Abstract
Dental and Medical practitioners as well as specialists in medicine and dentistry are often faced with the challenge of managing patients with infections. These infections can range in their severity from those that may only require antibiotic therapy to those that may require aggressive surgical intervention.

Oral and maxillofacial infections, in particular, have the tendency to spread rapidly along fascial planes and if left untreated they may lead to highly morbid clinical conditions with severe complications that may ultimately lead to death.

Careful diagnosis and sound clinical judgment have the potential to reduce morbidity associated with odontogenic infections. The success of these treatments are, in part, dependent on the virulence of the pathogen involved, the resistance of the host and strict adherence to sound medical, pharmacological and surgical principles.

An overview of the principles of antibiotic therapy, diagnostic laboratory and imaging studies and the principles of surgical management will be presented.

Introduction
Infections are complex processes which are multi-factorial in nature. They are caused by micro-organisms that could involve bacteria, fungi, viruses, virus-like microorganisms and protozoa. A few micro-organisms that cause odontogenic infections are an intricate normal component of the host and are responsible for infections when the immune system of the body is compromised. Patients presenting with different systemic disease conditions such as diabetes, vascular disease, cancer and infections as human immunodeficiency virus have increased chances of developing an infection.
Classification of Infections
In general, infections in the maxillofacial region are classified as either odontogenic whose primary cause is dental in origin or non-odontogenic. Examples of odontogenic infections are periodontal and periapical infections. Examples of non-odontogenic infections include systemic infections with oral manifestations. Occasionally, infections could develop following an anesthetic injection or a surgical procedure.

Dentists and dental specialists, deal primarily with infections that develop secondary to a carious dentition which is the most common cause of odontogenic infections. Caries could lead to pulpits, periapical abscesses, periodontitis, periodontal abscesses and pericoronitis.

Non-odontogenic infections in the maxillofacial region are related to infections of nearby structures such as the maxillary sinus, ear infections and other areas of the maxillofacial complex. However, sinus infections for example may develop primarily or secondary to an odontogenic infection.

Mechanism of Infections
The predisposition of an infection is related to an interruption of the fine balance between the host, the micro-organism and the environment. This imbalance, in turn, may lead to the multiplication of micro-organisms followed by invasion of different structures. The severity of infection is related to the number and virulence of micro-organisms and resistance of the host.

In general, the majority of odontogenic infections are caused by bacteria. Bacteria are classified as cocci or bacilli based on their shape and further classified into gram-positive or negative based on their staining characteristics or to their oxygen requirements into aerobic or anaerobic.

The bacteria that predominate aerobically in odontogenic infections belong primarily to the streptococcal species (aerobic) species and to a limited degree by staphylococci. The anaerobic micro-organisms mostly involved in odontogenic infections are peptostreptococci, bacteroides and fusobacterium.

Most of the odontogenic infections are mixed in nature involving a combination of the above named genera.

Fascial spaces and spread of infection
Propagation of odontogenic infections are related to many factors including the position of the roots within the alveolus, the position of muscle attachments, the potential spaces between muscles and the true fascial spaces. The true facial spaces are natural anatomic spaces in the maxillofacial region that are connected to each other and form natural channels through which infections could spread. These spaces could be superficial or deep. Examples of superficial spaces would be the infraorbital space, the vestibular space and the buccal space. Deeper spaces would be those associated with the muscles of mastication, submandibular, pretracheal, lateral and retro-pharyngeal spaces (Fig-1).

In general, the preliminary spread of an infection is localized to the area adjacent to the teeth involved. However, if not treated promptly, infections would rapidly spread into the potential fascial spaces. Maxillary and mandibular bicuspids and molars infections spread into the buccal space whereas maxillary canine infections spread into the canine space or infraorbital space and the orbit. Infections associated with mandibular molars spread into the submandibular space whereas those associated with mandibular canines and incisors spread into the submental space. Mandibular premolars and molars associated infections spread into the sublingual space. Infections associated with lower third molars especially impacted ones spread into the submasseteric, submandibular, lateral pharyngeal and pterygomandibular space. Upper molars infections might spread into the infra-temporal space.

Clinical Examination, Signs and Symptoms
The signs and symptoms of infection exhibited range over a wide spectrum such as pain, edema, erythema, limited function, malaise and lethargy.
These signs and symptoms could be recognized locally, regionally or systematically.

The clinical examination should focus on the general status of the patient such as lethargy or presentation of extreme sickness. Fever, extraoral and intraoral swelling, erythema, tenderness to palpation should be noted. Trismus in addition to any changes in the voice such as hoarseness and drooling should prompt the dentist to an emergency situation.

Urgent attention is required for patients who present with hard cellulitic presentation in the neck bilaterally especially if associated with an elevation of the tongue. These symptoms are classical symptoms for Ludwig’s angina which requires immediate attention.

**Diagnostic Tests**

Patients presenting with an odontogenic infection will require a panoramic radiograph taken to localize the source(s) of infection. In cases of extensive infections, computed tomographic imaging is required to localize areas of deep abscesses and the extent of spread of infection. Additional blood investigations including a complete blood count may be required. If pus could be expressed intra-orally or extraorally, samples should be collected and sent for bacteriological analysis including aerobic and anaerobic culture and sensitivity (Fig-2). Other tests could be performed as necessary.

**Management of Odontogenic Infections**

The management of odontogenic infections aims at the localization of the infection using heat, microbial destruction using antibiotics, microbial elimination using incision and drainage and treatment of symptoms using supportive care.

In addition, dealing with the critical problem at the time of presentation is necessary especially in the case of an airway compromise which requires emergency procedures to maintain the airway.

The antibiotics of choice would be those that cover the most likely causative microorganisms. If the infection is very recent and there is no abscess, a penicillin based antibiotic is usually sufficient.

If the infection has been active for few days, a combination of a penicillin-based antibiotic and metronidazole would be the ideal choice or clindamycin has also proved to be effective. These antibiotics would cover the most common aerobic and anaerobic microorganisms. The antibiotics could be given intra-orally or intravenously depending on the severity of the disease. It is also imperative to get rid of the source of infection. In case of an extra-oral communication, a first-generation cephalosporin would be required to cover staphylococci.

If there is an abscess, drainage becomes necessary and depending on how extensive an infection is, Penrose drains should be placed and secured in place using non-resorbable sutures (Fig-3&4). Drains are usually kept in place until drainage is minimal. The purpose of drainage is to remove bacteria, decompress the space and alter oxygen tension.

It is extremely important to administer the antibiotics at the appropriate dose and the appropriate duration for them to be effective. Otherwise, resistance to antibiotics may occur and spread of infection would continue to develop.

**Complications of Odontogenic Infections**

Odontogenic infections, left untreated, could lead to serious consequences leading to death. Maxillary infections have the potential to spread into the orbital or temporal area and may cause cavernous sinus thrombosis, a condition that is very severe in nature and that require immediate attention. Mandibular infections on the other hand have the potential to spread into deep spaces of the neck and the chest leading to mediastinitis and airway compromise in addition to the spread of the infection into the carotid sheath area that is comprised of the carotid artery, jugular vein and vagus nerve.

**Referral Guidelines**

Patients who appear very sick, are suspected to have a fascial space involved, are immuno-compromised, or who develop a rapidly spreading infection should be referred promptly to a maxillofacial surgeon. Any patient presenting with voice changes, lethargy, facial or submandibular edema, elevated tongue, difficulty breathing, difficulty swallowing, drooling or limited
opening should be referred to a hospital as soon as possible to be seen by a specialist in maxillofacial surgery.

Summary
An overview of odontogenic infections was presented including an overview of management and guidelines for referral. Odontogenic infections should be taken seriously when they occur. An understanding of the dentist’s limitations is important in order to ensure the safety and well-being of patients presenting with odontogenic infections.

References

Author: Hani A. Salam
(BSc, MSc, DDS, PhD)OMFSA
Oral & Maxillofacial Surgeon
haniomfs@yahoo.com