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Evaluation of the Mandibular Third Molar Pericoronitis Flora and Its Susceptibility to Different Antibiotics Prescribed in France

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This work assessed the polymicrobial flora of mandibular third molar pericoronitis. Obligate anaerobes were found in almost all cases (32 of 35). Amoxicillin and pristinamycin were the most effective against the flora, particularly aerobic organisms. Metronidazole alone or combined with spiramycin was the most effective drug against obligate anaerobes.

Pericoronitis is an inflammatory and infectious condition that may accompany the clinical emergence of teeth. The microbial flora that develops in the distally located pseudopocket is the major cause. This flora is predominantly anaerobic (3, 14, 17, 19, 20, 23, 26). Therapeutic management usually involves a local surgical procedure and the prescription of antibiotics, often of the β-lactam family (7). The frequency of antibiotic-resistant microorganisms is dependent on the populations and is related to the prescribing habits of practitioners in each country (9, 25). In a previous study with selective media, we demonstrated the presence of β-lactamase-producing bacteria in 9 out of 26 French patients suffering from pericoronitis (23). These results encouraged us to supplement the study in order to identify the flora in another 35 patients and to evaluate its susceptibility to different antibiotics.

Thirty-five adults (20 men, 15 women), aged 18 to 52 years (mean age, 26.8 ± 8.2 years), without systemic disease, suffering from pericoronitis associated with the eruption of a third mandibular molar, with acute pain and without antibiotic treatment in the previous 3 months, entered into this study with their informed consent (BIR 49 801). Clinical examination, sampling, microbiological processing with nonselective media, microbial identification, and β-lactamase production testing were performed as previously described (23).

Clinical examination showed a mean pseudopocket depth of 6.22 ± 2.79 mm. Edema, trismus, and suppuration were present in, respectively, 91, 50, and 23% of the patients. The samples comprised 1 to 17 detectable microorganisms (mean, 10.5 ± 3.58). Only one sample yielded a single microorganism, which was identified as *Actinomyces viscosus*.

The principal identification results are summarized in Table 1. Obligate anaerobes were detected in 32 out of 35 samples. The most frequently detected microorganisms were viridans group streptococci (32 of 35 samples) and those belonging to the genera *Actinomyces* (29 of 35 samples) and *Prevotella* (21 of 35 samples).

Most of the obligate anaerobes identified in this study may be found in the healthy oral cavity (12) but also are associated with oral diseases (13, 16, 22, 24), numerous localized infections, particularly of the ear-nose-throat region and the respiratory system (4, 11), usually in conjunction with infections associated with polymicrobial flora and systemic infections. The frequent presence of microaerophilic bacteria and facultative anaerobes that grow predominantly anaerobically (members of the genera *Actinomyces*, *Propionibacterium*, and *Capnocytophaga*) confirms the anaerobic shift of this flora. These data can tentatively be compared with those described in a previous study with DNA probes, in which the microbial index for some anaerobic bacteria was shown to be elevated compared with that of control patients with asymptomatic erupting third molars (3).

Interestingly, members of the genus *Actinomyces* were detected in 29 of the samples. The members of genus *Actinomyces* belong to the normal flora of the oral cavity and may be associated with dental caries and gingivitis (2, 24) or may also be responsible for more destructive diseases, such as actinomycosis (5, 8, 21), especially *Actinomyces israelii*. The presence of *A. israelii* in 15 samples, associated with that of other microorganisms found in cervicofacial actinomycosis lesions (21), suggests that in certain cases the pathogenic processes might be similar to those of actinomycosis. In order to confirm this hypothesis, further studies are needed with a demographically similar disease-free group for comparative and control purposes.

These data reinforce the concept of infection due to polymicrobial flora in the case of pericoronitis and highlight the need for efficacy against anaerobic flora when antibiotic treatment is administered. However, we must pay attention to the fact that some other bacterial agents that are not cultivable are still unknown and may have a role in pericoronitis.

Susceptibility to amoxicillin (A1, 0.5 mg/liter; A2, 4 mg/liter), spiramycin (S1, 1 mg/liter; S2, 4 mg/liter), metronidazole (M, 4 mg/liter), pristinamycin (P1, 1 mg/liter; P2, 2 mg/liter), and the combination of spiramycin and metronidazole (MS1, 1 and 4 mg/liter; MS2, 4 and 4 mg/liter) was evaluated at the critical concentrations defined by the Antibiotic Sensitivity

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TABLE 1. Microorganisms detected in this study

Microorganism(s)[a]	Frequency
Obligate anaerobes	
Gram-positive cocci	
Anaerococcus (*Peptostreptococcus*) *prevotii*	3
Peptococcus niger	1
Micromonas (*Peptostreptococcus*) *micros*	9
Peptostreptococcus anaerobius	1
Peptostreptococcus spp.	3
Gram-positive bacilli	
Bifidobacterium spp.	3
Clostridium spp.	4
Eggertella (*Eubacterium*) *lentum*	5
Eubacterium sp.	1
Mobiluncus spp.	3
Gram-negative cocci, *Veillonella* spp.	11
Gram-negative bacilli	
Bacteroides stercoris	1
Fusobacterium mortiferum	1
Fusobacterium necrogenes	1
Fusobacterium nucleatum	4
Leptotrichia buccalis	5
Prevotella bivia/tannerae/oeneca	2
Prevotella buccae	5
Prevotella buccalis	3
Prevotella corporis	1
Prevotella bivia disiens	3
Prevotella intermedia/nigrescens/pallens	14
Prevotella loescheii	2
Prevotella melaninogenica	2
Prevotella oralis	1
Prevotella oris	2
Porphyromonas gingivalis	1
Microaerophils	
Bacteroides ureolyticus	2
Campylobacter rectus	7
Campylobacter gracilis	4
Aerobes	
Gram-positive cocci	
Gemella haemolysans	5
Gemella morbillorum	7
Gemella spp.	2
Lactococcus lactis cremoris	1
Lactococcus raffinolactis	1
Staphylococcus spp.	7
Streptococcus acidominimus	1
Streptococcus adjacens	4
Streptococcus anginosus	21
Streptococcus constellatus	10
Streptococcus intermedius	2
Streptococcus gordonii	3
Streptococcus mitis	11
Streptococcus mutans	1
Streptococcus oralis	11
Streptococcus pyogenes	1
Streptococcus sanguinis	3
Streptococcus salivarius	2
Streptococcus viridans	2
Streptococcus sp.	3
Gram-positive bacilli	
Actinomyces gerencseriae	3
Actinomyces israelii	15
Actinomyces meyeri	4
Actinomyces odontolyticus	21
Actinomyces naeslundii/viscosus	10
Actinomyces spp.	2
Bacillus spp.	2
Corynebacterium afermentans	3
Corynebacterium bovis	1
Corynebacterium striatum	1
Corynebacterium sp.	3
Lactobacillus acidophilus	4
Lactobacillus sp.	1
Propionibacterium acnes	7
Propionibacterium propionicus	2
Propionibacterium granulosum	2
Gram-negative bacilli	
Capnocytophaga sp.	20
Pseudomonas sp.	1

[a] Classification into anaerobes, microaerophils, and aerobes according to *Bergey's Manual of Determinative Bacteriology* (10).

Test Committee of the French Microbiology Society in accordance with the recommendations of the NCCLS (18) and the Antibiotic Sensitivity Test Committee of the French Microbiology Society (6). Four reference strains were used on each dish tested: *Bacteroides fragilis* (ATCC 25285), *Bacteroides thetaiotaomicron* (ATCC 29741), *Escherichia coli* (CIP 7624), and *Actinomyces odontolyticus* (laboratory strain BC 21).

The results of the antibiotic susceptibility tests are summarized in Table 2. Susceptibility to the antibiotics tested was found in, respectively, 193 (A1), 209 (A2), 94 (S1), 158 (S2), 69 (M), 136 (MS1), 173 (MS2), 201 (P1), and 206 (P2) of the 211 strains tested. β-Lactamase production was detected in six strains (two *Staphylococcus* and four *Prevotella* strains) obtained from five samples. Amoxicillin and the combination of spiramycin and metronidazole are the antibiotics most regularly prescribed by French clinicians (15; Anonymous, Letter, Lett. Chir. Dent. **6:**15, 2002). Pristinamycin is one of the two antibiotics recommended in France for patients at high risk of infection who are allergic to amoxicillin (1). The results of the antibiotic sensitivity tests show that amoxicillin and pristinamycin are the most effective drugs against the strains tested and against the strains classified as aerobic in particular. Metronidazole alone or combined with spiramycin, amoxicillin at 4 mg/liter, and pristinamycin are the most effective drugs against obligate anaerobic bacteria. The efficacy of the latter drug confirms its value in acute cases and after the failure of other antibiotics.

The broad spectrum of amoxicillin fully encompasses the microorganisms found in pericoronitis. However, the presence of β-lactamase-producing microorganisms, as has already been demonstrated in a previous study (23), may cause failure of antibiotic treatment of pericoronitis. Metronidazole is particularly interesting in infections due to polymicrobial flora, in which anaerobic microorganisms predominate. Its combination with a macrolide (spiramycin) extends the spectrum to certain non-obligately anaerobic bacteria, allowing its use in

TABLE 2. Evaluation of antibiotic susceptibility of strains isolated from patients with pericoronitis on selective media containing antibiotics[a]

Microorganisms	n[b]	No. of strains resistant to concn tested[c]								
		A1	A2	S1	S2	M	MS1	MS2	P1	P2
Aerobes[f]	157	11	0	89	43	142	75	38	2	0
Actinomyces spp.	51	1	0	11	8	51	11	8	0	0
A. odontolyticus	19	1	0	1	1	19	1	1	0	0
A. israelii	16	0	0	3	2	16	3	2	0	0
A. naeslundii	8	0	0	4	3	8	4	3	0	0
Capnocytophaga spp.	21	1	0	16	5	7	5	2	0	0
Corynebacterium spp.	5	0	0	3	1	5	3	1	0	0
Gemella spp.	10	2	0	7	5	10	7	5	0	0
Propionibacterium spp.	11	1	0	2	1	10	2	1	1	0
Staphylococcus spp.	7	4	0	6	5	7	6	5	0	0
Streptococcus spp.	37	1	0	33	12	37	30	10	0	0
S. anginosus[d]	19	0	0	18	6	18	17	5	0	0
S. oralis[e]	12	1	0	11	5	12	9	4	0	0
Anaerobes[f]	54	7	2	28	10	0	0	0	8	5
Prevotella spp.	25	4	1	9	2	0	0	0	3	0
Veillonella spp.	5	2	1	5	5	0	0	0	5	5
Fusobacterium spp.	4	1	0	4	2	0	0	0	0	0
Micromonas micros	4	0	0	3	0	0	0	0	0	0

[a] Several strains of the same species from the same sample may have been tested. All of the strains tested are not listed.
[b] *n*, number of strains isolated.
[c] A1, amoxicillin at 0.5 mg/liter; A2, amoxicillin at 4 mg/liter; S1, spiramycin at 1 mg/liter; S2, spiramycin at 4 mg/liter; M, metronidazole at 4 mg/liter; MS1, metronidazole-spiramycin at 4 and 1 mg/liter; MS2, metronidazole-spiramycin at 4 and 4 mg/liter; P1, pristinamycin at 1 mg/liter; P2, pristinamycin at 2 mg/liter.
[d] *Streptococcus anginosus* group.
[e] *Streptococcus oralis* group.
[f] Classification into aerobes and anaerobes according to *Bergey's Manual of Determinative Bacteriology* (10).

pericoronitis with a well-documented mixed aerobic-anaerobic flora.

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REFERENCES

1. **Anonymous.** 2002. Prescription des antibiotiques en odontologie et stomatologie. Recommandations et argumentaire. Agence Française de Sécurité Sanitaire des Produits de Santé. Med. Maladies Infect. **32:**125–160.
2. **Becker, M. R., B. J. Paster, E. J. Leys, M. L. Moeschberger, S. G. Kenyon, J. L. Galvin, S. K. Boches, F. E. Dewhirst, and A. L. Griffen.** 2002. Molecular analysis of bacterial species associated with childhood caries. J. Clin. Microbiol. **40:**1001–1009.
3. **Blakey, G. H., R. P. White, Jr., S. Offenbacher, C. Phillips, E. O. Delano, and G. Maynor.** 1996. Clinical/biological outcomes of treatment for pericoronitis. J. Oral Maxillofac. Surg. **54:**1150–1160.
4. **Brook, I.** 2002. Anaerobic bacteria in upper respiratory tract and other head and neck infections. Ann. Otol. Rhinol. Laryngol. **111:**430–440.
5. **Clarridge, J. E., III, and Q. Zhang.** 2002. Genotypic diversity of clinical *Actinomyces* species: phenotype, source, and disease correlation among genospecies. J. Clin. Microbiol. **40:**3442–3448.
6. **Comité de l'Antibiogramme.** 2002. Communiqué 2002 du Comité de l'Antibiogramme de la Société Française de Microbiologie. Société Française de Microbiologie, Paris, France.
7. **Dahlén, G.** 2002. Microbiology and treatment of dental abscesses and periodontal-endodontic lesions. Periodontol. 2000 **28:**206–239.
8. **Hall, V., P. R. Talbot, S. L. Stubbs, B. I. Duerden, J. E. Clarridge III, and Q. Zhang.** 2001. Identification of clinical isolates of *Actinomyces* species by amplified 16S ribosomal DNA restriction analysis. J. Clin. Microbiol. **39:** 3555–3562.
9. **Herrera, D., A. J. van Winkelhoff, N. Dellemijn-Kippuw, E. G. Winkel, and M. Sanz.** 2000. Beta-lactamase producing bacteria in the subgingival microflora of adult patients with periodontitis: a comparison between Spain and The Netherlands. J. Clin. Periodontol. **27:**520–525.
10. **Holt, J. G., N. R. Krieg, P. H. A. Sneath, J. T. Staley, and S. T. Williams.** 1994. Bergey's manual of determinative bacteriology, 9th edition. Williams & Wilkins, Philadelphia, Pa.
11. **Jousimies-Somer, H. R., P. H. Summanen, and S. M. Finegold.** 1999. *Bacteroides*, *Porphyromonas*, *Prevotella*, *Fusobacterium*, and other anaerobic gram-negative rods and cocci, p. 690–711. *In* P. R. Murray, E. J. Baron, M. A. Pfaller, F. C. Tenover, and R. H. Yolken (ed.), Manual of clinical microbiology, 7th ed. ASM Press, Washington, D.C.
12. **Könönen, E., A. Kanervo, A. Takala, S. Asikainen, and H. Jousimies-Somer.** 1999. Establishment of oral anaerobes during the first year of life. J. Dent. Res. **78:**1634–1639.
13. **Kuriyama, T., T. Karasawa, K. Nakagawa, Y. Saiki, E. Yamamoto, and S. Nakamura.** 2000. Bacteriologic features and antimicrobial susceptibility in isolates from orofacial odontogenic infections. Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod. **90:**600–608.
14. **Leung, W. K., E. Theilade, M. B. Comfort, and P. L. Lim.** 1993. Microbiology of the pericoronal pouch in mandibular third molar pericoronitis. Oral Microbiol. Immunol. **8:**306–312.
15. **Matysiak, M., J. Gradelet, M. J. Mignée, and J. C. Mabriez.** 1997. Evaluation des prescriptions pharmacologiques des chirurgiens-dentistes de la circonscription de la CPAM de Grenoble. Rev. Med. Assurance Maladie **3:**71–88.
16. **Mombelli, A.** 2002. Microbiology and antimicrobial therapy of peri-implantitis. Periodontol. 2000 **28:**177–189.
17. **Mombelli, A., D. Buser, N. P. Lang, and H. Berthold.** 1990. Suspected periodontopathogens in erupting third molar sites of periodontally healthy individuals. J. Clin. Periodontol. **17:**48–54.
18. **NCCLS.** 2001. Methods for antimicrobial susceptibility testing of anaerobic bacteria: approved standard, 5th edition, vol. 21, p. 1–36. NCCLS, Wayne, Pa.
19. **Peltroche-Llacsahuanga, H., E. Reichhart, W. Schmitt, R. Lutticken, and G. Haase.** 2000. Investigation of infectious organisms causing pericoronitis of the mandibular third molar. J. Oral Maxillofac. Surg. **58:**611–616.
20. **Rajasuo, A., H. Jousimies-Somer, S. Savolainen, J. Leppanen, H. Murtomaa, and J. H. Meurman.** 1996. Bacteriologic findings in tonsillitis and pericoronitis. Clin. Infect. Dis. **23:**51–60.
21. **Rodloff, A. C., S. L. Hillier, and B. J. Moncla.** 1999. *Peptostreptococcus*, *Propionibacterium*, *Lactobacillus*, *Actinomyces*, and other non-spore-forming anaerobic gram-positive bacteria, p. 672–689. *In* P. R. Murray, E. J. Baron, M. A. Pfaller, F. C. Tenover, and R. H. Yolken (ed.), Manual of clinical microbiology, 7th ed. ASM Press, Washington, D.C.

22. **Rolph, H. J., A. Lennon, M. P. Riggio, W. P. Saunders, D. MacKenzie, L. Coldero, and J. Bagg.** 2001. Molecular identification of microorganisms from endodontic infections. J. Clin. Microbiol. **39:**3282–3289.
23. **Sixou, J. L., C. Magaud, A. Jolivet-Gougeon, M. Cormier, and M. Bonnaure-Mallet.** 2003. Microbiology of mandibular third molar pericoronitis: incidence of beta-lactamase-producing bacteria. Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod. **95:**655–659.
24. **Socransky, S. S., and A. D. Haffajee.** 2002. Dental biofilms: difficult therapeutic targets. Periodontol. 2000 **28:**12–55.
25. **van Winkelhoff, A. J., E. G. Winkel, D. Barendregt, N. Dellemijn-Kippuw, A. Stijne, and U. van der Velden.** 1997. Beta-lactamase producing bacteria in adult periodontitis. J. Clin. Periodontol. **24:**538–543.
26. **Wade, W. G., A. R. Gray, E. G. Absi, and G. R. Barker.** 1991. Predominant cultivable flora in pericoronitis. Oral Microbiol. Immunol. **6:**310–312.