EVALUATION OF DIMENSIONAL STABILITY OF IMPRESSION MATERIALS IMMERSED IN DISINFECTANT SOLUTIONS USING A METAL TRAY

AVALIAÇÃO DA ALTERAÇÃO DIMENSIONAL DE MATERIAIS DE MOLDAGEM IMERSOS EM SOLUÇÕES DESINFETANTES USANDO UMA MATRIZ METÁLICA

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SUMMARY

Introduction: When impressions are taken, saliva and blood are frequently seen in the material, and washing them does not always guarantee that all organisms have been removed. Therefore, methods for disinfecting impressions (immersion and spray) have become a necessity, but they can affect the accuracy of dental impressions. **Purpose:** This study aimed to evaluate the dimensional stability of dental impression materials after immersion in disinfectant solutions. **Material and methods:** This study used a total of 135 impressions, 45 of each of the following materials Impregun F® (polyether), Permlastic® (polysulfide) and Hydrogun® (irreversible hydrocolloid). Sodium hypochlorite and glutaraldehyde were selected as disinfectants and the immersion times were 10 and 15 min. Ten (10) impressions of each material were immersed in both solutions: 2% glutaraldehyde solution (Glutacid® 2%) and sodium hypochlorite solution (Milton 1%), for 10 min, and a further 10 impressions for 15 min. The other 5 impressions of each material were used as a control group without immersion in disinfectant solutions. **Results:** Neither polyether nor polysulfide impressions showed any statistically significant difference (ANOVA) from their control measurements after being soaked in the two disinfectant solutions. However, when the alginate impressions were disinfected by sodium hypochlorite for 15 minutes, a significant distortion (~0,122 mm) occurred, compared with control group. **Conclusion:** Within the limits of this study it can be concluded that the immersion practices for disinfection did not influence the quality of impressions obtained, except when sodium hypochlorite was used as disinfectant and immersion time was 15 minutes.

UNITERMS: dimensional stability; disinfection; impression materials.

RESUMO

Introdução: *Nas moldagens para obtenção de modelos para confecção de próteses, principalmente quando são realizadas em áreas retentivas da boca, resíduos de saliva e sangue ficam retidos no material e podem conter microoganismos patogênicos. Somente a lavagem do molde em água corrente não garante que todo sangue e microoganismos aderidos à superfície do molde tenham sido eliminados. Assim torna-se necessária a desinfecção dos moldes para a qual os métodos de desinfecção spray e imersão têm sido testados com várias soluções desinfetantes e provaram sua eficiência para esse propósito. No entanto, esse procedimento pode afetar a estabilidade dimensional do material de moldagem.* ***Objetivo:*** *Este estudo objetivou avaliar a estabilidade dimensional dos materiais de moldagem após a imersão em soluções desinfetantes de hipoclorito de sódio 1% e glutaraldeído 2%.* ***Material e métodos:*** *Foram realizadas 45 moldagens para cada um dos materiais: poliéter*

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(Impregun F), polissulfetos (Permlastic R), e hidrocolóide irreversível (Hydrogun). 40 moldes de cada material foram imersos nas soluções desinfetantes variando-se o tempo entre 10 e 15 minutos. 10 moldes foram imersos em glutaraldeído a 2% por 10 min, 10 por 15 min, outras 10 imersos em hipoclorito de sódio a 1% por 10 min, e 10 por 15 min. Os demais moldes 5 não foram imersas em nenhum desinfetante e serviram como grupo controle. ***Resultados:*** *Nos moldes obtidos foram medidas as distâncias (AB, CD, AC, BD) em um microscópio digital Mitutoyo (TM 500) e os resultados foram submetidos à análise de variância a 2 critérios e as diferenças pelo teste de Tukey com intervalo de confiança de 95%. A análise dos resultados mostrou que não houve diferenças estatísticas significantes para os moldes de poliéter e polissulfeto quando comparados ao grupo controle. No entanto, para os moldes de alginato desinfetados em hipoclorito de sódio a 1% por 15 min, observou-se uma distorção estatisticamente significante quando comparado ao grupo controle.* ***Conclusão:*** *Dentro dos limites dessa pesquisa pode-se concluir que a desinfecção dos moldes nas soluções de hipoclorito de sodio 1% e glutaraldeído 2% é uma prática segura, exceto para alginato que quando imerso durante 15 minutos em hipoclorito de sódio apresentou distorção, mas o mesmo não foi observado para esse material quando o tempo de 10 minutos foi usado.*

UNITERMOS: *estabilidade dimensional; desinfecção; materiais de moldagem.*

INTRODUCTION

During the past few decades, authors have perpetuated the notion that dental impressions can lead to transmitting diseases, such as B hepatitis, tuberculosis, herpes and AIDS (Bond et al.[3], 1983). When impressions are taken in retentive edentulous areas and subgingival preparations, blood has frequently been seen in the material, and washing alone does not clear it away, so there is no guarantee whatever that all organisms from the mouth that may have adhered to the impression surface have been removed (Look et al.[13], 1990; Rios et al.[18], 1996). Thus, disinfecting methods have become a necessity; but these can affect the accuracy of dental impressions (Minagi et al.[16], 1987; Setcos et al.[20], 1985; Setcos et al.[21], 1986; Johnson et al.[9], 1998; Drenon et al.[7], 1989). In 1985, The American Dental Academy (ADA) published guidelines for infection control in the dental office and commercial dental laboratory. Contaminated materials and impressions should be cleaned and disinfected before being handled in the dental laboratory (Drenon et al[7], 1989).

Immersion and spray disinfectants, as well as many other solutions have been tested and proved to be effective for this purpose. The most reliable disinfection method is to immerse the impression to ensure that the disinfectant solution comes into contact with all the impression material surfaces and the tray (Ada[5], 1977; Durr et al.[8], 1987; Johnson et al.[9], 1998; Johnson et al.[10], 1998; Langerwalter et al.[11], 1990; Merchant et al.[15], 1984).

Earlier studies have shown that chemical disinfectants are effective against the hepatitis B virus after 10 minutes of exposure (Bond et al.[3], 1983; Tullner et al.[23], 1988). However other authors had used different immersion times for disinfecting impressions and found results differing from those of Bond and Tullner (Bergman et al.[2], 1980; Johnson et al.[10], 1998). Thus, this study aimed to evaluate the dimensional stability of polyether, polysulfide and irreversible hydrocolloid impressions when immersed in two disinfectant solutions 2% glutaraldehyde (Glutacid® 2%) and sodium hypochlorite (Milton 1%) for periods of 10 and 15 minutes.

MATERIAL AND METHODS

A metal master model was used as described in The American Dental Association specification number 19 shown in Figure 1.

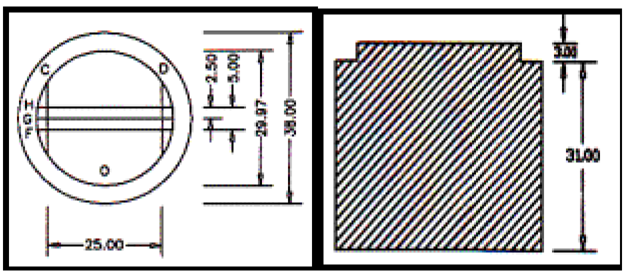
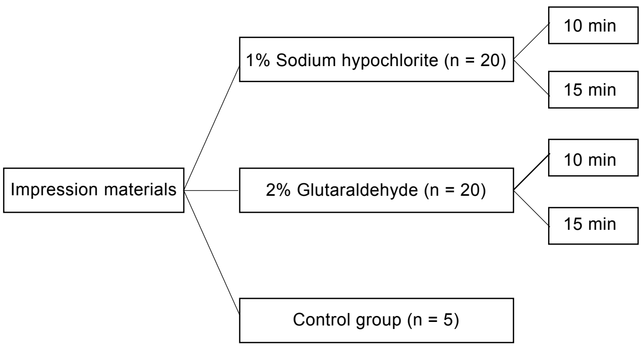


Figura 1 – Measurements of ADA specification nº 19.

Forty-five impressions were made with each of the following materials: Impregun F® (polyether), Permlastic® (polysulfide) and Hydrogun® (irreversible hydrocolloid). The selected disinfectants were: 1% sodium hypochlorite (Milton) and 2% glutaraldehyde (Glutacid). They were freshly prepared for each experiment.

The experimental groups were divided according to the diagram:



Ten impressions from each group of materials were immersed in glutaraldehyde solution for 10 min, and 10 impressions of the same materials were immersed for 15 min. The same procedure was carried out with the sodium hypochlorite solution. Five (5) impressions of each material were used as control group, without being immersed in any disinfectant solution.

The impression materials were dispensed and mixed according to the manufacturer's recommendations at room temperature (22° ± 1C). A gradual, constantly increasing pressure was applied to a perforated metal cast in order to expel excess material. Afterwards, a 1 kg weight was placed over the cast and the impressions were separated from the tray after 6 minutes. They were measured immediately after the impression procedure, to prevent any risk of distortion. Next, every impression was immersed in a disinfectant solution for 10 or 15 minutes, removed and rinsed under cold running water for 30 seconds and dried with compressed air. Immediately after drying, the original impressions were magnified × 30 and the distances between the lines AB, CD, AC and BD as shown in Figure 1 were measured three times by two examiners, for each elastomeric material. Irreversible hydrocolloid impressions were measured twice, because this material is more susceptible to syneresis and drench (Bayindir et al.[2], 2002). Mitutoyo digital measurement microscope (TM500) sensitivity of 1.0 μm was used.

The analysis of variance (ANOVA) model was used to test the null hypothesis that there was no difference between means for a particular impression material for disinfectants and the control, and the Tukey test was used to analyze dimensional changes of each impression material after immersion. All the hypotheses tested were conducted at a 95% level of confidence.

RESULTS

A total of 135 impressions were made and distributed between control and experimental groups. A graphic presentation of the data in Table 1 includes means and standard deviations. Standard deviations ranged from 0.009 to 0.140 for alginate impressions, 0.004 to 0.092 for polyether and 0.016 to 0.149 for polysulfide. The results of the measurements obtained are expressed in millimeters.

TABLE 1 – Means and standard deviations in millimeters.

Material/Condition	Means/AB	Means/CD	Means/AC	Means/BD
Alginate/control	**24,062 ± 0.035**	**24,108 ± 0.053**	**4,197 ± 0.009**	**4,094 ± 0.016**
Alginate/Hypochlorite 10 min	24,008 ± 0.046	24,077 ± 0.140	4,208 ± 0.029	4,108 ± 0.044
Alginate/Hypochlorite 15 min	**23,871 ± 0.123**	**23,804 ± 0.122**	**4,191 ± 0.035**	**4,182 ± 0.095**
Alginate/Glutaraldehyde 10 min	23,945 ± 0.126	23,935 ± 0.094	4,165 ± 0.047	4,079 ± 0.049
Alginate/Glutaraldehyde 15 min	23,983 ± 0.090	23,982 ± 0.098	4,166 ± 0.040	4,071 ± 0.024
Polyether/Control	23,997 ± 0.092	24,049 ± 0.056	4,182 ± 0.052	4,125 ± 0.045
Polyether/Hypoclorite 10 min	24,061 ± 0.021	24,079 ± 0.029	4,204 ± 0.007	4,139 ± 0.004
Polyether/Hypochlorite 15 min	24,083 ± 0.014	24,106 ± 0.012	4,215 ± 0.010	4,140 ± 0.006
Polyether/Glutaraldehyde 10 min	24,081 ± 0.008	24,079 ± 0.015	4,207 ± 0.015	4,123 ± 0.013
Polyether/Glutaraldehyde 15 min	24,089 ± 0.014	24,097 ± 0.015	4,208 ± 0.015	4,115 ± 0.010
Polysulfide/Control	24,103 ± 0.018	24,092 ± 0.019	4,220 ± 0.029	4,175 ± 0.049
Polysulfide/Hypoclorite 10 min	23,974 ± 0.149	23,998 ± 0.117	4,174 ± 0.016	4,141 ± 0.045
Polysulfide/Hypoclorite 15 min	24,062 ± 0.067	24,067 ± 0.021	4,171 ± 0.041	4,172 ± 0.024
Polysulfide/Glutaraldehyde10 min	24,102 ± 0.039	24,080 ± 0.018	4,193 ± 0.034	4,154 ± 0.035
Polysulfide/Glutaraldehyde15 min	23,994 ± 0.044	23,985 ± 0.107	4,188 ± 0.054	4,161 ± 0.031

The Tukey Test was used to analyze the results and showed no significant dimensional changes in polyether and polysulfide impressions in all periods of disinfection with glutaraldehyde and sodium hypochlorite ($p = 0.05$).

Neither polyether nor polysulfide impressions showed any statistically significant differences from their control measurements after soaking in the two disinfectant solutions. The null hypothesis for theses experiments was that the mean distances measured in the control group were the same, irrespective of the impression being soaked in either one of the disinfectant solutions. However, after the alginate impressions were disinfected with sodium hypochlorite for 15 minutes a significant change was observed when compared with control group. A reduction in measurement represented alginate shrinkage. Macro and microscopic porosities were also found. The differences attained 0.3 mm (3×10^{-4} m) mainly in the largest distances (AB and CD).

DISCUSSION

The effects of different disinfectant solutions and times on three impression materials have been evaluated. There have been disagreements regarding their dimensional stability after the process (Drenon et al.[7], 1989; Johnson et al.[9], 1998; Setcos et al.[20], 1985, Thouati et al.[22], 1996). According to the specifications provided by the Disease Control Centers, chemical disinfectants such as chlorine compounds, formaldehydes, glutaraldehydes, phenols, and iodophors have the potential to eliminate hepatitis, herpes, and AIDS viruses in 10 to 30 minutes (Matyas et al.[14], 1990). In this study, the choice was to evaluate polyether, polysulfide and irreversible hydrocolloid, because they are hygroscopic and thus less stable than polyvinyl siloxanes. Sodium hypochlorite and glutaraldehyde were chosen because these disinfectants are more widely used. There are also various types of test blocks used (with full arch casts, cavities for inlays). For this study, the American Dental Association Specification No 19 was chosen for standardizing the disinfection and impression procedures, because it's usefulness in dentistry has been professionally recognized. Individual acrylic resin trays were not manufactured for the impressions because of the risk of water absorption and introduction of other variations. Stainless steel trays were used instead. For the same reason, the gypsum material was not poured.

The problem of disinfecting dental impressions (Lepe et al.[12], 2002), particularly irreversible hydrocolloid and hydrophilic ones, such as polyethers is a major concern. Herrera et al.[7] (1986); Merchant et al.[15] (1984), Langerwalter et al.[11] (1990) and Matyas et al.[14] (1990) did not find dimensional change after the use of a 0.5% sodium hypochlorite solution for 30 minutes. In this study, the concentration of sodium hypochlorite was 2 times greater, which could explain the differences in the results. However, Minagi et al.[16] (1987) showed that immersion in 2% glutaraldehyde for 60 minutes for irreversible hydrocolloid impression materials did not jeopardize surface details. When it was immersed in 1% sodium hypochlorite for 15 minutes, however, it was possible to observe statistically significant differences, and macroscopic alterations, like little craters, which can affect the final results of dentures, because these surface imperfections would be transferred to the cast, and subsequently to the final restoration.

Although this study showed no significant linear dimensional changes in polyether impressions for any disinfectants, other studies have shown that a 15-minute immersion of this material adversely affected the resultant casts. The same authors recommended that polyethers should not be immersed in disinfectant, because they may expand in periods exceeding 5 hours (Bergman et al.[2], 1980; Chong et al.[4], 1969; Dellinger et al.[6], 1990, Drenon; et al.[7], 1989; Johnson et al.[9], 1998, Setcos et al.[20], 1985, Owen et al.[17], 1993; Sawyer et al.[19], 1974). Disinfection of the polyether impressions using an alcoholic glutaraldehyde solution (2%) and sodium hypochlorite solution (1%), for periods of 10 and 15 minutes led to non-significant variations in all measured distances (AB, CD, AC, BD) without loss of accuracy or surface detail, a result consistent with previous studies. (Johnson et al.[9], 1998; Drenon; et al.[7], 1989, Johnson et al.[10], 1998). The results obtained with polysulfide impression disinfections shows no difference in mean values after all times of disinfection with both disinfectant solutions.

The results of this research are important to the dentist to select the appropriate disinfectant solution for specific clinical conditions such as fabrication of study models, removable partial dentures or fixed partial dentures.

CONCLUSION

Within the limits of this study it can be concluded that disinfect immersion practices did not influence the dimensional stability of impressions obtained, except when sodium hypochlorite and a 15-minute immersion time were used for disinfecting irreversible hydrocolloid impressions.

REFERENCES

1. Bayindir F, Yanikoglu N, Duymus Z. Thermal and pH changes, and dimensional stability in irreversible hydrocolloid impression material during setting. Dent Mater J. 2002;21(2):200-9.
2. Bergman M, Olsson S, Bergman B. Elastomeric impression materials. Dimensional stability and surface detail sharpness following treatment with disinfectant solutions. Swed Dent J. 1980;4:161-7.
3. Bond WW, Favero MS, Petersen NJ, Ebert JW. Inactivation of Hepatitis B virus by intermediate-to-high-level disinfectant chemicals. J Clin Microbiol. 1983;18:535.
4. Chong MP, Docking AR. Some setting characteristics of elastomeric impressions materials. Aust Dent J. 1969;14:295-301.
5. American Dental Association. Council of Dental Materials and Devices: specification nº 19 for non-aqueous elastomeric dental impression materials. J Am Dent Assoc. 1977;94:733-41.
6. Dellinger EL, Williams KJ, Setcos JC. Influence of immersion and spray disinfectants on alginate impressions. J Dent. 1990;69:364 (Abst 2045).
7. Drennon DG, Johnson GH, Powell GL. The accuracy and efficacy of disinfection by spray atomization on elastomeric impressions. J Prosth Dent. 1989;62:468-75.
8. Durr DP, Novak EV. Dimensional stability of alginate of alginate impressions immersed in disinfecting solutions. J Dent Child. 1987;54:45-8.
9. Johnson GH, Chellis KD, Gordon GE, Lepe X. Dimensional stability and detail reproduction of irreversible hydrocolloid and elastomeric impressions disinfected by immersion. J Prosthet Dent. 1998;79:446-53.
10. Johnson GH, Drennon DG, Powell GL. Accuracy of elastomeric impression disinfected by immersion. J Am Dent Assoc. 1998;116:525-30.
11. Langenwalter EM, Aquilino SA, Turner KA. The dimensional stability of elastomeric materials following disinfection. J Prosthet Dent. 1990;63:270-6.
12. Lepe X, Johnson GH, Berg JC, Aw TC, Stroh GS.Wettability, imbibition, and mass change of disinfected low-viscosity impression materials. J Prosthet Dent. 2002;88(3):268-76.
13. Look JO. Preliminary results from disinfection of irreversible hydrocolloid impressions. J Prosth Dent. 1990;63:701-7.
14. Matyas, J, Dao N, Caputo AA, Lucatorto FM. Effects of disinfectants on dimensional accuracy of impression materials. J Prosth Dent. 1990;64:25-31.
15. Merchant VA, Radcliffe RM. Preliminary investigation of a method for disinfection of dental impressions. J Prosth Dent. 1984;52:877-9.
16. Minagi S, Yano N, Yoshida K, Tsuru HSE. Prevention of acquired immunodeficiency syndrome and hepatits B. II: Disinfection method for hidrophilic impression materials. J Prosth Dent. 1987;58:62-5.
17. Owen CP, Goolan R. Disinfection of impression materials to prevent viral cross contamination: a review and a protocol. Int J Prosthodont. 1993;6:480-94.
18. Rios MDL, Morgano SM, Stein RS, Rose L. Effects of chemical disinfectant solutions on the stability and accuracy of the dental impression complex. J Prosth Dent. 1996;76:356-62.
19. Sawyer HF, Neiman R et al. Accuracy of cast produced from the three classes of elastomer impression materials. J Am Dent Assoc. 1974;89:644-8.
20. Setcos JC, Gerstenblatt R, Palenik CJ, Hinoura K. Disinfection of a polyether dental impression material [abstract]. J Dent Res. 1985;62:244.
21. Setcos JC, Cheng M, Palenik CJ, Blumershine R. The effects of disinfectants on a polysulfide impression material [abstract]. J Dent Res. 1986;65:260.
22. Thouati A, Deveaux E, Iost A, Behin P. Dimensional stability of seven elastomeric impressions materials immersed in disinfectants. J Prosth Dent. 1996;76:8-14.
23. Tullner JB, Commette JA, Moon PC. Linear dimensional changes in dental impressions after immersion in disinfectant solutions. J Prosth Dent. 1988;60:725-8.

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