

## Literature review

### Fundamental principles for diagnosis, management, and treatment of odontogenic infections. A literature review

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#### ABSTRACT

Odontogenic infections (OI) are the main cause of dental visits. They represent a significant number of hospital admissions in the emergency room and intensive care units. Therefore, the review of the literature is necessary to have greater scientific evidence that helps in the analysis and proposal of actions or guidelines to define, diagnose, and resolve odontogenic infections more effectively. In addition, it will contribute to planning more precise treatments and for preventing the inappropriate or indiscriminate use of antibiotics. This review comprised the years 2006 to 2018. It included review articles, consensus documents, and different clinical guidelines. This report aims to give the professionals the tools to timely identify the presence of odontogenic infections and associated factors (clinical and/or systemic) that may influence their approach on odontogenic infections management. It also provides the guidelines for the control and treatment of these infections.

**Keywords:** Odontogenic infection, antibiotics, clinical guidelines, Dentistry

#### BACKGROUND

The odontogenic infection (OI) is the invasion and/or multiplication of pathogenic microorganisms into dental structures or surrounding tissues. The most common OI are cavities, gingivitis, periodontitis, and pericoronitis.<sup>1</sup> They are polymicrobial, mixed,<sup>2</sup> and by their primary location they produce intense local symptomatology, limitation of oral functions, dental loss, systemic compromise, and even death.<sup>3</sup>

OI are often a cause for emergency dental care,<sup>4,5</sup> and the main cause of consultation at the first level of care.<sup>4-6</sup> They account for 10% of the total antibiotic prescription in medical emergencies,<sup>7</sup> with 6.3 days of average stay in intensive care units and mortality ranging from 0.12<sup>8</sup> to 20%.<sup>9</sup> In Mexico, the Epidemiological Surveillance System of Oral Pathologies reported a prevalence of 93.2% for cavities<sup>10</sup> and of 56.8% for periodontopathic bacteria,<sup>11</sup>

this report being similar to those in other countries.<sup>5,12</sup> OI treated in emergencies are more common in men (55%) with a mean age of  $37.5 \pm 17.0$  years. The most frequent OI are apical periodontitis (45%), abscesses (20.8%), marginal periodontitis (17.3%), pulpitis (16.3%), and pericoronitis (5.8%). 64.5% of patients receive surgical treatment and 31.7% antibiotic therapy, mostly with amoxicillin (54.5%).<sup>5</sup>

The objective of this review is to propose concrete actions for the control of OI on the basis of the highest level of evidence supported by the surveyed articles,<sup>1,4,6,13-16</sup> consensus documents,<sup>17,18</sup> and national/international clinical guidelines.<sup>19,20</sup>

#### Management and/or control

The fundamental principles for the proper diagnosis, management, and treatment of OI should be reflected in a complete medical record.<sup>6,21,22</sup>

Three steps are proposed for the control of OI as follows:

##### Stage I: Identification of associated factors and diagnosis

The OI must be characterized according to their nature, etiology, pathogenesis, patient's current health status (oral and general), and health risks associated with the onset/evolution of the infection process.<sup>6,21,23,24</sup>

##### a) Clinical profile and microorganisms involved

A comprehensive anamnesis contributes to a presumptive or differential diagnosis.<sup>14</sup> The symptomatology referred to by the patient, the triggering preconditions, general predictors such as inflammation,<sup>25,26</sup> body temperature increase ( $> 38$  °C),<sup>27</sup> general discomfort, lymphadenopathy, pain, systemic involvement, odynophagia, dysphagia, and oral opening limitation ( $< 40$  mm)<sup>4,28</sup> are immediate considerations of an active infection process.<sup>4,6,25</sup>

The microbiota associated with the various OI is varied, depending on the origin of the infection and its time of evolution. Strict anaerobic gram-negative bacteria are more associated with a periodontal infection,<sup>2,24,29,30</sup> while optional anaerobic gram-positive bacteria are highly associated with an endodontic infection.<sup>2,24,31</sup>

##### b) Severity and stage of infection

The ascertainment of the evolution time including days/hours from the beginning of infection to the current status will help to establish the degree of severity of the OI. That, in addition to the signs and symptoms

referred to by the patient will define the current stage of infection and the alternatives of treatment.

The OI stages are inoculation, abscess formation (location and origin of lesion), formation of phlegmon or cellulite, and resolution. *Figure 1* outlines the main characteristics for identifying these stages.<sup>6,26,28,32</sup>

#### c) Probability of infection spread

If the infectious process continues untreated, the risk of spread increases considerably.<sup>33</sup> OI can extend to spaces that offer less resistance,<sup>1,2,28</sup> causing the following:

- Severe infections, such as odontogenic sinusitis, periorbital infections, or cavernous sinus thrombosis.<sup>33</sup>
- Airway obstruction (main cause of mortality).<sup>6</sup>
- Intracranial extension (cervical necrotizing fasciitis,<sup>34</sup> brain abscess, meningitis,<sup>26</sup> or mediastinitis),<sup>3</sup> which requires immediate referral to a hospital environment.<sup>8,28</sup>

In severe cases, an odontogenic abscess can develop into peri-orbital cellulitis, a cause of intracranial and/or orbital complications.<sup>35</sup> The thrombosis of the cavernous sinus is due to the spread of the OI into infraorbital space<sup>18</sup> by intracranial extension direct to that sinus. Ludwig's angina originates from second and third molar abscesses<sup>28</sup> and can obstruct the upper airway.<sup>36</sup>

#### d) Patient's response to infection

The presence of diabetes mellitus, nephropathies, heart disease, rheumatoid arthritis, malnutrition, hemophilia, and pregnancy, among others,<sup>1,6,16,17</sup> demands adaptations in the management of OI.<sup>4,15</sup>

Most of these conditions are inflammatory as are oral diseases, which facilitates the establishment, rapid evolution, and aggravation of OI.

The adequate metabolic control and referral for consultations with other specialists are essential actions to ensure the health of patients by reducing the risk of the spread or OI complication.<sup>9</sup>

#### e) Patient's history of previous infections and treatments

Alternate antimicrobial treatments should be considered,<sup>7</sup> given the effects of synergy, competition, antagonism, or the occurrence of emerging or opportunistic infections<sup>1,22,37</sup> due to the imbalance of the oral bacterial microbiota.<sup>30,38,39</sup> Overuse of antibiotics, toxicity, intolerance, or development of hypersensitivity and selectivity must be documented.<sup>1,22</sup>

In Mexico, as of 2010 and after the analysis of economic factors and poor public policies,<sup>40</sup> the government decided to regulate and control the prescription of antibiotics. However, self-medication, empirical treatment, postponement of local management,<sup>27</sup> and ineffective posology caused by lack of follow-up and specificity are still common in the treatment of OI.<sup>16,41,42</sup>

Inadequate diagnoses and treatments, such as prescription of antibiotic medication for viral infections, increase the development of antimicrobial resistance,<sup>39,41,43</sup> resulting in worsening or relapse processes that compromise OI control and increase recovery time and costs.<sup>44</sup>

### *Stage II: patient management*

For the proper control of OI we propose the following actions (alone or combined):

#### a) Local management

OI management should focus on infection containment and dental treatment.<sup>26</sup> In some situations it is necessary to implement supportive measures,<sup>6</sup> including I) the prescription of NSAIDs to eliminate pain,<sup>36</sup> II) the maintenance of metabolic balance with actions such as hydration,<sup>4</sup> III) the control of body temperature, IV) the maintenance of glycemic balance, and V) the start of antibiotic treatment<sup>13-14</sup> to prevent the spread of infection, thus reducing the bacterial inoculum in a qualitative and quantitative manner.<sup>1</sup>

### *Stage III: Types of treatment for control and/or resolution*

The steps taken to control infections occurring between dental procedures prevent the risk of infection spread and/or cross-infection.<sup>1,41</sup> Among these local antibacterial<sup>45</sup> control measures are the use of chlorhexidine gluconate (0.12% mouthwash or gingival rinse at 2 or 3%), iodine povidone or thymol to disinfect cavities or wounds, 0.05% cetylpyridinium chloride as oral antiseptic, calcium hydroxide as intracanal medication, hydrogen peroxide as irrigation solution, and sodium hypochlorite for irrigation in endodontic treatments.<sup>46</sup>

Surgical drains in early and self-limiting infections should be performed with simple incisions and proper tissue manipulation.<sup>26,27,47</sup> Most OI of pulp and periodontal origin respond effectively to these procedures.<sup>22</sup>

Periodontal or surgical treatment includes mechanical debridement of necrotic tissues, removal of dental biofilm, abscess drainage, root scaling/planning,

and even dental extractions, depending on the needs of the treatment to eradicate the infectious focus.<sup>1,22,30</sup>

With regard to the actions recommended for the management of OI, several authors<sup>1,13,14,16,18,48</sup> indicate that the first line of action is the eradication of infection with local means and measures according to the origin of the infection.

b) Management of pharmacological antibiotic therapy  
Management includes the use of antibiotics as adjuvants to prevent both the spread of OI and their complications due to hematogenous dissemination.<sup>14</sup> For some authors, periodontal abscess with evidence of spread, necrotizing gingivitis, pericoronitis, cellulitis,<sup>45</sup> as well as infections affecting cellulo-adipose spaces of head and neck region or rapidly evolving infections and fractures<sup>36</sup> are indicative of antibiotic prescription. In the case of periapical infections, their use will depend on evolution and dissemination. Bascones et al.<sup>18</sup> include periapical abscess and aggressive periodontitis<sup>45</sup> if there are signs such as general discomfort, fever, trismus, dysphagia and/or dyspnea.<sup>47</sup> Moreno Villagrana<sup>1</sup> mentions that some conditions of pulpitis and periapical abscess may require antibiotic administration.

**Table 1** summarizes the recommendations made by some authors for the antibiotic treatment of OI.<sup>1,13,16,18,48</sup> Recommended antibiotics are beta-lactams,<sup>22</sup> including natural penicillin,<sup>6,18,26</sup> amoxicillin,<sup>16,18</sup> and amoxicillin/clavulanic acid.<sup>14,49</sup> In cases of penicillin allergy, it is suggested to use clindamycin<sup>1,15,28,49</sup> and macrolides (such as erythromycin and azithromycin), as they have the advantage of reduced dosage.<sup>15</sup>

The American Dental Association indicates amoxicillin as the first choice. The Sanford Guide to Antimicrobial Therapy recommends broad-spectrum antibiotics such as clindamycin (300 to 450 mg/6 hours) and amoxicillin/clavulanic acid (2,000/125 mg/12 hours)<sup>20</sup> and considers erythromycin as the best choice in case of allergy. The British National Formulary (BNF) indicates amoxicillin (250 to 500 mg/8 hours) or amoxicillin/clavulanic acid (375 to 625 mg/8 hours).<sup>18</sup> In cases of allergy to beta-lactams, the BNF recommends clindamycin (150 to 450 mg/6 hours) or metronidazole (200 mg/8 hours).<sup>13</sup>

Recommendations on the duration of treatment are shortly mentioned.<sup>14,30</sup> Duration will depend on the professional's criterion and the stage of the infectious process. Herrera et al.<sup>30</sup> argue that the duration of antibiotic therapy should be equivalent to the duration of acute lesion (two to three days);

however, evidence shows that it can range from five to 10 days<sup>14,50</sup> or up to three to four days after the eradication of signs and manifestations.<sup>14</sup> The BNF recommends two to three days of antibiotic therapy for acute dentoalveolar OI.

c) Antibiotic prophylaxis (AP)

Prophylactic antibiotic administration for the dental procedure is recommended to decrease the possibility of complications by using high concentrations of antibiotics before, during, and after the procedures. There are some determinants for its indication; however, we recommend a thorough review of the issue for correct decision-making and choice of a proper scheme.<sup>15,20,51,52</sup> Also, the following should be considered before use:

- Trans-operative time should be reduced; there is a relative risk of bacteremia of 0.53 (95% CI, 0.49-0.57,  $p < 0.01$ ).<sup>53</sup>
- Clean incisions should be made with proper flap handling and gingival management.<sup>1,14,26</sup>
- In case of using an antibiotic scheme, the plasma peak must be taken into account.<sup>1</sup> Antibiotic intake is advisable two hours before or even after the intervention.<sup>15,2</sup>
- Pharmacokinetic/pharmacodynamic antibiotic parameters.<sup>1</sup>

## DISCUSSION

Several drugs are used in Dentistry,<sup>6,13,14</sup> so the proper mastery of clinical, scientific, and professional knowledge improves the consideration of basic principles related to Epidemiology, Public Health, and Evidence-Based Dentistry (EBD).<sup>52,53</sup>

Antibiotics are useful and effective in treating dental conditions, but overprescription or lack of treatment adherence triggers their excessive use or misuse.<sup>54-56</sup> OI management often regards antibiotics as the first line of action omitting local or surgical management. Microbial dysbiosis and bacterial resistance are current alarming public health issues manifested by WHO and PAHO.<sup>57</sup>

Today, nonclinical factors for the issuance of prescriptions with antibiotic indication are still considered, including uncertainty in diagnosis, the patient's influence, and even the prevention of complications.<sup>13,58</sup>

## CONCLUSIONS

The omission or exclusion of diagnostic factors (OI clinical and physical manifestations, physiological or

systemic conditions, and/or association between them) may have an impact on the success of treatment or damage to the patient's health. It is key to consider all factors that contribute to the spread and severity of the dental infection (Figure 1).

The effective way to resolve OI is to first perform local mechanical therapeutic actions. The use of combined therapeutics will depend not only on the dental condition, but also on the clinical manifestations or the involvement of the systemic status.

On the basis of the clinical diagnosis of an OI, the recommendations summarized in this document aim to optimize the actions of the professional by gathering and standardizing care criteria (Figure 2).

**Funding:** This research received funding from the Fund of the Educational Quality Strengthening Program of the Ministry of Public Education of Mexico with code: PFCE-UASLP 2017-2019.

**Conflict of interest:** The authors declare that there is no conflict de interest.

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