Cite this as:
J Can Dent Assoc 2010;76:a37

QUESTION 3

How are odontogenic infections best managed?

Background

Dental infections, including gingivitis, periodontitis, dental caries and odontogenic infections, result in numerous dental visits each year in Canada. They can range in severity from a mild buccal space infection to a severe life-threatening multi-space infection. All dentists should be comfortable with prompt diagnosis and management of these types of infections. This review of odontogenic infections describes causative organisms, management including appropriate antibiotic selection and the indications for referral to a specialist.

Most odontogenic infections are caused by more than 1 species of the bacteria normally found within the oral cavity. Roughly 50% of odontogenic infections are caused by anaerobic bacteria alone, 44% by a combination of aerobic and anaerobic bacteria and only 6% by aerobic bacteria alone.[1] The most common species of bacteria isolated in odontogenic infections are the anaerobic gram-positive cocci *Streptococcus milleri* group and *Peptostreptococcus*.[2] Anaerobic gram-negative rods, such as *Bacteroides* (*Prevotella*) also play an important role. Anaerobic gram-negative cocci and anaerobic gram-positive rods have little effect.[2]

Odontogenic infections progress through 3 stages: inoculation, cellulitis and abscess (**Table 1**).[3] Bacteria gain entrance to the surrounding facial spaces by direct extension from the periapical region of the involved tooth. The pattern of spread is predictable depending on the relationship between the point of attachment of the adjacent muscle and the tooth apex.[4]

Table 1 Characteristics of the 3 stages of infection

Characteristic	Inoculation	Cellulitis	Abscess
Duration (days)	0–3	2–5	4–10
Discomfort	Mild	Severe, diffuse	Mild, localized
Palpation	Soft, doughy	Firm, indurated	Fluctuant, tender
Pus	None	None	Present
Skin	Normal	Red	Red periphery
Severity	Minimal	Greater	Less
Bacterial species	Aerobic	Mixed	Anaerobic

Table 2 Antibiotics commonly prescribed for odontogenic infections[5]

Antibiotic	Usual adult dosage	Usual pediatric dosage
Penicillin V	600 mg every 6 h	25–50 mg/kg/day divided into 4 doses
Amoxicillin	500 mg every 8 h	25–50 mg/kg/day divided into 4 doses
Cephalexin	500 mg every 6 h 2 g 1 h pre-op (joint prophylaxis)	25–50 mg/kg/day divided into 4 doses
Metronidazole	500 mg twice daily	15–30 mg/kg/day divided into 3 doses
Clindamycin	300–450 mg every 6 h	10–30 mg/kg/day divided into 3 or 4 doses
Moxifloxacin	400 mg daily	Not established
Erythromycin	500 mg enteric coated every 8 h 333 mg enteric coated every 6 h 250 mg (base) every 6 h	30–50 mg/kg/day divided into 2–4 doses

Treatment of odontogenic infections includes diagnosis and management of the causative factor and, usually, prescription of appropriate antibiotics. It is imperative that the source of infection be addressed immediately. Placing a patient on antibiotics and rescheduling to have the source dealt with at a later time is not sound practice, as most often the infection will worsen. In addition, the patient's medical status must be optimized. The patient's fluid and nutrition status should also be addressed, as many patients with odontogenic infections have decreased oral intake due to pain and difficulty in chewing or swallowing.

The decision to place the patient on antibiotics depends on the location and severity of the infection and the patient's medical conditions. A mild vestibular space infection may not require antibiotics after the offending tooth has been removed. However, more serious infections do require appropriate antibiotics. The clinician must be aware of the most likely causative organisms and prescribe the narrowest spectrum of antibiotics that will cover all possible offending organisms. **Table 2** lists the antibiotics most commonly used to treat odontogenic infections and their usual oral adult and pediatric dosages.[5] Antibiotics are typically prescribed for 7 days or until 3 days after symptoms have resolved.

Severe infections must be identified and referred to a specialist in a timely manner. The signs and symptoms of a severe infection are fever (temperature > 38°C), stridor, odynophagia, rapid progression and the involvement of multiple spaces and secondary anatomic spaces.[3] The presence of any of these warrants referral to an oral and maxillofacial surgeon.

Beta Lactam Antibiotics

Penicillins: Penicillins are considered the first line of treatment for odontogenic infections. They produce their effect by inhibiting cross-linking in the bacterial cell wall and are, thus, bactericidal. They have a fairly narrow antimicrobial spectrum, but cover most bacteria associated with odontogenic infections. Penicillin resistance has been reported recently.[6] This occurs primarily through the production of beta lactamase. Evidence suggests a high incidence of penicillin resistance among patients previously treated with beta lactam antibiotics in in vitro studies.[7]

In culture and sensitivity testing on 94 patients with odontogenic abscesses, penicillin V was the least effective antibiotic for eradicating bacterial isolates.[7] Despite this, more than 95% of patients treated with surgical incision and drainage in conjunction with penicillin V recovered satisfactorily. The discord between in vitro testing and clinical response was thought to be due to the susceptibility to penicillin of the dominant causative strains of bacteria isolated from the abscesses.

Amoxicillin has a broader spectrum of activity than penicillin V, but does not provide any better coverage in treating odontogenic infections. Its dosing schedule and ability to be taken with food may make it more acceptable for patients, resulting in better compliance.

Cephalosporins: The mechanism of action of cephalosporins is similar to that of penicillins. There are 4 generations of cephalosporins; their spectrum of antibacterial coverage, especially against gram-negative bacteria, generally increases from the first to the fourth generation. The reported incidence of cross-reactivity with penicillin is about

7%–18%,[8] which should be considered when a patient reports an allergy to penicillin.

Cephalosporins are not a first-line treatment in the management of odontogenic infections. Cephalexin is more commonly used for sinus communications and for antibiotic prophylaxis in patients with prosthetic joints.

Metronidazole: Metronidazole is a synthetic antibiotic that is effective against anaerobic bacteria. It disrupts bacterial DNA, thus inhibiting nucleic acid synthesis. It provides excellent anaerobic coverage and should be used in conjunction with penicillin.

Clindamycin: Clindamycin inhibits bacterial protein synthesis and is bactericidal at high dosages. Its use has increased in recent years due to increasing concern over penicillin resistance. For example, it has replaced penicillin as the recommended antibiotic for the management of odontogenic infections in the *Sanford Guide to Antimicrobial Therapy*.[9]

Among 37 hospital patients with odontogenic infections, treated with intravenous penicillin G, incision and drainage, penicillin-resistant bacteria were found in 19% of isolated strains and the penicillin failure rate was 21%.[6] As this failure rate was unacceptably high, it was suggested that clindamycin be considered for hospital patients.

Clindamycin has excellent coverage of gram-positive cocci and anaerobic bacteria. *Eikenella* is inherently resistant to clindamycin and alternative antibiotics should be considered if this species is found to be the causative organism. Clindamycin should be considered the antibiotic of choice for the penicillin-allergic patient.

Fluoroquinolones: Fluoroquinolones interfere with bacterial DNA metabolism by inhibiting the enzyme topoisomerase and are bactericidal. The broad-spectrum antibiotic moxifloxacin has excellent bacterial coverage in the setting of an odontogenic infection. It is effective against *Eikenella* and most strains of bacteria that produce beta lactamase. Moxifloxacin has the highest rate of bacterial susceptibility among all antibiotics including penicillin and clindamycin for odontogenic infections.[7] However, given its broad spectrum and high cost, it should be considered as a second-line therapy to penicillin V, metronidazole and clindamycin.

Macrolides: In dentistry, the most commonly used macrolide is erythromycin, which has a spectrum of activity similar to that of penicillin V. Like penicillin-resistance, resistance to erythromycin has become a clinical concern. Kuriyama and colleagues[10] found that erythromycin was ineffective against *Streptococcus viridans* and most *Fusobacterium* species. Thus, erythromycin should be considered a historical antibiotic in the management of odontogenic infections.

Conclusion

Odontogenic infections are polymicrobial in nature. Prompt diagnosis and treatment, including elimination of the causative factor, are crucial to their successful management. Antibiotics are a useful adjunct in the treatment of odontogenic infections, but should not replace removal of the causative factor. All dentists should know when referral to a specialist is warranted.

Penicillin in conjunction with metronidazole provides excellent bacterial coverage for most odontogenic infections and should be considered the antibiotic of choice. Clindamycin also provides excellent coverage and should be used for the penicillin-allergic patient or in the setting of penicillin failure.

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