DISINFECTION OF IRREVERSIBLE HYDROCOLLOID IMPRESSION MATERIAL: EFFECT ON LINEAR DIMENSIONAL STABILITY

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ABSTRACT

Introduction:

The dental impressions contaminated with saliva and/or blood must be considered source of infection, with the potential of transmitting disease to the dentists, auxiliary personnel and laboratory technicians. The cross infection control measures must follow while handling these impressions or casts without compromising on their dimensional stability.

Objective:

The objective of this study was to evaluate the linear dimensional stability of irreversible hydrocolloid (alginate) when it is disinfected with 0.5% NaOCl by immersion and incorporation methods.

Subjects and Methods:

This was Quasi Experimental study. One-hundred-seventeen (117) impressions were made out of which Fifty-seven (57) were not included in the study. Impressions were made by non-probability purposive sampling technique. Casts were made from the impressions. Measurements of the casts at three specific points were carried out using measurement guiding template through screw gauge and were recorded. In this study Sodium Hypochlorite 0.5% was used as disinfectant material for irreversible hydrocolloid.

Results:

Immersion disinfection of irreversible hydrocolloid in 0.5% Sodium Hypochlorite showed statistically significant effect on its linear dimensional stability ($p<0.05$). On the other hand, incorporation of Sodium Hypochlorite 0.5% in irreversible hydrocolloid as a water substitute was not practical, as it resulted in detachment of material from the impression tray.

Conclusion:

Disinfection of irreversible hydrocolloid by immersion method results in linear dimensional instability of the material and by incorporation method it is not possible.

Key words:

Disinfection, cross infection, Sodium Hypochlorite, immersion, incorporation, imbibition.

INTRODUCTION

Dental impressions, casts, other intra-oral records and patient's oral prosthesis may be contaminated with oral micro-flora or other organisms of varying pathogenicity.[1-3] There is a constant risk of cross infection in dental clinics due to these contaminated items.[4] This has led to increase in awareness of cross infection control among professional and general public.[5-15] Because of increased frequency of Hepatitis and AIDS, a clinician approximately interacts with these patients at least once or twice a week in their (dental) practices.[16-18] Therefore, the importance of disinfection of impressions, casts and other intra-oral records cannot be overlooked.[9-11, 18-21] Various methods of disinfection

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and disinfectants are proposed [7-11] but no one is accepted widely.[15]

Irreversible Hydrocolloid i.e. Alginate is most commonly used dental impression material.[12-14] This material is porous and has the property of imbibition (saliva and blood), therefore it has the potential to carry significantly higher numbers of bacteria than others impression materials.[13-15,21-24] Sodium Hypochlorite is commonly used disinfectant and is considered quite effective against many bacteria and viruses including hepatitis B,C and HIV.[25-31]

Infectious diseases in Pakistan are one of the main contributors to the burden of the diseases.[32] The level of cross infection control in dental practices is of concern and there is need for the maintenance and monitoring of standards for infection control and safety at work.[33]

Linear dimensional stability of impression and/or cast is of great importance for the fabrication of dental prostheses. Disinfection of dental impression must not alter its dimensional stability and accuracy.[9-11, 18-21] The purpose of this in vitro study was to evaluate and compare the linear dimensional stability of irreversible hydrocolloid (alginate) when disinfection treatment is given by immersion method and/or incorporation of 0.5% Sodium Hypochlorite (NaOCl) as a water substitute.

MATERIALS AND METHODS

Hypothesis: Disinfection of Irreversible hydrocolloid impression material with 0.5% NaOCl results in linear dimensional instability.

Study design: Quasi Experimental Study

Setting: de'Montmorency College of Dentistry and Depatment of Metallurgy, Pakistan Council for Scientific and Industrial Research (PCSIR), Lahore, Pakistan

Duration: Six months, from June 1, 2006 to November 30, 2006.

Sampling Technique: Non-Probability Purposive Sampling.

Sample Size: One-hundred-seventeen (117)

Subjects: Irreversible Hydrocolloid Impressions

SAMPLE SELECTION:

Inclusion Criteria:

1. Improvised trays lined with tray adhesive, for IRH impression material, 8-10 minute before making impression.
2. Casts removed from the impression within one hour of mixing of Alginate.
3. NaOCl was freshly diluted every time before use to 0.5% with double distal water, using graduated cylinder.

EXCLUSION CRITERIA:

Impressions with following distortions were not considered

1. Under-extended impressions
2. Impressions which were detached from the tray before pouring
3. Impressions with voids

Impressions of rectangular aluminum master die were made with irreversible hydrocolloid and divided into two interventional groups 'A' & 'B' and one control group 'C' of Thirty (30) each. No formula was applied for the calculation of sample size and number of impressions were selected on the basis of availability.

One-hundred-seventeen (117) impressions were made out of which Fifty-seven (57) were not included in the study. Out of these Forty-nine (49) impressions were detached from the tray and Five (05) impressions had voids and Three (3) casts showed defects in pouring. Sixty (60) impressions were selected for the study.

An improvised impression tray was fabricated in Perspex sheet with internal dimensions facilitated in keeping 5mm ± 1mm distance between the master die and the internal surfaces of the impression tray. Ensuring the same thickness of irreversible hydrocolloid impression material on all sides of the tray. Tray adhesive was applied on the internal surfaces of the tray. Irreversible hydrocolloid was mixed according to the manufacturer's instructions. The tray was loaded with mixed irreversible hydrocolloid impression material and seated over the master die guided by the four-fixed guiders at same position. Constant finger pressure was applied on the tray for 5-minute till the material set. The tray was removed with a snapping motion and freshly mixed type – III dental gypsum was poured under vibration.

Dental gypsum was mixed in a vacuum mixer with water liquid ratio according to manufacturer's instructions. Type III dental cast was removed in 50±10-minute after poring. This procedure was repeated for all the models. Measurements of the models were taken in 24±1 hour using the measurement template with Screw Gauge. A template was designed and fabricated in perpex for the measurement of all the samples

Group A, thirty (30) impressions of the master die were immersed in 200 ml solution of 0.5% Sodium Hypochlorite for 10 minutes. Then the models were poured with dental gypsum type–III for measurement.

In the second Group B, thirty (30) irreversible hydrocolloid impressions were made. Solution of 0.5% NaOCl was used as water substitute. This group did not fulfill the inclusion criteria. Since, impression were impractical to retrieve therefore, the measurements could not be made and was discarded from the study.

Group C: This was the control group of thirty (30) samples. No treatment was provided to alginate impressions and gypsum casts.

RESULTS

The collected data was transferred and analyzed accordingly on SPSS version 11.0. Measurements of casts were taken through screw gauge at three points. Mean and standard deviation was calculated separately for three points of measurements. The mean and standard deviation of total casts were calculated. Comparison was made for total measurements of the cast between Group A1 and C with master die applying independent t-test. Group A, C and master die were compared by applying within and between groups statistics calculating one-way analysis of variance. á-error was fixed at 0.05.

The descriptive analysis regarding thickness of cast in different groups is as follows:

Table 1 shows the result of Group A (immersion of irreversible hydrocolloid in 200ml solution of 0.5% NaOCl for 10 minutes), Group B [(incorporation of 0.5% NaOCl in Irreversible Hydrocolloid Impression material in lieu of water). This technique is impractical. Impression could not be retrieved successfully even for once.] Group C (Control group) and Master Die. Measurement of Master Die M was done five times to minimize any error.

TABLE 1

	n=	Measurements ± Mean Standard		
		Point A	Point B	Point C
A	30	19.95 ± 0.03	19.94 ± 0.05	19.95 ± 0.04
B		N/A	N/A	N/A
C	30	19.99 ± 0.06	19.99 ± 0.05	20.01 ± 0.04
Master Die	-5	20.03 ± 0.004	20.03 ± 0.004	20.04 ± 0.004

In table 2 by applying Independent-Sample t-test for the quantitative data between the Group A (immersion of irreversible hydrocolloid in 0.5% NaOCl for 10 minutes) with Control Group (df =33) it shows significant difference in the groups at all three points.

TABLE 2

POINTS	MEANS STD DEV	T	p
A Control group	19.95 ± 0.03 19.99 ± 0.06	*	*
B Control group	19.94 ± 0.05 19.99 ± 0.05	*	*
C Control group	19.95 ± 0.04 20.01 ± 0.04	*	*

In table 3 by applying Independent-Sample t-test for the quantitative data between the Group A (immersion of irreversible hydrocolloid in 0.5% NaOCl for 10 minutes) with Master die (df =33) it shows significant difference in the groups at all three points.

TABLE-3

POINTS	MEANS STD DEV	T	p
A Master Die	19.95 ± 0.03 20.03 ± 0.004	-6.349	0.000*
B Master Die	19.94 ± 0.05 20.03 ± 0.004	-4.25	0.000*
C Master Die	19.95 ± 0.004 20.04 ± 0.004	-4.389	0.000*

DISCUSSION

The results of the study support the hypothesis that disinfection of irreversible hydrocolloid impression material (alginate) with 0.5% NaOCl immersion method results in linear dimensional instability of the material. NaOCl is widely used disinfectant in 0.525%[34,35] so the same concentration was used in this study. Most of the studies about the use of NaOCl focused on microbiological effectiveness of this disinfectant.[36-39] But this study focused around physical characteristics (linear dimensional stability) of the irreversible hydrocolloid.

Immersion of irreversible hydrocolloid impression for 10-minute in a solution of 0.5% NaOCl shows statistically significant difference from master die. The results of this study are similar to the results of Rueggeberg et al,[40] and Beall et al.[41] However Rentzia et al,[25] Taylor RL et al,[42] Hilton et al,[43] Vandewalle et al,[44] Habu et al,[45] Herrera and Merchant,[46] found no altered dimensional stability when compared with the control group. This difference in the result may be due to comparison with the control group not the master die, different brand of IRH, Gypsum and/or NaOCl.

Use of 0.5% NaOCl solution as water substitute for irreversible hydrocolloid impression material was not practical since impression could not be retrieved successfully even for once, hence group B was not investigated. This detachment of impression material from the tray was due to poor union of the impression material with impression tray, despite of the application of tray adhesive. However, in previous studies some other chemicals have either been impregnated in irreversible hydrocolloid impression material or disinfection solution was used as water substitute.[13,14,17] There has been no reported study in which incorporation of NaOCl has been used.

It is suggested for the future studies that physical characteristics of the irreversible hydrocolloid should be investigated with some other brands. Incorporation method should be investigated in more depth with different disinfectant chemicals. The disinfection of the cast with NaOCl can also be considered as an alternative method to overcome the dimensional instability of impression and to control the cross infection.

CONCLUSION

From the results of this study it can be safely concluded that the disinfection of irreversible hydrocolloid impressions by immersion in 0.5% NaOCl for ten-minute produces dimensional instability of the material. This study also revealed that the incorporation of 0.5% NaOCl in irreversible hydrocolloid as water substitute is not possible.

REFERENCES

1. Abdelaziz KM, Attia A and Combe EC. Evaluation of disinfected casts poured in gypsum with gum Arabic and calcium hydroxide additives. J Prosthet Dent 2004;92:27-34.
2. Boden J, Likeman P, Clark R. Some effects of disinfecting solutions on the properties of alginate impression material and dental stone. Eur J Prosthodont Restor Dent 2001;9:131-5.
3. Abdelaziz KM, Hassan AM, Hodges JS. Reproducibility of sterilized rubber impressions. Braz Dent J 2004;15:209-13.
4. Jones ML, Newcombe RG, Bottomley J. The dimensional stability of self-disinfecting alginate impressions compared to various immersion regimes. The Angle Orthodontist 1989;2:123-8.
5. Hovius M. Disinfection and sterilisation: The duties and responsibilities of dentists and dental hygienists. Int Dent J 1992;42:241-4.
6. Connor C. Cross-contamination control in prosthodontic practice. Int J Prosthodont 1991;4:337-44.
7. Kaplan BA, Goldstein GR, Boylan R. Effectiveness of a professional formula disinfectant for irreversible hydrocolloid. J Prosthet Dent 1994;71:603-6.
8. Twomey JO, Abdelaziz KM, Combe EC, Anderson DL. Calcium hypochlorite as a disinfecting additive for dental stone. J Prosthet Dent 2003;90:282-8.
9. Davis BA, Powers JM. Effects of immersion disinfection on properties of impression materials. J Prosthod 1994;3:31-4.
10. Adabo GL, Zanarotti E, Fonseca RG, Cruz CA. Effect of disinfectant agents on dimensional stability of elastomeric impression materials. J Prosthet Dent 1999;81:621-4.
11. Schutt RW. Bactericidal effect of a disinfectant dental stone on irreversible hydrocolloid impressions and stone casts. J Prosthet Dent 1989;62:605-7.
12. King BB, Norling BK, Seals R. Bypsum compatibility of antimicrobial alginates after spray disinfection. J Prosthodont 1994;3:219-27.
13. Ghani F, Hobkirk JA, Wilson M. Evaluation of a new antiseptic-containing alginate impression material. Br Dent J 1990;169:83-6.
14. Ramer MS, Gerhardt DE, McNally K. Accuracy of irreversible hydrocolloid impression material mixed with disinfectant solutions. J Prosthodontics 1993;2:156-8.
15. Hall BD, Munoz-Viversos CA, Naylor WP, Jenny Sy. Effects of a chemical disinfectant on the physical properties of dental stones. Int J Prosthodont 2004;17:65-71.
16. Soares CR, Ueti M. Influence of different methods of chemicals disinfection on the physical properties on type IV and V Gypsum dies. Pesqui Odontol Bras 2001;15:334-40.
17. Tobias RS, Browne RM and Wilson CA. An in vitro study of the antibacterial and antifungal properties of an irreversible hydrocolloid impression material impregnated with disinfectant. J Prosthet Dent 1989;62:601-5.
18. Pissiotis A, Panagiotoyni E, Kapari D, Kaloyiannides A. Changes of the elastomer impression materials after their immersion in some disinfection agents for AIDS infection control purposes Hell Stomatol Chron 1989;33:85-91.
19. Kugel G, Perry RD, Ferrari M, Lalicata P. Disinfection and communication practices: a survey of U.S. dental laboratories. J Am Dent Asso 2000;131:786-92.
20. Cook W. Alginate dental impression material; chemistry, structure, and properties. J Biomed Mater Res 1986;20:1-24.
21. Jennings KJ, Samaranayake LP. The persistence of microorganisms on impression materials following disinfection. Int J Prosthodont 1991;4:382-7.
22. Samaranayake LP, Hunjan M, Jennings KJ. Carriage of oral flora on irreversible hydrocolloid and elastomeric impression materials. J Prosthet Dent 1991;65:244-9.
23. Al-Omari WM, Jones JC, Hart P. A microbiological investigation following the disinfection of alginate and addition cured silicone rubber impression materials. Eur J Prosthodont Restor Dent 1998;6:97-101.
24. Sofou A, Larsen T, Fiehn NE, Owall B. Contamination level of alginate impressions arriving at a dental laboratory. Clin Oral Investig 2002;6:161-5.
25. Rentzia A, Coleman DC, O'Donnell MJ, Dowling AH, O'Sullivan M. Disinfection procedures: Their efficacy and effect on dimensional accuracy and surface quality of an irreversible hydrocolloid impression material. Jdent 2011;39: 133-140.
26. Dellanno C, Boesenberg D. The antiviral action of common household disinfectants and antiseptics against murine hepatitis virus, a potential surrogate for SARS coronavirus. Am J Infect Control 2009;37:649-52.
27. Hidalgo E, Bartolome R, Dominguez C. Cytotoxicity mechanisms of sodium hypochlorite in cultured human dermal ?broblasts and its bactericidal effectiveness. Chemico-Biological Interactions. 2002; 139:265–282

28. Bloomfield S F, Smith-Burchnell C A, Dalgleish AG. Evaluation of hypochlorite-releasing disinfectants against the human immunodeficiency virus (HIV). Journal of Hospital Infection. 1990; 15: 273-278.

29. Bloomfield SF, Smith-Burchnell CA, Dalgleish AG. Evaluation of hypochlorite-releasing disinfectants against the human immunodeficiency virus (HIV). Journal of Hospital Infection 1990;15:273–8.

30. Resnick L, Veren K, Salahuddin SZ, Tondreau S, Markham D. Stability and inactivation of HTLV-III/ LAV under clinical and laboratory conditions. Journal of the American Medical Association 1986;255:1887–91.

31. Bond WW, Favero MS, Peterson NJ, Ebert JW. Inactivation of hepatitis B virus by intermediate to high level disinfectant chemicals. Journal of Clinical Microbiology 1983;18:535–8.

32. Raza MW, Gould FK, Kazi BM. Infection control policies and practice in Pakistan. J Pak Med Assoc 2001;51:292-5.

33. Puttaiah R, Bedi R, Almas K. A survey of infection control practices among general Dental Practitioners in Lahore, Pakistan. J Pak Dent Assoc 2001;10:71-6.

34. Kotsiomiti E, Tzialla A, Hatjivasiliou K. Accuracy and stability of impression materials subjected to chemical disinfection. A literature review. J Oral Rehabil 2008.Apr;35(4):291-9.

35. Memarian M, Fazeli MR, Jamalifer H, Azimnejad A. Disinfection efficacy of Irreversible hydrocolloid impression using different concentrations of NaOCl: A pilot study. J Contemp Dent Prac 2007. May; 8(1):14.

36. Berg E, Nielsen O, Skaug N. High-level microwave disinfection of dental gypsum casts. Int J Prosthodont 2005;18:520-5.

37. Schwartz RS, Hensley DH, Bradley DV Jr. Immersion disinfection of irreversible hydrocolloid impression in pH-adjusted sodium hypochlorite. Part 1: Microbiology. Int J Prosthodont 1996;9:217-22.

38. Beyerle MP, Hensley DM, Bradley DV Jr, Schwartz RS, Hilton TJ. Immersion disinfection of irreversible hydrocolloid impressions with sodium hypochlorite. Part I: Microbiology. Int J Prosthodont 1994;7:234-8.

39. Koshmanova TN, Sherbakov AS. The disinfection of impressions to prevent hospital infections. Sodium hypochlorite as a disinfecting agent. Stomatologiia (Mosk) 1998;77:41-3.

40. Rueggeberg FA, Beall FE, Kelly MT, Schuster GS. Sodium Hypochlorite disinfection of irreversible hydrocolloid impression material. J Prosthet Dent 1992;67:628-31.

41. Beall FE, Schuster GS, Ruggeberg F. Disinfection and distortion of alginate impressions by hypochlorite [Abstract]. J Dent Res 1990;69:242.

42. Taylor RL, Wright PS, Maryan C. Disinfection procedures: Their effect on the dimensional accuracy and surface quality of irreversible hydrocolloid impression materials and gypsum casts. Dent Mater 2002;18:103-10.

43. Hilton TJ, Schwartz RS, Bradley DV Jr. Immersion disinfection of irreversible hydrocolloid impressions. Part 2: Effects on gypsum casts. Int J Prosthodont 1994;7:424-33.

44. Vandewalle KS, Charlton DG, Schwartz RS, Reagan SE, Koeppen RG. Immersion disinfection of irreversible hydrocolloid impressions with sodium hypochlorite. Part II: Effect on gypsum. Int J Prosthodont 1994;7:315-22.

45. Habu H, Uchida H, Ohta T et al. Study on the disinfection of alginate impressions Part 1. Effect of various disinfectants to the dimensional stability of alginate impression materials. Jpn J Dent Mater. 1988;7:741-7.

46. Herrera SP, Merchant VA. Dimensional stability of dental impressions after immersion disinfection. J Am Dent Assoc 1986;113:419-22.