Dimensional Stability of Elastomeric Impression Materials Disinfected in a Solution of 0.5% Chlorhexidine Gluconate and Alcohol

Tomislav Ivaniš[1]
Jasenka Živko-Babić[1]
Biserka Lazić[1]
Josip Pandurić[2]

[1]Department of Fixed Prosthodontics
[2]Department of Removable Prosthodontics
School of Dental Medicine
University of Zagreb

Acta Stomatol Croat
2000; 11-14

Summary

Disinfection of elastomeric impression materials used in prosthetic dentistry can cause dimensional changes in the impression materials. 0.5% chlorhexidine gluconate is usually used for disinfection of impressions at the School of Dental Medicine in Zagreb.

The purpose of this study was to measure and compare linear dimensional changes of three elastomeric impression materials after their immersion in a certain disinfectant.

The master dies were made according to the ADA specification no 19. The tested materials were Panasil (addition silicone), Blend-a-scon (condensation silicone) and Impregum F (polyether). Twelve samples were immersed in disinfectant, twelve in water and twelve left in the air for four different periods of time (10 min., 30 min., 60 min and 24 hours). Linear dimensional changes were measured by a non-contact digital tool microscope.

The smallest changes were noticed in addition silicone with the least tendency to expansion. The condensation silicone contracted within a tolerant range of 0.2 - 0.4%, according to DIN 13913. Polyether expanded in the disinfectant significantly.

Our results show that the tested polyether is not appropriate for disinfection by immersion in chlorhexidine gluconate, while the other two materials underwent 24-hour immersion with linear dimensional changes within a clinically acceptable range.

Key words: *elastomerics, disinfection, chlorhexidine gluconate, dimensional changes*

ORIGINAL SCIENTIFIC PAPER
Received: October 27, 1999

Address for correspondence:

Tomislav Ivaniš
Department of Fixed Prosthodontics
School of Dental Medicine
Gundulićeva 5, 10000 Zagreb

Introduction

The risk of infection through cross-contamination in dental practice is significant for certain infectious diseases including staphylo-coccal infections, tuberculosis, recurrent herpes virus, hepatitis A, B, C and human immunodeficiency virus (HIV) (1-5).

Impression materials that have been exposed to infected saliva and blood provide a significant source of cross-contamination (6). Microorganisms have also been recovered from gypsum casts poured from contaminated impressions (7).

It is therefore necessary to clean blood and saliva from dental impression materials and to disinfect the impressions before sending them to the dental laboratory (8).

Pleasure et al. first warned that impressions need to be disinfected (1). Many authors have reported the possible ways of disinfecting impressions, particularly rubber materials, as well as about their precision and stability (9-35). The possibility of ethylene oxide sterilization has also been mentioned, as well as hot steam sterilization for some materials such as vinylpolysiloxane. The impressions are deformed in this process and can only be used as study models (36).

There are four main categories of disinfectants: these are products based on chlorine, formaldehyde, glutaraldehyde and iodofor (37). The main aim is to make disinfections as short as possible, so as not to affect the precision of the impressions, (15).

It is important to note that the goal is to eliminate contamination of the impression by adding a disinfectant to the impression material, which is for now only with irreversible hydrocolloids (38). A contribution to this goal is definitely the rare application of prior mouth rinsing with an appropriate disinfectant (37).

The purpose of this study was to measure and compare linear dimensional changes of three elastomers after their immersion in a certain disinfectant. The antibacterial effect of the disinfectant on impression materials was already known.

Material and methods

The three representative impression materials used in the study are shown in Table 1. The disinfectant was 0.5% chlorhexidine gluconate in 70% ethanol (v/v) (Plivasept, PLIVA, Zagreb, Croatia). The master die prescribed by the ADA specification no 19 (39) was used to create 36 samples from each material. The impression materials were prepared according to the manufacturer's instructions (mixing time and setting time). The mixed material was placed in the mold, covered with a glass cover, pressed by a C-clamp and immersed in water at a temperature of 37°C for 7 minutes. Twelve samples were treated with disinfectants. Twelve were immersed in deionized water, and 12 were left in the air as a control group. Three samples were used for each period of time. The time of exposure to a certain medium was: 10 min., 30 min., 60 min. and 24 hours. The time was controlled by an electronic clock - chronometer (Hong Kong, China). After being exposed to the disinfectant, the samples were washed for 30 sec. under a stream of water and dried with compressed air.

Linear dimensions were measured before and after the exposure to a certain medium by a non-contact digital tool microscope (Zeiss, Jena, Germany). The possible error of measurement was 0.015%. The initial distance on the mold between two defined lines amounted to 25 mm. Three measurements were carried out for each parameter and the mean value calculated. The significance of differences was statistically analyzed and calculated (3-way ANOVA). To test for main effects and differences among means 1-way ANOVA was run.

Results

The results show that the obtained dimensional changes depended on the impression material, the medium and time of exposure. All the differences in dimensional changes are statistically significant (Table 2). Highly significant results were obtained for all the main effects (p=0.000) and with highly significant differences between means (p=0.000).

The smallest changes in the disinfectant were noticed in the addition silicone with the least tendency to expansion, while it was quite stable in air. The changes of the condensation silicone in the disinfectant were also within a tolerant range of 0.2-0.4%, but unlike the addition silicone, it showed a tendency to contract. The condensation silicone left in air contracted more, unlike the addition silicone.

Polyether in the disinfectant expanded significantly, while when left in air, it contracted within a tolerant range, but considerably more than the addition silicone.

Figures 1, 2, 3 and 4 show the average values and the range of results of the observed changes (Figs. 1-4). Generally speaking, the greatest variance of average value results was observed in changes of polyether in the disinfectant, and the smallest in the condensation silicone. These changes were confirmed by the regression analysis.

Discussion

In the light of the widespread use of chlorhexidine in medicine and dentistry for disinfection of work surfaces, instruments and tools, we tested its impact on some elastomers during disinfection, by immersion over a certain period of time. The use of chlorhexidine for the purpose of impression material disinfection is considerably less than the use of other disinfectants. Thus Rowe and Forrest (22) used a 0.5% solution of chlorhexidine in 70% alcohol for disinfection by immersion of a number of impression materials including silicone and polyether, during 30 sec., 1 min. and 24 hours. They did not establish dimensional differences between the treated and untreated materials, and neither did they provide more precise data. Similarly, Blair and Wassell mention chlorhexidine as a possible disinfectant in the form of spray, but without giving more detailed data about its possible impact on the characteristics of impression materials (23). They do not think chlorhexidine is appropriate for disinfecting polyether, even in the form of a spray. In our research polyether showed the greatest dimensional changes after immersion in chlorhexidine. Polyether expanded already after 10 minutes. It is obviously in appropriate for disinfection by immersion, which corresponds to the results obtained by other authors (13,14,24-27) who used various disinfectants during different times of immersion. Herrera and Merchant obtained a contrary result (28). They did not establish any significant dimensional differences, even with polyether (Impregum), in their measurement of plaster models of treated (30 min.) and untreated impression materials. Borneff and Pichl also obtained the same results after 5-10 min. immersion in Glyoxal/Pentandial-Basis (15).

According to our results, the addition silicone undergoes immersion in chlorhexidine without significant dimensional changes, as can be seen from Table 2 and graphs. Changes after 10 min. immersion amounted to a negligible 0.12%, and only after 24 hours reached 0.33%!

Such stable behavior of the addition silicone confirms the results obtained by different authors (5,13,14,28,30,37), which is not surprising with respect to the confirmed high quality of this type of material.

The tested condensation type of silicone, for which we expected more unfavorable results, proved to be a quite stable material. It contracted in disinfectant (from -0.12% to -0.30%), while, as already mentioned, the addition type expanded minimally (0.12% - 0.33%). The conclusion therefore is that after 24-hour immersion the nominal value of changes was smaller in the condensed type!

However, left in air, the condensation type contracted more, still within a tolerant range if the exposure does not last for more than an hour. After 24 hours of exposure to air the contraction amounted to -0.40%, while with the addition silicone it was only -0.16%. This result was similar to that obtained by Johansen and Stackhouse who achieved, after 16-hour immersion in glutaraldehyde, contraction of condensation silicone (Elasticon-Kerr) of -0.44% (13). On the contrary, Yutaka et al., testing the condensation type of silicone (Flexicon - GC) after 60 min. immersion in Glutaral, measured contraction of -0.20% (31). It is obvious that it is not only the chemical structure of the material which defines the level of quality which can be generalized. Thus Thouati et al. (32), testing the impact of various disinfectants on three main types of elastomers, found the greatest changes with the condensation silicone (from -0.51% to positive 0.46%), and not with polyethers as could be expected, according to our results and those obtained by other authors (13,14,24-27). Moreover, Pilar, after 30 min. and 60 min. immersion in glutaraldehyde and chlorophenol, did not establish any influence on the accuracy of polyethers, including Impregum, and therefore recommend this type of disinfection (33).

Our results show that the tested polyether is in appropriate for disinfection by immersion in chlorohexydine, since it expanded significantly only after 10 min. (0.68%), while the other two materials underwent 24-hour immersion with linear dimensional changes within a tolerant range (34, 35).

Conclusions

1. Plivasept (0.5% chlorhexidine gluconate in 70% ethanol) may be used for disinfection for up to 60 minutes of immersion of the tested addition and condensation silicone, without significant influence on their dimensional stability.
2. The described method of disinfection cannot be applied to the tested polyether, since it showed significant dimensional changes after only 10 minutes of immersion.
3. The results of such testing cannot be generalized for certain types of elastomers. In clinical practice they can only be used with the tested materials and used disinfectant.