

Antibiotic prophylaxis in dentistry

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Abstract

The aim of the present narrative review was to summarize the main indications of antibiotic prophylaxis in dentistry.

A search was performed via the search engines Pubmed, Scopus and Web of Science. All types of articles were included in the study except for those found in the various search engines and publications not related to the topic addressed, which were excluded.

With the limitations of this study, antibiotic prophylaxis could play a decisive role in avoiding post-operative infections, especially in more invasive surgeries and in compromised patients. Further clinical studies could be useful to further investigate the role of antibiotic prophylaxis according to individual systemic diseases.

Keywords: antibiotic prophylaxis, systemic diseases, oral surgery, dental implants.

Introduction to antibiotics used in dentistry

Waksman SA., defined an antibiotic as "a chemical substance, produced by microorganisms, which can inhibit the growth and even destroy bacteria and other microorganisms". (Waksman SA, 1956). Nowadays, the term antibiotic refers to a chemical substance of natural or synthetic origin that inhibits or kills pathogenic bacteria (Kl., 2016). The first antibiotic was described by Bartolomeo Gosio, an Italian physician, microbiologist and biochemist, who succeeded in isolating a substance (*Penicillium brevis*) from a mould, capable of preventing the

growth of a pathogen (*Bacillus anthracis*) responsible for an infectious disease (Kl., 2016). The action of the antibiotic on the bacterium can be of two types: bacteriostatic or bactericidal; in the first case, the drug allows bacterial replication to be stopped, while, in the second case, it causes its death (Kohanski, (2007)).

The most commonly prescribed antibiotics in dentistry are Amoxicillin 250 mg three times a day, Ampicillin 500-1000 mg four times a day, Penicillin 500 mg four times a day, Cephalexin 250-1500 mg four times a day, Cephadrine 250-1000 mg four times a day, Metronidazole 200-250 mg three times a day, Clarithromycin 250-500 mg twice a day, and finally Doxycycline 200 mg initially, then 100 mg daily. (Ramu C. et al., 2012).

According to the World Health Organization, antibiotics are abused drugs. This inappropriate use has led to the problem of resistance which is becoming a serious global threat. It is estimated that antibiotic resistance causes 25,000 deaths per year. (Morehead MS et al., 2018).

Prescribing antibiotics for prophylactic purposes are a very common practice among dentists, although the use of antibiotic prophylaxis in implantology and oral surgery is controversial. (Schwartz AB et al., 2007).

Prophylactic treatment is prescribed to avoid an infection that could occur if staphylococci and streptococci contaminate the surgical wound. Broad-spectrum antibiotics such as Amoxicillin are usually prescribed. (Dar-Odeh NS et al., 2010).

The antibiotic prophylaxis protocol involves the administration of 2 g of amoxicillin 30 to 60 minutes before surgery, according to guidelines published in 2018 by the National Institute for Health and Clinical Excellence (NICE). In case of possible allergy to amoxicillin, the antibiotic most frequently administered turns out to be clarithromycin (500g) or clindamycin (600 mg). (National Institute for Health and Clinical Excellence (NICE), 2008). Antibiotic prophylaxis appears to be extremely safe except for small cases of hypersensitivity and allergic reactions. Beta-lactams are the class of antibiotics that cause a higher percentage of adverse reactions, about 20%; followed then by sulfonamides with 2-10%, fluoroquinolones, macrolides, tetracyclines and glycopeptides. (Macy E. et al., 2012)

The literature shows that among the female and male population those who most frequently develop allergy to antibiotics turn out to be the female population. (Sousa-Pinto B et al., 2017)

The literature review by K de Leeuw et al, 2019, suggests prescribing antibiotic prophylaxis for dental procedures in high-risk immunocompromised patients who may develop systemic infections when undergoing procedures such as extractions or implant placement. These are patients with severe neutropenia, primary immunodeficiency

ciency or patients taking high doses of immunosuppressants. (de Leeuw K et al., 2019).

Oral surgery, periodontal and endodontic treatments and implant placement are dental procedures that may promote the occurrence of infective endocarditis (IE). (Cirus M, 2021).

Infective endocarditis is a rare infection that affects 5-10 people per 100,000 per year. Morbidity is high, requires prolonged courses of antibiotics and patients often undergo surgery to replace the valve. Mortality is high. It is therefore necessary to prevent this disease with appropriate antibiotic prophylaxis before the patient undergoes invasive dental procedures. (Hoen B et al., 2013). Amoxicillin reduces the frequency of bacteremia but is not 100% effective. (Limeres P. et al., 2016).

There are several protocols involving antibiotics before and after dental procedures, most of these describe the use of Amoxicillin and Amoxicillin clavulanate.

In particular the Stein et al. protocol (Stein, et al., 2018,), which stands Amoxicillin posology; amoxicillin should be taken 1 h before surgical procedures (2 g) and than, 500 mg every 8 h after surgery for 7 days.

Amoxicillin clavulanate has two methods of som-ministration;

500 + 125 mg 2 days before surgery and 500 + 125 mg every 12 h for another 4 days (paediatric use) or 875 + 125 mg 2 days before surgery and 875 + 125 mg every 12 h for another 4 days.

Indications for antibiotic prophylaxis in implantology

Systemic antibiotic prophylaxis is frequently prescribed by dentists before implant surgery to avoid both implant failure and the risk of post-operative infection. Indeed, bacterial contamination during oral implant surgery is thought to be responsible for early implant loss. Infected dental implants cannot always be recovered. (Esposito M. et al., 2008)

The scientific literature suggests that as far as the healthy patient is concerned, a single dose of antibiotic prior to surgery is sufficient. (Barnabeu-Mira et al., 2021) On the other hand, in the case of patients with systemic diseases there are cases in which implant treatment is contraindicated (patients undergoing chemotherapy or being treated with intravenous bisphosphonates), while in some cases patients can be treated by following certain precautions. (Hwang D et al., 2006).

To avoid septicaemia in an immunocompromised patient it is necessary, in agreement with the general practitioner, to prescribe antibiotic prophylaxis prior to implant procedures. (Scully C. et al., 2007)

This indication is also valid for uncontrolled diabetic patients, as the literature reports a high risk of implant failure compared to patients with controlled diabetes, as well as for patients treated with corticosteroids. (Wang F. et al., 2010) (Bencharit S. et al., 2010) Patients with coagulation disorders have no contraindications to implant treatment, but the possibility of intra-operative complications such as haemorrhage, with subsequent airway

obstruction, is quite high. In these patients, the current recommendation is to undertake implant surgery without modification of anticoagulation therapy provided that the INR is less than 3 or 3.5 and the surgery does not include the opening of an extended flap and insertion of a graft. In general, consultation with the treating physician is recommended, especially in congenital bleeding disorders. (Diz P. et al., 2013).

The placement of dental implants over the years has become, after ascertaining their success over time, a routine procedure (Ng P. et al., 2011) with a 2% failure rate in case of fibrointegration (Troiano et al., 2018) often associated with both bacterial contamination of the implant and the trauma of the surgery itself, in addition to the primary stability of the implant and variants related to the post-operative phase (Sakka S. et al., 2012).

The first bacterial species to colonise the implant surface and therefore associated with implant failure are streptococci, both gram-positive and gram-negative (anaerobic) (Mombelli A. et al., 1987).

A recent systematic review evaluates the use of preoperative Amoxicillin and argues that systemic antibiotic administration for a single implant placement surgery does not particularly affect its success (Romandini M. et al., 2019).

Nevertheless, an effective standard prophylaxis protocol that reduces the degree of implant failure to 2% has been proposed several times and by several studies (Lund B. et al., 2015), this consists of a single dose of Amoxicillin one hour before surgery (Rodriguez S., 2018) (Romandini et al., 2019).

Indeed, in terms of implantation failure, both prophylaxis, pre- and post-operative, proved to be as effective as the single-dose prophylaxis. In agreement with this, a prophylaxis involving the administration of multiple doses of antibiotic seems to be an overprescription (Romandini et al., 2019) (Esposito M. G., 2013).

Moreover, the incorrect use of antibiotics can cause various adverse reactions as well as lead to antibiotic resistance, from diarrhoea to allergic reactions, and this risk should always be considered when going to administer antibiotic prophylaxis (Surapaneni H. et al., 2016).

Although at this point it seems essential to outline a correct method of prophylaxis, the literature on this subject is conflicting on the preoperative or postoperative use of antibiotic prophylaxis in the clinically healthy patient, and its subsequent correlation with implant failure and success rates. (Surapaneni H. et al., 2016).

Indications for antibiotic prophylaxis in oral surgery

Dental infections affect both the soft and hard tissues of the oral cavity and can occur because of dental caries, pulpal necrosis, dental trauma, and periodontal disease. There is swelling and pain at the affected site. If not treated quickly, serious complications such as osteomyelitis, brain abscess, airway obstruction, carotid infections, sinusitis, septicemia, meningitis, cavernous sinus thrombosis, orbital abscess and loss of vision can develop (Igoumenakis D. et al. 2014).

If the infection occurs systemically, the possibility of administering intravenous antibiotics emerges from the

literature. According to current guidelines, antibiotic therapy should be administered only once the infectious agent has been removed and should be continued for approximately 2-3 days after surgery (Koyuncuoglu CZ. et. al. 2017).

Dental procedures in which antibiotic therapy is considered necessary, regardless of the patient's medical health, are risk of infection after extraction of a tooth element (included or not included), after periodontal surgery, after implant placement, after tooth reimplantation, after endodontic procedures with periapical lesions or endodontic surgery (Salmerón-Escobar JI. et. al. 2006). On the other hand, in the case of a patient with systemic disease, the literature suggests that antibiotic prophylaxis is a necessary option to prevent possible complications (Ahmadi H. et al., 2021).

Specifically, if oral surgery is to be carried out, both in the case of transplanted patients and patients on haemodialysis, antibiotics are necessary to protect them from possible bacteraemia (Bayraktar G. et al., 2009) (Pereira-Lopes O. et al., 2019).

In case of necrotising ulcerative gingivitis, acute periapical abscess, cellulitis, pericoronitis, peri-implantitis, infections of the deep fascial layers of the head and neck, and in case of fever, antibiotic prescription is recommended. Antibiotic prophylaxis is crucial for the control of dental infections following surgery involving incisions, drainage, and pulpal organ involvement (Gutiérrez JL. et. al. 2006).

Indications for antibiotic prophylaxis in extractive surgery

Dental extractions are performed for various reasons: destructive caries, included elements, orthodontic treatment, periodontal treatment, or trauma (McCaul LK et al., 2001).

The prescription of antibiotics to prevent alveolitis and surgical site infections during third molar extraction is a widespread practice among dentists (Cervino G. et al., 2019), although the literature is ambiguous, as the use of antibiotics for prophylactic purposes does not significantly reduce the presence of infections at the surgical site (Lee JY et al., 2013).

In the randomised controlled trial by Dios et al., 2006, microbiological analysis of postoperative bacteremia was performed to determine the effectiveness of antibiotic prophylaxis in dental extraction. Amoxicillin and moxifloxacin prophylaxis showed high efficacy, whereas clindamycin prophylaxis did not. Thus, the results of the study suggest that amoxicillin and moxifloxacin are two antibiotics that can reduce postoperative infections following dental extraction (Diz Dios P. et. al 2006).

Given the low risk of infection, there is no evidence to support antibiotic prophylaxis for healthy people undergoing third molar extraction surgery (Martín-Ares M. et al. 2017).

Indications for antibiotic prophylaxis in endodontics

The administration of antibiotic prophylaxis is indicated in the following cases (Segura-Egea JJ. et. al 2017): acute apical abscesses in unhealthy patients; acute periapical

abscesses with systemic compromise (localised fluctuating swelling, fever above 38°C, general malaise, lymph node swelling and muscle lockjaw); infections with a rapid and progressive onset within 24 hours, cellulitis and osteomyelitis; re-implantation of the tooth element, where topical antibiotics are sometimes recommended (Hinckfuss SE. et. al 2009) (Andersson L. et al., 2012) and soft tissue trauma from surgery (Diangelis AJ. et al., 2012).

Indications for the use of antibiotic therapy in periodontology

Antibiotic administration in periodontal surgery is indicated in periodontal, regenerative and Guided Bone Regeneration (GBR) bone surgery. The literature shows that, in periodontal bone surgery, the prescription may be postoperative (Powell CA. et al., 2005) Mohan RR. et al., 2014) on the contrary some studies report that the prescription is only necessary in the presence of an already ongoing infectious process (Tseng CC. et al., 1993).

In regenerative surgery, the most commonly used antibiotics are the penicillin family (69.5%) or doxycycline (24.2%), while only 2.3% use other types of antibiotics. The same recommendations also apply to GBR (Lindeboom JA. et al., 2003) (Powell CA. et al., 2005).

Use of antibiotics in pediatric dentistry

Dentists prescribe different types of drugs in order to manage specific oral diseases and conditions (Goel D. et al., 2020). Poor knowledge of the appropriate clinical indications for prescribing antibiotics contributes to the formation of antibiotic-resistant strains; in fact, children as young as four years old have been found to have multi-resistant bacteria in their oral cavities (Ready D. et al., 2003).

Some complications that can be found when inappropriate prescriptions are made in the pediatric population are: the risk of developing diabetes from sugar-containing antibiotics, the risk of developing allergies and asthma (Droste JH. et al., 2000). In addition, early exposure to antibiotics is also thought to change the gut microbiota, with long-term adverse effects such as obesity and *Candida Albicans* infections (Al-Shayyab MH. et al., 2015).

Enamel development defects on the first permanent molars and maxillary central incisors may be correlated with Amoxicillin intake during early childhood (Hong L. et al., 2005).

There are several clinical situations that should be appropriately considered when prescribing antibiotics in pediatric patients. Facial lacerations and puncture wounds may simply require topical antibiotic agents, but when these appear to be contaminated and the risk of infection is high enough, then systemic antibiotics can be administered (American Academy of Pediatric Dentistry).

In cases of irreversible pulpitis, necrotic pulp, and localized acute apical abscesses, but without systemic signs and symptoms, antibiotics are not indicated (Segura-Egea JJ. et al., 2017). In addition, on pain associated with dento-alveolar infection, antibiotics have no effect; in these cases it is sufficient to prescribe analgesic/anti-inflammatory drugs (Palmer NO., 2006).

Antibiotic prescription should be made when acute odon-

togenic abscess is associated with pyrexia in the last 24 h (Palmer NO., 2006). Antibiotic prescription is also required in cases of facial cellulitis, associated with systemic signs and symptoms (Dar-Oden N. et al., 2018). In these cases, the antibiotic of choice is amoxicillin (2-3 days, max 5 days) or phenoxymethyl penicillin (2-3 days, max 5 days (American Academy of Pediatric Dentistry). Whereas the antibiotic regimen to be administered, when patients are allergic to penicillin, involves metronidazole (3 days), or clarithromycin (7 days) (American Academy of Pediatric Dentistry).

If drainage is effective, antibiotics are not necessary, and their use should be reserved for immunocompromised patients. The drug of choice is tetracycline (2 times a day for 7 days). but the child's age should be considered in the systemic use of tetracycline because of the risk of discoloration in the developing permanent dentition (American Academy of Pediatric Dentistry).

When dislocation occurs in deciduous dentition, antibiotics are not indicated (Dangelis AJ. et al., 2012). Gingivitis induced by dental plaque should be managed with professional and home oral hygiene and no antibiotics should be prescribed (Al-Ghutaimel H., et al., 2014), whereas, when patients are affected by periodontitis, antibiotic therapy involving Amoxicillin or Metronidazole may be necessary; when the patient is allergic to penicillin, Azithromycin may be prescribed (Muppa R., et al., 2016).

In the presence of infections of viral origin, antibiotics should not be prescribed, while in cases of bacterial infections of the salivary glands, antibiotics can be prescribed when the patient does not show signs of clear improvement within 24-48 hours. Amoxicillin/clavulanate is used as the drug of first choice, and in patients allergic to penicillin, clindamycin can be given (American Academy of Pediatric Dentistry).

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