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Original article

STUDY ON DECONTAMINATION LEVELS IN DENTAL IMPRESSIONS AND CONSTRUCTIONS

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SUMMARY

Purpose: Infection control within dental offices is essential for preventing pathogen transmission among patients, staff, and between clinical and laboratory settings. Despite established guidelines, adherence to protocols remains inconsistent, posing a risk of cross-infections. This study focuses on the decontamination rates of dental impressions used in removable and non-removable prosthetics in Bulgaria, aiming to highlight current decontamination practices and their efficacy.

Materials and methods: We conducted a prospective microbiological and epidemiological study involving 50 dental impressions and 8 finished constructions from individual and group dental practices, as well as samples taken by dental students. The microbiological examination included screening for facultative anaerobic and aerobic microorganisms, serving as an indicator for conducted decontamination practices. Specimens were obtained from adults by using dry sterile cotton swabs in a transport medium, subsequently inoculated on blood agar, eosin-methylene blue agar, and chromogenic medium for *Candida spp.*

Results: Our results showed that 18 (47.4%) of impressions for non-removable and 4 (33.3%) impressions for removable dental prosthetics tested positive for facultative anaerobic and aerobic bacteria as well as fungi. Predominant bacteria included viridans streptococci and resident *Neisseria* spp. Additionally, Gram-negative enteric bacteria were also found predominantly in non-removable impressions – 4 (14.8%). A single *Candida albicans* isolate was cultured in both non-removable and removable impressions. Among finished constructions, one sample tested positive for *Escherichia coli.*

Conclusion: These findings indicate significant gaps in decontamination practices, particularly with non-removable dental impressions, highlighting the necessity for improved training and adherence to infection control protocols.

Keywords: dental impressions, dental practice, removable and non-removable prosthetics, microbial contamination, decontamination, disinfection,

INTRODUCTION

Infection control in dental offices should be a definite priority for everyone working in the field. As part of the dental team, we can name not only the dental medical doctors but also the dental assistants/nurses, the dental technicians, and the administration. Patient-to-patient, patient-to-staff, and staff-to-patient transmission of infections is possible during the treatment of patients in dental offices [1].

Guidelines have been formulated to prevent pathogen transmission in the dental office using the above-described patterns. Back in 1985, the Centers for Disease Control and Prevention (CDC) developed the so-called "Universal precautions" aimed at controlling the risk of transmission of infections in dental practice, including blood-borne microorganisms such as hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) [2]. Based on this infection prevention algorithm, the American Dental Association (ADA) also developed updated recommendations, including guidelines for infection control in the dental laboratory [3]. Despite these protocols, which should be known and followed by the corresponding healthcare workers, our observations, surveys, and literature data indicate that they are not always followed, and such insufficient practices carry the risk of cross-infection between dental offices and the dental laboratories, with blood-borne pathogens being of major concern [4].

A dental impression captures an accurate mold of a patient's teeth and oral structures, serving as the foundation for creating restorations, orthodontic devices, and diagnostic models. It plays a critical role in producing crowns, dentures, braces, implants, and other custom dental appliances [5]. Thus, one way of transmitting pathogens from the dental office could be through contaminated and improperly disinfected impression materials, etc., for removable and non-removable prosthetics. Such

dental impressions can now become an epidemiological factor for the transmission of microorganisms. On the other hand, the transfer of microorganisms from the dental laboratory to the dental office is also possible, mainly through ready-made structures from removable and non-removable prosthetics – crowns, bridges, prostheses, etc. [3, 6].

During their daily training and clinical work, students of prosthetic dentistry, as well as patients, are also exposed to the real risk of transferring microorganisms between the clinical rooms and the dental laboratory and thus acquiring infections (blood-borne, airborne, and others). All this leads to the need to know the correct decontamination and disinfection of dental impressions and finished constructions, which must be carried out by the dentist when handing over the impression to the dental technician and by the dental technician when handing over the finished construction to the dentist. Only in this way can the epidemiological chain between these units be interrupted.

Although the transmission of infections during the delivery of dental care is well-documented, we believe that there are still dental practices that seem to neglect the recommendations and the preventive measures. In Bulgaria, the decontamination practices are based on the Medical Standard for the Prevention and Control of Nosocomial Infections [7].

Thus, we **aimed** to evaluate the current practices of disinfection of dental impressions among dental medical practices in the Plovdiv region.

MATERIAL AND METHODS

Study design and settings

We performed a prospective study on 50 dental impressions and 8 constructions from adults, involving individual and group dental practices. The research involved working with randomly selected dental laboratories, with the dentists and dental technicians being anonymized. In addition, some impressions were taken by dental medical students during their practical studies. The samples were collected throughout 2021 and 2022.

The staff of dental offices and dental technicians' laboratories were informed in advance of the aim of the research. The current study was exempt from Ethical board review and approval since all procedures and tests were performed on no human samples, and no additional testing was performed on the patients specifically for research purposes.

Microbiological analysis

The microbiological examination included screening for facultative anaerobic and aerobic microorganisms, serving as an indicator for decontamination practices.

The samples for microbiological evaluation were collected with dry sterile cotton swabs, vigorously rubbed, and placed in a transport medium (Amies, Biolife Italiana S.r.l., Milan, Italy). The samples were processed in the microbiological laboratory no longer than 24 hours after the collection. The specimens were inoculated on 5% sheep-blood agar (Diachim, Sofia, Bulgaria), eosin-methylene blue agar (Diachim, Sofia, Bulgaria), and Candida Chromagar (Diachim, Sofia, Bulgaria). The plates were incubated at 36–37ºC for a maximum period of 48 h. For bacterial identification, we used routine manual biochemical tests (catalase, coagulase, oxidase, esculin hydrolysis, arabinose) as well as the automated system MALDI-TOF MS (Vitek MS, bioMerieux, France). *Candida spp.* were identified based on the color of their colonies and using the manufacturer's manual.

Statistical analysis

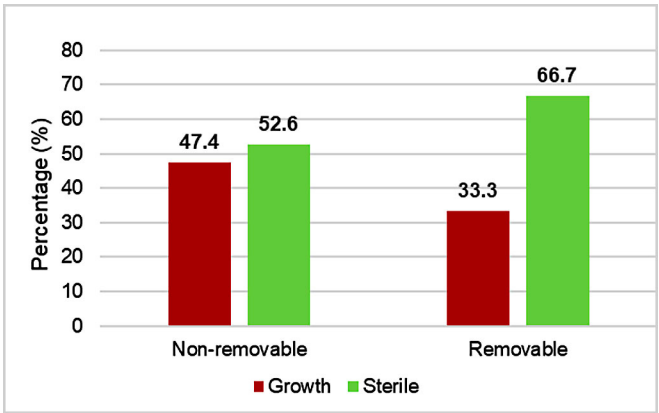
Data was coded and analyzed using SPSS software, version 25.0 (IBM Corp, Armonk NY, USA). Standard descriptive statistics were used to analyze the data. Qualitative variables are presented as numbers, absolute/relative frequencies, totals and percentages. The Kolmogorov-Smirnov test was utilized to ascertain the distribution of the sampled patients. The chi-square test for independence was used to determine whether differences between observed and theoretical distributions existed. Statistical tests were considered to have statistical significance if the p-value was less than 0.05.

RESULTS

The 50 studied impressions included 38 impressions for non-removable constructions (76%) and 12 for removable (24%). Overall, there were 23 positive results from culturing (46%). In non-removable dental impressions, culturing produced a positive result in 18 (47.4%), whereas in removable impressions, it was seen in 4 (33.3%) (Fig. 1).

No statistically significant difference was found between the two groups of impressions in regard to the culture results (Pearson $\div^2$ test=0.729, p=0.393). There was one positive result from culturing in ready-made constructions (12.5%).

Fig. 1. Percentage of positive results from the microbiological evaluation in impressions for removable and non-removable constructions



A total of 37 positive isolates were detected. The majority of the bacteria cultured from both non-removable and removable dental impressions were viridans streptococci in association or without association with resident *Neisseria spp.* – 14 (51.9%) and 4 (50%) respectively. In addition, one isolate of *S. aureus* and *E. faecalis* was also cultured in non-removable impressions. Gram-negative bacteria within the *Enterobacterales* order were predominantly cultured in non-removable – 4 (14.8%). Fungi were evenly detected among the studied samples. *Candida albicans* dominated among fungal isolates. Results are summarized in Table 1.

Table 1. Results from the microbiological evaluation by major microorganisms

	Non-removable constructions n (%)	Removable constructions n (%)	Ready-made constructions n (%)
Types of microorganisms			
Viridans streptococci	14 (51.9)	4 (50.0)	0 (0)
Enterococcus spp.	1 (3.7)	0 (0)	0 (0)
Enterobacterales	4 (14.8)	0 (0)	1 (50)
Neisseria spp. (resident)	6 (22.2)	3 (37.5)	0 (0)
S. aureus	1 (3.7)	0 (0)	0 (0)
Candida spp.	1 (3.7)	1 (12.5)	1 (50)
Total isolates	27	8	2

DISCUSSION

Dental impressions can carry mainly saliva and blood that may harbor pathogenic bacteria and viruses, so they are considered potentially infectious materials [4, 8, 9]. The transportation of non-decontaminated impressions from the dental medical office to the dental laboratories and vice versa could subsequently transmit pathogens between the facilities [1]. Without proper decontamination, these impressions can transfer pathogens to the laboratory environment, equipment, and other materials, posing a risk to both dental laboratory personnel and subsequent patients. Sofou A, et al. reported higher levels of contamination of dental impressions, reaching 61%, compared to our results [10]. The majority of bacteria were similar. Another study from Egusa H, et al. demonstrated the presence of mainly streptococci, followed by staphylococci (56.7%, 65.4%), *Candida spp.* (46.2%), MRSA (15.4%), and *P. aeruginosa* (6.7%, 7.7%) [11. However, the obtained results from the current preliminary study are worrying, owing to the fact that the growth of bacteria and/or fungi is an indirect marker that decontamination practices are insufficient. It indicates that dental impressions could transfer potentially infectious microorganisms, including blood-borne pathogens such as HBV, HCV, *M. tuberculosis*, etc. For instance, HBV can survive in dried blood up to a week [4, 12].

Many professional organizations issue recommendations and guidelines to ensure compliance with health and safety standards. The International Dental Federation (IDF), American Dental Association (ADA), and Centers for Disease Control and Prevention (CDC) all endorse disinfection of impressions or impression materials to be carried out before sending impressions to the laboratory. They also state that dentists or dental assistants are solely responsible and suggest disinfection of impressions or impression materials to prevent cross-infection, and this can be accomplished by either immersion or spraying with disinfectants or other methods [13, 14, 15].

We think that the studies of compliance with the recommendations for decontamination of dental impressions and finished structures, which are objectively registered through the relevant microbiological samples, are extremely important. A previous study by part of our team showed an unsatisfactory knowledge of the protocols for disinfection of impressions and prostheses, and hence their non-compliance in practice. For the period September 2019 - January 2020, an anonymous 19-question survey was conducted among 92 dental technicians. The majority (77.2%; n=71) responded that hands are a factor for the transmission of microorganisms from person to person, but for the rest (16.3%; n=15), the hands pose a risk only if they are visibly contaminated. Only 31.5% (n=29) disinfect their hands for 30 seconds, which is the appropriate time for hand disinfection (16, 17).

As for dental impressions and dentures, 59.8% (n=55) know that they must always be disinfected before working with them. The most commonly used preparations for disinfection of impressions are alcohols in 44.6% (n=41), but 22.8% (n=21) wrongly only use water and soap, which is not a recommended method of disinfection, but for removing organic matter. Only 1/3 correctly state that the finished dentures should be disinfected before being handed to the dentist [16].

Interesting results were reported by other authors

in their survey: Only 66,67% of the surveyed 39 practicing dental technicians know upon receiving if the dental impressions have been disinfected beforehand but they should all be.94.86% of respondents are aware of the risk for their health if the impressions are not disinfected upon received and 58,97% additionally disinfected impressions [17].

Unfortunately, these results show there are evident gaps in knowledge, adherence, and communication between dentists and dental technicians, as well as gaps in their knowledge regarding disinfection. In the interest of good dental practice, adherence to a strict anti-epidemic regime in dental offices and dental technician laboratories would be controlled through regular inspections by the controlling Institutions. Adhering to these protocols ensures a safe working environment and prevents infection risks in both the lab and clinical settings.

Another potential explanation for our finding could be that the disinfection protocols can vary between dentists, as well as the antimicrobial effectiveness of the substances used [5, 18]. Common substances include sodium hypochlorite, chlorhexidine, alcohol, glutaraldehyde, and hydrogen peroxide [19]. Shikh A, et al. concluded that alcohol-based spray disinfection of dental impressions may be inferior to aldehyde spray. *Salvia* reported effective disinfection with 1% sodium hypochlorite, 2% chlorhexidine, and 50% vinegar [8].

Study limitations

A significant limitation of the current study is the relatively small sample size. Based on the initial observations and to address this limitation, the research team plans to expand the study by including additional samples. To gain a deeper understanding of the factors contributing to the observed insufficient decontamination practices, we are planning to study additional factors in a follow-up study by using a detailed and practical-oriented questionnaire as well as a comprehensive evaluation of hand hygiene and disinfection protocols followed by medical personnel. By including these additional elements, we aim to provide a more thorough analysis of the underlying causes and offer more effective strategies for improving dental health care practices.

CONCLUSION

The culturing of bacteria and/or fungi from dental impressions is an indicator of insufficiencies in decontamination practices or a complete ignorance of the rules of good dental medical practice. Our results demonstrated that it is more prevalent to recover resident bacteria and fungi from sampling non-removable dental impressions.It shows that such impressions are a prerequisite to the transmission of infections related to delivering dental care.

Our results also showed the necessity for focused continuing education and training on infection prevention and control of practising dental doctors and dental technicians, not only during their studies but also post-graduation.

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