TESTING OF MICROORGANISMS SENSITIVITY TO IMPRESSION MATERIALS COMMONLY USED IN DENTAL PROSTHODONTICS

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Abstract: *The harmful action of oral cavity bacteria on the teeth is exerted through the dental plaque. The purpose of this study was to isolate and identify some dental plaque microorganisms and to test their sensitivity to impression materials most commonly used in dentistry. Testing was carried out using the adapted Kirby-Bauer method.*

INTRODUCTION

As we know, in dentistry, the most important microbial biofilm is represented by the dental plaque. Thus, the harmful action of oral cavity bacteria on the teeth is exerted by the dental plaque having a variable thickness between 5 and 200 microns and which is found especially in the areas least accessible to mechanical and / or professional dental brushing, as well as in the most retentive regions of dental anatomy (fissures, cracks, pits).(1-4)

PURPOSE

In the first stage sampling, isolation and identification of microorganisms from the dental microbial plaque was performed on 63 patients rehabilitated by fixed prosthodontic restorations. Then, the actual study was carried out, namely testing the sensitivity of these microorganisms to the most commonly used dental materials: addition and condensation silicones in different consistencies, polyethers, zinc oxide eugenol paste, as well as irreversible hydrocolloids (alginates).

MATERIALS AND METHODS

To achieve this goal, we have stopped on the impression materials that are most commonly used materials in the dental office. Specifically, we have opted for silicone based impression materials (putty condensation silicone - 1 , ligth body condensation silicone - 1 , putty addition silicone - 1 , light body addition silicone - 1, on an irreversible hydrocolloid (alginate) -1, on a zinc oxide eugenol paste -1, but also on a polyether -1). The impression materials mentioned above were prepared according to the manufacturer's instructions and subsequently, after seting, cut into small circular blades with a diameter of about 5 mm in order to be used for microbiological tests. Even though the condensation silicones (putty and soft body consistency) and addition silicones (also putty and soft body consistency) are used together in the clinical activity, all the microbiological tests made in this scientific material were made individually for each impression material.

Sensitivity testing of microorganisms to common impression materials was performed by the Kirby-Bauer adapted method - on an agar medium surface (Mueller Hinton agar) cultured in canvas" with a standardized inoculum (0.5 McFarland) obtained from the strain of interest, pieces (fragments) are placed at equal distances on the growth material. If the strain is sensitive to a particular material, the microbial growth will be inhibited on a certain surface around it, a surface called the growth inhibition zone. Reading of the results is done by measuring the diameters of the growth inhibition zones using a graduated ruler. Interpretation of results is based on the size of the growth inhibition areas.

In this situation, the microorganisms used by us to carry out this study were sampled, isolated and identified from dental microbial plaque originate from 63 patients rehabilitated with fixed prosthodontic restorations, these being: *Streptococcus acidominimus, Staphylococcus epidemidis, Gemella morbillorum, Actinomyces naeslundii and Enterococcus faecium.* The identification of microorganisms was based on the examination of the culture and colony characters, Gram character, conventional biochemical tests (catalase, oxidase) and API standardized biochemical identification systems (BioMérieux, France).

In fact, oral streptococcs are among the species that originally colonize the dental surfaces due to the ability to adhere directly to the salivary film and represent 60-90% of the bacteria that colonize the teeth in the first 4 hours after their professional cleaning. Other primary colonizers are the genus species of *Actinomyces, Veillonella, Gemella, Granulicatella, Prevotella, Rothia and Neisseria,* which are part of the normal microbiota. Having a fast enough colonization capacity, these microorganisms (selected microbial strains of the same genus) were used to carry out this study, as follows (T-digits are an indication given to these samples by our microbiologist colleagues, T = strain and the accompanying number represents the number of the isolated sample): T63.2 *Streptococcus sp.*, T47 *Streptococcus mitis*, T123 *Streptococcus acidomonas,* T41.6 *Streptococcus sp.*, T33.3 *Enterococcus faecium*, T48 *Streptococcus acidominimas*, T41.1 *Actinomyces naeslundii*, T42.1 *Gemella morbillorum*, T110 *Actinomyces naeslundii*, T62.1 *Streptococcus mitis*, T67 *Staphylococcus epidermidis*,

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T73 *Staphylococcus sp.*, T50 *Pasteurella haemolytica.*

RESULTS

The impression is the negative copy of the prosthetic field, a very important link in the technological flow of fixed or mobile prosthetic restorations.

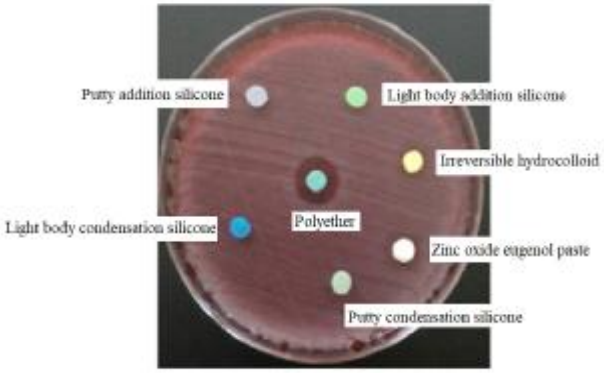
Impression materials are prosthetic materials, with which all the intimate details of the prosthetic field are recorded. The actual time the impression materials come into contact with prosthetic field elements is different and varies with the setting time of each impression material, averaging about 4-5 minutes: for condensation silicones it is 3- 5 minutes for addition silicones is also 3-5 minutes, for irreversible hydrocolloids (alginates) is 3-5 minutes, for zinc oxide eugenol pastes is 4-5 minutes, while the setting time for polyether is about 5-6 minutes. Practically, actual contact with microbial biofilms existing in the oral cavity varies on average from 3 to 6 minutes, depending on the impression material used, allowing for a serious microbial contamination of these materials.

The antimicrobial effect of tested impression materials can be very briefly shown in figure no. 1 and table no. 1.

DISCUSSIONS

In this study, we tested the sensitivity of microorganisms to common impression materials, in fact we watched the antimicrobial activity of the previously mentioned impression materials, each material being studied individually. We used discs or rings with a diameter of about 5 mm for putty condensation silicone - 1, light body condensation silicone - 1 , putty addition silicone - 1, light body addition silicone - 1, on an irreversible hydrocolloid (alginate) -1, on a zinc oxide eugenol paste -1, but also on a polyether -1. Thus, analysis of the antimicrobial activity of impression material discs revealed that they did not affect the development of bacterial strains they come in contact with, except for the irreversible hydrocolloid and the zinc oxide eugenol paste which had inhibitory effect on T73 strain. *Staphylococcus sp.* (figure no. 1, table no. 1), as well as the polyether which inhibited the development of strain T41.6 *Streptococcus sp* (table no. 1).

Figure no. 1. Inhibitory action of impression materials (more precisely of polyether) on the microbial strain T41.6 *Streptococcus sp.*



The inhibitory (antibacterial) effect of zinc oxide eugenol pastes on the development of the T73 *Staphylococcus sp.* strain can be explained by the fact that eugenol has a strong antiseptic character, being a substance that also enters in the composition of paste for the root canals. In fact, the main component of *Eugenia caryophyllata* extract, the eugenol, is known for its antimicrobial and antibiofilm properties.(5-7)

Regarding the inhibitory (antibacterial) effect of the irreversible hydrocolloid on the development of the Staphylococcus sp. T73 strain, this can be explained by the fact that, probably in the structure of this impression material, the manufacturers, even if not mentioned in the summary of product characteristics (SPC), incorporated ammonium quaternary salts, also in the idea of reducing the microbial load on this alginate surface, which is known to be extremely porous.

Table no. 1. The inhibitory action (antimicrobial activity) of the impression materials on the microbial strains of the first selection (expressed in mm)

Strain	Putty condensation silicone	Light body addition silicone	Putty addition silicone	Light body addition silicone	Irreversible Hydrocolloid (alginate)	Zinc oxide eugenol paste	Polyether
T63.2 *Streptococcus sp.*	-	-	-	-	-	-	-
T47 *Streptococcus mitis*	-	-	-	-	-	-	-
T123 *Streptococcus acidomonas*	-	-	-	-	-	-	-
T41.6 *Streptococcus sp.*	-	-	-	-	-	-	**12**
T33.3 *Enterococcus faecium*	-	-	-	-	-	-	-
T48 *Streptococcus acidominimas*	-	-	-	-	-	-	-
T41.1 *Actinomyces naeslundii*	-	-	-	-	-	-	-
T42.1 *Gemella morbillorum*	-	-	-	-	-	-	-
T110 *Actinomyces naeslundii*	-	-	-	-	-	-	-
T62.1 *Streptococcus mitis*	-	-	-	-	-	-	-
T67 *Staphylococcus epidermidis*	-	-	-	-	-	-	-
T73 *Staphylococcus sp.*	-	-	-	-	**24**	**23**	-
T50 *Pasteurella haemolytica*	-	-	-	-	-	-	-

Concerning the polyether inhibitory (antibacterial) effect on the development of T41.6 *Streptococcus sp.* strain, in the category of secondary polyether reaction products there are substances from the alcohol group (one or more -OH groups), chemical substances entering frequently in the composition of antiseptics and disinfectants and which in our case can generate a strong antimicrobial effect precisely on this bacterial strain (T41.6 *Streptococcus sp.*). As can be seen, on the other tested microbial strains, the secondary polyether reaction products did not show inhibitory effects.

CONCLUSIONS

After studying the results of this study, we were able to draw a number of conclusions, of which we will remember the ones that we have appreciated as the most important:

There may be inhibitory action (antimicrobial action) of impression materials on microbial strains, either because of the antimicrobial action of the secondary reaction products and / or some of the base substances in the composition of these materials (like in case of zinc oxide eugenol paste) or due to the incorporation of antispastic substances in the structure of these materials by manufacturers), However, this aspect is totally inadequate, the infectious risk due to contamination of these materials is real, and to prevent this risk, a firm decontamination of impression materials is required.

Voluntary incorporation by manufacturers of antiseptics into the impression materials structure may be a viable alternative to prevent infectious dental prosthesis, but at this moment it is totally inadequate to eliminate the decontamination procedures of these materials.

REFERENCES

1. Timoşca SF. Microbiologie stomatologică. Litografie I.M.F. Iaşi; 1987, p. 245-247.
2. Lazăr V. Aderența microbiană. Editura Academiei Române, Bucureşti; 2003.
3. Zijnge V, Van Leeuwen MBM, Degener JE, Abbas F, Thurnheer T, et al. Oral biofilm architecture on natural teeth. PLoS ONE. 2010;5(2):e9321.
4. Wood SR, Kirkham J, Marsh PD, Shore RC, Nattress B, et al. Architecture of intact natural human plaque biofilms Studied by Confocal Laser Scanning Microscopy. J Dent Res. 2000;79:21-27.
5. Lee KG, Shibamoto T. Antioxidant property of aroma extract isolated from clove buds (*Syzygium aromaticum* (L) Merr. Et. Perry). Food Chemistry. 2001;74:443-448.
6. Bersan SMF, Galvão LCC, Goes OFF, Sartoretto A, Figueira GM, Rehder VLG, Alencar SM, Duarte RMT, Rosalen PL, Duarte MCT. Action of essential oils from Brazilian native and exotic medicinal species on oral biofilms. BMC Complement Altern Med. 2014;14:451.
7. Mirsasan Mirpour, Zohreh Gholizadeh Siahmazgi, Masoumeh Sharifi Kiasaraie. Antibacterial activity of clove, gall nut methanolic and ethanolic extracts on *Streptococcus mutans* PTCC 1683 and *Streptococcus salivarius* PTCC 1448. Journal of Oral Biology and Craniofacial Research. 2015;5(1):7-10.