheostomy. Host factors affected by the patient's general health condition play a significant role.

## 5.2 Late complications

1. Ankylosis of the temporomandibular joint
2. Myositis ossificans and
3. Subperiostitis osteomyelitis- the last two is common with improperly treated submassetric abscess
4. Bone destruction and facial deformities
5. Blindness and deafness.

In the study of Akinbami et al., hospitalized patients were rehydrated with intravenous fluids, 5% dextrose/saline alternate with 0.9% normal saline 1litre 8hrly for 72 hrs. Dextrose fluid was avoided in patients treated for diabetics. 10 I.U of subcutaneous insulin (humulin) 4hrly was commenced for patients with diabetes mellitus and physicians were consulted to continue management. The mortality figure was 11.8%. In most studies reviewed, caries was the most predominant local factor, while diabetic mellitus and malnutrition were commonest systemic diseases.

## 6. Conclusion

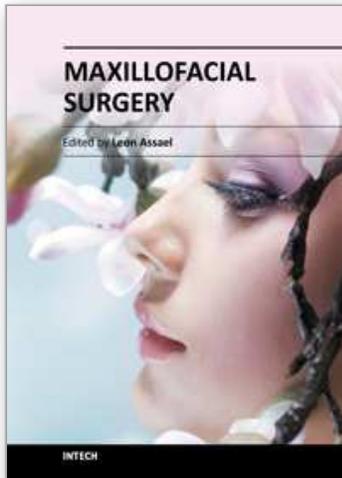
Control of systemic factors/diseases is a vital and integral component in the management of these patients with orofacial infections, therefore holistic approach must be adopted to ensure recovery and reduce mortality.

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