

Colonization of denture plaque by respiratory pathogens in dependent elderly

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Abstract

Objectives: Recently, there has been a resurgence of interest in the interactions between oral conditions and a number of prevalent systemic diseases. The morbidity and mortality of the dependent elderly that result from aspiration pneumonia have been recognized as a major geriatric health problem. The purpose of this study was to gain more information on the microflora of plaque on dentures and to assess the existence of oral infectious pathogens potentially causing the respiratory disease in the dependent elderly. **Subjects and Methods:** The denture bacterial flora of 50 dependent elderly were examined to identify microorganisms by the culture method. **Results:** 18 species of microorganisms were detected in denture plaque in this study. A variety of pathogens with the potential to cause respiratory infection pathogens colonized on the dentures of dependent elderly. **Conclusion:** The results of the present study revealed that bacteria that commonly cause respiratory infection colonized on the dentures of dependent elderly, suggesting that denture plaque may function as a reservoir of potential respiratory pathogens to facilitate colonization on the oropharynx.

Key words: denture plaque, dependent elderly, aspiration pneumonia, bacterial flora

Introduction

In a number of societies, the proportion who are elderly is steadily increasing. Japan faces a globally unprecedented future as an aging society. It is widely acknowledged, both in and outside government, that by 2020 more than one in four Japanese will be over 65¹. It is known that the prevalence of denture wearing increases with age², and that most denture-wearing patients, especially dependent elderly, do not keep their prostheses clean³.

Pneumonia can be a life-threatening infection, especially in the elderly, and it is a significant cause of morbidity and mortality⁴. Aspiration of pharyngeal bacteria has been identified as the major route of infection in the development of pneumonia⁵. Poor denture hygiene may promote oropharyngeal colonization by potential

respiratory pathogens. Oral bacteria can be released from the denture plaque into the salivary secretions which are then aspirated into the lower respiratory tract to cause pneumonia. Several studies have reported that denture plaque may be a source of respiratory pathogens⁶⁻⁹. However, few studies have investigated whether respiratory pathogens colonize the denture plaque of dependent elderly despite the facts that: (1) the oral hygiene of dependent elderly individuals is extremely poor³, (2) the mortality and morbidity of pneumonia in elderly institutionalized individuals are high⁴, and (3) the prevalence of denture wearing increases with age².

To gain more information on the microflora of plaque on dentures, we have undertaken this microbiological study, with special attention to the

presence or absence of respiratory pathogenic bacteria in the denture plaque. The purpose of this study was to determine if potential respiratory pathogens colonize the denture plaque of dependent elderly.

Materials and methods

1. Subjects

Fifty patients of the Department of Dental Surgery of National Chubu Hospital participated in this study. They consisted of 50 dependent elderly (24 women and 26 men, age range: 60-89 years old; mean age: 74.9 ± 9.7) who wear maxillary complete dentures and require oral care by their caregivers. The study population satisfied the following requirements for inclusion within this project: (a) the absence of active oral disease, (b) no history of antimicrobial therapy within the previous eight weeks, and (c) no history of diabetes. All dentures were functional, and had been worn for at least two years and a maximum of 18 years. All patients showed plaque on the fitting surface of their maxillary complete dentures.

2. Methods

The denture surface was first carefully dried by a sterile gauze to avoid contamination by saliva. Denture plaque from the fitting surface of upper full dentures was rubbed with No. 1 Seed Swab (Eiken Kagaku, Tokyo Japan) to collect specimens, which were then checked for microorganisms by the culture method. All oral microbiological sampling was conducted by a single examiner. The

sample was immediately transported to the laboratory. Specimens were inoculated onto 5 percent sheep's blood agar plates, chocolate agar plates, MacConkey agar (Eiken Kagaku, Tokyo Japan), OPA agar plates (Nippon Beckton Dickinson, Tokyo Japan), CHROM agar candida (Kanto Kagaku, Tokyo Japan) for aerobic organisms, especially respiratory pathogenic bacteria. The prevalence of potential respiratory pathogens was determined by culture. The plates were incubated at $35 \pm 2^\circ$ for 48 hours under aerobic conditions, and representative colonies isolated were subcultured and identified by standard methods¹⁰. In this study, subjects were considered colonized with respiratory pathogens only if *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Pseudomonas aeruginosa*, *Haemophilus influenzae*, *Haemophilus parainfluenzae*, *Enterobacter cloacae*, *Klebsiella pneumoniae*, *Serratia marcescens*, *Proteus mirabilis* or *Escherichia coli* were isolated from any denture sample.^{7,11,12}

Results

1. Microflora of denture plaque of dependent elderly

Aerobic bacteria were isolated in 50 patients. The detection rates of aerobic organisms of denture plaque are summarized in Figure 1. The predominant aerobic organisms on dentures were *Streptococcus* spp. (detection rate: 98%), *Candida* spp. (80%) and *Neisseria* spp. (64%).

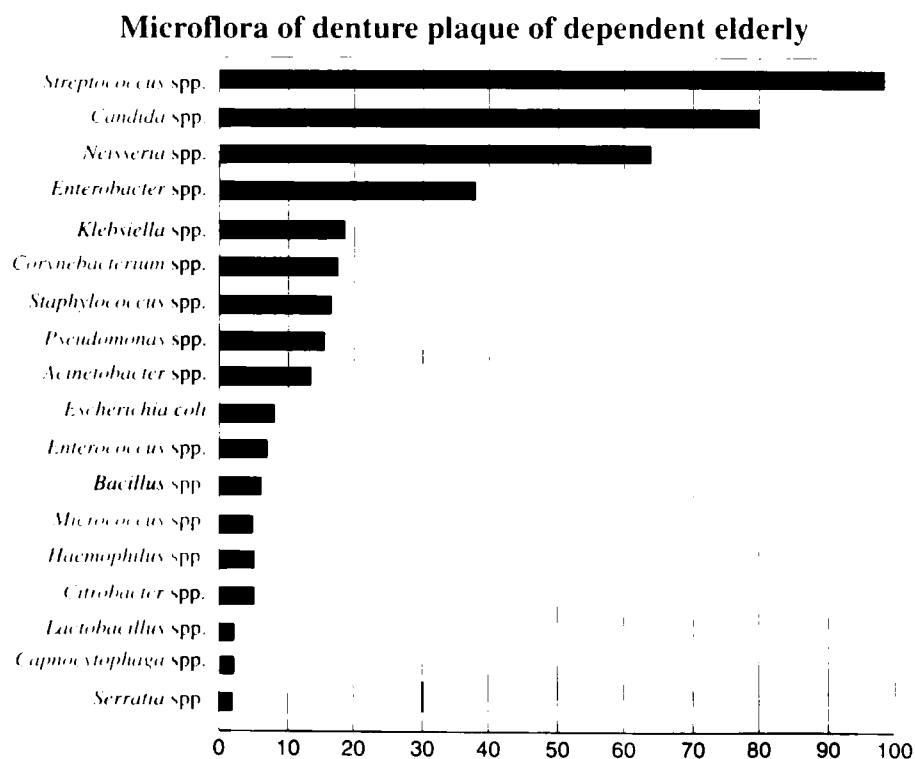


Figure 1. Microflora of denture plaque of dependent elderly.

2. Respiratory pathogens

A variety of potential respiratory pathogens colonized the oral cavities of the denture of dependent elderly (Figure 2). The predominant potential respiratory pathogens detected on dentures were *Enterobacter cloacae* (18%), *Klebsiella pneumoniae* (16%), and *Staphylococcus aureus* (10%). No *Haemophilus influenzae*, *Serratia marcescens*, *Proteus mirabilis* or *Streptococcus pneumoniae* were detected in denture plaque.

In 23 cases out of 50 (46%), potential respiratory pathogens colonized in the denture plaque.

Discussion

1. Microflora of denture plaque of dependent elderly

The oral cavity harbours a complex microbiota, with >300 identified (and probably a similar number of unnamed) species of bacteria so far isolated. These bacteria form complex, but well-ordered structures referred to as dental plaque on the teeth, and also as denture plaque on the denture surfaces⁶. Theilade *et al.* reported that the microflora of denture plaque is highly variable, and to a large extent similar to that of some forms of dental plaque, where streptococci, facultative actinomyces, and in some cases also lactobacilli, predominate¹³. Carlsson *et al.* demonstrated that *Streptococcus mutans* and *Streptococcus sanguis* were prominent members of the flora on dentures¹⁴. The results of the present study demonstrated that the predominant aerobic organisms on dentures were *Streptococcus* spp. (detection rate: 98%),

Candida spp. (80%) and *Neisseria* spp. (64%). Coulter *et al.*¹⁵ reported that the denture could induce an increase in pathogens such as *Neisseria* spp. etc., which is supportive of the results in the present study. In this study, 18 species of microorganisms were detected in denture plaque, among the most numerous numbers mentioned in previous reports. Lack of attention to oral hygiene results in an increase in the mass and complexity of denture plaque, which may foster an environment that promotes colonization by many organisms. Since functionally-impaired elderly patients often receive poor oral care, they may have denture bacterial colonization with aerobic flora. The results of this study were slightly different from those of former reports. Further studies are needed to clarify the difference in the detected species.

Previous microbiological studies have mainly concentrated on the presence and possible role of yeasts in denture-induced stomatitis^{16,17}. Gusberti *et al.* reported that *Candida albicans* represented only a minor part of the total cultivable flora¹⁸. However, our results showed that *Candida* spp. is one of the most predominant organisms. These findings suggested that the denture plaque on the dependent elderly might be different from that of a healthy patient or the flora might have changed within 25 years because of the use of many drugs including antibiotics. When the plaque is left undisturbed, there will be an increase in *Candida* spp. colonization. Therefore, poor denture hygiene may also be responsible for the high levels of *Candida* spp. found in this study.

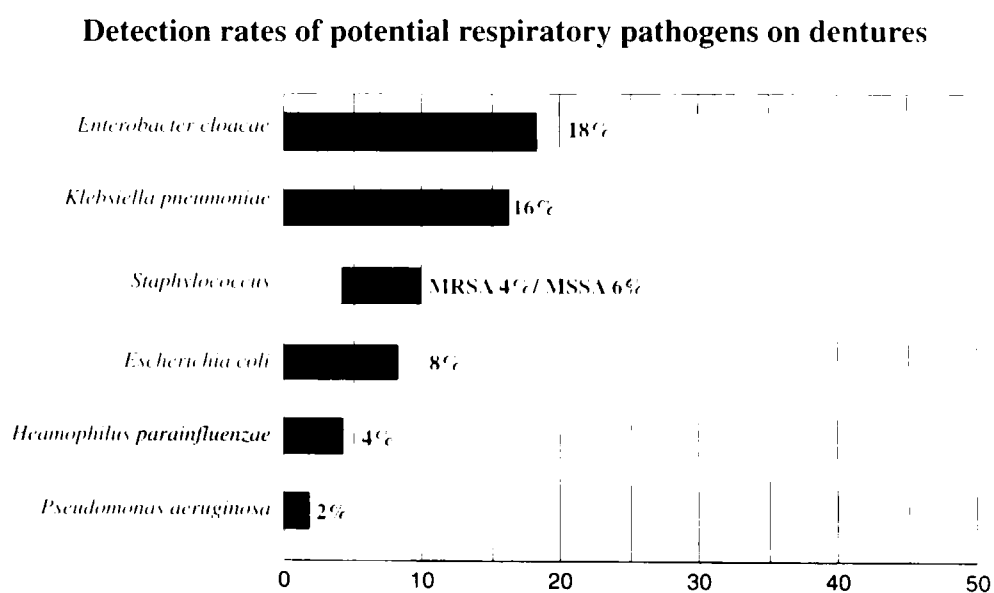


Figure 2. Detection rates of potential respiratory pathogens on dentures

2. Presence of potential respiratory pathogens on denture

Bacterial pneumonia in adults is the result of aspiration of oropharyngeal flora into the lower respiratory tract and failure of host defence mechanisms to eliminate the contaminating bacteria, which multiply in the lung and cause infection. Respiratory pathogens are not usually prominent members of the oral indigenous flora of healthy adults⁶. Because colonization of the pharyngeal mucosa by respiratory pathogens is thought to be a transient phenomenon, it is possible that respiratory pathogens could originate from the oral cavity⁷. Recent studies have suggested that dental plaque is a potential reservoir for respiratory infection¹⁹⁻²¹. An increase in potential respiratory pathogens in the oral cavity has thus been considered a high risk factor for aspiration pneumonia. Russell *et al.* reported the prevalence and distribution patterns of suspected respiratory pathogens in the dental plaque of older individuals living in a long-term care facility⁷. Few studies have reported the possibility of denture plaque as a source of respiratory pathogens. The possibility that denture bacterial plaque might be involved during the sequence of initial colonization and may represent a specific source of nosocomial infection has been poorly examined. The present study evaluated the prevalence of potential respiratory pathogens in the denture plaque of dependent elderly.

The results of this study detected potential respiratory pathogens with a high frequency in denture plaque samples. Denture plaque may therefore provide a reservoir for respiratory pathogen colonization that can be shed into saliva. These results also indicated that dependent elderly, who are at greater risk for lower respiratory infection, have a greater tendency for their denture plaque to be colonized by respiratory pathogens. It is suggested that the denture plaque may constitute an additional, possibly more stable, reservoir of respiratory pathogens. Oral health care for elderly patients in nursing homes reduces bacterial pneumonia²¹, and denture plaque control is essential for the prevention of bacterial pneumonia.

We conclude from our study that denture plaque must be considered a specific reservoir of colonization and subsequent aspiration pneumonia in dependent elderly. Therefore, maintenance of good denture hygiene may by itself reduce oropharyngeal colonization by potential respiratory pathogens. In the light of the well-recognized relationship between denture cleanliness and the

oral health of the denture patient, the importance of plaque removal from a denture cannot be overemphasized.

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