

Review

# Endodontics in the adult patient: the role of antibiotics

L.P. Longman<sup>a,\*</sup>, A.J. Preston<sup>b</sup>, M.V. Martin<sup>c</sup>, N.H.F. Wilson<sup>d</sup>

<sup>a</sup>Restorative Dentistry, Liverpool University Dental Hospital, Pembroke Place, Liverpool L3 5PS, UK

<sup>b</sup>Restorative Dentistry, Leeds Dental Institute, Clarendon Way, Leeds LS2 9LU, UK

<sup>c</sup>Oral Microbiology, Liverpool University Dental Hospital, Pembroke Place, Liverpool L3 5PS, UK

<sup>d</sup>Operative Dentistry and Endodontology, University Dental Hospital of Manchester, Higher Cambridge Street, Manchester M15 6FH, UK

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## Abstract

**Objectives:** The aim of this study was to review the published work on the indications and efficacy for antibiotics in endodontic therapy.

**Data sources:** Published works in the medical and dental literature.

**Study selection:** Evaluation of published clinical trials in endodontic and other pertinent literature.

**Conclusions:** Antibiotics are not routinely indicated in the practice of endodontics. Therapeutic antibiotics may be required as an adjunct to operative treatment when there is pyrexia and/or gross local swelling; they are only rarely indicated in the absence of operative intervention. Prophylactic antibiotics may be required for certain patients who are susceptible to serious infective sequelae. © 2000 Elsevier Science Ltd. All rights reserved.

**Keywords:** Endodontics; Antibiotics

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\* Corresponding author. Tel.: +44-151-706-5110.

E-mail address: lplong@liv.ac.uk (L.P. Longman).

Antibiotics should only be prescribed on the basis of a defined need [1] otherwise their use may present more of a risk to the patient than the infection being treated or prevented. Antibiotics can be responsible for various adverse effects, including drug interactions, selection and overgrowth of resistant microorganisms, nausea, gastrointestinal upsets, potentially fatal allergic reactions and antibiotic associated colitis [1–3]. The indiscriminate prescribing of antibiotics can cause drug resistance which is an emerging and significant problem in oral microorganisms [4–7]. There is clear evidence that antimicrobials are being used inappropriately by dentists for a variety of conditions [3,8–10]. One discipline of restorative dentistry in which antibiotics are used extensively is endodontics [3,9–12]. It is the purpose of this paper to review the indications and contraindications for the use of topical and systemic antibiotics in endodontic practice.

There are few controlled double blinded clinical trials on the use of antibiotics in endodontics that give conclusive evidence of therapeutic benefit. There is, however, some evidence that antibiotics are not beneficial [13]. Antibiotic usage in endodontic therapy is almost totally empirical driven by opinion and medicolegal concerns. The rational use of antibiotics is based upon three variables: a defined indication, the appropriateness of the antibiotic and the adverse effects associated with the drug [2]. The first factor is the most contentious because there is a paucity of scientific evidence to support the use of antibiotics in clinical practice [2,9,12]. Antibiotics are prescribed in endodontic practice for either therapeutic or prophylactic purposes. The principles underlying the therapeutic use of antibiotics are fundamentally different from those applied to chemoprophylaxis.

## 1. Endodontics and therapeutic antibiotics

The primary treatment of endodontic infections is to establish and maintain surgical drainage and to remove the cause of the infection. In practice, drainage may not always be possible, as a consequence there are two possible indications for therapeutic antimicrobials.

### 1.1. Adjunct to operative treatment

In healthy patients, most endodontic infections can be treated solely by the early establishment of drainage and removal of the cause of the problem, for example, debridement of the infected root canal system or surgical removal of extraradicular infection. In some patients with acute dentoalveolar infection, antibiotics may be indicated because there is a diffuse spreading infection or evidence of systemic involvement [14–16]. This may be accompanied by a feeling of malaise and an elevated body temperature [15,17]. Antibiotics are not an alternative to dental intervention; they are an adjunct to it [12,14,15,18–21].

In medically compromised patients, the host-defence

mechanisms may be thought to be inadequate, and as a consequence, the operative treatment of acute dentoalveolar infections may sometimes be supplemented with therapeutic antibiotics [14]. A patient's resistance to infection may be reduced by medication (e.g. corticosteroids, antimetabolites), systemic disease such as leukaemia, HIV or poorly controlled Type I diabetes [2,22–24]. Each patient should be assessed and antibiotics prescribed only where necessary. Irrespective of the use of antibiotics, medically compromised patients should be reviewed during the treatment of acute infections to monitor their response to therapy.

### 1.2. Contingency treatment

On rare occasions, it may not be possible to obtain drainage or remove the cause of infection by operative treatment. There is no evidence that the use of antibiotics in this situation is of any benefit; definitive treatment is required. The principle purposes of prescribing are to: limit the local spread of infection, treat systemic infection and bring about symptomatic relief [18–20].

One example when therapeutic antibiotics are required is when a patient has a cellulitis associated with an acute periapical infection, originating from a tooth that has a well-retained intraradicular post. In this situation drainage of infection cannot be achieved by the incision of the soft tissues and cannot be readily achieved by intracanal instrumentation. It is thus reasonable to prescribe therapeutic antibiotics prior to definitive treatment. Failure to achieve anaesthesia for the extraction of an abscessed tooth can necessitate a prescription for antimicrobials in acute periapical infection. Therapeutic antibiotics can be used when an anxious or phobic patient presents with acute periapical infection, and cannot accept treatment without the assistance of sedation. In these circumstances, root treatment would normally have to be postponed until it was possible to administer sedation. Similarly, uncooperative patients with physical or learning disabilities may not be amenable to immediate operative treatment. There is evidence to suggest that systemic antibiotics are frequently prescribed as first line management for pulpitis [3,9,15,18]. This practice is unwarranted [3,15] and is not an alternative to operative intervention.

#### 1.2.1. Antibiotics at obturation

Anecdotal evidence cites the use of systemic antibiotics at the time of obturation, when pus remains in the root canal system, despite repeated inter-appointment dressings [25]. There is no scientific evidence that this practice is beneficial. Antibiotic therapy has also been suggested for one visit endodontics, undertaken when there is infection present in the root canal [26,27]. There is no evidence that antibiotics are efficacious in this situation, the root canal is dressed rather than obturated [28].

### 1.2.2. Antibiotics for perio-endo lesions

There are no authoritative studies to support the use of systemic antibiotics in the management of “perio-endo” lesions. The treatment of combined lesions is based upon the basic principles of endodontic and periodontal therapy, and is dependent upon the aetiology of the condition. Endodontic treatment usually involves root canal treatment, or less commonly root resection or repair of a perforation. Systemic antibiotics are not a substitute for effective mechanical debridement of the root canal system and root surface.

### 1.2.3. Which antibiotic?

It is generally agreed that the majority of extraradicular and intracanal endodontic infections contain a mixture of oral facultative flora and anaerobes [29–31], but some Gram-negative enteric bacteria have been found [15,32]. At least 70 different bacterial species have been isolated from root canals and synergistic relationships are thought to exist between them [17,32]. Certain bacteria seem to occur in pairs and these include: *Bacteroides vulgaris* and *Fusobacterium necrophorum*; *Peptostreptococcus* spp. and *Prevotella* spp; *P. micros* and *P. melaninogenica*; *Prevotella* and *Eubacterium* ssp. [17,30]. The majority of symptomatic, infected root canals contain anaerobes; it has been proposed that the larger the number of bacterial species present the more symptoms will be experienced [17,31]. It has also been demonstrated that intracanal flora from teeth with failed endodontic therapy differs markedly from the root canals of untreated teeth [33].

Empirical prescribing of anti-microbials as part of endodontic management is problematic, given the diversity of potential pathogens and their differing drug sensitivities. Culture and sensitivity testing is not routinely recommended for endodontic procedures. Microbiological investigation of an infected root canal is difficult due to the risk of sample contamination. The most commonly prescribed antibiotics are erythromycin, amoxicillin, penicillin and metronidazole [3,10,11,16,18]. Some anaerobes isolated from the endodontic lesions are resistant to penicillin and therefore serious infections are treated empirically with a combination of metronidazole and a penicillin [1,16]. The cephalosporins and clindamycin are prescribed less frequently for endodontic infections [9,18]. Cephalosporins may be indicated in endodontic practice as they have good bone penetration [34,35]. Cephalosporins are active against some oral anaerobes and facultative bacteria. Clindamycin has a similar spectrum of anti-microbial activity to the cephalosporins and penetrates bone well, but is not recommended for routine use in endodontic practice because of its serious side effects [1,12].

The duration of antibiotic therapy required for acute dentoalveolar infections has never been defined precisely. There has been a tendency in dental practice to use courses of antibiotics, lasting 3–5 days for the treatment of infection [1,19]. There is increasing awareness of the value of the

commensal flora in the host’s defence system both in the oral cavity and in other body sites [36–39]. Prolonged courses of antibiotics destroy the commensal flora and abolish colonisation resistance [36–38]. The prescribing of systemic antibiotics must therefore be justifiable.

However, recent studies on the use of antimicrobials have supported the view that it is not necessary to complete the course of antibiotics [14,19,20]. One study has advocated that a two-dose administration of an anti-microbial agent is as efficacious as a 5 day course in the management of acute dentoalveolar infections; this was not a double blind placebo controlled trial [14]. Two separate investigations, compared three anti-microbial agents, and showed that the majority of patients were asymptomatic after 2 days therapy [19,20]. It is the opinion of the authors that in the majority of patients 2 or 3 days of oral antibiotics, in doses recommended by the BNF, will suffice for acute dentoalveolar infections. Alternatively, a two-dose regime of 3 g amoxicillin can be used in patients who are not allergic to penicillin [14].

## 2. Topical antibiotics and endodontics

Antibiotic-containing preparations can be used in endodontic therapy as topical agents. The limited spectrum of activity of the antibiotic preparations available, the potential for bacterial resistance, the risk of drug hypersensitivity and the potential to mask certain aetiological factors limit their usefulness. There is no clear scientific evidence for the use of topical antibiotics in root canal therapy.

### 2.1. Pulpitis

There is no indication for the use of topical antibiotics in the treatment of pulpitis [3,15]. The treatment of reversible pulpitis usually involves the placement of a definitive restoration or temporary sedative dressing [40]. The treatment of irreversible pulpitis is normally root canal therapy or extraction. There is no convincing evidence to justify the use of Ledermix (Lederle Laboratories Gosport, Hants, UK) to sedate the pulp prior to definitive treatment.

### 2.2. Pulp capping

Calcium hydroxide, despite recent reports of the use of adhesive systems, remains a most popular agent for both direct and indirect pulp capping [41]. It has been shown to be effective for this purpose, due to its anti-bacterial action and it has been suggested that it stimulates secondary dentine formation [42–46].

Several topical antibiotic-containing preparations have been evaluated for their use as pulp capping agents but their efficacy is equivocal. Ledermix is the most commonly used alternative to calcium hydroxide and contains a steroid (triamcinolone) and an antibiotic (demethylchlortetracycline) [47,48]. Ledermix is a topical preparation, available

Table 1  
Indications for systemic prophylactic antibiotics in endodontics

Dental procedure	Medical status				
	Endocardial disease	Total joint replacement	Immunocompromised, transplants, dialysis	Radio-therapy to jaws	Healthy patient
Extractions, biopsy	Yes	No, unless requested by specialist	No, unless requested by specialist	Yes	No
Scaling, root planing	Yes	No, unless requested by specialist	No, unless requested by specialist	No	No
Periodontal surgery, repair of root perforation, root resection, Apicectomy, retrograde root filling	Yes	No, unless requested by specialist	No, unless requested by specialist	Yes <sup>a</sup>	No
Incision of an abscess	Yes	No	No	No	No
Re-implantation	Yes <sup>b</sup>	Yes	Yes, but re-implantation may be contraindicated	Re-implantation is contraindicated	Yes
Repositioning	Yes <sup>b</sup>	No, unless requested by specialist	No, unless requested by specialist	Individual assessment required — repositioning may be contra-indicated	No
Determination of root canal length	Yes	No	No	No	No
Pulp extirpation, intracanal biomechanical preparation	No	No	No	No	No
Root canal irrigation, obturation	No	No	No	No	No
Intracoronaral preparations: e.g., pulp caps, pulpotomy	No	No	No	No	No
Placement of rubber dam	No	No	No	No	No

<sup>a</sup> The elevation of mucoperiosteal flaps is not recommended in patients susceptible to osteoradionecrosis, especially in the mandible.

<sup>b</sup> Antibiotics *must* be administered pre-operatively.

as either a paste or a cement. Preparations containing other antibiotics have also been used, such as erythromycin estolate [49] and vancomycin [50]; none of these antibiotics have been shown to be very effective and they have unwanted side effects.

In a multi-centre study more than 400 teeth were pulp capped and followed up for 2 years [48]. Calcium hydroxide and Ledermix were equally efficacious as pulp capping agents in asymptomatic teeth. In symptomatic teeth, the most efficacious treatment was the application of Ledermix for 3 days, followed by permanent pulp capping with calcium hydroxide. However, Ledermix has been shown to be irritant to the pulp in animal studies [51] and its use as a pulp capping agent, albeit for a few days, is not recommended [52]. The efficacy of pulp capping agents remains unresolved.

### 2.3. Root canal therapy

The most important elements of root canal preparation are effective access and aseptic biomechanical preparation. Early investigations evaluated two antibiotic-containing preparations: Grossman's polyantibiotic paste, which contains penicillin, bacitracin or chloramphenicol and

streptomycin [53] and the other a mixture of neomycin, polymixin and nystatin [54]. Both of these had some efficacy as intracanal medicaments. A more recent study has shown that clindamycin gave no advantage as a root canal dressing when compared with conventional root canal dressings [55]. Further in vitro investigations have produced more favourable results when antibiotic mixtures such as ciprofloxacin, metronidazole and minocycline have been used as topical root canal agents [56,57]. However, the consensus of clinical opinion is that calcium hydroxide is the most appropriate agent for the purpose of controlling bacterial activity [41].

#### 2.3.1. Flare-ups

Topical antibiotics have been used to reduce post-operative pain and swelling following root canal preparation; this is often referred to as a flare-up. There is no definitive evidence as to which intracanal medicament, if any, is most likely to prevent flare-ups [58–60]. Flare-ups can occur during multi-visit root canal therapy. In the treatment of infected root canals where there is often a need to carry out the treatment over more than one visit, with an antibacterial intracanal medicament placed between visits [28]; the

Table 2  
Prophylactic antibiotic regimes

Medical status Endodontic procedure	No penicillin allergy	Penicillin allergy
<i>Healthy</i> (1) Re-implantation of avulsed teeth (2) Endodontic surgery (if the clinician believes that prophylaxis is indicated)	(1) 1 g cephadrine orally, 1–1.5 h pre-operatively (2) 3 g amoxicillin orally, 1 h pre-operatively	(1) 600 mg Clindamycin <sup>a</sup> orally 1 h pre-operatively (2) 600 mg Clindamycin <sup>a</sup> orally 1 h pre-operatively
<i>Endocardial disease</i> Determination of root canal length, apicectomy, root resection, repair of root perforation, root planing, extraction, biopsy, incision and drainage, re-implantation of avulsed teeth, repositioning of displaced teeth	3 g amoxicillin, orally 1 h pre-operatively  If special risk <sup>b</sup> follow BSAC recommendations [78–82]	600 mg Clindamycin <sup>a</sup> orally 1 h pre-operatively  If special risk <sup>b</sup> follow BSAC recommendations [78–82]
<i>Immunocompromised</i> Chemoprophylaxis is only required for exodontia, root planing and surgical endodontics if requested by the patients specialist	3 g amoxicillin, orally 1 h pre-operatively 600 mg Clindamycin <sup>a</sup> orally 1 h pre-operatively	
<i>Artificial joint replacement</i> Chemoprophylaxis is only required for exodontia, root planing and surgical endodontics if requested by the patients specialist	1 g cephadrine orally, 1–1.5 h pre-operatively	600 mg clindamycin <sup>a</sup> orally 1 h pre-operatively
<i>Susceptible to osteoradionecrosis</i> Exodontia, endodontic surgery	1 g cephadrine and 200 mg metronidazole orally, 1–1.5 h pre-operatively and 200 mg metronidazole, post-operatively three times daily for 3 days	600 mg Clindamycin <sup>a</sup> orally 1 h pre-operatively and 200 mg metronidazole, post-operatively three times a day for 3 days

<sup>a</sup> Patients who have been given clindamycin must be advised to consult their doctor if diarrhoea develops. Clindamycin tablets should be swallowed with a glass of water to prevent oesophageal irritation.

<sup>b</sup> *Special risk patients.* The British Society of Antimicrobial Chemotherapy (BSAC) has recognised a group of patients, with endocardial disease, who they consider as “special risk”; these are considered to be particularly susceptible to IE and are normally referred to hospital for dental treatment requiring prophylaxis. Special risk patients are classified as those patients with endocardial disease who: (i) have had IE before OR; (ii) require a general anaesthetic and (a) have a prosthetic heart valve or; (b) are allergic to penicillin or have had penicillin more than once in the previous month [78–82].

intracanal medicament that has been recommended is calcium hydroxide [35].

#### 2.4. Perio-endo lesions

Topical antibiotics, such as the tetracyclines or metronidazole, may be applied by some clinicians, to the periodontal defect as an adjunct to root planing. The effectiveness of topical anti-microbials has not been evaluated in this situation.

#### 2.5. Tooth avulsion

Topical antibiotics are rarely indicated in the management of tooth avulsion. There is evidence to suggest that they may be of value in the control of infection and the prevention of root resorption [15,61,62]. Ledermix has been used as an intracanal medicament in the management of tooth avulsion [61,63], but it is not clear whether the beneficial effect is due to the action of the steroid or the antibiotic. There is a need for controlled trials to evaluate the role of topical antibiotics in avulsed teeth.

### 3. Antibiotic prophylaxis and endodontics

It is sometimes necessary to prescribe antibiotics during

the practice of endodontics to prevent infection, the indications are summarised in Table 1. If antibiotic prophylaxis is to be rational, the clinician needs to be able to identify the patients who are thought to be susceptible to significant infection, the dental procedures that present an infection risk, and an appropriate anti-microbial regime. To achieve any protective effect antibiotics must be administered pre-operatively to provide adequate tissue concentrations at the time of operation [64–66]. The most effective use of prophylactic antibiotics is in short term, high dosage regimens that are active against the common pathogens [39,67]. There is no evidence that continuing prophylactic antibiotics beyond surgery (operative intervention) reduces the risk of infection [67]. The antibiotic regimes that may be used for prophylaxis are given in Table 2.

#### 3.1. Healthy patients

There is no evidence that antibiotic prophylaxis, given to healthy patients undergoing surgical endodontics is efficacious [68–70]. Despite this, antibiotics are sometimes prescribed prophylactically to prevent infection at the site of surgery. Some authorities feel it justifiable to prescribe prophylactic antibiotics when the maxillary antrum or floor of the nose has been perforated [69], however, others disagree with this opinion [71]. When clinicians wish to

prescribe prophylaxis, the single dose regimes shown in Table 2 would be suitable, rather than erroneously prescribing ineffective therapeutic regimes post-operatively. When there has been an unexpected breach in the respiratory mucosa a single oral or intravenous dose of antibiotic prophylaxis rather than a 3–5 day course can be given on completion of the procedure.

### 3.1.1. Avulsed, re-implanted and displaced teeth

There is a strong body of opinion that antibiotic prophylaxis is recommended following the re-implantation of avulsed teeth, and should be commenced as soon as possible [15,23,72]. The evidence to support this recommendation is weak, and mainly based on opinion. There is limited scientific evidence which suggests that antibiotics may be beneficial in the prevention of bacterial invasion of the pulp and there is some evidence that root resorption is inhibited [15,62]. Ideally, antibiotics should be given prior to re-implantation. This is often not possible and could necessitate a delay in tooth replacement, adversely affecting the prognosis [72–75]. Re-implantation is therefore, one of the rare situations when chemoprophylaxis may have to be given post-operatively, assuming there are no medical contraindications [23].

There is difficulty in providing definitive guidelines for the re-implantation of avulsed teeth in medically compromised patients [23,72]. The re-implantation of teeth should not be considered if the procedure places the patient at risk from haematogenous spread of infection. An example would be a patient with acute leukaemia or HIV infection. The UK guidelines in paediatric dentistry suggest that it may sometimes be possible to re-implant a tooth in medically compromised patients, but this should only be undertaken if the prognosis is favourable and only then in consultation with the patient's specialist physician [23]. Once the decision to re-implant has been made the timing of antibiotic prophylaxis is critical if serious sequelae are to be avoided. It would be logical to administer antibiotic prophylaxis prior to implantation, to ensure adequate antibiotic serum levels at the time of operation.

No national recommendations exist on the most appropriate prophylactic antibiotics for re-implantation of avulsed teeth. It would seem reasonable to prescribe antibiotics that are bactericidal against the putative pathogens and achieve high concentrations at the site of trauma. However, it is not possible to give prophylaxis to cover all potential pathogens to which an avulsed tooth may be exposed. The exogenous pathogens are mainly skin commensals transferred whilst handling the tooth. Thorough pre-operative preparation of the tooth should be undertaken in such a way as to minimise this risk. Endogenous organisms are always going to be present and will principally consist of oral flora. A broad-spectrum antibiotic should be used which penetrates bone and has activity against both facultative and anaerobic oral organisms. The authors would recommend a single dose regime of cephadrine for

patients who are not penicillin allergic; clindamycin could be used in penicillin-sensitive patients (Table 2). This regimen is the same as that used to protect against infections involving bone in other situations [34,76]. The pre-operative administration of a single dose of antibiotic is in contrast to the 7–14 day course recommended by other workers [15,63,77].

Patients who have an avulsed tooth and are at risk from infective endocarditis (IE) require careful assessment. In the opinion of the authors, re-implantation should only be undertaken after antibiotic prophylaxis has been administered. A single dose of clindamycin may be appropriate as it has good penetration into bone and may also be of value in the prevention of IE [78,79].

There is no evidence that systemic antibiotics are of value when repositioning displaced teeth, however, they are used by some clinicians [72]. The authors recommend that prophylactic antibiotics are only indicated when repositioning displaced teeth in patients who have a history of endocardial disease. In this situation tooth movement should be delayed until after antibiotics have been administered, in accordance with the BSAC guidelines for the prevention of IE [78–82].

### 3.2. Flare-ups

There is conflicting evidence about the efficacy of systemic antibiotics in preventing post-treatment symptoms of pain and swelling following root canal preparation and obturation [16,25,83–86]. These studies are difficult to compare because of differences in experimental design and the criteria used to define a post-treatment flare-up. It has also been argued that the use of antibiotics in this situation is not strictly prophylaxis. This has been proposed because teeth that have necrotic pulps with associated periapical radiolucencies are invariably infected [84]; antibiotic administration in this situation is therapeutic. In the absence of definitive evidence, the authors do not advocate the use of antibiotics for this purpose. The use of systemic prophylaxis for single appointment RCT is highly contentious [25,83,87].

### 3.3. Prophylaxis for the medically compromised

Patients in this group fall into two distinct categories. One group is those patients in whom the risk of infection is small, but the consequences very serious. Patients who are susceptible to IE, or osteoradionecrosis, and those who have endoprostheses are included in this category. The second category is patients with impaired host-defence mechanisms. These patients are potentially at risk from opportunistic infections. Patients who are receiving renal dialysis or have had organ transplants are included in this group.

#### 3.3.1. Infective endocarditis

Patients who have a damaged endocardium have an

increased susceptibility to IE. It is possible that dental procedures that reliably cause a transient bacteraemia could result in IE. The use of chemoprophylaxis is well established and necessary medico-legally for surgical endodontics, in patients at risk from IE, and national guidelines should be followed [78,79]. The role of some dental procedures in the aetiology of IE has recently been challenged [88]. Other authorities take a contrary view (ref MVM, BSAC, AHA) Antibiotic prophylaxis for non-surgical endodontics in this group of patients is controversial [80,89]. It is unrealistic and undesirable to give systemic prophylaxis for every endodontic procedure that may occasionally cause bleeding or a bacteraemia, including the placement of rubber dam. Simple pre-operative mouthrinsing and disinfection of the gingival tissues with chlorhexidine reduces the magnitude of a bacteraemia [82,91]. However, root canal therapy deserves special consideration. IE as a consequence of root canal therapy has, however, only been reported infrequently [90,92]. Intracanal instrumentation does cause a bacteraemia [93,94], however, it has never been associated with a proven case of IE. It has been shown that extra-canal instrumentation regularly causes a bacteraemia [89,95,96]. The American Heart Association amended their recommendations in 1997, and now advise the use of systemic prophylaxis for instrumentation beyond the apex, in patients “at risk” from IE [97]. Extracanal instrumentation often occurs during the blind negotiation of a root canal; it is therefore, prudent to administer antibiotic prophylaxis for the radiographic determination of root canal length. In the opinion of the authors antibiotic cover would not be required for biomechanical preparation and obturation at future visits when extracanal instrumentation would be very unlikely [97].

It is important to emphasise that elective endodontic procedures should be avoided wherever possible, in patients who have a damaged endocardium and concomitant gingival inflammation. There appear to be no consistent recommendations concerning the risk of IE in cardiac transplant patients, advice should be sought from the supervising physician or surgeon.

### 3.4. Radiotherapy

Patients who have previously been exposed to therapeutic radiation to the jaws may be susceptible to local infection. After radiotherapy, there is a diminution of the vascular supply in the irradiated area especially in the mandible. This is a progressive risk that does not reduce with time. When feasible, the patient’s oncologist should be asked to comment upon the risk of osteoradionecrosis. The risk of infection is much greater with exodontia than root canal therapy, consequently non-surgical endodontics is the preferred treatment for a necrotic pulp in irradiated patients [98,99]. The value of chemoprophylaxis for root canal therapy is doubtful and is not routinely recommended. The benefit of antibiotics is questionable in this group of

patients due to poor penetration into the ischaemic irradiated bone. It is nevertheless a common practice to give antibiotic prophylaxis to patients who are at risk from osteonecrosis for extractions and surgery. Numerous regimens have been advocated, some specifying a 10 day course of antibiotics [99]. The authors suggest the regime stated in Table 2, which combines both prophylactic and post-operative antimicrobials. The elevation of a mucoperiosteal flap is to be avoided when possible, especially in the mandible, because this further reduces the blood supply to the underlying bone.

#### 3.4.1. Prosthetic implants

In 1992 the British Society of Antimicrobial Chemotherapy (BSAC) found no evidence to support the routine use of antibiotic cover for dental treatment in patients with prosthetic joints [100]. The BSAC did not think that the advantages of antibiotic prophylaxis outweighed the potential risks. Despite the BSAC guidelines many orthopaedic surgeons continue to recommend antibiotic prophylaxis for dental patients with total joint replacements [76,101]. It has further been suggested that well-defined groups of patients are particularly susceptible to late joint infections [34,76]. These patients include those who have severe rheumatoid arthritis, a history of infections of prosthetic joints, poorly controlled insulin dependent diabetes or take long-term immunosuppressants.

When the decision has been made to give prophylaxis the procedures requiring cover are principally scaling, extractions and oral surgery, including surgical endodontics. There is no evidence to implicate root canal therapy with late infections of artificial joints. The prophylactic antibiotics should target the putative pathogens, staphylococci and to a lesser extent oral streptococci [34]. The regime proposed by Field and Martin [34] is advised (Table 2). This differs from that used to prevent IE in that it recommends the use of cephadrine, which has anti-staphylococcal activity, as opposed to amoxicillin.

Patients with cardiac pacemakers, intraocular lenses, breast implants, penile implants and prosthetic vascular grafts are not considered to be especially susceptible to infection from dental bacteraemias [80,97,102]. The use of antibiotic prophylaxis in patients with intravascular access devices and CSF shunts is contentious [103]. Neurosurgeons are more likely to recommend prophylaxis for patients with ventriculoatrial shunts, than for the more commonly used ventriculoperitoneal shunts [103]. Advice from the consultant regarding the need for prophylaxis for surgical endodontics should be sought. Non-surgical endodontics does not require antibiotic cover in patients with CSF shunts.

#### 3.4.2. Immunocompromised patients

The Working Party of the BSAC states that, in the absence of any other indication, patients who are immunocompromised, including patients who have organ transplants

or indwelling intraperitoneal catheters, do not require antibiotic prophylaxis for dental treatment [1]. It can be concluded, therefore, that endodontic treatment does not require antibiotic prophylaxis. In clinical practice, it is, however, not unusual for physicians or surgeons to specifically request that their patient is given systemic prophylaxis for certain dental procedures. When managing immunocompromised patients it is prudent for the dentist to liaise with the supervising consultant to seek their views on prophylaxis. If chemoprophylaxis is recommended a single dose regime should be used, amoxicillin or clindamycin would be a suitable pre-operatively (Table 2). Some renal specialists object to the use of clindamycin, and may advise an alternative agent. Procedures such as extractions, minor oral surgery and scaling would require systemic prophylaxis; in contrast to RCT and other forms of non-surgical endodontics.

#### 4. Conclusions

Systemic antibiotics should normally only be prescribed to treat dental infections on the basis of a defined need [1]. Clinicians can become complacent when prescribing antimicrobials and this may give rise to the dangerous assumption that they cause no harm. The potential benefits of antibiotic administration should therefore outweigh the possible disadvantages associated with their use. A dentist who prescribes an antibiotic for a questionable indication may be seen as placing a patient at risk from potential adverse effects of drugs.

The treatment of acute and chronic infections of endodontic origin is primarily by operative intervention. The therapeutic use of antibiotics is thus as an adjunct to mechanical treatment. There is no evidence that systemic antibiotics are justified in the treatment of pulpitis. Prophylactic antibiotics, when indicated for endodontic treatment, should be given pre-operatively — preferably as a single high dose. Prophylactic antibiotics are usually only indicated in medically compromised patients; an exception would be in the re-implantation of an avulsed tooth. The use of topical anti-microbial agents has declined and requires further research and evaluation.

This paper has presented a rational approach to the use of systemic and topical antibiotics in the practice of endodontics, based upon review of the available literature. The adoption of protocols for the prescribing of antibiotics in endodontics could result in considerable financial savings and a reduction in the number of adverse reactions associated with their use.

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