



CLINICAL REVIEW

Management of severe acute dental infections

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Acute dental infection typically occurs when bacteria invade the dental pulp (nerve) and spread to tissues surrounding the tooth. Radiological signs of tooth associated infection in the supporting bone are extremely common, affecting 0.5-13.9% (mean 5.4%) of all teeth in a large systematic analysis of cross sectional studies.¹ In addition to localised disease, dental infections can spread regionally and haematogenously, causing serious disseminated infections, especially in patients who are medically compromised.^{2,3} General medical practitioners and those working in emergency departments are frequently asked to treat patients presenting with dental problems but often have little or no training in this area.⁴ The purpose of this review is to help general practitioners and non-specialists with the initial diagnosis and management of acute dental infections.

What is it?

The tooth is made up of a visible crown composed of dentine and enamel and a root composed of dentine. Within is a soft fibrous tissue called dental pulp. An acute dental abscess occurs as a result of bacterial invasion of the pulp space. The condition is commonly precipitated by advanced dental caries, failure of root canal treatment, advanced chronic infection of the supporting structures of the tooth (periodontitis), or trauma. The infection may be restricted to the pulp space or to the periapical area of the affected tooth, or it may spread to surrounding dentoalveolar bone as well as to the soft tissues, causing cellulitis and potentially compromising the airway. Dental abscesses can also arise from partially erupted teeth (pericoronitis). This most commonly affects the third molars, otherwise known as the wisdom teeth (fig 1 ↓).

Who gets it?

Dental infections that affect the pulp and cause pain are common worldwide, and 90% of people have experienced dental problems or toothache caused by caries.⁵ Although dental caries

is more of a problem in developing countries, it also affects countries with well developed healthcare systems. In the United Kingdom 2% of adults in a cross sectional study showed signs of tooth associated infection of the supporting bone.⁶ Access to dental treatment is a major factor in the development of dental infection worldwide, with figures ranging from one dentist per 1000 patients in places such as Germany and the United Kingdom to one dentist per 900 000 in sub-Saharan Africa.⁵ The number of patients admitted to English hospitals for treatment of spreading dental infections doubled from 1998 to 2008.⁷ This increase disproportionately affected patients from lower socioeconomic groups, who find access to a dentist potentially problematic.⁸ Immunocompromised patients, such as those with poorly controlled diabetes and elderly people, are also at risk for more severe spreading dental infections.^{3,9} In a small retrospective study from Finland and a larger study from Taiwan, medically compromised patients with dental infections were found to be more at risk from systemic complications, including fatal systemic infections, than previously healthy patients with dental infections.^{2,3}

What causes it?

The bacteria commonly isolated with dental infections comprise a mixture of oral streptococci, in particular the *Streptococcus anginosus* group (commonly referred to as “milleri” group streptococci) and strict anaerobes such as, anaerobic streptococci, *Prevotella* species, and *Fusobacterium* species.¹⁰ In general these isolates are usually susceptible to the commonly prescribed antibiotics (amoxicillin or erythromycin). Combination with metronidazole is rarely indicated unless local surveillance data suggest a high prevalence of *Prevotella* species positive for β lactamase.

The bottom line

- Dental infection is a common and potentially life threatening condition and in some areas admissions for surgical treatment of dental infections are increasing
- As many doctors are asked inappropriately to see patients with dental pain, service providers must ensure out of hours access to emergency dental treatment
- Antibiotics are ineffective in the treatment of pulpal pain evoked by hot and cold and are not appropriate in the absence of signs of spreading infection or systemic upset as they do not prevent the development of severe complications
- Localised dental abscesses respond well to incision and drainage, root treatment, or extraction and therefore it is important to arrange for prompt dental surgery rather than prescribe unnecessary antibiotics
- Patients presenting with signs of sepsis, facial swelling, trismus (limited mouth opening), or dysphagia should be reviewed by a dental or maxillofacial surgeon without delay for appropriate surgical and medical management

Sources and selection criteria

We searched Medline 1950-2013 for the keywords "dental abscess", "odontogenic infection", "endodontic abscess", "periapical abscess and microbiology", and "clinical trials". Embase was also searched, including the Cochrane database of systematic reviews. Searches were carried out of abstracts and where the title and abstract was thought to be potentially relevant we reviewed the full text articles. No meta-analyses have been carried out on this topic; however, the literature search revealed systematic reviews of a small number of relevant randomised clinical trials investigating the treatment of dental abscesses.

Can it be prevented?

Most dental abscesses are secondary to dental caries and therefore can be largely avoided if basic oral health measures are followed. Box 1 gives a summary of measures to prevent caries in children.¹¹

What are the signs and symptoms of localised dental infection?

Box 2 lists the key presenting symptoms in patients with localised dental infection. Patients who present with trismus (limited mouth opening), dysphagia, or systemic upset require immediate medical attention.

Several other potential diagnoses need to be excluded.

Pulpitis, or toothache—is an inflammatory condition of the pulp usually caused by dental decay or a failed filling. It is characterised by severe pain in the mouth and jaw, which is stimulated by hot and cold, and in later stages the tooth can feel sore during biting. The pain can be either sharp or dull and poorly localised and can radiate to the ear. Crucially, there is no bacterial infection of the surrounding tissue, swelling, or suppuration. The infection does not respond to antibiotics and analgesia is often ineffective. This condition requires management by a dentist.

Temporomandibular disorders—temporomandibular pain dysfunction syndrome is characterised by pain, clicking, jaw locking or limitation of opening the jaw, and tenderness of facial muscles. Pain from disease of the temporomandibular joint is usually dull, poorly localised, and intensified by movement of the jaw and may be associated with trismus. Patients may be aware of clenching or grinding their teeth and stress in their lives.

Sinusitis—patients occasionally present with symptoms of sinusitis or dental pain, which may complicate diagnosis. For uncomplicated sinusitis, pain is often accompanied by a blocked nose and headaches and pain is often made worse when the head is moved forward. Dental examination can be helpful in excluded dental disease mimicking sinusitis-like symptoms.

Parotitis—is an infection of the parotid salivary gland. Bacterial infections are usually associated with debilitated and dehydrated patients. Viral infections, such as mumps, are more common in younger patients.

Sialolithiasis—is a condition where a stone forms within the salivary duct—commonly the submandibular duct. Pain and swelling are associated with the stimulation of salivary flow, and includes thinking about food, chewing, and hunger.

Trigeminal neuralgia—is a rare nerve disorder that causes episodes of unilateral intense, stabbing, electric shock-like pain of the face lasting for a few seconds up to a couple of minutes. Onset is mainly in the 50–70 year age group.

Giant cell arteritis—is a rare vasculitis that most commonly affects patients aged more than 50 years. There is usually an intense, deep, throbbing and persistent headache, jaw pain on eating, and double vision and the scalp can be sore to touch. Undiagnosed this condition can lead to blindness. Blood tests show a significant increase in erythrocyte sedimentation rate.

Trauma—dental and maxillofacial trauma or fracture can present with pain and swelling in the maxillofacial region. The history will guide the clinician to seek the opinion of a maxillofacial specialist.

What are the red flag symptoms of spreading dental infection?

While localised dental infection is by definition limited to the mouth, infections have the potential to spread to other areas of the maxillofacial region and beyond through tissue planes and the bloodstream. Maxillofacial cellulitis or spreading odontogenic infection has the potential to be life threatening. A spreading odontogenic infection presents with varying degrees of facial swelling, trismus, and pain. Features of localised dental infection may also be present. Box 3 lists the key red flag symptoms and signs indicating a severe spreading infection, potential comprised upper airway, and sepsis.

Patients with severe signs and symptoms should be seen by an oral and maxillofacial surgeon in a hospital setting without delay. The route of spread of the dental abscess is determined by the relation of the apex of the root to relevant muscle insertions and fascial planes and may include various anatomical potential spaces, the neck, periorbital area, cavernous sinus, or mediastinum (fig 3⇓). Patients who have either had no previous dental treatment or had treatment with only antibiotics have higher mean C reactive protein and white blood cell counts and are therefore at a higher risk of prolonged hospital stays and admission to an intensive care unit.^{13 14} The mainstay of treatment is promptly administered intravenous antibiotics such

Box 1 Advice on prevention of dental caries in children

- Teeth should be brushed twice a day using toothpaste containing at least 1000-1500 ppm fluoride, the toothpaste spat out, and water for rinsing the mouth avoided
- Both the quantity and the frequency of sugar intake should be decreased; in particular sugary snacks should be avoided between meals and immediately before bedtime
- Non-sugar sweeteners should ideally be used in food and drink; if a sweetener is required consider xylitol
- It is important for patients to register with a dentist and attend according to individual risk assessment
- Doctors should be aware of the risk of dental caries from sugared medicines and consider this when prescribing
- Non-dental professionals should be aware of the noticeably increased risk of dental caries in the presence of dry mouth
- Low sugar artificial saliva or sugar-free chewing gum should be considered for patients with dry mouth as appropriate
- General practitioners should actively encourage patients at high risk of caries to attend for dental care¹¹

Box 2 Signs and symptoms of localised dental infection

- Pain in mouth and jaws
- Swelling inside mouth
- Mobile tooth
- Tenderness on biting or tapping of the affected tooth
- Pain on palpation of surrounding gum
- Spontaneous drainage of pus

Box 3 Ref flags suggestive of a spreading dental infection

- Pyrexia
- Tachycardia or tachypnoea
- Trismus; may be relative due to pain or absolute due to a collection within the muscle causing muscle spasm in cases of masticator space involvement
- Raised tongue and floor of mouth, drooling
- Periorbital cellulitis
- Difficulty with speaking, swallowing, and breathing (fig 2¹²)
- Hypotension
- Increased white blood cell count
- Lymphadenopathy
- Dehydration

as benzyl penicillin and metronidazole together with appropriate surgical drainage. Severe trismus and airway compromise require urgent expert anaesthetic review and often also support in the management. Dental infections should be recognised as a potential source of sepsis, and patients must be assessed accordingly and the oral source of infection treated appropriately.

What diagnostic tests are helpful?

Confirmation of a diagnosis can be supported by dental radiographs.¹⁵ Although the orthopantomogram often available in hospitals is a useful panoramic view of the entire dentition and jaws it can lack sufficient detail to show early changes in the periapical bone, especially in the anterior region of the mouth. Periapical radiographs are often required for a more detailed view, but these are normally only available to general dental practitioners.¹⁵ As with all radiographs, these should only be requested and interpreted by someone with appropriate training—that is, dentist, oral and maxillofacial specialist, or radiologist. Radiolucency in the crown of the tooth confirms the presence of decay as it is less dense than healthy tooth structure. Similarly, a radiolucency around the apex of the root confirms the presence of periapical bony destruction and identifies the offending tooth (fig 4¹¹). The use of computed tomography, magnetic resonance imaging, and ultrasound imaging can all be useful to ascertain the route of spread of

more serious dental infections.^{16 17} The pulp of a tooth affected by a periapical abscess will have undergone necrosis and as such will be painful when pressure is applied and will not respond to vitality testing such as application of cold or heat stimulus. These tests may not be available in a non-dental emergency setting.

For microbiological investigations, to guide treatment in difficult cases and for informing empirical prescribing guidelines, ideally an aspirate through intact disinfected mucosa should be taken for culture and sensitivity testing. Appropriate processing and reporting by the microbiology laboratory is important, although reports of “normal oral flora” are unhelpful. The results will be useful should the patient fail to respond to initial treatment¹⁸ or if there are signs and symptoms of continuing deterioration. Knowledge about the epidemiology of antimicrobial susceptibility patterns is also useful to inform guidelines for empirical antimicrobial prescribing underlying the requirement for high quality laboratory investigations. Blood cultures should be taken from patients with signs of systemic inflammatory response syndrome, including pyrexia, tachycardia, tachypnoea, and white blood cell counts less than 4000 cells/mm³ (4×10^9 cells/L) or greater than 12 000 cells/mm³ (12×10^9 cells/L); or the presence of greater than 10% immature neutrophils.

How is it managed?

Box 4 summarises the key points in the management of severe dental infection.

Non-specialist management by general and emergency medical practitioners

Medical practitioners may be faced by patients presenting with dental problems but have limited training and experience in managing these cases. Patients often present to emergency departments or general practitioners because of ease of access, lack of registration with a dentist, fear of dental intervention, or the expectation that a course of antibiotics will fix the problem. These issues are exacerbated in the out of hours setting, where access to dental care is more difficult: it is recognised that at present service provision for emergency dental care is difficult to access at times, making management difficult. The treatment of localised acute dental infection should follow sound surgical principles of prompt diagnosis and surgical drainage. It seems that these principles are not universally applied for the reasons described above.³⁰

The role of the doctor is to identify and treat patients who have severe spreading dental infections with sepsis and red flags and to refer to an oral and maxillofacial surgeon immediately for treatment following the sepsis guidelines.

For those patients who need to see a dentist, doctors should refer or redirect them in an appropriate timescale while providing appropriate analgesia. Medical practitioners are unable to carry out intraoral surgical procedures so should be aware of local dental services, including commissioned salaried dental services, out of hours emergency dental services, or local oral and maxillofacial departments.

In the absence of a definitive diagnosis, doctors should avoid potentially diverting those who need to see a dentist by prescribing possibly ineffectual antibiotics, which may delay presentation to a dentist and worsen outcomes. Medical indemnity would not cover a medical practitioner for the management of a dental problem as it is classed as being outside the scope of their practice. Antibiotics should only be prescribed when the diagnosis is clear and there is facial swelling or localised swelling but no possibility of access to dental care within the next few hours. It is wise to arrange to review these cases to ensure resolution, as randomised controlled trials have shown that antibiotics may only provide short term relief.^{17 18 24 31}

Specialist management by dental and oral and maxillofacial surgeons

Management of localised dental infection usually can be achieved by extraction of the infected tooth; incision and drainage of any collections of pus; or root canal treatment. In a systematic review all three methods have been shown to be safe and effective for dealing with dental infection.²⁰ A randomised controlled clinical trial and a systematic review both showed that acute dental infection normally responds to surgical dental treatment that deals with the source of the infection without the adjunctive use of antibiotics.^{20 24}

Two other placebo controlled trials investigated the efficacy of antibiotic treatment in the absence of overt signs of infection and found that antibiotics were ineffective in preventing the spread or recurrence of infection and that they should not be used in place of correct surgical management.^{31 32} Based on three randomised controlled trials, antibiotics have also been shown to be of no additional benefit in the management of localised acute dental infection in addition to drainage in

immunocompetent patients.^{19-21 32-34} Randomised controlled clinical trials have provided evidence for the use of amoxicillin, phenoxymethylpenicillin, and clindamycin.^{23 32} Cross sectional studies have shown that patients with evidence of spreading dental infections and those at risk of infection (for example, immunocompromised patients and patients with diabetes) should be treated with caution and appropriate urgent referral.¹²

There are no good quality randomised controlled trials comparing methods of management of severe spreading dental infection, and treatment remains empirical based on surgical and drug management of sepsis. Expert opinion and case series suggest that management requires admission to hospital for intravenous antibiotics together with airway management and surgical drainage of all infected tissue planes under general anaesthesia and close observation and management of underlying diseases.²⁵⁻²⁷ Sepsis should be managed according to the international guidelines produced by the Society of Critical Care Medicine.^{28 29} Parenteral antibiotic prescribing is based on broad spectrum β lactams, metronidazole, and gentamicin.²⁵

Further good quality clinical trials of sufficient size and scientific rigour are needed to answer the remaining questions about the ideal treatment of acute severe dental infection.

Commissioning of services

In some parts of the world patient outcomes are compromised by limited access to appropriately trained dental professionals.³⁵ To ensure that patient care is not compromised, service commissioners should make sure that a pathway exists for quality dental care for patients experiencing these potentially serious infections that provides both appropriate and timely care both within and out of normal working hours.

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Box 4 Management of severe dental infection*Localised dental infection**General medical and emergency practitioners*

- Acute dental abscesses respond well to local surgical treatment and so early diagnosis and referral to a dentist is advised
- In the absence of overt signs of spreading infection other than pain, antibiotics should not be prescribed even if it is not possible to start definitive dental treatment immediately. Analgesia and non-steroidal anti-inflammatory drugs should be prescribed^{19,20}
- Antibiotics should only be prescribed in patients exhibiting signs of local or systemic spread or for those who are moderately or severely immunocompromised.^{2,13,19} Evidence is currently insufficient to advocate the use of one regimen over another; however, a low dose used for as short a course as is consistent with a clinical cure has been shown to be effective and may reduce the development of resistance.^{21,22} Amoxicillin remains the antimicrobial of first choice²¹ and clindamycin an alternative in those who are allergic to the penicillin group of antibiotics²³

Dental surgeon

- Drainage must be established as soon as possible. This can be achieved by any of the following:
 - Extraction of the tooth
 - Access through the root canal by a dentist
 - Incision of the abscess (achieved by timely access to dental services)
- Where drainage has been achieved, supplemental antibiotics are not required for immunocompetent patients^{19,24}
- Pus should be sent for culture and susceptibility testing
- Good practice dictates that patients should be reviewed within 24 hours to ensure resolution and that appropriate analgesia is provided to enable adequate nutrition and hydration
- The choice of treatment will be based on whether the tooth can be saved, the severity of infection, and the patient's wishes.

Spreading dental infection

More severe dental infections must be clinically assessed to ascertain the level of local and systemic involvement. Deep neck infections and descending necrotising fasciitis pose a significant risk to life.

Assess risk of compromised airway and promptly provide airway support if required

Evacuation of pus is essential without delay. All affected fascial spaces must be explored and necrotic debris removed

Adjunctive use of parenteral broad spectrum antibiotics is indicated—for example, combinations of a broad spectrum β lactam, metronidazole, and gentamicin²⁵

The antibiotic of choice should be reviewed with microbiological testing to ensure that the most appropriate antibiotic is used^{25,26}

These should be treated in a multidisciplinary environment with access to computed tomography, magnetic resonance imaging, and ultrasound imaging, and the facilities for both maxillofacial and cardiothoracic surgery as well as the ability to provide intensive medical care and management of underlying diseases^{26,27}

Management of sepsis is of high priority if present and should be managed following the recently published guidelines from the surviving sepsis campaign^{28,29}

Questions for future research

Why is the incidence of dental abscess increasing in the United Kingdom, particularly in low socioeconomic groups?

What is the optimal treatment of dental abscess and where do newer antibiotics fit?

Chronic infection of teeth is common but only a few of these will become acutely infected. What are the factors that control this process?

Additional educational resources*Resources for healthcare professionals*

Scottish Dental Clinical Effectiveness Programme (www.sdcep.org.uk/index.aspx?o=3158)—provides guidance on a range of dental problems

Simple steps to better dental health. Dental caries (cavities) (www.simplestepsdental.com/SS/ihtSS/r.==/st.32219/t.25018/pr.3.html)—provides a general overview of dental caries and its management

Roberts G, Scully C, Shotts R. ABC of oral health. Dental emergencies. *BMJ* 2000;321:559-62 (www.pubmedcentral.nih.gov/picrender.fcgi?artid=1118447&blobtype=pdf)—this article provides an outline for the management of dental emergencies aimed at medical practitioners

Nair PNR. Pathogenesis of apical periodontitis and the causes of endodontic failure. *Crit Rev Oral Biol Med* 2004;15:348-81 (<http://crobm.iadrjournals.org/cgi/content/full/15/6/348>)—this article provides further reading on the pathogenesis of dental infections

Resources for patients

Scottish dental (www.scottishdental.org)—provides accessible patient information about dentistry and dental conditions

Scottish Dental Clinical Effectiveness Programme (www.sdcep.org.uk/index.aspx?o=3158)—provides information to professionals and patients about evidence based management of dental conditions

NHS Choices. Dental abscess (www.nhs.uk/conditions/dental-abscess/pages/introduction.aspx)—describes the management of dental abscesses and directs patients from England to access dental care

NHS Choices. Find services (www.nhs.uk/servicedirectories)—website enabling patients in England to search for local dental services

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Figures

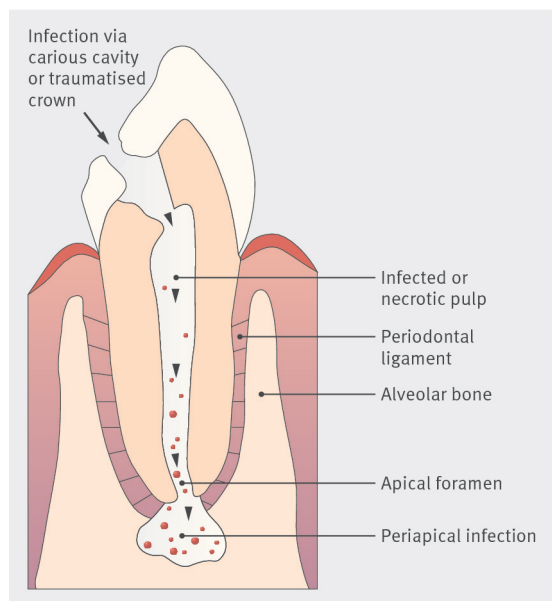


Fig 1 Mechanism for formation of dental abscess



Fig 2 Right sided submandibular swelling with trismus and swelling of floor of mouth due to a sublingual abscess. The patient required admission to hospital for surgical incision and drainage of all infected cervicofacial spaces

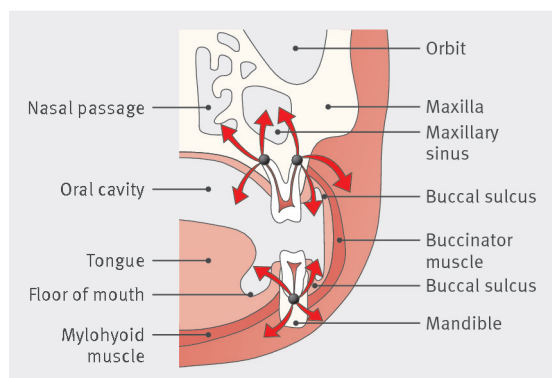


Fig 3 Spread of infection in the maxillofacial region is complicated by the variety of vital structures. Routes of spread are determined by fascial planes and this affects the presentation and management of each subdivision of cervicofacial infection

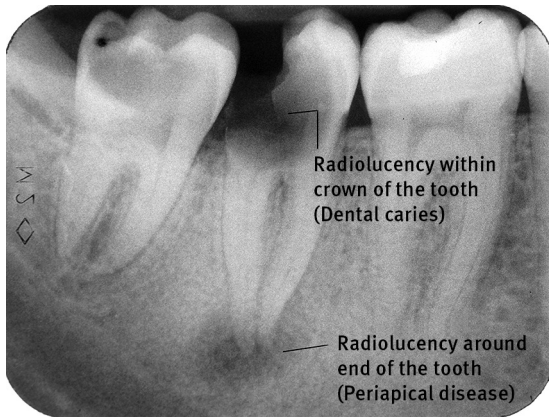


Fig 4 Radiographic signs of dental abscess