

Clinical and microbiological characterization of periodontal abscesses

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Abstract

Background/Aim: The knowledge of clinical features, microbial composition and susceptibility to antimicrobials of periodontal abscesses has recently improved. This descriptive clinical and microbiological study provides more information on the characteristics of periodontal abscesses.

Materials and Methods: Clinical parameters and subgingival samples were examined from 54 subjects presenting 60 periodontal abscesses. Samples were cultured for anaerobic and facultative bacteria, and data were expressed as frequency detection and mean proportion of isolation for microorganisms. Selected isolates of *Porphyromonas gingivalis*, *Actinobacillus actinomycetemcomitans* and *Prevotella intermedia/nigrescens* were used to test susceptibility to amoxicillin, azithromycin, tetracycline and metronidazole. Statistical descriptive analysis was conducted.

Results: Most periodontal abscesses were present in patients with ongoing Chronic Periodontitis. Bleeding on probing, tumefaction and suppuration were present in almost all abscesses. Affected teeth were lower anterior teeth, upper anterior teeth and lower molars. The subgingival microbiota was composed of periodontal pathogens such as *Fusobacterium* spp. (75%), *P. intermedia/nigrescens* (60%), *P. gingivalis* (51%) and *A. actinomycetemcomitans* (30%). Some periodontopathogens showed antimicrobial resistance to tetracycline, metronidazole and amoxicillin, but not to azithromycin.

Conclusions: Periodontal abscesses showed typical clinical features associated with untreated periodontitis, and the organisms identified were important periodontopathic bacteria. Rationale use of antibiotic adjunctive therapy in abscess treatment should be taken into account.

Key words: aggressive periodontitis; antimicrobial sensitivity; chronic periodontitis; microbiota composition; periodontal abscess; periodontopathic bacteria

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A periodontal abscess is defined as a localized purulent infection affecting the tissues surrounding a periodontal pocket that can lead to the destruction of supporting structures (Meng 1999). Recently, the scientific information regarding periodontal abscesses has improved. Different aetiologies have been proposed, some of them related to the exacerbation of a non-treated periodontitis, to periodontal treatment (occlusion of the gingival margin after mechanical therapy) (Dello Russo 1985) and to antibiotic use in untreated periodontitis (Helovuoto et al. 1993). Periodontal

abscess can also be associated to periodontal trauma in patients without periodontitis (Kareha et al. 1981). Clinical reports showed that the presence of periodontal abscesses was related to tooth loss in a group of patients with chronic periodontitis (McLeod et al. 1997), suggesting that the control of acute infections is relevant for the maintenance of periodontal health.

Patients with a history of periodontitis and concomitant treatment tend to have a higher frequency of periodontal abscesses (Herrera et al. 2000c). Clinically, the tissues appear edematized

with bleeding on probing (BOP), suppuration and periodontal pocketing (Herrera et al. 2000a). The subgingival microbiota shows a composition that resembles that of periodontitis (Herrera et al. 2000b), indicating its relationship with the acute inflammatory process.

The treatment for periodontal abscesses includes drainage through the pocket or an incision, debridement, irrigation with saline solution, surgery or tooth extraction. The administration of systemic antibiotics can serve as an adjunct to mechanical therapy, and the recommended drugs have been tetracy-

cline (Hafstrom et al. 1994), penicillin (Genco 1991), metronidazole (Smith & Davies 1986), amoxicillin/clavulanate and azythromycin (Herrera et al. 2000b).

The purpose of this study was to describe the clinical and microbiological characteristics of periodontal abscesses.

Materials and Methods

Fifty-four patients attending the dental clinics of the University of Valle (Cali, Colombia) from November 2002 to January 2005 were invited to participate in the study. Subjects who presented one or more periodontal abscesses were included. A periodontal abscess was defined as an acute localized infection adjacent to a periodontal pocket. Negative pulp testing, consumption of antibiotics in the past 3 months and non-controlled systemic diseases were used as exclusion criteria. An informed written consent was obtained in each case, previously approved by the Ethics Committee on Human Research, at the University of Valle, Faculty of Health.

Clinical examination

A periodontal chart was completed for each patient recording the following parameters: BOP, pain, redness, tumefaction and suppuration as positive or negative. Probing depth (PD) was recorded using a marked periodontal probe (UNC-15, Hu-Friedy, Chicago, IL, USA). Increased tooth mobility was assessed using an ordinal score: 1 – horizontal displacement of 1 mm, 2 – horizontal displacement > 1 mm and 3 – horizontal and vertical displacement > 1 mm. Bone loss was evaluated in dental radiographs and classified as: slight – one-third of the root length, moderate – two-thirds of root length and severe – > two-thirds of root length. Other information regarding periodontal and dental history was collected for analysis.

Microbiological analysis

Subgingival microbial samples were taken from the periodontal pocket associated to the abscess. Before sampling, supragingival plaque was removed from the tooth with a sterile gauze and isolated with cotton rolls. Three sterile paper points were inserted into the bottom of the periodontal pocket for 15 s, and were pooled in screw cap vials

containing VMGA III transport medium. The samples were analysed using microbial culture techniques for the presence of periodontopathic and super-infecting bacteria according to previous reports (Slots 1986). Briefly, most samples were processed within 24 h, with a maximum of 48 h at room temperature (25°C) and incubated in CO₂ and anaerobic culture systems. Brucella blood agar medium was incubated at 35°C in an anaerobic jar for 10 days. The TSBV medium was incubated in 10% CO₂ at 37°C for 4 days. Presumptive identification was performed according to the methods described (Slots & Reynolds 1982, Slots 1986, Rams et al. 1992) and using a commercial identification micromethod system (RapID ANA II, Remel, Norcross, GA, USA) for *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia/nigrescens*, *Tannerella forsythia*, *Campylobacter* spp., *Eubacterium* spp., *Fusobacterium* spp., *Peptostreptococcus micros*, *Eikenella corrodens*, and *Dialister pneumosintes*. Total viable counts (TVC) were defined as the total number of colony-forming units obtained on non-selective media plates. Species found on selective media were enumerated and their percentage of TVC was calculated. Special attention was paid to the growth of Gram-negative enteric rods and yeasts on TSBV and Brucella agar. Gram-negative enteric rods were sub-cultured and colony purified on MacConkey and Cetrimide agar plates (Scharlau, Barcelona, Spain) and identified using a standardized biochemical test (API 20E[®], bio-Merieux Inc., Marcy l'Etoile, France).

Antimicrobial susceptibility

Selected colonies of *P. gingivalis*, *A. actinomycetemcomitans* and *P. intermedia/nigrescens* from pure cultures were used to test their susceptibility to amoxicillin, azithromycin, tetracycline and metronidazole (E-test[®], AB Biodisk, Solna, Sweden). Briefly, viable colonies were homogenized in 0.85% saline, and the turbidity was adjusted to MacFarland 1.0 standard (3×10^8 CFU/ml). Using a sterile glass rod, 0.1 ml of the inoculum was spread over Brucella blood agar plates (BD, Sparks, MD, USA) and dried for 15 min. at room temperature. E-test strips were gently placed onto the agar surface and incubated under anaerobic conditions for 4 days. The elliptical zone of inhibition was

examined after 96 h of incubation. The reading at the intersection of the bacterial zone of inhibition and the E-strip represented the minimal inhibitory concentration (MIC) of the organism. The breakpoints used for interpretation were as follows: amoxicillin, azithromycin and tetracycline $\leq 4 \mu\text{g/ml}$, for metronidazole $\leq 8 \mu\text{g/ml}$ (Andres et al. 1998, Luong et al. 2001, NCCLS 2001, de Sousa et al. 2003, Jacinto et al. 2003).

Statistical analysis

Descriptive analyses were carried out (mean, standard deviation, frequency of detection) for clinical and microbiological parameters. All data were analysed with statistical software (GraphPad Prism version 4.00 for Windows, GraphPad Software, San Diego, CA, USA).

Results

A group of 54 subjects (mean age 48.3 years old) were included for analysis (Table 1). In most cases, patients suffered from chronic periodontitis (87%) and, to a lesser degree, aggressive periodontitis (9.3%).

Table 2 depicts the clinical characteristics of periodontal abscesses. Periodontal abscesses were localized purulent accumulations accompanied by redness, inflammation and periodontal destruction (Fig. 1a, b). BOP was detected in all lesions, while redness, tumefaction and suppuration were present in 93.3%, 95% and 93.3% of the cases, respectively. An increased probing pocket depth (9.3 ± 2.5 mm) was the most frequent characteristic, followed by radiographic bone loss and increased tooth mobility. This is of importance considering that

Table 1. Demographic description and periodontal diagnosis of the study sample

	Frequency, n(%)
Subjects	54
Gender	F = 29
Age, mean \pm SD	48.3 \pm 15.5
Periodontal diagnosis, n (%)	
Chronic periodontitis	47 (87)
Aggressive periodontitis	5 (9.3)
Periodontal health	2 (3.7)
Diabetes, n (%)	2 (3.5)
Current smoker, n (%)	6 (11.1)

SD, standard deviation.

Table 2. Clinical description of periodontal abscesses

Clinical parameter*	Frequency (n = 60), n(%)
BOP	60 (100)
PD (mm ± SD)	9.3 ± 2.5
Redness	56 (93.3)
Tumefaction	57 (95)
Suppuration	56 (93.3)
Mobility	
1	30 (50)
2	17 (28.3)
3	13 (21.6)
Radiographic bone loss	
Slight	4 (6.6)
Moderate	19 (31.6)
Severe	37 (61.6)
Radiographic absence of periodontal ligament space	54 (90)
Pain	41 (68.3)
Dental extrusion	14 (23.3)
History of periodontitis	52 (86.6)
History of past periodontal treatment	7 (11.6)
Periodontitis-related abscess	49 (81.6)
Periodontal treatment-related abscess	4 (6.6)
Trauma-related abscess	3 (5)

*As described in "Materials and Methods".
BOP, bleeding on probing; PD, probing depth.

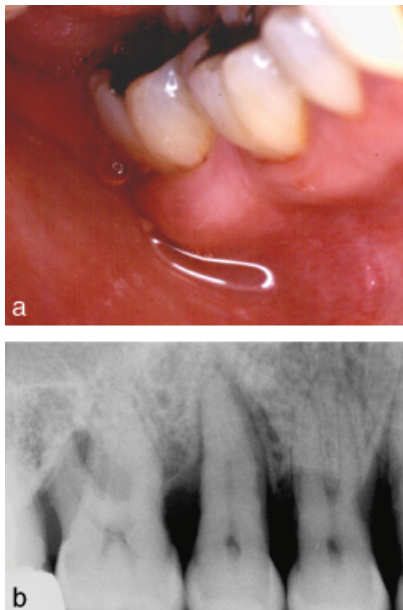
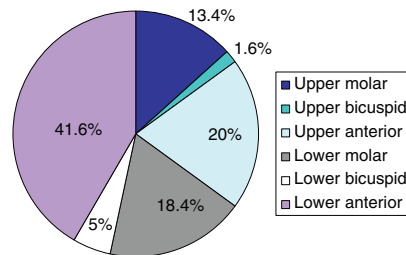


Fig. 1. (a) Clinical appearance of periodontal abscess affecting the lower second right molar. The site shows localized purulent accumulation, redness, bleeding on probing and suppuration. (b) Radiographic aspect of periodontal abscess affecting the first upper right molar. Notice severe periodontal destruction and the involvement of the furcation area.

81.6% of the analysed abscesses had a history of past periodontitis or ongoing periodontal destruction. Abscesses resulting from periodontal treatment were found in 6.6% of the cases. Patients



Lower anterior teeth were most affected by abscesses followed by upper anterior and lower molar teeth.

Fig. 2. Frequency distribution (%) of abscesses according to teeth.

reported discomfort related to pain (68.3%) and dental extrusion (23.3%).

The frequency distribution of abscesses is displayed in Fig. 2. Lower anterior teeth were most affected (41.6%), followed by upper anterior teeth (20%) and lower molars (18.4%).

The composition of the subgingival microbiota in periodontal abscesses is presented in Fig. 3 and Table 3. While *Fusobacterium* spp. had a frequency detection of 75%, *P. gingivalis* and *T. forsythia* were detected in 51.7% and 15% of the cases, respectively. The presence of other black-pigmented microorganisms (*P. intermedia/nigrescens*, 60%) was also frequent. This is supported by the fact that the percentage of this microorganism in the cultivable microbiota (8.46%) was the highest. The recovery of *A. actinomycetemcomitans* (30%) was lower than *P. gingivalis*. In

general, the subgingival microbiota in periodontal abscesses was mainly composed of microorganisms related to periodontal disease. Superinfecting bacteria (Gram-negative enteric rods) were the sixth most prevalent group of organisms (13 cases, 21.7%) and the isolated organisms were *Enterobacter aerogenes* (3.3%), *Pseudomonas* spp. (3.3%), *Klebsiella pneumoniae* (1.7%), *Acinetobacter lwoffii* (1.7%), *A. baumannii* (1.7%), *E. agglomerans* (1.7%), and unidentified non-fermenter Gram-negative rods (8.3%).

Susceptibility to antimicrobials of selected isolates of periodontopathic bacteria is depicted in Table 4. We found intermediate resistance for tetracycline in two of 14 isolates of *P. intermedia/nigrescens*. Three of four isolates of *A. actinomycetemcomitans* and one of 11 of *P. gingivalis* were resistant to metronidazole. One isolate of *A. actinomycetemcomitans* and two of *P. intermedia/nigrescens* were resistant to amoxicillin. None of the bacteria tested presented resistance to azithromycin.

Discussion

In this study, most periodontal abscesses were found to be related with a previous history of periodontitis, suggesting that it could be considered as a complication of periodontitis, as reported by others (McLeod et al. 1997, Herrera et al. 2000a). In a small proportion of cases (6.6%), abscesses were found to be a complication of periodontal therapy. Most likely, the presence and occlusion of periodontal pockets because of periodontal instrumentation could explain the development of these lesions.

Interestingly, the most common group of teeth affected by periodontal abscess in this study population was lower incisors. In contrast, Herrera et al. (2000a) found the molar group to be the most affected.

The microbiota of periodontal abscesses has been characterized by the presence of periodontal pathogens present in chronic and aggressive periodontitis. In this study, *Fusobacterium* spp., *P. intermedia/nigrescens* and *P. gingivalis* were found to be the most prevalent microorganisms associated with periodontal abscesses. This is in agreement with previous reports (Newman & Sims 1979, van Winkelhoff et al. 1985, Topoll et al. 1990). Other microorgan-

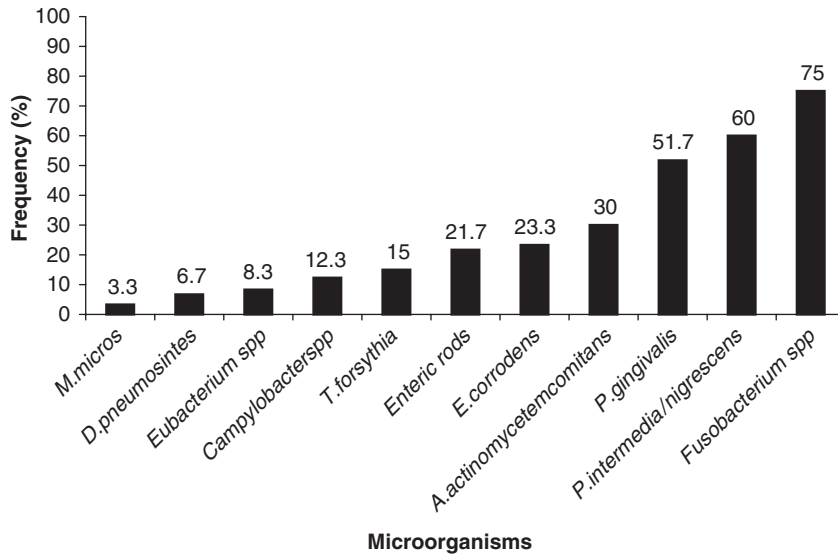


Fig. 3. Frequency isolation (%) of periodontopathic microorganisms in periodontal abscesses.

Table 3. Percentage of cultivable microbiota in periodontal abscesses

Microorganism*	Periodontal abscesses (n = 60), % ± SD
<i>Prevotella intermedia/nigrescens</i>	8.46 ± 16.50
<i>Fusobacterium</i> spp.	3.65 ± 4.40
<i>Porphyromonas gingivalis</i>	3.34 ± 5.37
Gram-negative enteric rods	2.46 ± 9.05
<i>Eikenella corrodens</i>	0.96 ± 3.08
<i>Tannerella forsythia</i>	0.61 ± 1.83
<i>Campylobacter</i> spp.	0.33 ± 1.06
<i>Eubacterium</i> spp.	0.16 ± 0.71
<i>Dialister pneumosintes</i>	0.09 ± 0.34
<i>Actinobacillus actinomycetemcomitans</i>	0.09 ± 0.26
<i>Micromonas micros</i>	0.08 ± 0.42

*The percentage of the cultivable microbiota was calculated on the basis of the total colony count (TCC) obtained on non-selective Brucella blood agar plates.

Table 4. Antimicrobial susceptibility of selected periodontopathic isolates from periodontal abscesses

Antimicrobial*	<i>Actinobacillus actinomycetemcomitans</i> (n = 4)		<i>Porphyromonas gingivalis</i> (n = 11)		<i>Prevotella intermedia/nigrescens</i> (n = 14)		
	susceptible	resistant	susceptible	resistant	susceptible	intermediate	resistant
Tetracycline	4	0	11	0	12	2	0
Metronidazole	1	3	10	1	14	0	0
Azithromycin	4	0	11	0	14	0	0
Amoxicillin	3	1	11	0	11	1	2

*Antimicrobial susceptibility was assessed using the E-test®. See "Materials and Methods".

isms have been isolated from periodontal abscesses. In a previous report (Herrera et al. 2000b), a higher prevalence of *T. forsythia* was found (66.7%) than that in the present study (15%). This difference could be attributed to its

lower frequency, to differences in the populations or to the longer time of incubation used in that report (14 days).

A. actinomycetemcomitans was found in 30% of the cases in this study. In contrast, Häfstrom et al. (1994) found a

lower prevalence of this organism (25%), and Herrera et al. (2000a) did not find any presence of *A. actinomycetemcomitans* in periodontal abscesses. We also found a lower prevalence of *Micromonas micros* (3.3%) than that reported by Herrera et al. (2000a) of 70.6%. Differences of prevalence also occurred with *Campylobacter rectus*, which was found in 11.7% of cases, in contrast to Herrera et al. (2000a) (4.2%) and Häfstrom et al. (1994) (80%). Differences in the composition of subgingival microbiota between people of diverse geographical locations could partly explain these findings.

The presence of enteric and non-fermenter Gram-Negative rods in periodontal abscesses has not been previously reported. Considering that this group of microorganisms has previously been proposed as possible superinfecting agents in periodontal diseases (Slots et al. 1988, 1990b, Rams et al. 1990, Dahlen & Wikstrom 1995, Sedgley et al. 1996, 1997, Barbosa et al. 2001) and the fact that they have important virulence factors that facilitate tissue invasion (Slots et al. 1990a, Sedgley & Samaranyake 1994), we suggest that they could have a potential role in the rapid tissue destruction observed in periodontal abscesses.

D. pneumosintes, another recently suspected periodontopathogen (Contreras et al. 2000, Ghayoumi et al. 2002), was found in low proportions and represents a new finding in periodontal abscesses.

Regarding the relative proportions of cultivable microbiota of each microorganism, the highest proportion was found for *P. intermedia/nigrescens* (8.46%), in contrast with Herrera et al. (2000a), who found higher relative proportions for *P. gingivalis* (13.6%).

In vitro susceptibility of bacteria associated with the aetiology of odontogenic infections has been previously evaluated. Luong et al. (2001) reported resistance of *P. intermedia* and *P. nigrescens* to amoxicillin and tetracycline, and to metronidazole (Jacinto et al. 2003). We found a variable proportion of isolates of *P. intermedia/nigrescens*, *A. actinomycetemcomitans* and *P. gingivalis* resistant to amoxicillin, metronidazole and tetracycline, but these isolates were not resistant to azithromycin (Table 4). This could be explained by the fact that azithromycin is not frequently used in the treatment of dental and medical infections. However, results regarding antimicrobial suscept-

ibility in our population cannot be generalized to all isolates from different countries. Previous studies comparing different European populations (Spanish and Dutch patients) with different levels of antibiotic consumption showed a higher level of resistance for the population with the highest level of antibiotic consumption (Spanish sample), both in a full-sample evaluation (van Winkelhoff et al. 2000), and in the prevalence and amounts of β -lactamase-producing bacteria (Herrera et al. 2000d). Moreover, a recently published study comparing antimicrobial profiles of periodontal pathogens by E-test, from periodontitis patients between these two European populations, found higher levels of resistance to antimicrobial agents in Spanish patients than in Dutch patients. Spanish strains had significantly higher MIC values for different antimicrobials, especially to β -lactam antibiotics such as amoxicillin and penicillin (van Winkelhoff et al. 2005).

We suggest that the indiscriminate use of antimicrobials could be influencing the appearance of resistant strains associated with periodontal diseases in our population. Our results also support the notion that the use of antibiotics must be based on susceptibility testing, instead of a unique protocol of adjunctive antimicrobial regimen.

Conclusions

The periodontal abscess depicts typical features, and in this study was associated with untreated chronic periodontitis. The more prevalent organisms cultured from periodontal abscesses were *Fusobacterium* spp., *P. intermedia/nigrescens*, *P. gingivalis* and *A. actinomycetemcomitans*. However, the presence of Gram-negative enteric rods may be of clinical importance.

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Clinical Relevance

Information regarding periodontal abscesses is still limited. Our data support a periodontal disease aetiology that could lead to further attachment loss and tooth loss. The clinical manifestation of abscesses was that

of a localized infection with an inflammatory response. The microbiology was composed of periodontopathic bacteria and other superinfecting organisms. Taking these findings in perspective, treatment should be intended to control

infection and to reduce inflammation by means of mechanical debridement. The use of antibiotics should be rationalized to avoid microbial resistance.