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IN VITRO EVALUATION OF DIMENSIONAL ACCURACY OF TWO ELASTOMERIC IMPRESSION MATERIALS USING SPRAY AND IMMERSION DISINFECTION

Dental Science

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ABSTRACT

Context: Dental impressions are principal route for cross-contamination, as they come in contact with patient's blood and saliva and thus they should be disinfected before handling. Disinfection procedures employed for dental materials may affect their dimensional accuracy which would further affect the quality of the final restoration.

Aim: The aim of this in vitro study is to evaluate the effect of disinfection on the dimensional accuracy of addition silicone and polyether impression materials.

Methodology: A standard reference die was milled with four tapered abutments and occlusal grooves onto it. Addition silicone and polyether impressions were divided into group I & II respectively, which were further divided into subgroups A, B & C for control group, immersion and spray disinfection respectively.15 impression were made out of which 10 were treated with the disinfectant and 5 were taken as control group. All the casts were scanned by using 3D scanner.

Results: In the present study, the statistical analysis was performed using statistical product and service solution (SPSS) version 18 for windows (SPSS inc, Chicago, IL). ANOVA test for the inter-abutment distances among subgroup IA, IB &IC showed non-significant p value. Tukey's post-hoc multiple individual pair wise comparison test was done after ANOVA test, non-significant statistical differences were found between Subgroup IA &IB, IA &IC &Subgroup IB &IC. ANOVA test for the interaction between second group showed significant p value. Tukey's post-hoc multiple individual pair wise comparison test showed significant statistical differences for the second group.

Conclusion: This in vitro study shows that polyvinyl siloxane and polyether rmaterials display acceptable accuracy for clinical use with immersion and spray disinfection. Thus disinfection of the impressions had no detrimental effects.

KEYWORDS

Polyvinyl Siloxane, Polyether, Dimensional Stability, Disinfection

Introduction

Dental impressions are principal route for cross-contamination, as they come in contact with patient's blood and saliva and thereby render the dental professionals, who handle the impressions or cast made from them, vulnerable to risk of blood borne infections[1]. Due to the possibility of cross-infection between patients, dental professionals and technicians, the British Dental Association published the infection control guidelines, it states that "the only safe approach to routine treatment is to assume that every patient may be a carrier of an infectious disease" and every impression should be handled in the same way as an impression from a high risk patient[2,3]. Important factors to be considered while disinfecting an impression include the effectiveness of the disinfectant used, chemical interaction between the set material and the disinfecting solution and the influence of the disinfectant on the dimensional stability and surface reproduction of the impression and resultant cast[4].

Different methods of disinfection have been suggested including sterilization by autoclave or microwave, ultraviolet irradiation, argon radiofrequency and glow discharge. Spray disinfection of the impression is very convenient and is therefore a very popular method of disinfection. Immersion however, is the most reliable method because, it guarantees that all surfaces of the impression and impression tray will come into contact with the disinfectant solution[5]. Disinfection of impression by spray and immersion has long become a more practical and convenient alternative.

Final prosthesis is fabricated on the master die obtained from the impression; therefore the prosthesis is only as accurate as the impression[5]. The choice of impression material is equally important in recording accurate impression. Elastomeric impression materials are capable of making good impressions of both hard and soft tissues; hence the impression materials considered in this investigation were addition silicone and polyether. Polyether exhibits the highest degree of hydrophilicity compared to all the elastomeric impression materials and also they are reported to absorb water from disinfecting solutions. Addition silicone has excellent physical properties and when compared with other types of elastomeric impression materials[6]. The aim of this in vitro study was to evaluate the effect of disinfection on the dimensional accuracy of addition silicone and polyether impression materials.

The null hypothesis was that there would be no difference in the dimensional accuracy of two impression systems and the resultant casts following disinfection.

Material and Methods

A standard reference die was milled from steel according to ANSI/ADA specification no.19. Four tapered abutments measuring 6 mm in diameter and 10 mm in height were placed in the canine (right and left) and molar region (right and left).On master die, two grooves were placed on the occlusal surface at right angle to each other crossing at the centre of the abutment. The centre of the occlusal groove of the first abutment to the second abutment represented the inter-abutment distance. Dimensions of abutments in master die are listed in Table 1.This model was used for the comparison of the impression materials in this study. The master die and reference area of measurements are shown in the schematic diagram (fig. 1A & 1B).

Table 1: Dimensions of abutments in master die

Height of the abutment	10mm
Diameter of the abutment	6mm
Inter-abutment distance	A1-A2 =26.0240 mm B1-B2 =26.0242 mm A1-B1 = 29.9059 mm A2-B2 = 44.9436 mm

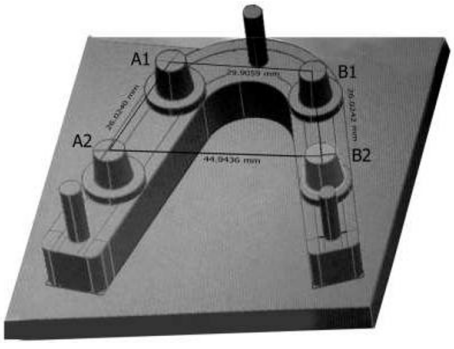

Fig1A.Schematic Representation

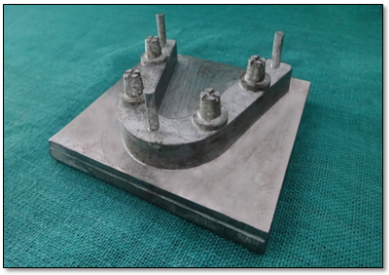

Fig1B. Metal Die

The impression materials used are given in Fig 2 and 3. From each impression material, 15 impressions were made out of which 10 were disinfected, while the other 5 were considered as control group. A total of 30 samples were made for this study. All the impression materials were mixed at room temperature and placed within the working time recommended by the manufacturer. After a setting time of 10 min, impressions were removed from the master model and rinsed for approximately 10 s under cold tap water to simulate

Fig-2.Polyvinyl Siloxane Impression

Fig no 3.Polyether Impression

saliva removal. The controls were air-dried and left to bench set for 1 hour while the test impressions were immersed or sprayed in appropriate disinfectant (sodium hypochlorite, 2.45%, Isopropyl) at room temperature for 10 min. Disinfectants used in the study are listed in Table 2 (fig 4).

Table 2: Disinfectants used in the study

Product	Type	Method of disinfection	Percentage
Deor	Sodium hypochlorite	Immersion	5%
Techspray	Isopropyl	Spray	99.8%

Fig.4: Disinfection Solution a) Sodium Hypochlorite 5% (Deor,India) , b) Isopropyl spray Disinfectant (Techspray, India)

All the impressions were poured after 1 hour with die stone. A ratio of 26 ml water to 100 gms of die stone was used. It was manually mixed to incorporate the water for 10 seconds and then mixed mechanically under vacuum for 20 seconds. After disinfection, both control and test impressions were rinsed again for 10 s under cold tap water and dried with air. The impressions were then poured, vibrated and allowed to set for 1 hour before the cast being separated from the impressions.

All the casts were scanned by using 3D scanner. By using computer aided software(fig 5), buccolingual and anteroposterior dimensions were measured on the casts obtained from each impression material.

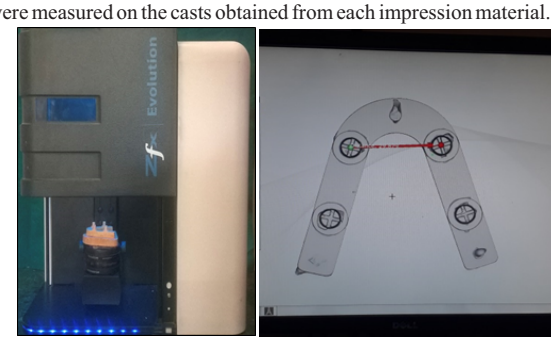

Fig.5: Scanning

Results:

In the present study, the statistical analysis was performed using statistical product and service solution (SPSS) version 18 for windows (SPSS inc, Chicago, IL).SPSS Inc. Descriptive quantitative data was expressed in mean and standard deviation respectively. Probability of accepting alpha error was set at 5%, $p < 0.05$ considered as significant. Comparison of dimensional accuracy of individual materials (Polyvinlysiloxane, Polyether) using two different disinfection techniques (spray and immersion) was done by Tukey's post –hoc test to understand multiple individual pair wise comparison in terms of buccolingual and anteroposterior dimensions. In the Table no 3, when dimensional accuracy was observed, the mean dimensions using both the disinfection procedure for polyvinyl siloxane was 31.7265 mm and 31.7263 mm respectively.

Table 3: Comparision of disinfection solution and spray for Polyvinylsiloxane 10 min

Method	Mean	Standard deviation	P value
Immersion disinfection	31.7265	7.99726	p = 0.985
Spray disinfection	31.7263	7.99729	p = 0.892

In the Table 4, when dimensional accuracy was observed, the mean dimensions using both the disinfection procedure for polyether were31.7284mm and 31.7283 mm respectively. ANOVA test for the inter-abutment distances among subgroup IA, IB &IC showed non-significant p value. Tukey's post-hoc multiple individual pair wise comparison test was done after ANOVA test, non-significant statistical differences were found between Subgroup IA &IB, IA &IC &Subgroup IB &IC. ANOVA test for the interaction between second group showed significant p value. Tukey's post-hoc multiple individual pair wise comparison test showed significant statistical differences for the second group.

Table 4: Comparision of disinfection solution and spray for Polyether 10 min

Method	Mean	Standard deviation	P value
Immersion disinfection	31.7284	7.9991	p<0.001
Spray disinfection	31.7283	7.9990	P=0.001

Discussion:

The impression material can act as a vehicle for the transfer of microbes. Pathogenic microbes associated with local and systemic diseases have been isolated and cultured from dental impressions as blood and saliva have been proved to carry high concentration of potentially infective viruses and bacteria. In a healthy patient, the chances of cross contamination are minimal but in the diseased and debilitated patients, chances of cross infection to the dental personnel are high and can pose serious health issues if proper precautions are not taken[7]. The increased awareness of the dangers of cross contamination with hepatitis B virus (HBV) and human immunodeficiency virus (HIV) during dental procedures is having a growing impact on attitudes toward infection control in the dental clinic and laboratory[8].Runnells stated that prosthetic work may expose professionals and technicians in the vicinity to contagious diseases, additional control procedures should be followed during the handling of dental impressions, such as washing and disinfecting impressions immediately after removal[9].

Various factors that need to be evaluated for disinfection of impression materials, include biocompatibility of the disinfectants, effect of disinfection on the mechanical properties of the material, wetting

characteristics and hydrophobicity of the material and ability of the material to retain the surface details following disinfection. The dimensional stability of the impression material is critical, from a clinical perspective, while considering a method of disinfection[10,11].

The impression material used must produce an accurate replica of the teeth and the supporting tissues following disinfection because; the prosthesis can be no more accurate than the impression from which it is made. Fabrication of well-fitting prosthesis depends on the degree of accuracy that is maintained from the impression to the final restorative procedure[12].Impression materials used in the study possess different surface properties. Polyether, owing to its high degree of wettability, is well suited for the moist intraoral environment[13].Polyvinyl siloxane is hydrophobic, to improve wetting characteristics of polyvinyl siloxane materials, surfactants have been added by manufacturers. These surfactants generally consist of an oligoether or polyether substructure as the hydrophilic component resulting in reduction of surface tension and rendering them hydrophilic[13].

A number of methods for disinfection have been investigated and recommended including antimicrobial immersion system and/or spraying. It has been suggested that immersion system is better than spraying as the latter leads to the pooling effect and its effect may be localized in patches. Merchant suggested that immersion disinfection technique has potential to be popular, reliable and a method of choice as compared to the spraying technique. Though immersion ensures more even contact but it is time consuming and has inherent chances of distortion of the impression[14,15] .

Sodium hypochlorite (NaOCl) is one of the earliest and most widely used disinfectants. Scientific literatures show that it is effective against a broad spectrum of micro-organisms like viruses, including human immunodeficiency virus & hepatitis B virus as well as numerous other bacterial species & their spores and fungi[16].

Herrera et al concluded that disinfection of impressions via short-term immersion sodium hypochlorite does not significantly affect the dimensional accuracy of the resultant casts. The results of this study, coupled with the findings of other authors, support that use of immersion disinfectants would be suitable for rubber impressions for cast restorations for disinfection of impressions for fixed prostheses[10]. Tullner et al, Langenwalter in their study demonstrated that various impression materials produced statistically significant linear distortions which were clinically insignificant. The results of the present study are comparable to the results of similar past studies of polyether and polyvinyl siloxane impressions, in which the dimensions of the master casts were shown to be larger compared to the standard die.[17,5,18,19,20,21]

In the current study Deor, an alcoholic based spray was used to disinfect impression for 10 minutes and the results obtained were similar to the study conducted by Drennon et al were spray disinfectants exhibited little effect on the accuracy of rubber based impressions[22].

Results obtained from Tukey's post-hoc multiple individual pair wise comparison test for Group I showed non-significant statistical difference, whereas, significant statistical differences were found for Group II . However, the differences observed were within ADA specification no. 19 for elastomeric impression materials, thereby, the clinical impact of detected differences is considered to be minor.

The present study only examined dimensional stability following disinfection for polyvinyl siloxane & polyether. The impressions in the study were made of a stainless steel die; these conditions differ from that of intraoral environment. There is need for further in vivo studies that determine the 3 dimensional effect of disinfection on dimensional stability of elastomeric impressions.

Conclusion:

Considering the limitations of this in vitro study, it was shown that polyvinyl siloxane and polyether materials display acceptable accuracy for clinical use with immersion and spray disinfection, since the results obtained were within the ADA specification no. 19 for elastomeric impression materials. Differences obtained were statistically significant among the 2 impression systems; their clinical impact was minor, since the overall accuracy of casts was high. The disinfection of the impressions had no detrimental effects.

References

1. Dario Melill et al. The effect of immersion disinfection procedures on dimensional stability of two elastomeric impression materials. Journal of Oral Science 2008; 50(4): 441-446.
2. Watkinson AC. Disinfection of Impressions in UK Dental Schools. Br Dent J 1988; 164: 22-23.
3. British Dental Association: Guide to blood-borne viruses and the control of cross - infection in Dentistry.London1987.
4. Gerhardt et al. Factors affecting the stability of sodium hypochlorite solutions used to disinfect dental impressions. Quintessence International 1991; 22(7):587-591.
5. Langenwalter et al. The dimensional stability of elastomeric impression materials following disinfection. J Prosthet Dent 1990; 63:270-6.
6. Bianca A. Dauis, and John M. Powers. Effect of Immersion Disinfection on Properties of Impression Materials.J Prosthod 1994;3:31-34.
7. Idris B, Houston F, Claffey N. Comparison of the dimensional accuracy of one and two step techniques with the use of putty wash addition silicone impression materials. J Prosthet Dent 1995;74:535-41.
8. R. K. SamraS. V. Bhide. Efficacy of different disinfectant systems on alginate and addition silicone impression materials of indian and international origin: a comparative evaluation J Indian Prosthodont Soc. 2010;10:182–9.
9. Storer R, McCabe JF. An investigation of methods available for sterilising impressions. Br Dent J. 1981;151:217–219.
10. Runnels RR. An overview of infection control in dental practice. J Prosthet Dent 1988; 59:625-9.
11. Herrera et al. Dimensional stability of dental impressions after immersion disinfection. J Am Dent Assoc 1986; 113(3):419-22.
12. Martin et al. The dimensional stability of dental impression materials following immersion in disinfecting solutions. Dental Materials 2007; 23:760–768.
13. Ahila et al. Comparative evaluation of dimensional stability and surface quality of gypsum casts retrieved from disinfected addition silicone impressions at various time intervals: An in vitro study. Journal of Dentistry and Oral Hygiene. 2012; 4(4):34-43.
14. Powers JM, Sakaguchi RL. Craig's restorative dental materials. 12th ed. St. Louis:Elsevier; 2006. p. 270-312.
15. MohamadRafiul ,Ahsana, Kazi , ZiaulIslamb, Jebunnesabegumc : Study on antimicrobial effect of disinfecting solutions on alginate impression materials : April-2013 ,Vol 3 Issue 1,18
16. U Sukhija, M Rathee, N Kukreja, S Khindria, V Singh, J Palaskar : Efficacy of Various Disinfectants on Dental Impression Materials: The Internet Journal of Dental Science. 2009 Volume 9 Number 1.
17. Rentzia , D.C. Coleman , M.J. O'Donnell , A.H. Dowling , M. O'Sullivan, Disinfection procedures: Their efficacy and effect on dimensional accuracy and surface quality of an irreversible hydrocolloid impression material, journal of dentistry 2011;39:133–140.
18. Tullner JB, Commette JA. Linear dimensional changes in dental impressions after immersion in disinfectant solutions. J Prosthet Dent 1988; 60(6):725-8.
19. Johnson GH, Chellis KD, Gordon GE, Lepe X. Dimensional stability and detail reproduction of irreversible hydrocolloid and elastomeric impressions disinfected by immersion.JProsthet Dent 1998;79:446-53.
20. Wadhwani CP, Johnson GH, Lepe X, RaigrodskiAJ. Accuracy of newly formulatedfast-setting elastomeric impression materials. J Prosthet Dent 2005;93:530-9.
21. Lepe X, Johnson GH. Accuracy of polyether and addition silicone after long-term immersion disinfection. J Prosthet Dent 1997;78:245-9.
22. David Drennon , Glen Johnson, Lynn Powell. The accuracy and efficacy of disinfection by spray atomization on elastomeric impressions. J Prosthet Dent 1998;62:468-75.