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Partial spectrum of microorganisms found in dentures and possible disease implications

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While it would appear that denture surfaces alone become colonized by microorganisms, this study showed that the porosity of denture material allows for contamination throughout the entire denture. Further, the numerous opportunistic and pathogenic microorganisms found in this study were unexpected and are known to produce not only substantial oral infections, but also systemic diseases.

(Key words: disease transmission, nosocomial infection, denture contamination, denture stomatitis)

A causal relationship between denture wear and persistent or recurrent stomatitis has been suggested by a number of investigators since 1970.[1,2] Additional studies indicated that dentures made from polymethyl methacrylate (PMMA; the most commonly used material) are readily colonized by various microorganisms. These organisms initially adhere to the surface of the denture material and subsequently penetrate into the dentures via a complex of pores and tracks formed by the release of gases during the construction polymerization process. This creates the potential for the contaminated dentures to function thereafter as indigenous reservoirs for recurring infection.[3-5] Substantial contamination has been reported in vitro after only 8 hours of contact between the denture material and microorganisms.[6] The purpose of this study was to determine if a similar contamination of dentures occurs in vivo.

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Methods

Dentures were obtained directly from patients by protocols previously approved by the institutional review board, stored in sterile collecting bags, and aseptically divided into multiple samples. Each sample was cultured in triplicate by direct contact with chocolate agar, reduced brain-heart infusion blood agar, and Sabouraud dextrose agar. The resultant growth was subcultured by standard techniques to obtain pure cultures, which were identified using Analytical Profile Index (bioMerieux) and appropriate biochemical tests.

Results

Identification of isolates confirmed that patients' dentures harbor numerous pathogenic and opportunistic bacteria and fungi (*Table*). Marked quantitative and qualitative differences in microbial flora were noted among individual dentures as well as among samples taken from the same dentures. Posterior samples were usually more heavily contaminated than anterior samples, which is consistent with greater hydraulic pressures in the molar regions during mastication. The physical appearance of dentures, which had been used for periods ranging from 3 weeks to more than 40 years, was generally unrelated to degree of contamination. Surprisingly, the depths of most dentures were generally more contaminated than their respective surface areas.

Staphylococcus species were the dominant gram-positive cocci present, although some *Streptococcus* species were present as well. Gram-positive rods were infrequent but included *Arcanobacterium haemolyticum* and *Actinomyces* species.

A wide array of opportunistic and pathogenic gram-negative rods were identified, including *Pseudomonas aeruginosa*, *Pseudomonas fluorescens*, *Burkholderia cepacia*, *Stenotrophomonas maltophilia*, *Enterobacter cloacae*, and *Klebsiella pneumoniae*. Gram-negative cocci such as *Neisseria perfava* and other unidentified *Neisseria* species were also present.

Although one *Aspergillus* isolate was noted, fungal isolates were primarily yeasts and included *Candida glabrata* (most common), *Candida albicans*, and *Candida paratropicalis*.

Comments

The microorganisms isolated in this study are responsible for numerous serious diseases in humans. Therefore, physicians and dentists must remain aware that dentures are not only a potential source of recurring oral infection, but also systemic infection. In addition to the significant gram-positive and fungal isolates that were identified, the gram-negative infections that become systemic are of particular concern because they possess lipopolysaccharides (endotoxin), which may initiate cascades of harmful cytokines such as tumor necrosis factor α. The already difficult chemotherapy of these microorganisms has been further complicated in recent years by the well-documented overall increase in antimicrobial resistance. For example, it has

Table
Microorganisms Isolated From Dentures and Associated Diseases

Microorganism	Diseases
■ **Gram-negative cocci**	
☐ *Moraxella lacunata*	Chronic angular blepharoconjunctivitis
☐ *Neisseria perfava*	Endocarditis; septicemia; meningitis
■ **Gram-negative rods**	
☐ *Acinetobacter* spp	Nosocomial infections; respiratory tract infections (RTIs); periodontal disease; recurring oral ulcers (ROUs)
☐ *Burkholderia cepacia*	Nosocomial infections; cystic fibrosis infections; osteomyelitis
☐ *Enterobacter aerogenes*	RTIs; urinary tract infections (UTIs); septicemia, especially in intensive care and burn units; ROUs
☐ *Enterobacter amnigenus*	Intravenous catheter–induced infections
☐ *Enterobacter cloacae*	UTIs; hospital bacteremia; ROUs
☐ *Klebsiella pneumoniae*	Severe bronchopneumonia; stomatitis; ROUs
☐ *Providencia rettgeri*	UTIs; nosocomial infections of wounds, burns, and blood
☐ *Pseudomonas aeruginosa*	RTIs; nosocomial infections of wounds, burns, blood, and infections induced by indwelling devices
☐ *Pseudomonas fluorescens*	Rare in hospital patients
☐ *Serratia marcescens*	Meningeal sepsis; RTIs; UTIs; wound infection; septicemia; endotoxic shock; endocarditis; epidemic septic arthritis; stomatitis
☐ *Serratia liquefaciens*	Opportunistic infections
☐ *Stenotrophomonas maltophilia*	Nosocomial infections
■ **Gram-positive cocci**	
☐ *Enterococcus avium*	Rare human infection
☐ *Gemella morbillorum*	Normal intestinal flora; opportunistic infection
☐ *Lactococcus lactis*	Unknown pathogenicity
☐ *Staphylococcus aureus*	Folliculitis; furunculosis; impetigo; abscess; wound infection; pneumonia; osteomyelitis; septicemia; endocarditis; eczema; decubitus ulcer; food poisoning; toxic shock syndrome; scalded skin syndrome; ROUs
☐ *Staphylococcus epidermidis*	Endocarditis; peritonitis; UTIs; infection associated with intravascular cannula; infection associated with indwelling medical device; neonatal infections; immunocompromised opportunistic infections; jaw osteomyelitis; eye infections
☐ *Staphylococcus hominis*	UTIs; catheter- or prosthesis-induced infection; abscess; endocarditis
☐ *Staphylococcus xylosis*	UTIs; pyelonephritis; infection-induced kidney stones
☐ *Streptococcus salivarius*	Subacute bacterial endocarditis; transient bacteremias
☐ *Vagococcus* spp	Unknown pathogenicity
■ **Gram-positive rods**	
☐ *Arcanobacterium haemolyticum*	Pharyngitis; peritonsillar abscess
☐ *Actinomyces* spp	Cervicofacial, thoracic, abdominal, skin, bone, and central nervous system infections (acute and chronic)
■ **Yeasts and fungi**	
☐ *Aspergillus* spp	Thrombosis; sinusitis; RTIs; endocarditis; cutaneous infection; multiorgan dissemination (nodules and abscesses)
☐ *Candida albicans*	Acute mucocutaneous candidiasis; chronic stomatitis; deep-seated candidiasis (any organ); disseminated systemic disease
☐ *Candida glabrata*	Stomatitis; vaginitis
☐ *Candida paratropicalis*	Systemic infection; stomatitis
☐ *Trichosporon mucoides*	Systemic infection

been reported that *C. glabrata* has become resistant to fluconazole, so that treatment of oral and esophageal yeast infections in patients with dentures may require a different therapeutic regimen.[7]

Other PMMA prostheses such as partial dentures, mouth guards, and orthodontic appliances also should be considered as possible sources of pathogenic microorganisms. Accordingly, family members and attendant healthcare workers who wear PMMA prostheses may unwittingly function as carriers who facilitate disease transmission in both community and nosocomial environments. Therefore, it is essential that clinicians be cognizant of the importance of appropriate PMMA prosthesis hygiene so that denture-related diseases can be avoided.

Considering the number and magnitude of serious diseases associated with denture-borne microbial isolates, all clinicians must be aware of the potential role that dentures may play in the transmission of oral inflammatory conditions and related systemic diseases. Several conditions contribute to this transmission:

- Substantial denture contamination by microorganisms can occur after only 24 hours' exposure.
- Contaminated dentures are placed in patient's mouth on a daily basis.
- In some cases, microorganism-laden dentures are worn 24 hours a day. Continuous reinfection by dentures may lead to microbial diseases that vary clinically from subclinical to acute or chronic.

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