



## MECHANISMS OF PRIMARY ADHESION AND COLONIZATION BEHAVIOR OF PERIODONTOPATHOGENIC BACTERIA AND FUNGI OF THE GENUS CANDIDA ON DENTAL POLYMER SURFACES

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### ABSTRACT

This study focuses on evaluating the ability of microorganisms, including *Staphylococcus aureus*, *Escherichia coli*, and fungi of the genus *Candida*, to form biofilms on various dental polymers. The results demonstrate that the Vitacryl polymer exhibits low adhesive properties due to its hydrophobic nature, reducing microbial colonization risk compared to polystyrene. These findings highlight the importance of selecting materials with antimicrobial properties to prevent infectious complications in dentistry.

**Keywords:** dental polymers, microbial adhesion, *Candida albicans*, infectious complications, Vitacryl.

### INTRODUCTION

The relevance of research into the biofilm-forming activity of microorganisms on dental polymers is driven by the growing problem of infectious diseases of the oral cavity associated with the use of orthopedic devices and implants. In recent years, increased attention has been paid to the formation of biofilms composed of various pathogens, including *Staphylococcus aureus*, *Escherichia coli*, and fungi of the genus *Candida*. These biofilms not only complicate the treatment of infections but can also lead to serious consequences such as periodontitis and systemic infections

Studies on microbial adhesion to dental materials emphasize the need to select optimal polymers with low adhesive capacity, which can significantly reduce the risk of infectious complications (3). It is important to note that different dental polymers, such as polyvinyl chloride, polyurethane, and thermoplastic materials, exhibit different properties and responses to microbial colonization (4).

Understanding the mechanisms of biofilm formation and stability on various polymer materials is particularly important in the context of selecting optimal materials for dental applications. The use of materials with low microbial adhesion capacity can help reduce the risk of infections and improve clinical outcomes (9).





Thus, studying the interaction of microorganisms with various dental polymers, such as polyvinyl chloride, polyurethane, and thermoplastic materials, allows us to identify the most effective solutions to prevent biofilm formation and ensure safer and more effective orthopedic treatment. This research has practical significance for improving the quality of dental care and preventing infectious complications, making it highly relevant in modern dentistry.

## **MATERIALS AND METHODS**

Reference strains of various microorganisms were used in the study. The strains included *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus pyogenes*, and *Escherichia coli* to study bacterial activity. Additionally, a strain of *Candida albicans* was used to evaluate the colonization activity of fungi of the genus *Candida*. These strains allowed a detailed investigation of the adhesion and colonization characteristics of pathogens. Controls were biofilms formed in the wells of polystyrene flat-bottom plates and on polymer samples.

Evaluation was performed using a microplate reader measuring the optical density of the solution, which allowed determination of the level of biofilm formation. This method is widely used to assess the adhesive properties of microorganisms and their ability to form biofilms. An important aspect of evaluating the thermoplastic polymer for dental splinting in periodontitis treatment is studying its effect on the oral microbiota and its potential to prevent bacterial complications. For this purpose, microorganisms such as *S. aureus*, *S. epidermidis*, *Candida*, *E. coli*, and *S. pyogenes* were cultured in the laboratory to study biofilm-forming bacteria.

## **RESULTS**

It was found that strains of *S. aureus*, *S. epidermidis*, *E. coli*, *S. pyogenes*, *Enterococcus faecalis*, and fungi of the genus *Candida* showed lower levels of colonization on the surface of the polymer material Vitacryl. At the same time, the degree of colonization of these microorganisms, especially fungi of the genus *Candida*, was significantly higher on polystyrene. It was established that strains of *S. aureus*, *S. epidermidis*, *E. coli*, *S. pyogenes*, *E. faecalis*, and fungi of the genus *Candida* demonstrated a lower level of colonization on the surface of the Vitacryl polymer. In contrast, on polystyrene surfaces, the colonization of these microorganisms, particularly fungi of the genus *Candida*, was significantly higher. This may indicate that Vitacryl possesses properties less favorable for microbial adhesion and growth, enhancing its potential in dental practice for the prevention of infectious complications. A key factor influencing this property is the hydrophobic





surface profile of the Vitacryl polymer. Our results are consistent with other studies confirming that increased hydrophobicity of materials significantly reduces microbial adhesion. This is explained by the fact that hydrophobic surfaces create less favorable conditions for the attachment and growth of bacteria and fungi, making Vitacryl a promising material for dental applications aimed at reducing the risk of microbial colonization and infectious complications. The study showed that staphylococcal growth on the surface of the thermoplastic material was lower compared to control samples. The colonization index for *S. aureus* was 0.3 units. A moderate degree of biofilm formation on the Vitacryl polymer was observed for strains of *S. epidermidis* (0.32), *S. pyogenes* (0.4), and *E. faecalis* (0.40). These results confirm that Vitacryl possesses properties that hinder the active adhesion of pathogenic microorganisms, potentially reducing the risk of infection when used in dental practice.

The highest level of colonization after 48 hours was demonstrated by *Candida albicans* (0.43); however, this value was statistically significantly lower compared to the control on polystyrene (0.68). These data indicate that the Vitacryl polymer creates less favorable conditions for fungal growth, which may be beneficial in designing dental structures that reduce the risk of microbial contamination. The presence of polyoxymethylene in the composition of Vitacryl contributes to reduced colonization by strains such as *S. aureus* and fungi of the genus *Candida*. Nevertheless, the growth rate and enzymatic activity of *C. albicans* may partially compensate for the bacteriostatic effect of the polymer, allowing this microorganism to still form a biofilm (4,5).

## CONCLUSIONS

*Staphylococcus aureus*, *Escherichia coli*, and fungi of the genus *Candida* exhibit the ability to form microbial biofilms on various dental polymers, such as polyvinyl chloride and polyurethane. The level of biofilm formation is significantly higher on polyurethane samples compared to polystyrene, highlighting their greater susceptibility to microbial contamination. On polyvinyl chloride samples, noticeable colony growth was recorded only for fungi of the genus *Candida*, indicating specific interactions between these microorganisms and the material. These results underscore the importance of selecting polymers for dental prostheses that take into account the risk of microbial colonization, especially in the context of using materials with antiseptic properties. However, the findings also indicate the need to consider alternative materials for orthopedic constructions in certain cases, particularly in



patients with oral candidiasis. This will allow more effective management of issues related to microbial contamination and ensure safer treatment.

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