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Transmission of Microorganisms from Dentists to Dental Laboratory Technicians through Contaminated Dental Impressions

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SUMMARY

During dental procedures, dentists and their assistants, dental laboratory technicians and their assistants may be exposed to a wide variety of microorganisms in the blood, saliva, and oral cavity of the patients. These microorganisms may cause various air-borne and blood borne infections. The efficient infection control procedures in the dental office and the dental laboratory are not sufficiently used, mainly because these procedures cause inconveniences in dental practice. If pathogenic microorganisms on dental impressions and interim prostheses making devices are not decontaminated, direct transmission of infection can occur from patient to dentist, dental laboratory technician or vice versa.

The study showed that infection can be transmitted through insufficiently decontaminated alginate and silicon impressions. A comparison was made between the two chemical structures of dental impressions material (alginate or silicon) with an objective to find out which can transmit more bacteria and which is less resistant to disinfectants. After 10 tests, three groups of impressions of both materials were sprayed with the suspension of bacteria culture *Serratia rubidaea* (1 ml/10^6 CFU) and taken from phantom heads. Then, the impressions of Group 1 were rinsed under running tap water, the impressions of Group 2 were immersed into METASYS Green & Clean AD disinfectant for 3 seconds, and the impressions of Group 3 were left as a control group. The effectiveness of the treatment was evaluated by examining the contamination of plaster models made from the impressions, assessing the count of *Serratia rubidaea* CFUs (colony forming units) per one 1 cm^2.

Key words: infection transmission, silicon and alginate impressions, disinfection.

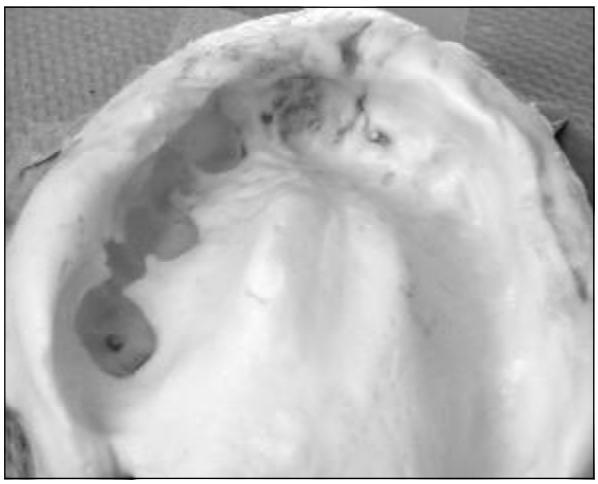
INTRODUCTION

More than 100 yeas ago professor W.C. Barrett from Buffalo Dentistry School (USA) underlined the utmost importance to a practicing dentist to determine the danger of infection in the patient's mouth and objectively evaluate it [1]. Although he was talking about the risk of syphilis transmission during dental interventions, this statement is just as relevant nowadays. It is imperative that dentists immediately identify symptoms of infection in the oral cavity as during dental procedures the pathogens spreading into the environment can infect dentists and assistant personnel. During dental procedures the patient's mucous membrane and the gums can be damaged, and during the process of taking impressions, saliva and blood can easily get into impression material (1 picture) [2]. Bacteria and viruses attach to setting impression material.

When a plaster model is moulded from such an impression, the microorganisms from its surface spread into the model, and thus the infected work material gets into dental laboratory premises and may pose a danger to the remotely working dental technicians. The impressions and models are being touched by technicians' hands, whose skin as a result of their work nature is often damaged. As literature indicate, 44 % of dental technicians in England wear protective gloves when working with the material delivered from medical institutions, 15 % of them wear gloves for about 50 % of their working time, and 26 % of them do not wear protective gloves at all [3]. During their work, the plaster dust from the infected models gets into their respiratory tract, sets on clothes and environmental surfaces, and remains viable for a considerable time. For example, the pathogen of tuberculosis *Mycobacterium tuberculiosis* remains dangerous for several weeks [4].

The objective of this study:

1) to determine the possibility of bacteria to spread from teeth to impressions and to models 2) to assess the disinfection effectiveness of alginate and silicon impressions, eliminating microorganisms that get on their surfaces.



Picture 1. Alginate impression removed from the mouth.

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MATERIAL AND METHODS

The experiment was carried out using *Serratia rubidaea* bacteria belonging to *Enterobacteriaceae* bacteria family. This microorganism is undemanding, not dangerous to a healthy person, easily cultured in the laboratory, and synthesizes red colour pigment.

Preparation of Serratia rubidaea culture suspension. Standard culture of *Serratia rubidaea* was cultured on commercially available standardized BBL (Becton Dickinson and Company) nutrient medium – tryptone soya agar. The bacterial culture was cultivated in tryptone soya agar for 24 hours at 37ţC. Then, the cultured bacteria were washed in sterile 0,9% sodium chloride solution and according to a 0,5 McFarland turbidity standard suspensions of cultured serratia were prepared: 10^8 CFU/1 ml (CFU– colony forming units).

Calculating the count of *Serratia rubidaea* on the surface of impressions. In order to preserve the same concentration of standard culture in each experiment, at the beginning and the end of the experiment, the phantom's oral cavity was disinfected with spray disinfectant METASYS Green & Clean SD for surfaces and instruments, in accordance with manufacture's recommendations After the surfaces were treated with the disinfectant, the standard *Serratia rubidaea* culture was equally sprayed with a pulverizer until the surface of the phantom's mouth cavity was covered. Then, using a sterile standard metal spatula, the alginate impression Elastic cromo (SpofaDental, a Kerr company) is taken from phantom teeth maxilla. The same procedure is repeated using the silicon (A-silicon GC Exafast Putty + Regular (GC, Japan) impression material. Impressions were grouped into 3 groups each consisting of 10 samples:

1. Group 1– impressions rinsed under running tap water.

2. Group 2– impressions immersed into METASYS Green & Clean AD impressions disinfectant solution for 3 sec and then dried for 10 min.

3. Group 3 – control group: impressions were not treated in any way and microbiologically examined straight away.

When plaster teeth models of all groups of impressions were made, they (plaster models) were microbiologically examined for the count of *Serratia rubidaea* CFUs per 1 cm^2 of plaster tooth model. In an aseptic environment the central bite of approximately 2 cm^2 is snapped off from each plaster tooth model. Snapped teeth are immersed into sterile test-tubes with 5 ml of sterile 0,9% sodium chloride solution. The immersed teeth, constantly shaken, were kept in the physiological solution for 30 min., and the dilutions of 1:10, 1:100, 1:1000 and 1:10000 were prepared from the wash liquid. After that, 1 ml of each dilution is placed on sterile Petri plates, 15 ml liquid tryptone soya agar of 45–50 ţC is added and mixed. When agar sets, Petri plates are put into thermostat and cultivated for 24 hours at 37 ţC. After the incubation, the number of colonies of cultured bacteria (*Serratia rubidaea*) is counted in each dilution (1 colony of bacteria grows out of one bacterium, i.e. from one CFU – one colony forming unit). The number of CFUs is multiplied by dilution factor and the count of bacteria in 1 ml of tooth impression wash. After the area of the teeth used in the experiment is calculated, the count of *Serratia rubidaea* CFU per 1 cm^2 is found.

RESULTS

The results of microbiological study are presented in Table 1.

The given results indicate that there is no statistically significant difference ($p>0,05$) between the count of *Serratia rubidaea* colonies cultured in the control group of alginate impressions (1590,0 ± 94,0 CFU/1 cm^2) and the group of alginate impressions rinsed under running tap water (1350,0 ± 110,0 CFU/1 cm^2). Practically all microorganisms were killed by the disinfectant, only 1,5 ± 2,4 CFU/1 cm^2 have grown ($p<0,05$, compared with Group 1 and the control group). Silicon impressions because of their structural properties get less infected by microorganisms (during this experiment 54% less when compared to alginate impressions). The difference between the count of *Serratia rubidaea* bacteria in the control group (725,0±110,0 CFU/1cm^2) and in group of silicon impressions rinsed under running tap water (350,0±100,0 CFU/1cm^2) was found to be statistically significant ($p<0,05$). The disinfecting material entirely eliminated microorganisms on the surface of silicon impressions.

A comparison of *Serratia rubidaea* bacterial growth between alginate and silicon impressions is presented in diagram 1.

It is obvious that the silicon impressions get less contaminated with microorganisms than the alginate impressions (the third tested group – the removed impressions

Table 1. Data of the experiments.

Examined groups	Alginate impressions			Silicon impressions		
	Rinsed under running tap water	Disinfected with METASYS Green & Clean AD	Control	Rinsed under running tap water	Disinfected with METASYS Green & Clean AD	Control
Experiments n=10 Serratia Rubidea CFU/cm^2	1200	0	1500	425	0	650
	1300	0	1600	625	0	900
	1400	0	1300	350	0	550
	1600	0	1700	250	0	950
	1200	5	1600	150	0	700
	1400	0	1500	200	0	700
	1500	0	1600	300	0	550
	1200	0	1700	400	0	750
	1300	10	1800	350	0	650
	1400	0	1600	450	0	850
Mean	**1350**	**1,5**	**1590**	**350**	**0**	**725**
Error	±110	±2,4	±94	±100	0	±110

were not treated with any disinfectant and tested microbiologically straight away) $p<0,05$. Microorganisms from alginate impressions virtually cannot be rinsed with water as compared with silicon impressions (the first tested group – the impressions rinsed under running tap water) $p<0,05$. During this experiment the number of microorganisms in the alginate impressions washed under running tap water decreased by 15%, and in silicon impressions - by 52%.

The bacterial growth of *Serratia rubidaea* in tryptone soya agar during the experiment is shown in Picture 2.

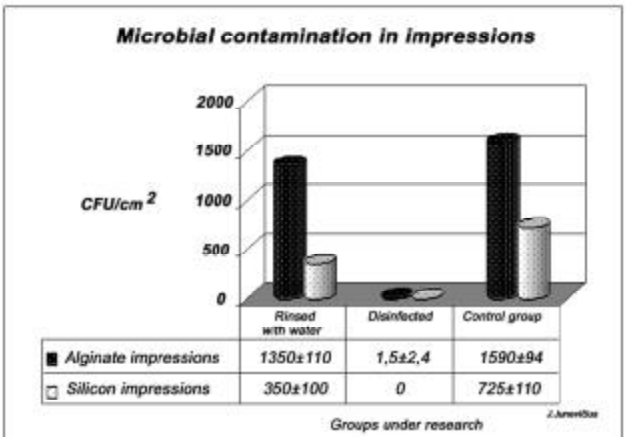

Diagram 1. Microbial contamination in impressions

DISCUSSION

The data obtained in this study demonstrate that alginate impressions because of their composition, texture and hydrophilic setting mechanisms get easily contaminated with microorganisms present in the oral cavity. A more monolithic texture of silicon material and its not hydrophilic setting mechanism substantially reduce the possibility for the microorganisms to stay longer on the surface of impressions. It is also possible to state that pathogenic agents can be transmitted not only through impressions, but also through the interim elements of prostheses manufacturing that are used in the patient's mouth and not disinfected afterwards. Therefore the reverse migration of pathogens is also possible – from dental laboratory to dentist's office.

A significant positive correlation was observed between the spread of microorganisms to dental laboratory and decontamination methods used for impressions treatment (not rinsed, rinsed under running tap water, immersed in disinfecting solution). Rinsing an impression under running tap water turned out to be ineffective infection control method. The data of our study indicate that the count of *Serratia rubidaea* CFUs in the alginate impressions decreased only by 15%, and in the silicon impressions - by 52%.

The data of this study indicate that the disinfection of impressions is obligatory as it eliminates microorganisms from the surface of impressions. The study also demonstrates the effectiveness of METASYS Green & Clean AD disinfecting material as a means of bacterial decontamination of impression surfaces. In the group of impressions disinfected with this disinfectant, the bacterial growth was virtually not observed. Other authors, such as L.Z.G.Touyz, M.Rosen (South Africa), suggest using chlorhexidin 0,2 % water solution instead of usual water in the process of alginate material preparation [5] in order to reduce the count of microorganisms not only on the surface of the impression, but also in its deeper layers. However, our tests prove METASYS Green & Clean AD disinfecting material to be sufficiently effective, and thus a patient can avoid direct contact with additional chemical substances.

It is of an utmost importance to disinfect not only the impressions and interim prostheses making devices removed from the patient's oral cavity, but also to seal them in plastic bags for transportation. It is just as important not to rely solely on the short-lasting and weak disinfecting effect of ethyl alcohol or hydrogen peroxide. The safety of both patient and doctor can be guaranteed by disinfecting prostheses by spraying with or immersion in appropriate disinfectants. This prevents the spread of pathogenic microorganisms during the transportation, manufacturing and storage of prostheses.

CONCLUSIONS

1. Pathogenic agents of oral cavity absorbed into dental impressions and interim prostheses making devices can be transmitted from patient to dentist or dental technician.
2. In order to reduce the risk of infection caused by pathogens of oral cavity, dental impressions must be disinfected with effective disinfecting materials.
3. Silicon based impression material in terms of microbiological contamination is superior to alginate based impression material.

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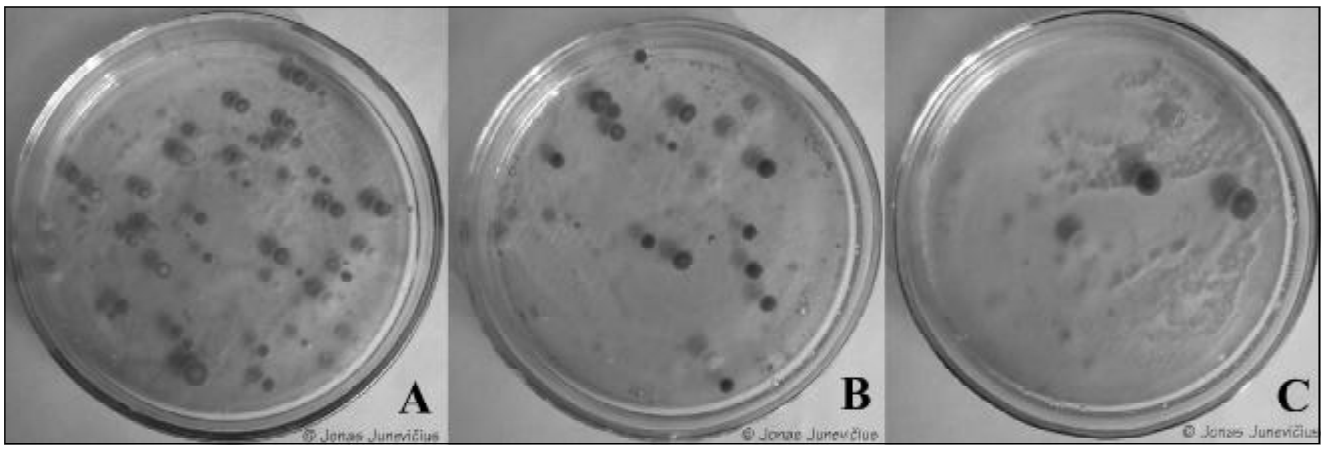

Picture 2. The growth of *Serratia rubidaea* in tryptone soya agar. A – dilution 1:10; B – dilution 1:100; C – dilution 1:1000.

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