PRELIMINARY STUDY REGARDING DIMENSIONAL MODIFICATIONS OF C-SILICONES AFTER DECONTAMINATION

LORELAI GEORGETA SFARGHIU[1], SORIN POPȘOR[2], MIHAI BURLIBAȘA[3], CLAUDIA-CAMELIA BURCEA[4], ANCA TEMELCEA[5], TRAIAN BODNAR[6], ION ALEXANDRU POPOVICI[7], DANA CRISTINA BODNAR[8]

[1]PhD Candidate, University of Medicine and Pharmacy Tîrgu-Mureș, SC DENTALMED COM SRL Brașov, [2]University of Medicine and Pharmacy Tîrgu-Mureș, [3,4,5,6,7,8]"Carol Davila" University of Medicine and Pharmacy Bucharest

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Abstract: *Decontaminating impressions in dental prosthetics by immersion or atomizing lately tends to become a fundamental step in the technological process of manufacturing fixed or removable prosthetic restorations. Nevertheless, the time allotted for every impression to be disinfected depends on two distinct factors: the antimicrobial capacity of the chemical substance and its likelihood to alter the physical, chemical and biological factors of the material used for creating the impression. Thereby, this article presents a preliminary study regarding the dimensional modifications that c-silicones of medium-fluid consistency could sustain after their immersion in disinfection substances such as glutaraldehyde, peracetic acid or sodium hypochlorite.*

INTRODUCTION

It is a known fact that every professional who carries out his/her profession in dentistry (dental surgeon, dental assistant, dental technician) is under a constant but fluctuant infectious risk by handling impressions. This is why decontaminating these impressions by immersing or by atomizing the disinfectant substance on its surface tends to become, even in Romania, a customary step during the technological process of manufacturing fixed or removable prosthetic restorations.(1-4)

PURPOSE

Generally speaking, the time allotted for decontaminating one dental impression, regardless of its type, depends on two factors, namely:(1-4)

- The optimal time necessary for the used substance with antimicrobial capacity to deactivate the microorganisms existing on the impression's surface.
- The minimal time within which the impression has to be under the influence of the substance with antimicrobial capacity, without altering its physical (here, referring especially to the dimensional parameters), chemical and biological features characteristic for the material used in making the impression.

Therefore, in this article, we first accomplished a preliminary study of the dimensional variations of the materials used for impressions after undertaking decontamination of the actual impressions by immersing them in several chemical substances with antimicrobial potential for different time intervals, with the purpose of highlighting an optimal time frame in which the dimensional parameters of the impression's material would not modify at all or within minimal acceptable values, which will not damage the future manufacture of the fixed or removable prosthetic restorations.

MATERIALS AND METHODS

Even though in the study's extended version we have analyzed the dimensional variations that appeared during decontaminating almost all types of impression materials used in dental prosthetics, in the present article we are strictly referring to c-silicones, these being the most accessible materials used for elastomeric impressions commonly encountered in dental practices from Romania. To be more precise, we have concentrated our efforts on c-silicones with a medium-fluid consistency, this type of material being in fact the element of great precision within the structure of any kind of dental impression.(1-4)

For this study, there have been comparatively used two types of c-silicones with medium-fluid consistency with the purpose of reaching a number of conclusive results, which would allow a continuation of further studies, namely Oranwash (Zhermack) and Xantopren L blue (Heraeus Kulzer). As chemical disinfectant substances, we have used glutaraldehyde 2%, peracetic acid and sodium hypochlorite. As decontamination method, we have used immersion. Nevertheless, determining the way these chemical substances could influence the dental impressions' dimensions meant not only taking the proper measurements, but also finding a solution to the following problems:

a) Establishing the sample. Taking into account the irregular and customized shape of the dental impression, measuring its dimension can inadvertently lead to significant errors, related to both handling the measuring instrument and repeatedly taking measurements. This is why we have used several lamellar samples, with parallel, smooth facets, obtained by placing the impression materials between two glass plates, on which we have applied an even pressure throughout the hardening process (in this case, we are dealing with c-silicones with medium fluid consistency previously specified). After the impression materials have hardened, the glass plates are removed, obtaining the lamellar samples which can be easily measured. We have analysed the variation of only one parameter, namely thickness.
b) Establishing the means of measurement. Before choosing the means of measurements, we have taken into account the following goals:

[3]Corresponding author: Mihai Burlibașa, B-dul. Mărășești, Nr. 2B, Bl. A, Sc. 2, Et. 5, Ap. 17, Sector 4, București, România, E-mail: mburlibasa@gmail.com, Phone: +04723 472632
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Table no. 1. Measurement instrument and type of equipment

Name of measurement instrument	Type of equipment	Measurement precision	Observations regarding the instrument usage
Calliper	Mechanical equipment with sliding capacity	0,1 mm (10^{-1} mm)	Low precision and the impossibility of controlling the gripping force are factors that exclude the calliper from this calibration.
Micrometre	Mechanical equipment with micrometric screw gauge	0.01 mm (10^{-2} mm)	A relatively low precision but especially the impossibility of controlling the gripping force excludes the micrometre from this calibration.
Device Measuring Length	Micro-mechanic apparatus with contact perception heads	0.001-0.003 mm (10^{-3} – $3x10^{-3}$ mm)	High precision, the possibility of taking measurements for non-rigid and irregular surfaced materials, under different compression forces recommend further usage of this instrument.
Laser interferometer	Interferential apparatus	0.1 µm	The measurement method implies that the surface of the material whose thickness we are trying to determine has to be smooth (like a mirror), fact that eliminates the interferometer from this calibration, despite its high precision.

- Choosing a measuring instrument with the best accuracy, in other words the division value and measurement inaccuracies to be between one and three microns (micrometre or 10^{-3} mm);
- The instrument with which we have taken measurements on the impression material should not provide errors due to the material's elasticity and/or asperity.

The measuring appliances that we have come to rest upon are the following: The accepted dimensional variations in comparison with the control-samples range from 10^{-3} to 7 x 10^{-3} mm. From the selected impression materials, there have been made sixteen samples (four for each type of disinfectant substance), obtained as it was stated previously, by applying an even pressure upon the medium-fluid fresh c-silicone spread between two glass plates, until the material hardens. The samples have been measured before decontamination: at the starting point and after 10, 45 and 360 minutes respectively. The measurements have been repeated after decontamination by immersion in one of the selected disinfecting substances, for ten minutes. After that, the samples were cleansed with distilled water and dried with the aid of absorbent paper.

A third series of measurements was undertaken after keeping the samples in the disinfectant substance for 45 minutes, followed by cleaning them in distilled water and also drying them with absorbent tissues. A forth series of measurements was taken in the same conditions, with the difference that the samples were immersed this time for 360 minutes. All measurements have been made within a special laboratory, observing the reference environmental conditions (a temperature of 20° C; the horizontal standard position for every means of measurement; humidity lower than 60%) imposed by regulations. The calibrations were made using a Device Measuring Length, for compression forces of 50 cN, 100 cN, 175 cN and 300 cN.

RESULTS AND CONCLUSIONS

After ending this cycle of measurements, the obtained results can lead us to elaborating a series of extremely interesting preliminary conclusions, as follows:

- We have observed the appearance of some dimensional modifications in measuring the thickness of the first control-samples (for both Xantopren L blue and Oranwash) taken initially, but also after 10 and 45 minutes respectively. There were recorded diminishing dimensional variations ranging between 3x10-3 – 5x10- 3mm, considered to be insignificant values and accepted as so, which could also be given by the inaccuracy of the measuring apparatus;
- There have been significant modifications concerning the thickness of the control-samples of impression material measured after 360 minutes, before decontamination, as opposed to the first control-samples (for both types of fluid silicones): the initial measurement and those taken after 10 and 45 minutes respectively. The dimensional variations recorded in a diminishing pattern are ranging between 2x10-2 – 4x10- 2 mm, values that are considered to be too high to be accepted;
- Moreover, we have discovered that between the first control-samples, namely those measured initially and after 10 and 45 minutes respectively, as opposed to those immersed for 10 and 45 minutes respectively, there are differences (dimensional variations) varying between 2x10-3 mm and 6x10-3 mm. These extremely small differences are negligible and are accepted as such.
- Another essentially important aspect we have discovered was the fact that after decontamination by immersing the fluid silicone samples in disinfectant substances previously mentioned for 360 minutes, all these as opposed to the control-samples measured also after 360 minutes, present modifications ranging between 2x10-2 mm and 6x10-2 mm, in a diminishing pattern. In comparison with the other control-samples, measured initially and after 10 and 45 minutes respectively, we have observed that the dimensional variations fluctuate between 4x10-2 and 10-1 mm also in a diminishing pattern. Furthermore, it has to be pointed out that these differences between samples are probably the result of disinfecting substances interacting with these types of impression materials.
- By using, in this case, two medium-fluid c-silicones, we could observe that both impression materials suffer almost identical dimensional variations after decontamination by immersion.
- All three used disinfectant substances have caused significant dimensional modifications for the medium-fluid c-silicones, for decontaminating periods longer than 100 minutes.

It is our belief that the maximum time accepted for decontaminating through immersion c-silicones of medium-fluid consistency in such a way that dimensional parameters stay constant or under variable limits, is of approximately 30 minutes. Regarding the microbiologic efficiency of disinfectant substances used in this case (glutaraldehyde, peracetic acid, sodium hypochlorite), this will be the object of a future study.

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