

## Comparison of Staphylococcal Flora in Denture Plaque and the Surface of the Pharyngeal Mucous Membrane in Kidney Transplant Recipients

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### ABSTRACT

**Background.** Biofilm occurring on removable prostheses is a reservoir of bacterial flora, consisting of both physiological and pathogenic multidrug-resistant microorganisms. Patients undergoing dialysis and organ transplantation are particularly prone to bacterial infections, which can have its source in denture plaque. This study was a comparison of the composition of staphylococcal flora within the surface of the pharyngeal mucous membrane as well as denture plaque in kidney transplant recipients.

**Methods.** The study included 44 subjects with removable prostheses who reported for a kidney transplant procedure. Swab samples were collected from prostheses and the pharyngeal wall. Isolated strains were identified and investigated for drug resistance.

**Results.** A total of 72 strains of *Staphylococcus* were isolated from the denture plaque and 53 from the pharynx. In the pharynx, the following species prevailed: *Staphylococcus epidermidis*, *Staphylococcus warneri*, and *Staphylococcus aureus*. The following species prevailed in denture plaque: *S epidermidis*, *S aureus*, and *Staphylococcus haemolyticus*. Among the pharyngeal strains, antibiotic resistance most commonly referred to natural penicillin (77%), constitutive macrolide-lincosamide-streptogramin B resistance (28%), and tetracycline (26.4%). In case of denture plaque, the highest percentage of strains demonstrated resistance to natural penicillin (60%), fosfomycin (32%), and cefoxitin (25%). In 10 subjects (48%), *Staphylococcus*-induced infections occurred in the first year after transplantation, 5 of which had the same bacterial strain as cultured previously from dentures.

**Conclusions.** The denture biofilm and surface of the pharynx differ in terms of bacterial composition and bacterial drug resistance profiles. Denture plaque constitutes a considerable reservoir of staphylococcal flora, which can be a potential source of infection in organ transplant recipients.

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**T**HE ORAL cavity is an environment for 700 different bacterial species detected with conventional methods (bacterial cultures) as well as molecular biology methods (polymerase chain reaction) [1]. A range of microniches exists within the oral cavity; they differ from one another in terms of bacterial composition and demonstrate high microflora variability dependent on a number of factors,

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including age, diet, and systemic diseases [2,3]. Among bacteria inhabiting the oral cavity, there are both nonpathogenic species, which constitute physiological flora, and pathogenic bacteria, which may be divided into conditionally pathogenic (opportunistic) and unconditionally pathogenic [4].

Bacteria of the *Staphylococcus* genus are facultative anaerobic, gram-positive cocci occurring commonly in the natural environment. In humans, they colonize mainly in the skin and mucous membrane, accounting even for 60% of this flora composition. Some species may be responsible for opportunistic infections. These infections involve subjects with decreased immunity, such as patients undergoing dialysis and those undergoing organ transplantation [5].

In Poland, ~1000 kidney transplants are performed annually. This treatment modality is considered to be the most economical and convenient for the patient with end-stage kidney failure. Most patients who qualify for a transplant undergo routine hemodialysis while waiting for a suitable donor [6]. In this study group, the death risk is multiple times higher than in generally healthy subjects, and infectious etiology is the second leading cause of death after cardiovascular conditions [7]. Patients undergoing hemodialysis are particularly prone to colonization by multidrug-resistant (MDR) opportunistic bacteria [8]. Frequent antibiotic therapy and repeated hospital visits and stays in dialysis centers, as well as a suppressed immune system, contribute to this susceptibility [7]. MDR bacteria may colonize individual niches in the oral cavity, and when dental prostheses are used, they also colonize the surface of those. They form a part of the organized biofilm structure also referred to as denture plaque.

Particular affinity to synthetic materials is observed in bacteria of the *Staphylococcus* genus [9]. With adhesion and coaggregation properties exhibited toward other bacteria and yeast-like fungi, they are extremely difficult to eradicate with conventional methods of denture hygiene [10,11]. Staphylococci inhabiting the oral cavity and prosthetic material may include both nonpathogenic and conditionally pathogenic bacteria [1,12]. Routine microbiologic testing in organ transplant recipients does not cover denture swab sampling, which may lead to omission of significant pathogenic organisms posing a threat to their health and life. Moreover, carrying of opportunistic strains facilitates cross-contamination among medical personnel and patients of dialysis centers and hospital wards admitting patients.

The goal of the present study was to perform a microbiologic evaluation of staphylococcal flora composition on the surface of the mucous membrane in the anterior pharyngeal wall as well as the impression surface of dental prostheses used by kidney transplant recipients.

## PATIENTS AND METHODS

The study involved 44 patients who reported to the Department of General and Transplant Surgery at the Infant Jesus Teaching Hospital (Warsaw, Poland) for a kidney transplant procedure. The

group comprised 26 male subjects and 18 female subjects undergoing renal replacement therapy with hemodialysis who used removable dental prostheses (complete prostheses, 24 subjects, partial prostheses, 18 subjects; skeletal prostheses, 2 subjects). Clinical and demographic characteristics are summarized in Table 1. Exclusion criteria were as follows: systemic antibiotic therapy, the use of antifungal formulations, and the use of dental rinses within a period of up to 1 month before the organ transplant. The study was conducted with the consent of the Bioethics Committee at the Medical University of Warsaw, and each of the participants declared their informed consent in writing.

General medical history was taken, including information on previous renal replacement therapy, the period undergoing dialysis, medications taken, concomitant diseases, and dental history in terms of the dentures used (Table 1). Directly before pharmacologic preparation for the surgery, samples were collected with a sterile swab kit with transport medium from the surface of the mucous membrane of the anterior pharyngeal wall (tonsil) as well as the impression surface of the prosthetic plate used to restore defects in the upper arch. The material was then transported to a microbiologic laboratory and, within 48 hours of collection, cultures were grown. The study used blood agar medium and Chapman selective and differential medium targeted at bacterial flora of the *Staphylococcus* genus. The culture plates were incubated at 37°C for 48 hours. The procedures included isolation and series of streak plating. In cases of bacterial colonies that demonstrated atypical morphology on the blood agar medium, additional catalase tests, as well as Gram staining, were performed. Affiliation of individual strains to a genus was determined with the VITEK 2 system, an automated identification device (bioMérieux, Marcy l'Etoile, France). The device functions based on an analysis of biochemical properties of microorganisms conducted in a series of catabolic reactions. With the VITEK 2 dedicated cards, the microorganism's susceptibility to antibiotics and chemotherapeutic agents was determined. Interpretation of the results complied with the

**Table 1. Clinical and Demographic Characteristics of Patients**

Variable	Value
Sex	
Female	20 (45%)
Male	24 (55%)
Mean (range) age, y	60.5 (40–71)
Cause of renal failure	
Renal cystic disease	11 (25%)
Diabetes mellitus	6 (14%)
Glomerulonephritis	7 (16%)
Arterial hypertension	5 (12%)
Other	15 (34%)
Mean (range) duration of dialysis treatment, y	3.25 (0–8)
Type of denture used	
Complete	23 (52%)
Partial	20 (45%)
Skeletal	1 (2%)
Mean duration of denture use, y	5 (0.7–10)
Daytime denture use	20 (45%)
Daytime and nighttime denture use	24 (55%)
Mean (range) no. of <i>Staphylococcus</i> strains	
Pharynx	1.17 (0–4)
Denture	1.62 (0–4)

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