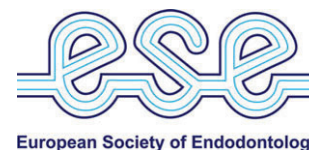


REVIEW

**European Society of Endodontology
position statement: the use of
antibiotics in endodontics**

European Society of Endodontology developed by: J. J. Segura-Egea¹ , K. Gould², B. Hakan Şen³ , P. Jonasson⁴, E. Cotti⁵, A. Mazzone⁶, H. Sunay⁷, L. Tjäderhane^{8,9} & P. M. H. Dummer¹⁰

¹Department of Endodontics, School of Dentistry, University of Sevilla, Sevilla, Spain; ²Newcastle upon Tyne Hospitals NHS Foundation Trust, Newcastle upon Tyne, UK; ³Private Practice, Alsancak, Izmir, Turkey; ⁴Department of Endodontology, Institute of Odontology, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden; ⁵Department of Conservative Dentistry and Endodontics, University of Cagliari, Cagliari, Sardinia, Italy; ⁶Department of Biomedical and Neuromotor Sciences, DIBINEM, University of Bologna, Bologna, Italy; ⁷Department of Endodontology, Dental Faculty of Istanbul, Kemerburgaz University, Istanbul, Turkey; ⁸Department of Oral and Maxillofacial Diseases, Helsinki University Hospital, University of Helsinki, Helsinki, Finland; ⁹Research Unit of Oral Health Sciences, Medical Research Center Oulu (MRC Oulu), University Hospital and University of Oulu, Oulu, Finland; and ¹⁰School of Dentistry, College of Biomedical & Life Sciences, Cardiff University, Cardiff, UK

Abstract

European Society of Endodontology developed by: Segura-Egea JJ, Gould K, Hakan Şen B, Jonasson P, Cotti E, Mazzone A, Sunay H, Tjäderhane L, Dummer PMH. European Society of Endodontology position statement: the use of antibiotics in endodontics. *International Endodontic Journal*, 51, 20–25, 2018.

This position statement represents a consensus of an expert committee convened by the European Society of Endodontology (ESE) on Antibiotics in Endodontics. The statement is based on current scientific evidence as well as the expertise of the committee. The goal is to provide dentists and other healthcare workers with evidence-based criteria for when to use antibiotics in the treatment of endodontic infections, traumatic

injuries of the teeth, revascularization procedures in immature teeth with pulp necrosis, and in prophylaxis for medically compromised patients. It also highlights the role that dentists and others can play in preventing the overuse of antibiotics. A recent review article provides the basis for this position statement and more detailed background information (*International Endodontic Journal*, 2017, <https://doi.org/10.1111/iej.12741>). Given the dynamic nature of research in this area, this position statement will be updated at appropriate intervals.

Keywords: antimicrobial agents, apical periodontitis, endodontic infection, periapical periodontitis, pulpitis.

Received 16 April 2017; accepted 19 April 2017

Introduction

Endodontic infections, resulting in pulpitis or apical periodontitis, are polymicrobial, involving a combination of Gram-positive, Gram-negative, facultative anaerobes and strict anaerobic bacteria (Siqueira &

Roças 2014). Most endodontic infections are confined within the tooth and can be successfully managed by established local operative treatment (European Society of Endodontology 2006), drainage or tooth extraction without the need for local or systemic antibiotics. However, when there is evidence of systemic involvement and gross, rapid and diffuse spread of infection, antibiotics may be indicated as an adjunct to local treatment.

Prevention of bacterial contamination in traumatic injuries affects the prognosis of the affected teeth.

Correspondence: Paul M. H. Dummer, Secretary, European Society of Endodontology, Postboks 1237 Vika, 0110 Oslo, Norway (e-mail: secretary@e-s-e.eu).

Minimization of the bacterial load during the healing phase is beneficial in the management of injuries (Andreasen *et al.* 2006), and systemic or topical antibiotics can play an important role (<https://dentaltraumaguide.org/>).

The use of antibiotics to disinfect the root canal system has been commonplace in regenerative endodontic procedures (REPs) in immature teeth with necrotic pulps and apical periodontitis (Diogenes *et al.* 2013, Kontakiotis *et al.* 2015, Galler 2016). However, their continued use is being questioned (European Society of Endodontology 2016).

In healthy individuals, any bacteraemias generated by endodontic treatments are rapidly scavenged and cause no complications (Parahitiyawa *et al.* 2009), but in susceptible individuals, antibiotics can be given prophylactically to prevent local postoperative infections and metastatic spread of infection.

Systemic antibiotics in Endodontics

Indications for systemic antibiotics in Endodontics

Adjunctive systemic antibiotic treatment in conjunction with endodontic therapy is indicated in the following (Segura-Egea *et al.* 2017):

1. Acute apical abscess in medically compromised patients;
2. Acute apical abscess with systemic involvement (localized fluctuant swellings, elevated body temperature >38°C, malaise, lymphadenopathy, trismus);
3. Progressive infections (rapid onset of severe infection in <24 h, cellulitis or a spreading infection, osteomyelitis) where onward referral to oral surgeons may be necessary;
4. Replantation of avulsed permanent teeth (Hinckfuss & Messer 2009, Segura-Egea *et al.* 2017). In these cases, topical administration of antibiotics may also be indicated (Andersson *et al.* 2012).
5. Soft tissue trauma requiring treatment (e.g. sutures, debridement) (Diangelis *et al.* 2012).

Contra-indications for systemic antibiotics in Endodontics

Most endodontic infections are confined within the tooth and can be successfully managed by established local operative treatment (European Society of Endodontology 2006), drainage or tooth extraction without the need for local or systemic antibiotics.

Thus, adjunctive systemic antibiotic treatment during endodontic therapy is not indicated in the following (Agnihotry *et al.* 2016, Segura-Egea *et al.* 2017):

1. Symptomatic irreversible pulpitis (pain, with no other symptoms and signs of infection);
2. Pulp necrosis;
3. Symptomatic apical periodontitis (pain, pain to percussion and biting and widening of periodontal ligament space);
4. Chronic apical abscess (teeth with sinus tract and periapical radiolucency);
5. Acute apical abscess without systemic involvement (localized fluctuant swellings).

From current knowledge (Segura-Egea *et al.* 2017) and based on the International Association of Dental Traumatology (IADT) guidelines (Andersson *et al.* 2012), antibiotic administration is not indicated in the treatment of tooth fractures, concussion, subluxation, luxation injuries and extrusion.

Types of antibiotics, recommended dosages and duration

Beta-lactam antibiotics (penicillin V and amoxicillin) are recommended for the treatment of endodontic infections (Segura-Egea *et al.* 2017) (Table 1). Antibiotics should be prescribed at the correct frequency, dose and duration so that the minimal inhibitory concentration is surpassed and so that side effects and the selection of resistant bacteria are prevented (Bax 2007). Recommended loading doses are 1000 mg of penicillin V administered orally followed by 500 mg

Table 1 Type, dosages and duration of antibiotics prescribed in Endodontics

| Drug of choice | Loading dose | Maintenance dose | Duration |
|----------------------------------|--------------|---------------------------|----------|
| Penicillin VK ^a | 1000 mg | 500 mg q4-6h | 3–7 days |
| Amoxicillin | 1000 mg | 500 mg q8h or 875 mg q12h | 3–7 days |
| Amoxicillin with clavulanic acid | 1000 mg | 500 mg q8h or 875 mg q12h | 3–7 days |
| Clindamycin ^b | 600 mg | 300 mg q6h | 3–7 days |
| Clarithromycin ^b | 500 mg | 250 mg q12h | 3–7 days |
| Azithromycin ^b | 500 mg | 250 mg q24h | 3–7 days |
| Metronidazole | 1000 mg | 500 mg q6h | 3–7 days |

^aIf Penicillin VK alone is not effective after 48–72 h, metronidazole (loading dose 1000 mg followed by 500 mg q6 h) can be used in combination with penicillin VK or penicillin VK is switched to amoxicillin/clavulanic acid or clindamycin.

^bIf the patient is allergic to penicillin.

every 4–6 h (Segura-Egea *et al.* 2017), or 1000 mg amoxicillin, with or without clavulanic acid, followed by 500 mg every 8 h (Segura-Egea *et al.* 2017). If penicillin V is used and therapy is ineffective, the combination of penicillin V with metronidazole (loading dose 1000 mg followed by 500 mg every 6 h) or amoxicillin with clavulanic acid is recommended (Segura-Egea *et al.* 2017). When no response occurs, consultation with a specialist (clinical microbiologist, infectious disease specialist) will be necessary.

Beta-lactam antibiotics can cause allergy. If a true penicillin allergy is confirmed, alternatives are substituted: clindamycin (600 mg loading dose followed by 300 mg every 6 h), clarithromycin (500 mg loading dose followed by 250 mg every 12 h) or azithromycin (loading dose of 500 mg followed by 250 mg once a day) (Baumgartner & Smith 2009, Skučaitė *et al.* 2010, Segura-Egea *et al.* 2017). Clinical improvement in symptoms must be the guide for the duration of antibiotic treatment. As soon as the symptoms have resolved and there is clinical evidence of healing, the antibiotic therapy should be discontinued (American Association of Endodontists (AAE) 1999). Treatment duration of 3–7 days is often sufficient to control the infection, but patients should be seen after 2 or 3 days to determine whether treatment should be stopped or continued (Dar-Odeh *et al.* 2010). As part of general antibiotic stewardship, it is currently recommended to prescribe antibiotics for 3 days and review the patient; further antibiotics should only be prescribed if indicated clinically.

Topical antibiotics in Endodontics

There is no scientific evidence to support the use of topical antibiotics in pulp capping procedures or in root canal disinfection. Moreover, microorganisms isolated from root canals are resistant against tetracyclines (Skučaitė *et al.* 2010, Al-Ahmad *et al.* 2014) and their use may promote fungal growth (MacNeill *et al.* 1997) and cause discolouration of teeth when used as intracanal topical medicaments (Chen *et al.* 2012).

The antibiotic mixture composed of ciprofloxacin, metronidazole and minocycline (100 µg mL⁻¹ of each antibiotic, 300 µg mL⁻¹ of mixture) known as triple antibiotic paste (TAP) or '3mix' has been used as intracanal therapy to achieve disinfection and resolution of infection in regenerative endodontic procedures (Diogenes *et al.* 2013). However, the use of TAP containing minocycline as intracanal dressings in REP may cause dentine discolouration (Miller *et al.* 2012, Diogenes *et al.* 2013, Rodríguez-Benítez *et al.* 2015). The replacement of minocycline with cefaclor can reduce the risk of discolouration (Miller *et al.* 2012). However, the ESE position statement on revitalization procedures advocates the use of calcium hydroxide instead of antibiotics to avoid discolouration (European Society of Endodontology 2016). In the absence of strong evidence to support the use of antibiotics in regenerative endodontic procedures, their use should be avoided (Galler 2016).

After avulsion of immature teeth with open apices, topical application of tetracyclines (minocycline or

Table 2 Indications of antibiotics prophylaxis in Endodontics

| Patient group | Indications |
|--|--|
| Impaired immunologic function (Leukaemia, HIV/AIDS, end-stage renal disease, dialysis, uncontrolled diabetes, chemotherapy, steroids or immunosuppressive post-transplant medications or inherited genetic defects) | Nonsurgical root canal treatment and, especially, endodontic surgery, considering: <ul style="list-style-type: none"> • State and control of the disease • Risk of infection-related complications • Risk of adverse drug reaction If doubt, the management of patient should be discussed with a physician |
| Risk of developing infective endocarditis (Patients with complex congenital heart defects, prosthetic cardiac valve or a history of infective endocarditis) | Nonsurgical root canal treatment Endodontic surgery |
| Prosthetic joint replacement | Nonsurgical root canal treatment Endodontic surgery During the first 3 months after joint operations |
| Patients whose jawbones are exposed to high-dose irradiation | Nonsurgical root canal treatment Endodontic surgery |
| Patients receiving intravenous bisphosphonate treatment | Endodontic surgery |

Please consult local guidelines as these indications may vary from country to country.

Table 3 Recommended antibiotic prophylaxis regimens in Endodontics

| Patient group | Antibiotic | Route | Dose | | Timing before procedure |
|--|--------------------------------|---------|--------|------------------------|-------------------------|
| | | | Adults | Children | |
| Standard general prophylaxis | Amoxicillin | PO | 2 g | 50 mg kg ⁻¹ | 1 h |
| Unable to take oral medication | Ampicillin | IV o IM | 2 g | 50 mg kg ⁻¹ | Within 30 min |
| Allergic to penicillin | Clindamycin | PO | 600 mg | 20 mg kg ⁻¹ | 1 h |
| | Cephalexin or cefadroxil | PO | 2 g | 50 mg kg ⁻¹ | 1 h |
| | Azithromycin or clarithromycin | PO | 500 mg | 15 mg kg ⁻¹ | 1 h |
| Allergic to penicillin/amoxicillin/ ampicillin and unable to take oral medications | Clindamycin | IV | 600 mg | 20 mg kg ⁻¹ | Within 30 min |
| | Cefazolin | IV | 1 g | 25 mg kg ⁻¹ | Within 30 min |

Some countries may recommend other antibiotic regimens. Please consult local Guidelines.

doxycycline, 1 mg per 20 mL of saline for 5 min) onto the root surface before reimplantation increases the chance of root canal revascularization and periodontal healing, reducing the incidence of tooth resorption (Andersson *et al.* 2012).

Antibiotic prophylaxis in Endodontics

The use of prophylactic antibiotics in medically compromised patients undergoing endodontic therapy is controversial and should only be considered when the benefit has been demonstrated or when there is consensus for such use (Lockhart *et al.* 2007, Segura-Egea *et al.* 2017). In all treatment situations (Table 2), particularly in surgical endodontic treatment, an overall medical assessment must be based on the individual case, considering the state and control of the disease, the risk of infection-related complications and the risk of an adverse drug reaction. In cases of doubt, patient management should be discussed with a physician prior to endodontic treatment (Segura-Egea *et al.* 2017).

Antibiotic prophylaxis should be considered in individuals who are at risk of developing infective endocarditis following an invasive dental procedure, such as patients with complex congenital heart defects, prosthetic cardiac valves or a history of infective endocarditis (Wilson *et al.* 2007, Richey *et al.* 2008, Nishimura *et al.* 2008). The definition of invasive dental procedures includes all dental treatments requiring manipulation of the gingival or periapical region of the teeth or perforation of the oral mucosa and root canal procedures (European Society of Cardiology 2015).

Antibiotic prophylaxis before endodontic therapy is not indicated routinely for healthy patients after prosthetic joint replacement (Berbari *et al.* 2010, Skaar

et al. 2011, Sollecito *et al.* 2015). However, during the first 3 months after joint operations, antibiotic prophylaxis should be considered (Segura-Egea *et al.* 2017).

Endodontic treatment in patients whose jawbones are exposed to high-dose irradiation for cancer treatment in the head and neck should be preceded by antibiotic prophylaxis (Tolentino Ede *et al.* 2011, Segura-Egea *et al.* 2017).

Patients receiving intravenous bisphosphonate treatment warrant antibiotic prophylaxis in bone invasive procedures, such as endodontic surgery (Dannemann *et al.* 2007, Montefusco *et al.* 2008).

The recommended prophylaxis regimen is presented in Table 3; however, please note that some countries may recommend other antibiotic regimens. Please consult local Guidelines.

Acknowledgements

Further contributions and revisions were made by ESE Executive Board members C. Löst and J. Whitworth.

Conflict of Interest

The European Society of Endodontology and the authors state explicitly that there are no conflict of interests related to this ESE position statement.

References

- Agnihotry A, Fedorowicz Z, van Zuuren EJ, Farman AG, Al-Langawi JH (2016) Antibiotic use for irreversible pulpitis. *Cochrane Database Systematic Reviews*. <https://doi.org/10.1002/14651858.CD004969.pub4>.
- Al-Ahmad A, Ameen H, Pelz K *et al.* (2014) Antibiotic resistance and capacity for biofilm formation of different

- bacteria isolated from endodontic infections associated with root-filled teeth. *Journal of Endodontics* **40**, 223–30.
- American Association of Endodontists (AAE) (1999) Prescription for the future: responsible use of antibiotics in endodontic therapy. *AAE Endodontics Colleagues for Excellence* **1999**, 1–8.
- Andersson L, Andreasen JO, Day P et al. (2012) International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. *Dental Traumatology* **28**, 88–96.
- Andreasen JO, Bakland LK, Andreasen FM (2006) Traumatic intrusion of permanent teeth. Part 3. A clinical study of the effect of treatment variables such as treatment delay, method of repositioning, type of splint, length of splinting and antibiotics on 140 teeth. *Dental Traumatology* **22**, 99–111.
- Baumgartner JC, Smith JR (2009) Systemic antibiotics in endodontic infections. In Fouad A, ed. *Endodontic Microbiology*. Iowa, IA: Wiley – Blackwell.
- Bax R (2007) Development of a twice daily dosing regimen of amoxicillin/clavulanate. *International Journal of Antimicrobial Agents* **30**(Suppl 2), S118–21.
- Berbari EF, Osmon DR, Carr A, et al. (2010) Dental procedures as risk factors for prosthetic hip or knee infection: a hospital-based prospective case-control study. *Clinical Infectious Diseases* **50**, 8–16.
- Chen BK, George R, Walsh LJ (2012) Root discoloration following short-term application of steroid medicaments containing clindamycin, doxycycline or demeclocycline. *Australian Endodontic Journal* **38**, 124–8.
- Dannemann C, Gratz KW, Riener MO, Zwahlen RA (2007) Jaw osteonecrosis related to bisphosphonate therapy: a severe secondary disorder. *Bone* **40**, 828–34.
- Dar-Odeh NS, Abu-Hammad OA, Al-Omiri MK, Khraisat AS, Shehabi AA (2010) Antibiotic prescribing practices by dentists: a review. *Therapeutic and Clinical Risk Management* **6**, 301–6.
- Diangelis AJ, Andreasen JO, Ebeleseder KA et al. (2012) International Association of Dental Traumatology. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 1. Fractures and luxations of permanent teeth. *Dental Traumatology* **28**, 2–12.
- Diogenes A, Henry MA, Teixeira FB, Hargreaves KM (2013) An update on clinical regenerative endodontics. *Endodontic Topics* **28**, 2–23.
- European Society of Cardiology (2015) ESC Guidelines for the management of infective endocarditis. *European Heart Journal* **36**, 3075–123.
- European Society of Endodontology (2006) Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. *International Endodontic Journal* **39**, 921–30.
- European Society of Endodontology (2016) European Society of Endodontology position statement: revitalization procedures. *International Endodontic Journal* **49**, 717–23.
- Galler KM (2016) Clinical procedures for revitalization: current knowledge and considerations. *International Endodontic Journal* **49**, 926–36.
- Hinckfuss SE, Messer LB (2009) An evidence-based assessment of the clinical guidelines for replanted avulsed teeth. Part II: prescription of systemic antibiotics. *Dental Traumatology* **25**, 158–64.
- Kontakiotis EG, Filippatos CG, Tzanetakis GN, Agrafioti A (2015) Regenerative endodontic therapy: a data analysis of clinical protocols. *Journal of Endodontics* **41**, 146–54.
- Lockhart PB, Loven B, Brennan MT, Fox PC (2007) The evidence base for the efficacy of antibiotic prophylaxis in dental practice. *Journal of the American Dental Association* **138**, 458–74.
- MacNeill S, Rindler E, Walker A, Brown AR, Cobb CM (1997) Effects of tetracycline hydrochloride and chlorhexidine gluconate on *Candida albicans*. An *in vitro* study. *Journal of Clinical Periodontology* **24**, 753–60.
- Miller EK, Lee JY, Tawil PZ, Teixeira FB, Vann WF Jr (2012) Emerging therapies for the management of traumatized immature permanent incisors. *Pediatric Dentistry* **34**, 66–9.
- Montefusco V, Gay F, Spina F, et al. (2008) Antibiotic prophylaxis before dental procedures may reduce the incidence of osteonecrosis of the jaw in patients with multiple myeloma treated with bisphosphonates. *Leukemia and Lymphoma* **49**, 2156–62.
- Nishimura RA, Carabello BA, Faxon DP, Freed MD, Lytle BW, et al. (2008) American College of Cardiology/American Heart Association Task Force. ACC/AHA 2008 guideline update on valvular heart disease: focused update on infective endocarditis: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines: endorsed by the Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *Circulation* **118**, 887–96.
- Parahitiyawa NB, Jin LJ, Leung WK, Yam WC, Samaranayake LP (2009) Microbiology of odontogenic bacteremia: beyond endocarditis. *Clinical Microbiology Reviews* **22**, 46–64.
- Richey R, Wray D, Stokes T (2008) Prophylaxis against infective endocarditis: summary of NICE guidance. *British Medical Journal* **336**, 770–1.
- Rodríguez-Benítez S, Stambolsky C, Torres-Lagares D, Gutiérrez-Pérez JL, Segura-Egea JJ (2015) Pulp revascularization of immature dog teeth with apical periodontitis using tri-antibiotic paste and platelet-rich plasma: radiographic study. *Journal of Endodontics* **41**, 1299–304.
- Segura-Egea JJ, Gould K, Hakan-Sen B et al. (2017) Antibiotics in Endodontics: a review. *International Endodontic Journal* **50**, 1169–84.
- Siqueira JF, Roças I (2014) Present status and future directions in endodontic microbiology. *Endodontic Topics* **30**, 3–22.

- Skaar DD, O'Connor H, Hodges JS, Michalowicz BS (2011) Dental procedures and subsequent prosthetic joint infections. Findings from the Medicare Current Beneficiary Survey. *Journal of the American Dental Association* **142**, 1343–51.
- Skučaitė N, Pečiulienė V, Manelienė R, Mačiulskienė V (2010) Antibiotic prescription for the treatment of endodontic pathology: a survey among Lithuanian dentists. *Medicina (Kaunas)* **46**, 806–13.
- Sollecito TP, Abt E, Lockhart PB, et al. (2015) The use of prophylactic antibiotics prior to dental procedures in patients with prosthetic joints: evidence-based clinical practice guideline for dental practitioners—a report of the American Dental Association Council on Scientific Affairs. *Journal of the American Dental Association* **146**, 11–16.e8
- Tolentino Ede S, Centurion BS, Ferreira LH, Souza AP, Damante JH, Rubira-Bullen IR (2011) Oral adverse effects of head and neck radiotherapy: literature review and suggestion of a clinical oral care guideline for irradiated patients. *Journal of Applied Oral Science* **19**, 448–54.
- Wilson W, Taubert KA, Gewitz M, et al. (2007) Prevention of infective endocarditis: guidelines from the American Heart Association: a guideline from the American Heart Association Rheumatic Fever, Endocarditis and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group. *Journal of the American Dental Association* **138**, 739–60.