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An Insight in the Microbiological Aspects and Management of Orofacial Infection- an Overview

KEYWORDS: Orofacial infection, odontogenic infection, dental abscess

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ABSTRACT *In dental sciences dental practitioners as well as specialists are often facing up many problems in managing patients with infections. These infections can range in their severity from those that either require only antibiotic therapy or aggressive surgical intervention. Oral and Maxillofacial infections have the tendency to spread rapidly along facial planes and lead to highly morbid clinical conditions if left untreated with severe complications that may ultimately lead to death. Careful diagnosis and sound clinical judgment have the ability to decrease morbidity associated with orofacial odontogenic infections. The victory of treatment depends upon the virulence of pathogen involved, the resistance of the host and strict observance to follow medical, pharmacological and surgical principles. An overview of orofacial odontogenic infection microbiology, mechanism and spread of infection along with its management is presented in this article.*

INTRODUCTION

Most human orofacial infections originate from odontogenic infections and are the most frequently encountered by oral and maxillofacial surgeons [1]. In the majority of patients these infections resolve either by spontaneous drainage through the mucosa, gingival tissues (intra oral) or by drainage through the skin (extra oral). Low grade infection resolves only with antibiotic therapy but in severe cases removal of offending tooth results in quick resolution of the infection. These minor tooth related infections may occasionally or unfortunately become serious and life threatening but over past few decades it has been observed that early management is required to prevent or minimize the development of potentially serious complications [2]. Odontogenic infections have two major origins: periapical origin, results as of pulpal necrosis along with subsequent bacterial invasion in periapical tissue and periodontal origin as a result of deep periodontal pocket that allows inoculation of bacteria into the underlying soft tissues. Consequently these infections culminate into odontogenic abscess. Necrosis of the dental pulp as a result of deep caries allows a pathway for bacteria to enter periapical tissues. Once normal oral flora become pathogenic they can cause local and disseminated complications including pleuropulmonary infection, septicemia, sinusitis, bacterial endocarditis, brain abscess and many more.

Suppuration or purulent inflammation is characterized by the production of purulent exudates (pus) consisting of neutrophils, necrotic cells and edema fluid. They are produced by deep seeding of pyogenic bacteria into a tissue. Staphylococci produce this localized suppuration and thus referred as pyogenic or pus producing bacteria [3].Surgical drainage of any discernible pus collection is the primary therapeutic modality for odontogenic infections, followed by endodontic therapy or extraction of the responsible tooth [4, 5]. Other diseases including acute periapical abscess, periodontal abscess, pericoronitis and deep facial space infections may require antimicrobial therapy. However, by initiated antimicrobial therapy soon after diagnosis and before surgery may help to shorten the period of infection and minimized associated risks [6], but never be used as a replacement for appropriate surgical drainage and should only used as a adjunctive therapy[7, 8].

Microbiology of odontgenic infections

Odontogenic infections are always polymicrobial and are a mix of aerobic, facultative and strict anaerobes. *Streptococcus viridians* are the most common microorganism in dentoalveolar infection [9, 10]. There is consensus in most of the studies that the bacteria most commonly found in odontogenic infections are *Streptococci* which are aerobes and *peptostreptococci*, pigmented and non-pigmented *prevotella* and *fusobacterium* are anaerobes. Many investigations have demonstrated that *Viridans streptococci*, *Peptostreptococcus*, *Prevotella*, *Porphyromonas* and *Fusobacterium* are the organisms which are frequently isolated from orofacial odontogenic infection [11, 12, 13, 14].

The pathogenic microbiota of the oral cavity is complex and fluctuates with age, diseases, conditions and site of resistance. Study indicates that the pathogenesis of odontogenic infections depends on the relationship between anaerobic and aerobic bacteria within the infection. The majority of infections consist of mixed aerobic and anaerobic flora (65% to 67%) or exclusively anaerobic (25% to 28%) whereas only 5% are exclusively aerobic **(Figure 1 A)**. Other organisms like fungi, virus as etiologic factors for abscess are rarely reported in literature [15]. In one of the study *Staphylococcus aureus* was isolated in total 24 cases (21.43%) and frequent isolation of *staphylococci* in pus exudates from odontogenic infections have been reported in some other studies too[16,17]. The isolation of *Pseudomonas* in 13 cases (11.60%) is high when compared

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to other studies [13]. The imprudent use of antibiotics in dentistry may be the reason for isolation of more percentage of drug resistant pathogen in this study. *Streptococcus pyogenes* have been isolated in 10.72% of the cases in this study. *Sakaguchi et al.* [18] reported 13.8% of *Streptococcus pyogenes* in his study [19, 20]. Other gram-negative bacilli like *Klebsiella*, *Proteus vulgaris* were also isolated and found similar results as other studies **(Figure 1 B)**. Based on the studies of various investigations, important possible conclusions can be drawn regarding the microbiology of odontogenic infections. Firstly, aerobic bacteria alone are rarely the cause for infection. Secondly, about half of the infections are caused by anaerobic bacteria only. Thirdly, in almost every patient, multiple organisms grow from the infection. In the mixed infections there is preponderance of anaerobic bacteria [21]

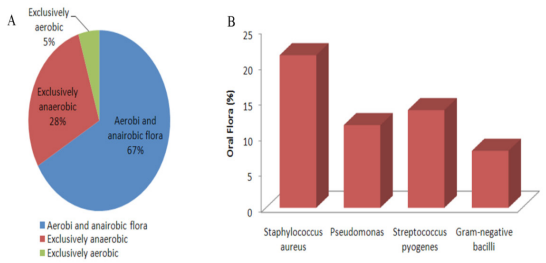

Figure 1 Microbiology of odontogenic infections, [A] The majority of infections consist of mixed aerobic and anaerobic flora, exclusively anaerobicand exclusively aerobic [B] Percentage of drug resistant pathogen.

Mechanism of orofacial infection

The tendency of an infection is related to an interruption of the fine balance between the host, micro-organism and the environment **(Figure 2)**. This imbalance in turn, may lead to the multiplication of organisms followed by invasion. The severity of infection is related to the number and virulence of micro-organisms and resistance of the host. According to Finegold [22] the organisms of greatest importance in mixed polymicrobial infections are those that are most virulent in comparison to those that are resistant to common antimicrobial agents as well as those which are present in higher numbers. Anaerobic bacteria appear to fulfill all these criteria in odontogenic infections. Anaerobes mainly *Streptococci* of viridans group [23, 24] and more fastidious pathogens such as *Eikenella corrodens* may be involved in a majority of patients [25, 26, 27]. There are three most important virulence factors in anaerobic bacteria [28, 29] i.e. the ability to survive the oxygen tension of the living tissues, the presence of cell surface constituents such as capsular polysaccharide or lipopolysaccharide endotoxin and the production of enzymes, toxins or other substances associated with tissue damage.

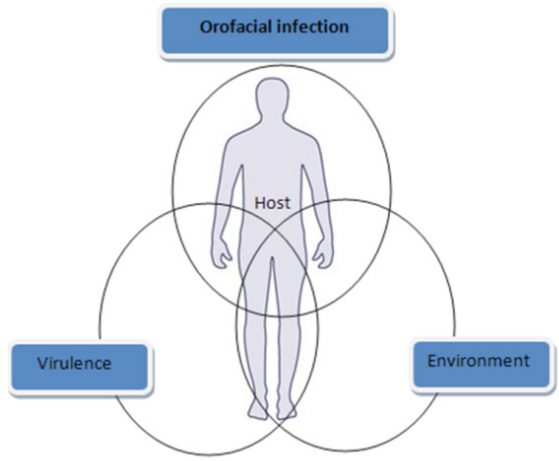

Figure 2 Mechanism of orofacial infection between the host, micro-organism and the environment. Severity of infection is related to the virulence of microorganisms and resistance of the host

Facial spaces and spread of infection

Most odontogenic infections arise as a consequence of pulp necrosis which is caused by caries or trauma. Periodontal infections, pericoronitis, trauma and surgery are other sources responsible for such orofacial infections. Patient with different presentations of odontogenic infections shown in **(Figure 3)** Studies have described the development of such infections in varying age groups ranging from 6 to 79 years [17]. Dissemination of odontogenic infections are related to many factors including the position of the roots within the alveolus, the position of muscle attachments and the potential spaces between muscles and the true facial 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 infection spreads out **(Table 1)**. These spaces could be superficial or deep. Dependent on the type, quantity and virulence of organisms they have capability to spread infection into the maxilla or mandible and then to the surrounding face, jaws or neck. Among many other cases of head and neck infections, odontogenic infections found as the most common one. Huang *et al.*, 2004[9] found 50% of 185 cases of deep neck infections were odontogenic in origin, 53% in their 107 cases [30], 89% in 121 cases [31], 86% in [32] and 14 are of true Ludwig's angina cases [10].

Figure 3 Patient with different presentations of odontogenic infections, [A] Odontogenic abscess, [B] Superficial. Right canine fossa and buccal space infection (Low airway

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risk), [C] Deep Right submandibular space abscess (patient is intubated), [D] Deep bilateral Ludwig's angina (patient is on multiple drains and Intubation)

Severity Score	Anatomic Space
Severity score =1 Low risk to airway or vital structures	Vestibular Subperiosteal Space of the body of the mandible Infraorbital Buccal
Severity score =2 Moderate risk to airway or vital structures	Submandibular Submental Sublingual Pterygomandibular Submasseteric Superficial temporal Deep temporal (or infratemporal)
Severity score =3 High risk to airway o r vital structures	Lateral pharyngeal Retropharyngeal Pretracheal Danger space (space 4) Mediastinum Intracranial infection

Table 1 Severity scores for severe odontogenic infections

Generally the preliminary spread of an infection is localized to the area adjacent to the teeth involved, however if not treated on time infection would rapidly spread into the potential facial spaces. The majority of the infections are seen to involve the mandibular teeth (57.60%) than the maxillary teeth (42.39%). The mandibular first molar (26%) was the most frequently involved tooth. Wang *et al*. (2005) [33] and Krishnan *et al*. (1993) [34] have also found that mandibular teeth were more involved in odontogenic infections. Obayashi *et al*. (2004) [35] stated that among the maxillary teeth, maxillary first molar was the common cause tooth of odontogenic infection. The maxillary first molar was involved in 18.47% of the cases only. It is found that there is some variation in the nomination of anatomic spaces, which may confuse the exact prevalence of affected spaces when compare to different studies [36]. Some of the dental and oral mucosal pain disorders arise from sources in the dental structuresor the mucosal tissues of the oral cavity.

Clinical examination, signs and symptoms

The signs and symptoms of infection remain same over a wide spectrum such as pain, edema, erythema, fever, trismus, dysphagia, swelling, limited function, malaise and lethargy [16,37,38,39]. These 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. Elevated body temperature is a common finding in acute infections and has also been recorded in odontogenic maxillofacial infection [16, 36] and it has been also linked to longer hospital stay.

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 along with symptomatic treatment with supportive care. The antibiotics of choice would be those that cover the most likely causative microorganisms in treatment of localized odontogenic abscesses [40] , although immunocompetant patients have been shown to receive no additional benefit from antibiotics in addition to surgical intervention [41,42]. Antibiotics have long-term effects on the microbiota, reducing richness and lowering the prevalence of commensal bacterial families [43]. In locally invasive odontogenic infections, antimicrobial therapy is justified, in contrast to localized abscesses. Antimicrobial therapy is selected empirically in acute situations [44]. At hospitals intravenous antibiotic regimes are preferred. Ampicillin or cefuroxime in combination with metronidazole are the first-line drugs of choice [45, 46]. Since antiquity severe odontogenic infections have been known as a serious illness or cause of death [47]. In the modern surgical but pre-antibiotic era odontogenic infections were associated with a significant death rate but with the subsequent developments of a range of antibiotics, this infection considered as easily managed conditions. However, in the last 10-15 years there has been a progressive return of serious antibiotic resistance [48].

Conclusions

Odontogenic infections are typically polymicrobial. A notable change in the last decade has seen in manner of odontogenic infection. The infection was far greater in the past, which demands quick recognition of disease followed by prompt treatment. It should be taken seriously when happened which if left untreated may result in disastrous outcomes. It appears to increase in cases where patient is prolonged neglect routine dental problems although sometimes unsuccessful dental treatment may also be reason. The appearance of resistance to antimicrobials has presented an urgent and challenged treatment. It is concluded that clinical updates provide guidance for selecting appropriate antimicrobial therapy against odontogenic conditions. This approach may help to enhance resolution of infection and make possible recovery.

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CONFLICTS OF INTEREST

It is ensured that there is no conflict of interest regarding the research work and to any of the data that are provided in the manuscript. This manuscript has not been previously published elsewhere and is not currently submitted to any other journals and will not be submitted elsewhere before a decision is obtained from this journal.

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