Management of the Oral Infection: Part 1
A Peer-Reviewed Publication
Written by Ian Shuman, DDS, MAGD, AFAAID

Abstract
This two-part course will review the management of the acute oral infection. Part one focuses on the essentials that must be considered when treating the dental infection including microbiology, triage, anatomy, and laboratory testing. It includes the surgical, antibiotic, and palliative actions needed in the treatment of the acute dental abscess. Part two will emphasize the treatment of oral infections due to fungal, viral, and bacterial organisms.

Educational Objectives
At the conclusion of this educational activity participants will be able to:
1. Describe the features of oral microbiology as they relate to oral infection.
2. Identify the clinical issues related to dental infection.
3. Describe the various strategies for treating the acute dental abscess.

Author Profile
Ian Shuman DDS, MAGD, AFAAID maintains a full-time general, reconstructive, and aesthetic dental practice in Pasadena, Maryland. Since 1995 Dr. Shuman has lectured and published on advanced, minimally invasive techniques. He has taught these procedures to thousands of dentists and developed many of the methods. Dr. Shuman has published numerous articles on topics including adhesive resin dentistry, minimally invasive restorative, cosmetic and implant dentistry. He is a Master of the Academy of General Dentistry, an Associate Fellow of the American Academy of Implant Dentistry, a Fellow of the Pierre Fauchard Academy. Dr. Shuman was named one of the Top Clinicians in Continuing Education since 2005, by Dentistry Today.

Author Disclosure
Dr. Shuman has no commercial ties with the sponsors or the providers of the unrestricted educational grant for this course.

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Scientific Integrity Statement: The information presented in this educational activity is derived from the data and information contained in reference section. The research data is extensive and provides direct benefit to the patient and improvements in oral health.

Registration: The cost of this CE course is $59.00 for 3 CE credits.

Cancellation/Refund Policy: Any participant who is not 100% satisfied with this course can request a full refund by contacting PennWell in writing.
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Introduction
The frequency of periapical abscess is supported by a volume of statistical proof. The results of a nine-year retrospective study (2000–2008) of hospital admissions showed that more than 61,000 hospitalizations in the United States were directly related to dental infection in the form of periapical abscess. Sixty-six patient deaths were attributed to these infections. Using the Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project, a 2007 study conducted by Allareddy et al, it was found that there were 7,886 hospitalizations for periapical abscess in the United States, amounting to total hospital costs of $105.8 million.

The Global Burden of Disease Study in 2010 showed that cleft lip/palate, edentulism, oral cancer, caries, and periodontal disease accounted for over 18 million disability-adjusted life years. Evaluation of the global burden of oral diseases such as caries, periodontal disease, and cancer showed a marked increase of 45.6% from 1990 to 2010, on par with major non-communicable diseases such as diabetes. Dentists are usually the first to see patients with early odontogenic infections. Therefore, it is vital that they be prepared to evaluate and treat problems before they become severe enough to demand hospitalization.

The complexities of oral infection
Enormous numbers of pathogenic bacteria, nonpathogenic bacteria, and fungal organisms naturally colonize the oral mucous membranes. Numerous transient and potentially infective organisms (e.g., viruses) can be present as well. Opportunistic microorganisms such as Escherichia coli, Streptococcus pneumoniae, Staphylococcus aureus, and Klebsiella pneumoniae can cause systemic versus oral disease.

With respect to oral hard tissue, multiple bacterial interactions exist within the diverse dental microenvironments and within each biofilm substrate. Biofilm is a combination of bacteria, extracellular DNA, protein, and polysaccharides that rapidly accumulate intraorally. If left undisturbed for several days, a biofilm may contain up to $10^{11}$ microorganisms/mL. In relation to this fact, oral hard tissue disease in the form of apical periodontal infection and marginal periodontitis has been associated with 200 to 500 bacterial species.

Bacterial interaction within a biofilm may either boost or suppress metabolic activity that leads to dental infection. Many factors regulate the number and types of oral bacteria within biofilm including the complexity of the flora, bacterial retention and interaction, native resistance, saliva, hygiene, and diet. For example, a carbohydrate-rich diet favors bacteria such as Streptococcus mutans, an organism that causes dental caries. Diet consistency is also important because coarser foods can help to eliminate lodged food particles and disrupt the biofilm that can support microorganisms. In addition, oral bacteria have regional preferences vis-à-vis tissue adherence; Streptococcus salivarius is found primarily on the tongue while S. mutans and Streptococcus sanguis typically adhere to hard surfaces.

The presence of systemic disease also influences the oral microbial population. Host defense mechanisms can be compromised by conditions such as diabetes, heart failure, chronic lung disease, lymphoproliferative disorders, renal failure, malnutrition and alcoholism, among others. This compromise of the immune function can lead to a reduction in phagocytic activity, pulmonary clearance and circulation, among others. Immunosuppressant medications that are cytotoxic also reduce host defense mechanisms and increase the risk of infection. Prolonged systemic antibiotic therapy reduces normal bacterial flora, resulting in the selection of resistant flora and/or the emergence of competing fungal organisms. Other factors associated with oral infection include age, behavioral considerations, drug abuse, the social environment, and the patient’s psychological status.

A further consideration is the concept of virulence. Virulence is a harmful quality possessed by microorganisms that can cause disease. It involves the invasive nature of the organism and the detrimental toxins and/or metabolic and enzymatic byproducts produced in the course of the infectious process. Infection involves the interactions of microbial populations, microbial virulence, and host defenses. Intraorally, host defenses are part of the mucosal immune system, an important factor in the prevention of oral and systemic infection. This system includes advantageous elements to protect the host against invading pathogens that include the resistance to tear and compression forces provided by the lamina propria. Colonization is minimized by cell shedding from the surface layer and by salivary secretion. Beside mechanical protection, chemical protection is present in the form of an elaborate immune system. One example is the production of lymphoid cells producing immunoglobulins. In addition, serum proteins such as histamine, prostaglandins and lymphokines are released as a result...
of inflammation. There are also cellular defenses dependent on receptors, phagocytes, and lymphocytes (e.g., B and T cells).13,14,15

**Triage**

The majority of acute oral infections are self-limiting and can be managed with minimal intervention. However, some types of oral infection can be associated with significant morbidity and mortality. The treating clinician must recognize the significance of the history and clinical signs. This information is vital in the diagnosis of the disease process and providing appropriate triage for the patient. For example, consider a patient who presents with pallor, reporting a rapidly increasing swelling under the jaw into the neck or superiorly into the eye (suggesting spread beyond the oral cavity). This coupled with other local and systemic symptoms such as difficulty breathing or swallowing, fever (with chills or cold sweats), a thready pulse with lethargy and/or altered consciousness, trismus, a changing pain quality (i.e., change of pain from a mild ache to a severe throb), and dehydration should be considered for urgent oral surgical or medical referral as these clinical signs and symptoms indicate systemic toxicity.

**Anatomic considerations**

A basic understanding of head and neck anatomy including the location of lymph nodes and fascial spaces is useful in determining the relative risk associated with infection. Lymph nodes that are tender, enlarged, indurated, or fixed suggest the presence of infection. Infection and swelling of the pterygomandibular, parapharyngeal (lateral pharyngeal and retropharyngeal), peritonsillar and cervical spaces, and the infratemporal or parotid space is considered high risk and necessitates urgent intervention.

Another potentially life threatening ailment is cellulitis. Cellulitis is a spreading bacterial infection just below the skin surface (i.e., the fascial planes) most commonly caused by *Streptococcus pyogenes* or *S. aureus*.16 Ludwig’s angina, a cellulitis-causing condition, arises from the oral cavity. This infection most commonly originates from an infected second or third mandibular molar tooth invading the submandibular space. This space consists of two compartments in the floor of the mouth, the sublingual space and the submylohyoid (figure 1). It is an aggressive, rapidly spreading cellulitis without lymphadenopathy and with the potential for airway obstruction. It requires careful monitoring and rapid intervention for prevention of asphyxia and aspiration pneumonia. Clinical signs include upward and backward displacement of the tongue and bilateral submandibular swelling extending inferiorly into the anterior neck to the clavicles and dysphagia.

Another example of an anatomic area of great importance in life-threatening infection is the infratemporal space (figure 2). Infection of the maxillary molars can invade the infratemporal space with a possible risk of spread to the orbit and ascension to the cavernous sinus via the venous plexus in the ovale and spinosum foramen.17

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**Figure 1: Ludwig’s Angina**

![Ludwig’s Angina](image1.png)

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**Figure 2: Infratemporal Space**

![Infratemporal Space](image2.png)
Laboratory considerations

Minor oral infections can be well managed empirically without culture if attention is paid to three important considerations: infection origin, involved anatomy and bacterium most likely involved. Most oral infections are odontogenic, superficial in nature, and in the majority of patients caused by Streptococcus bacteria. Infection by anaerobic bacteria such as Staphylococcus, Neisseria, and others can also occur, though with much less frequency.18,19

Infections that do not respond to routine antibiotic therapy require identification of the culprit microorganism(s) by way of laboratory evaluation. This provides the greatest precision in selecting appropriate antibiotic coverage. As a rule, a culture must be taken if (1) the infection has spread to one or more fascial planes of the head and neck, (2) initial antibiotic treatment has failed to contain the infection, (3) the patient’s underlying health is compromised by other conditions that affect immune response, and (4) the patient shows evidence of systemic toxicity.20

Of the various in-office examination techniques that should be considered in assessing infectious microorganisms, the Gram stain may be the most useful procedure as it provides immediate results and allows determination of the type and numbers of species involved.21 Techniques for assessing infected (purulent) oral material include pulp chamber access of an infected tooth with collection of the emerging pus, transmucosal aspiration, and tissue biopsy. Unless the treating clinician is competent with these in-office techniques, it is best to refer to a specialist for collection, further lab evaluation, and subsequent dental or medical treatment.

Managing the dental abscess

The dental abscess develops as a result of bacterial invasion of the pulp and ultimately, the alveolar bone. Therefore, the prevention of caries is still the best first line of defense against the development of the dental abscess. The other effective preventive measure against dental caries and dentoalveolar abscess is proper dental hygiene. This includes brushing teeth after meals and regular dental check-ups. ADA Dental Practice Parameters suggest that the dentist should utilize treatments designed to “reduce pulpal symptoms and/or protect the pulpal tissue of the tooth with pulptis.”22 The document recommends that management of the dental abscess should be considered as follows: nonsurgical approaches (e.g., antibiotics), chemotherapeutic modalities, dental restorations, endodontic therapy, tooth extraction and surgery.16 However, with any acute infection, prior to the initiation of an antibiotic, purulence must be eliminated via surgical drainage.

Incision and drainage

Drainage of odontogenic purulence can be accomplished through pulpal access, surgical incision, or tooth extraction. Surgical incision requires that the tissue is incised and spread with a hemostat followed by placement of a Penrose drain.23 A Penrose drain is a surgical device, typically a strip of latex or soft rubber tubing, placed inside a wound to drain fluid (figure 3). The drain is sutured into place with a patent opening, allowing fluids to drain from the infection site. In addition, the infected site can be decontaminated by irrigation with a saline solution (typically 60–100 ml) or chlorhexidine mixed with saline if necessary. The patient should be advised to: avoid touching the area after surgery, apply firm direct pressure for 30–60 minutes, use a moistened tea bag to control bleeding, avoid the application of ice, and not apply heat until three days have passed to avoid spread of the infection. The drain is removed as soon as drainage output is minimal or has ceased.

Figure 3:
Antibiotics

In most instances, antibiotics should only be prescribed for the dental abscess when the infection has spread beyond the radicular area, causing local involvement and/or systemic symptoms.\(^2\) Once the infection spreads beyond the radicular area, the involved bacteria typically include a combination of anaerobic and aerobic organisms. This change in bacterial composition is a complication that can significantly alter the relative virulence of the infection and complicate antibiotic selection. An important consideration when using antibiotics is microbial resistance.\(^25\) The best approach for curtailing resistance is to prescribe a high dose of antibiotic for as short a course as possible.

The choice of antibiotic is largely empirical because the science supporting the efficacy of one antibiotic or treatment regimen over another is presently not definitive. This is due to the confusion posed by a number of methodological problems associated with the published research. These include issues related to study design and choice of outcome measures.\(^26\) In general, penicillin is often the first drug of choice for dental infections. An article by Olsen and Winkelhoff describes acute oral infections that can spread extraorally, recommending penicillin (when suspicion of methicillin-resistant \(S.\) aureus is low).\(^27\)

Historically, antibiotic use has included the use of the penicillins, including penicillin \(V\) (table 1).\(^28,29\) Amoxicillin is favored as the drug of first choice due to its broad spectrum of action against many gram positive and negative bacteria.\(^30\) If there is a history of antimicrobial resistance, metronidazole (although the drug itself has also been associated with increased resistance\(^32\)) or amoxicillin combined with clavulanic acid should be considered.\(^33\) For individuals allergic to the penicillin-based antibiotics, clindamycin can be prescribed.\(^34\) Clindamycin is effective against both aerobic and anaerobic bacteria and penetrates bone readily.

### Table 1: Empiric Antibiotics of Choice for Odontogenic Infections\(^38\)

<table>
<thead>
<tr>
<th>Type of Infection</th>
<th>Antibiotic of Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early (first 3 days of infection)</td>
<td>Penicillin VK, amoxicillin, clindamycin, cephalexin (or other first-generation cephalosporin)(^1)</td>
</tr>
<tr>
<td>No improvement in 24-36 hours</td>
<td>Beta-lactamase-stable antibiotic: clindamycin or amoxicillin/clavulanic acid (Augmentin(^*))</td>
</tr>
<tr>
<td>Penicillin allergy</td>
<td>Clindamycin, cephalaxin (if penicillin allergy is not anaphylactoid type), clarithromycin (Biaxin(^*))</td>
</tr>
<tr>
<td>Late (&gt;3 days)</td>
<td>Clindamycin, penicillin VK-metronidazole, amoxicillin-metronidazole</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin VK</td>
<td>$\leq 12$ years: $25-50$ mg/kg body weight in equally divided doses q6-8h for at least 7 days; maximum dose: $3g$/day $&gt; 12$ years: $500$ mg q6h for at least 7 days</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>$0.8-2.5mg/kg$ in 3-4 equally divided doses</td>
</tr>
<tr>
<td>Cephalexin (Keflex)</td>
<td>$25-50$ mg/kg/day in divided doses q6h Severe infection: $50-100$ mg/kg/day in divided doses q6h; maximum dose $3g$/24h $&gt; 40$kg: $250-500$ mg q6h; maximum dose $1.8g$/day</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>$&lt; 40$ kg: $20-40$ mg/kg/day in divided doses q8h $&gt; 40$ kg: $250-500$ mg q8h or $875$ mg q12h for at least 7 days; maximum dose $2g$/day $&gt; 40$kg: $250-500$ mg q8h or $875$ mg q12h for at least 7 days; maximum dose $2g$/day</td>
</tr>
<tr>
<td>Amoxicillin/clavulanic acid (Augmentin(^*))</td>
<td>$&lt; 40$ kg: $20-40$ mg/kg/day in divided doses q8h $&gt; 40$ kg: $250-500$ mg q8h or $875$ mg q12h for at least 7 days; maximum dose $2g$/day $&gt; 40$kg: $250-500$ mg q8h or $875$ mg q12h for at least 7 days; maximum dose $2g$/day</td>
</tr>
</tbody>
</table>

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Azithromycin, a structural derivate of erythromycin, has also been recommended as an option for the treatment of mild to moderate bacterial infection.\(^35\) It has a broader spectrum of activity, increased bioavailability, and fewer gastrointestinal (GI) effects. For the patient with identified cephalosporin- or penicillin-resistant Gram-negative bacteria, cefoxitin has also been shown to be effective.\(^28\) The reader should refer to this and other guidelines for the latest information and proper dosing for the adult patient.

Antibiotics may also need to be prescribed to children with infection, although the dosage will be lower, as it based on body weight. Several rules exist to compute the dosage of a drug for a child, the most common being Clark’s Rule and Young’s Rule (tables 2 and 3) and empiric antibiotic options are available (table 4). The American Academy of Pediatric Dentistry has published prescription guidelines for children needing antibiotic coverage.\(^37\) The reader should refer to this and other guidelines for the latest information and proper dosing for the pediatric patient.

### Table 2: Clark’s Rule for Pediatric Dosing\(^39\)

| Child’s Weight lb. (or kg) X Adult Dose = Child’s Dose |
|-------------------|--------|
| 150 lb. (or 70 kg) |

### Table 3: Young’s Rule for Pediatric Dosing\(^39\)

| Adult Dose X (Age ÷ (Age+12)) = Child’s Dose |
|-------------------|--------|
|  |

### Table 4. Empiric Antibiotics of Choice for Odontogenic Infections\(^38\)

1. For better patient compliance, second-generation cephalosporins (cefator: cefuroxime) at twice daily dosing has been used.
2. A. macrolide useful in patients allergic to penicillin, given as twice daily dosing for better patient compliance.
Management of the dental infection can also be treated based on time of involvement. Emergent infections can be treated with penicillin V, amoxicillin, clindamycin, or a first-generation cephalosporin.40 If there is no improvement within the first 24 to 36 hours, clindamycin or amoxicillin/clavulanic acid combination (Augmentin) may then be considered. Another consideration is to begin antibiotic therapy with a loading oral dose two times the standard maintenance dose so that a therapeutic blood level is achieved faster than what would be expected with an initial maintenance dose.41, 42

Despite the effectiveness of the penicillin-based antibiotics, they should be used with caution in patients with compromised renal function or in individuals with a history of seizures or significant GI hypersensitivity to antibiotics.43 Mild adverse GI reactions (e.g., nausea, diarrhea) are not uncommon with the penicillin antibiotics. True penicillin allergy is rare with the estimated frequency of anaphylaxis in one to five per 10,000 cases of penicillin therapy.44 Hypersensitivity is the more common and most important adverse reaction resulting in nausea, vomiting, pruritus, urticaria, wheezing, laryngeal edema and ultimately, cardiovascular collapse. In these patients, clindamycin is recommended; however it can cause nausea, vomiting, diarrhea, and abdominal pain, and has been associated with the development of pseudomembranous colitis.45 Consequently, it is contraindicated in these patients as well as patients with a history of regional enteritis or ulcerative colitis. In addition, clindamycin should be used cautiously in the patient with liver disease.46

A highly controversial concern is the interaction between oral contraceptives and antibiotics. For years, the medical community has been advised that this interaction can lead to breakthrough pregnancy. With the exception of rifampin-like drugs used primarily to treat tuberculosis, there is a lack of scientific evidence supporting the ability of commonly prescribed antibiotics, including all those routinely employed in outpatient dentistry, to either reduce blood levels and/or the effectiveness of oral contraceptives.47 To date, all clinical trials studying the effects of concomitant antibiotic therapy (with the exception of rifampin and rifabutin) have failed to demonstrate an interaction. A 10-year retrospective study by Toh et al. found no association found between concomitant antibiotic use and the risk of breakthrough pregnancy among oral contraceptive users.48 Therefore, dentists are now being advised that there is no need to warn women taking the combined oral contraceptive pill of the routine need to use additional contraceptive measures while taking courses of broad spectrum antibiotics.49

Prolonged use of any antibiotic may produce an oral yeast infection.48 Listed precautions, contraindications, potential risks (e.g., in pregnant patients) and known drug interactions (e.g., nonsteroidal anti-inflammatory drugs [NSAIDs] reduce the bioavailability of some but not all antibiotics) should be reviewed prior to prescribing. It should also be fully appreciated that improper prescription of antibiotic continues to be a prime contributor to the development of antibiotic resistance.51

Palliative care
The management of acute dental infection should also incorporate palliative measures. No special precautions need be considered for hydration or nutrition unless retropharyngeal swelling prevents intake, in which case the patient should be immediately hospitalized. A soft diet is recommended during recovery from incision and drainage or tooth extraction. Pain management should include over-the-counter pain medication as well as cases requiring prescriptions that include NSAIDs and opioid analgesics.

Analgesics for acute pain
Acute pain arising from oral infections may present from mild to severe. Analgesics used in the management of mild to moderate acute pain include acetaminophen, aspirin, and NSAIDs.52 Cox-2 inhibitors are also effective, however, they must be used with caution due to recently identified cardiovascular adverse reactions.53 Moderate pain can be controlled by opioids or tramadol and these are often combined with acetaminophen or NSAIDs.54

A recent systematic review indicates that a 50% or greater reduction in severe pain following oral surgery can be achieved with 400 mg of ibuprofen, 50 mg of diclofenac, 120 mg of etoricoxib, 60 mg of codeine with 1000 of mg acetaminophen, 400 mg of celecoxib (Celebrex), and 500 or 550 mg of naproxen.55,56 Pain relief greater than eight hours can be achieved with 120 mg of etoricoxib, 500mg of diflunisal, 10 mg of oxycodone plus 650 mg of acetaminophen, 500 or 550mg of naproxen, and 400 mg of celecoxib. The study authors note that adverse events were more likely to be associated with the aspirin and opioids.

Patients sometimes misuse over-the-counter pain medications,57 and prescription medications, when taken in combination with over-the-counter medications, can lead to toxicity. In 2014, the FDA published a drug safety caution regarding the prescription of opioids containing acetaminophen due to the potential for acetaminophen-related hepatotoxicity.58 The maximum amount of acetaminophen (in combination with opioids) is 325 mg when taken every four to six hours. Support for this alert comes in part from a study of unintentional acetaminophen overdose. In data collected by querying the French Pharmacovigilance database over a nine-month period, 13 patients were identified as having mild unspecified clinical symptoms and 4 of 10 had abnormal liver enzyme activity. The median dose of acetaminophen was 137mg/kg per 24 hours.59

Opioids also have potential for misuse. It is estimated that dentists prescribe approximately 12% of all opioids dispensed in the United States.60 The potential for misuse and toxicity of all pain relievers can be reduced by limiting the amount prescribed, performing a preassessment for potential drug interactions, and careful prescribing in patients with coexisting medical problems.
(e.g. liver abnormality, kidney disease, stomach ulcers, alcoholism, anticoagulant therapy, hemorrhagic disorders, allergy, depression) and pregnancy. Effective opioid management includes patient education, monitoring for substance abuse, and appropriate referral if abuse is suspected. For the pregnant or nursing female patient with abscess, a physician consult is recommended before prescribing drugs for pain management.61

According to Dental Management of the Medically Compromised Patient, aspirin and ibuprofen should be avoided throughout pregnancy; however, acetaminophen can be prescribed any time during pregnancy.56 For this and other prescribing recommendations, the reader must contact the patient’s obstetrician for treatment and prescribing approval.

Conclusion

Dentists face an important responsibility when treating the oral infection. An understanding of oral microbiology, laboratory assessment tools, and head and neck anatomy is necessary. The importance of triage based on patient presentation and treatment strategies are critical. In addition, the appropriate prescription of medication is of paramount importance in avoiding potential morbidity and mortality.

Bibliography

1. The outcome for patients hospitalized for periapical abscess in the United States was evaluated with 7,886 hospitalizations amounting to total hospital charges of $105.8 million using research from the:
   a. CAMBRA
   b. North American Medical and Research Foundation
   c. National Science Foundation
   d. Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project

2. The Global Burden of Disease Study in 2010 showed that cleft lip/palate, edentulism, oral cancer, caries, and periodontal disease accounted for over how many disability-adjusted life years.
   a. 18
   b. 18,000
   c. 180,000
   d. 18,000,000

3. From 1990 to 2010, evaluation of the global burden of oral diseases such as caries, periodontal disease, and cancer showed a marked increase by:
   a. 10.2%
   b. 45.6%
   c. 34.9%
   d. 83.2%

4. In regard to oral soft tissue, which of the following organisms do not colonize the oral mucous membranes:
   a. pathogenic bacteria
   b. non-pathogenic bacteria
   c. fungal organisms
   d. plasmodians

5. Which of the following opportunistic microorganisms mentioned in this course can cause systemic versus oral disease:
   a. Verrucomicrobium mrhankii
   b. Cyanobacter cori
   c. Klebsiella pneumoniae
   d. Fusobacterium preponderii

Author Profile
Ian Shuman DDS, MAGD, AFAAID maintains a full-time general, reconstructive, and aesthetic dental practice in Pasadena, Maryland. Since 1995 Dr. Shuman has lectured and published on advanced, minimally invasive techniques. He has taught these procedures to thousands of dentists and developed many of the methods. Dr. Shuman has published numerous articles on topics including adhesive resin dentistry, minimally invasive restorative, cosmetic and implant dentistry. He is a Master of the Academy of General Dentistry, an Associate Fellow of the American Academy of Implant Dentistry, a Fellow of the Pierre Fau-chard Academy. Dr. Shuman was named one of the Top Clinicians in Continuing Education since 2005, by Dentistry Today.

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6. Biofilm contains:
   a. bacteria
   b. extracellular DNA
   c. intracellular DNA
   d. a and b

7. Within a biofilm, interaction of what microorganism type may either boost or suppress metabolic activity that leads to dental infection:
   a. spirochetes
   b. bacterial
   c. protozoa
   d. ameba

8. Many factors regulate the number and types of oral bacteria within biofilm including:
   a. the complexity of the flora
   b. bacterial retention and interaction
   c. native resistance
   d. all of the above

9. Streptococcus salivarius is found primarily on what oral structure:
   a. palate
   b. labial mucosa
   c. tongue
   d. buccal mucosa

10. Streptococcus mutans and Streptococcus sanguis typically adhere to:
    a. hard surfaces
    b. soft tissue
    c. a and b
    d. none of the above

11. Host defense mechanisms can be compromised by which of the following conditions:
    a. diabetes
    b. lymphoproliferative disorders
    c. renal failure
    d. all of the above

12. A harmful quality possessed by microorganisms that can cause disease is known as:
    a. virulence
    b. viral spread
    c. virulent reproduction
    d. all of the above

13. Advantageous salivary lymphoid cells produce:
    a. Megakaryocytes
    b. immunoglobulins
    c. Natural Killer (NK) Cells
    d. granulocytes

14. Serum proteins released as a result of inflammation include all of the following except:
    a. histamine
    b. prostaglandins
    c. lymphokines
    d. porphyrin

15. Lymph nodes that are tender, enlarged, indurated or fixed suggest the presence of:
    a. infection
    b. Graves disease
    c. Goiter
    d. cancer

16. Which of the following is a spreading bacterial infection just below the skin surface:
    a. Acanthosis nigricans
    b. Cherry hemangioma
    c. Cellulitis
    d. Granuloma annulare

17. Cellulitis is most commonly caused by which of the following microorganisms:
    a. Streptococcus pyogenes or Staphylococcus aureus
    b. Entamoeba histolytica or Cyclospora cayetanensis
    c. Giardia lamblia or Microsporidia
    d. Schistosomiasis or Echinococcus granulosus

18. One of the conditions arising from the oral cavity that spreads to the fascial planes is known as:
    a. Aarskog-Scott syndrome
    b. Acromegaly
    c. Ludwig’s angina
    d. Angiocentric T-cell lymphoma

19. The submandibular space consists of which two compartments in the floor of the mouth:
    a. pterygomandibularis and hyoid
    b. sublingual space and submynlophysical
    c. medial pterygoid and retromolar pad
    d. platsyma and sublingual gland

20. Complete the following statement: The treatment of any oral infection should begin with identification of the culprit microorganism(s) by way of laboratory evaluation.
    a. after an appropriate antibiotic regimen.
    b. prior to the initiation of therapy.
    c. during antibiotic therapy.
    d. none of the above

21. Most oral bacterial infections are:
    a. odontogenic
    b. superficial in nature
    c. caused by Streptococcus bacteria.
    d. all of the above

22. As a rule, a culture must be taken if:
    a. The infection has spread to one or more fascial planes of the head and neck.
    b. Initial antibiotic treatment has failed to contain the infection.
    c. The patient shows evidence of systemic toxicity.
    d. all of the above

23. Of the various examination techniques that should be considered in assessing infective organisms in office, which of the following may be considered the most useful procedure:
    a. Hygiena indicator
    b. Gram stain
    c. Glucose broth with Durham tubes
    d. Streak-stab technique

24. Techniques for assessing purulent material include:
    a. transmucosal aspiration
    b. pulp chamber access
    c. tissue biopsy
    d. all of the above

25. The best first line of defense against the development of the dental abscess is:
    a. antibiotic therapy
    b. pulpotomy
    c. caries prevention
    d. a and b

26. Drainage of purulence can be accomplished through the surgical placement of a:
    a. French catheter
    b. closed drainage system
    c. Penrose drain
    d. a and b

27. Which of the following authors describes acute oral infections that can spread extraorally, recommending Penicillin as being the drug of first choice:
    a. Presley and Martindale
    b. Keaton and Winkler
    c. Olsen and Winkelhoff
    d. Dreyfus and Alexander

28. Which of the following analgesics are not contraindicated during pregnancy:
    a. acetaminophen
    b. aspirin
    c. ibuprofen
    d. b and c

29. Patient education, monitoring for substance abuse, and appropriate referral if abuse is suspected is required for the management of which class of drugs:
    a. Cannabinoids
    b. Opioids
    c. NSAIDs
    d. b and c

30. Infection of the maxillary molars can initially invade what anatomic area:
    a. dura
    b. infrasyndrome
    c. brain stem
    d. infratemporal space
1. Describe the features of oral microbiology as they relate to oral infection.
2. Identify the clinical issues related to dental infection.
3. Describe the various strategies for treating the acute dental abscess.

Course Evaluation
1. Were the individual course objectives met?
   Objective #1: Yes No Objective #2: Yes No Objective #3: Yes No
2. To what extent were the course objectives accomplished overall? 5 4 3 2 1 0
3. Please rate your personal mastery of the course objectives. 5 4 3 2 1 0
4. How would you rate the objectives and educational methods? 5 4 3 2 1 0
5. How do you rate the author's grasp of the topic? 5 4 3 2 1 0
6. Please rate the instructor's effectiveness. 5 4 3 2 1 0
7. Was the overall administration of the course effective? 5 4 3 2 1 0
8. Please rate the usefulness and clinical applicability of this course. 5 4 3 2 1 0
9. Please rate the usefulness of the supplemental webliography. 5 4 3 2 1 0
10. Do you feel that the references were adequate?  Yes No
11. Would you participate in a similar program on a different topic? Yes No
12. If any of the continuing education questions were unclear or ambiguous, please list them.
13. What additional continuing dental education topics would you like to see?  

For Questions Call 800-633-1681
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