Comparative Evaluation of Various Disinfecting Agents Efficiency Over Alginate Impression — an Ex Vivo Trial

B.Avantika[1], V. Vishnu Priya[2*], Jayalakshmi Somasundaram[3], Gayathri. R[4], Kavitha.S[5]

[1]Saveetha Dental College and Hospitals Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India
[2*]Department of Biochemistry, Saveetha Dental college and Hospitals Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India
[3]White Lab - Material Research Centre Saveetha Dental college and Hospitals Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India
[4]Department of Biochemistry, Saveetha Dental college and Hospitals Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India
[5]Department of Biochemistry, Saveetha Dental college and Hospitals Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India

Abstract

Introduction:
In order to avoid the spread of pathogens from patient to health care personnel and laboratory assistants,it is the duty of health care personnel to disinfect the infection . In this pandemic scenario it is a necessity to critically evaluate the efficiency of the impression disinfectant to implement in our clinical practice.

Aim and Objective:
To evaluate the impression disinfectant (iodophor,povidone iodine, 2% of glutaraldehyde).

Materials and Methods:
Sample from 9 patients, Bioluminometer swabs were used then disinfectants were used to disinfect the infection.

Results and Conclusion:
Totally 3 disinfectants are used for the efficiency of disinfecting the infection on the alginate impressions. In this study I conclude that glutaraldehyde could be an effective disinfectant for impression disinfection for its use in clinical dentistry.

Keywords: Pathogens, novel method, health care person, impression disinfectant,alginate, bio luminometer, innovative technique.

1. INTRODUCTION

Currently available impression material were not designed for disinfection or sterilisation, and it is conceivable that disinfectants may adversely affect impressions.(1)One concern regarding infection control is the effect of disinfection on impression material commonly used in dentistry (1](2). The importance of cross-infection control cannot be overemphasised. Disinfection and sterilisation methods are used to achieve disinfection and sterility of the medical and surgical instruments. (3)In order to avoid the spread of pathogens from patients to

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patient, patient to health care personnel and health care personnel to patient, it is the duty of the health care policies makers to allocate the appropriate methods of cleaning, disinfection and sterilisation for various surfaces and instruments.(4).

Cleaning is the removal of all foreign material (e.g. blood, saliva, debris) from objects while decontamination is the removal of pathogenic microorganisms from objects. Disinfection is the process that eliminates many to all pathogenic microorganisms on inanimate objects except bacterial endospores. While sterilisation is the complete elimination of all microorganisms including spores.(5) Disinfection can be divided into three categories according to their efficacy. High level disinfection involves bacterial spore inactivity along with other microbial forms. Intermediate level disinfection involves destruction of micro- organisms like tubercle bacilli but not able to kill spore.(6)Dental impressions are categorised under semi-critical objects in dental practice and require high level disinfection or sterilization.In recent times, a pre wash of the impression with running water is advocated first to cast off all particles, blood and saliva prior to active disinfection procedure.

Disinfection of dental impression should be a routine procedure in the dental office and dental laboratory.(7) So,the aim of the study is to evaluate various disinfecting agents efficiency over alginate impression. (8). Glutaraldehyde: It is a high level disinfectant and is available in neutral, alkaline and acidic forms. It is a broad spectrum chemical agent with fast killing capability. It is also called chemo steriliser. If it is used in proper concentration and specialised equipment, it can destroy all types of microorganisms including bacterial and fungal spores, tubercle bacilli and viruses.(9). It is a colourless liquid with pungent odour. Although it is considered as the best disinfectant for cold sterilisation of medical equipment, it also has many health hazards including irritation to skin, eyes and respiratory tract. It is a sensitizer of skin and respiratory tract, so special precautions are needed while using it e.g.(10) wearing butyl or nitrile gloves, closed system for solution handling, exhaust ventilation of the places of handling and keeping the temperature of the solution low as it will reduce the airborne concentration of the solution (8).

Iodophors: These halogens provide low to intermediate level disinfection. These are bactericidal, mycobactericial and virucidal. It is also fungicidal but requires more contact time. (11)These are mainly used as antiseptics rather than disinfectants. These are not sporicidal and cause staining of fabrics. They are not flammable. They have an irritating effect on mucous membrane.20,21 Organic material present on any surface can lead to neutralisation of disinfectant capability of iodine. (8). Our team has extensive knowledge and research experience that has translated into high quality publications (12–21) (22–31).

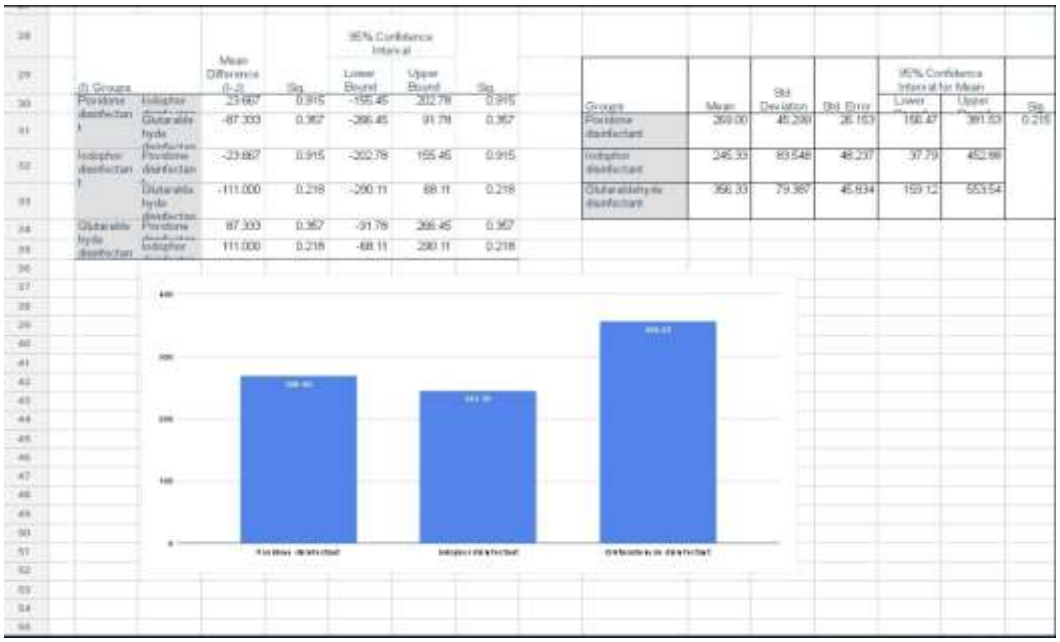
Povidone-iodine (PVP-I) is an iodinated polyvinyl polymer that has been used as a topical antiseptic to prevent infections of the skin or mucous membranes during surgery. PVP-I possesses broad-spectrum antimicrobial activity against bacteria, yeasts, molds, other fungi, Acanthamoeba, and certain viruses but it has a low toxicity to human cells and tissues(32). On the basis of its low toxicity at the ocular surface, a 5% solution of PVP-I has been applied as an antiseptic before intraocular surgery and has been shown to markedly reduce the abundance of the conjunctival bacterial flora. No toxic effects of such irrigation on the ocular surface were observed (8). The aim of this study is to evaluate the impression disinfectant (iodophor,povidone iodine, 2% of glutaraldehyde).

2. MATERIALS AND METHODS:

We took samples from 9 patients from our clinic, so we got 18 impressions in total, 6 impressions per group of people. Once the samples are collected, the impressions which was taken from the patients using bio luminometer swabs were used to collect the saliva from the impression surface then the impression were immersed in respective disinfectants i.e iodophor , povidone iodine,2% of glutaraldehyde and again by using bio luminometer swabs are used to collect the sample from the immersed impression surface to evaluate the efficiency of the respective disinfectants.

3. RESULTS AND DISCUSSION

In the graph if you observe , there exist no significant difference between three disinfectants (i.e iodophor,povidone iodine,2% of glutaraldehyde).but as compared with these disinfectants 2%glutaraldehyde was observed to show more effective disinfectant compared with the other 2 disinfectant(iodophor and povidone iodine)then povidone and iodophor disinfectant showed more effective in disinfecting the infection.



Two per cent glutaraldehyde is classified as a disinfectant. According to.Mallison, "Disinfection is a process in which only certain infectious agents, usually the vegetative forms of pathogenic bacteria or funguses, are destroyed."The Environmental Protection Agency has established the standards according to which 2 per cent glutaraldehyde is measured. The chemical is considered to be bactericidal in ten minutes, destroying all bacteria including Mycobacterium tuberculosis, viruses, and developed after this combination of procedures. Many Pseudomonas aeruginosa. It is sporicidal in ten hours and is considered to be a sterilising agent after use for ten hours (8,33).

Glutaraldehyde is a saturated dialdehyde that has gained wide acceptance as a level disinfectant. However, in the present study, the results indicate that glutaraldehyde is a choice of immersion disinfectant for Impregum soft when it is used for only 10 min. If used for 30 min, glutaraldehyde has shown to decrease the wettability significantly (34). Our team has extensive knowledge and research experience that has translate into high quality publications

(35), (36), (37), (38), (39), (40,41), (42), (43), (44), (45).

The disinfection of dental impressions particularly the hydrophilic ones such as polyether is a concern. However, iodophor holds promise as an effective disinfectant for Impregum soft without affecting its wettability property. Iodophor disinfected polyether impression has shown to produce dies as clinically accurate and smooth as the master cast (34). Cross-infection control is of prime importance in dental practice but impression disinfection is still a widely neglected aspect. The proper criteria for impression disinfection involves:
1) The most suitable method is spray or immersion. 2) Appropriate application (time of contact. 3) Periodic check for efficacy. The factors to be considered for any disinfection protocol for dental impression are effectiveness, chemical stability and efficacy of the disinfectant solution. The disinfection procedure should not alter the dimensions and surface details of the impression and resultant cast. (8)

4. CONCLUSION

Cross infection control is a very important aspect of patient safety. Impression disinfectants can prevent spread of infection from dental clinic to dental laboratory technician,patients and dental auxiliaries. So this study may conclude that glutaraldehyde would be an effective disinfectant for impression disinfection for its use in clinical dentistry.

Conflict of Interest :
The authors hereby declare that there is no conflict of interest in this study.

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A) B.Avantika - contributed in designing the study, execution of the project, statistical analysis, manuscript drafting.
B) Dr. Selvaraj - contributed in designing the study, execution of the project, statistical analysis, manuscript drafting.
C) Dr.V.Vishnupriya - contributed in study design, guiding the research work, manuscript correction.
D) Dr. Gayathri R - study design, statistical analysis, manuscript proofreading and correction.
E) Dr. Kavitha S - study design, statistical analysis, manuscript proofreading and correction.

5. REFERENCES

1. Mahajan T. Comparative Evaluation of Disinfecting Alginate Using Aloe Vera and 0.2% Chlorhexidine Digluconate by Internal Disinfection Method - An In Vivo Study [Internet]. Vol. 9, Journal of Evolution of Medical and Dental Sciences. 2020. p. 1944–7. Available from: http://dx.doi.org/10.14260/jemds/2020/423
2. Rios M del P, del Pilar Rios M, Morgano SM, Sheldon Stein R, Rose L. Effects of chemical disinfectant solutions on the stability and accuracy of the dental impression complex [Internet]. Vol. 76, The Journal of Prosthetic Dentistry. 1996. p. 356–62. Available from: http://dx.doi.org/10.1016/s0022-3913(96)90538-7

3. Abolits AI. To comparative evaluation of efficiency of the satellite communications systems using various orbits [Internet]. 3rd International Conference on Satellite Communications (IEEE Cat. No.98TH8392). Available from: http://dx.doi.org/10.1109/icsc.1998.741376
4. Samra RK, Bhide SV. Efficacy of Different Disinfectant Systems on Alginate and Addition Silicone Impression Materials of Indian and International Origin: A Comparative Evaluation [Internet]. Vol. 10, The Journal of Indian Prosthodontic Society. 2010. p. 182–9. Available from: http://dx.doi.org/10.1007/s13191-010-0040-y
2. Muzaffar D, Braden M, Parker S, Patel MP. The effect of disinfecting solutions on the dimensional stability of dental alginate impression materials [Internet]. Vol. 28, Dental Materials. 2012. p. 749–55. Available from: http://dx.doi.org/10.1016/j.dental.2012.03.013
3. Hisamitsu H. Study on the disinfection of alginate impressions part 1. Effect of various disinfectants to the dimensional stability of alginate impression materials [Internet]. Vol. 17, Journal of Dentistry. 1989. p. 309. Available from: http://dx.doi.org/10.1016/0300-5712(89)90057-2
4. Mahajan T. An In Vivo Study to Evaluate the Efficacy of Aloe-Vera and 0.2% Chlorhexidine Digluconate as Preprocedural Mouth Rinses for Disinfecting Alginate Impression [Internet]. Vol. 9, Journal of Evolution of Medical and Dental Sciences. 2020. p. 2521–5. Available from: http://dx.doi.org/10.14260/jemds/2020/548
5. Mushtaq MA, Khan MWU. An Overview of Dental Impression Disinfection Techniques A Literature Review [Internet]. Vol. 27, Journal of the Pakistan Dental Association. 2018. p. 207–12. Available from: http://dx.doi.org/10.25301/jpda.274.207
6. Sayed M. Alginate Substitute as a Promising Impression Material for Dental Implant Restorations: A Comparative In-vitro Study [Internet]. Journal of Medicine and Health Studies. 2022. p. 1–11. Available from: http://dx.doi.org/10.37881/jmahs.111
7. Nakashima Y, Niizeki N, Usuki D, Ueno T, Kumagai T. Evaluation of surface roughness of alginate impression materials [Internet]. Vol. 34, Dental Materials. 2018. p. e84. Available from: http://dx.doi.org/10.1016/j.dental.2018.08.176
8. Vellutato A. Disinfecting Agents [Internet]. Handbook of Validation in Pharmaceutical Processes. 2021. p. 395–417. Available from: http://dx.doi.org/10.1201/9781003163138-24
9. Sathivel A, Raghavendran HRB, Srinivasan P, Devaki T. Anti-peroxidative and anti-hyperlipidemic nature of Ulva lactuca crude polysaccharide on D-galactosamine induced hepatitis in rats. Food Chem Toxicol. 2008 Oct;46(10):3262–7.
10. Sekar D, Lakshmanan G, Mani P, Biruntha M. Methylation-dependent circulating microRNA 510 in preeclampsia patients. Hypertens Res. 2019 Oct;42(10):1647–8.
11. Rajeshkumar S, Menon S, Venkat Kumar S, Tambuwala MM, Bakshi HA, Mehta M, et al. Antibacterial and antioxidant potential of biosynthesized copper nanoparticles mediated through Cissus arnotiana plant extract. J Photochem Photobiol B. 2019 Aug;197:111531.
12. Lakshmi T, Krishnan V, Rajendran R,

Madhusudhanan N. Azadirachta indica: A herbal panacea in dentistry - An update. Pharmacogn Rev. 2015 Jan;9(17):41–4.
13. Felicita AS, Chandrasekar S, Shanthasundari KK. Determination of craniofacial relation among the subethnic Indian population: a modified approach - (Sagittal relation). Indian J Dent Res. 2012 May;23(3):305–12.
14. Thejeswar EP, Thenmozhi MS. Educational research-iPad system vs textbook system. J Adv Pharm Technol Res. 2015;8(8):1158.
15. Saravanan A, Senthil Kumar P, Jeevanantham S, Karishma S, Tajsabreen B, Yaashikaa PR, et al. Effective water/wastewater treatment methodologies for toxic pollutants removal: Processes and applications towards sustainable development. Chemosphere. 2021 Oct;280:130595.
16. Menon A, Thenmozhi MS. Correlation between thyroid function and obesity. J Adv Pharm Technol Res. 2016 Oct;9(10):1568.
17. Sahu D, Kannan GM, Vijayaraghavan R. Size-dependent effect of zinc oxide on toxicity and inflammatory potential of human monocytes. J Toxicol Environ Health A. 2014;77(4):177–91.
18. Wang Y, Zhang Y, Guo Y, Lu J, Veeraraghavan VP, Mohan SK, et al. Synthesis of Zinc oxide nanoparticles from Marsdenia tenacissima inhibits the cell proliferation and induces apoptosis in laryngeal cancer cells (Hep-2). J Photochem Photobiol B. 2019 Dec;201:111624.
19. Wadhwa R, Paudel KR, Chin LH, Hon CM, Madheswaran T, Gupta G, et al. Anti-inflammatory and anticancer activities of Naringenin-loaded liquid crystalline nanoparticles in vitro. J Food Biochem. 2021 Jan;45(1):e13572.
20. Reddy P, Krithikadatta J, Srinivasan V, Raghu S, Velumurugan N. Dental Caries Profile and Associated Risk Factors Among Adolescent School Children in an Urban South-Indian City. Oral Health Prev Dent. 2020 Apr 1;18(1):379–86.
21. Eapen BV, Baig MF, Avinash S. An Assessment of the Incidence of Prolonged Postoperative Bleeding After Dental Extraction Among Patients on Uninterrupted Low Dose Aspirin Therapy and to Evaluate the Need to Stop Such Medication Prior to Dental Extractions. J Maxillofac Oral Surg. 2017 Mar;16(1):48–52.
22. Devarajan Y, Nagappan B, Choubey G, Vellaiyan S, Mehar K. Renewable Pathway and Twin Fueling Approach on Ignition Analysis of a Dual-Fuelled Compression Ignition Engine. Energy Fuels. 2021 Jun 17;35(12):9930–6.
23. Barabadi H, Mojab F, Vahidi H, Marashi B, Talank N, Hosseini O, et al. Green synthesis, characterization, antibacterial and biofilm inhibitory activity of silver nanoparticles compared to commercial silver nanoparticles [Internet]. Vol. 129, Inorganic Chemistry Communications. 2021. p. 108647. Available from: http://dx.doi.org/10.1016/j.inoche.2021.108647
24. Manickam A, Devarasan E, Manogaran G, Priyan MK, Varatharajan R, Hsu CH, et al. Score level based latent fingerprint enhancement and matching using SIFT feature. Multimed Tools Appl. 2019 Feb 1;78(3):3065–85.
25. Subramaniam N, Muthukrishnan A. Oral mucositis and microbial colonization in oral cancer patients undergoing radiotherapy and chemotherapy: A prospective analysis in a tertiary care dental hospital [Internet]. Vol. 10, Journal of Investigative and Clinical Dentistry. 2019. Available from: http://dx.doi.org/10.1111/jicd.12454

26. Rohit Singh T, Ezhilarasan D. Ethanolic Extract of Lagerstroemia Speciosa (L.) Pers., Induces Apoptosis and Cell Cycle Arrest in HepG2 Cells. Nutr Cancer. 2020;72(1):146–56.
27. Wahab PUA, Abdul Wahab PU, Senthil Nathan P, Madhulaxmi M, Muthusekhar MR, Loong SC, et al. Risk Factors for Post-operative Infection Following Single Piece Osteotomy [Internet]. Vol. 16, Journal of Maxillofacial and Oral Surgery. 2017. p. 328–32. Available from: http://dx.doi.org/10.1007/s12663-016-0983-6
28. Krishnamurthy A, Sherlin HJ, Ramalingam K, Natesan A, Premkumar P, Ramani P, et al. Glandular odontogenic cyst: report of two cases and review of literature. Head Neck Pathol. 2009 Jun;3(2):153–8.
29. Stewart M (gladwin), Bagby M. Clinical Aspects of Dental Materials. Jones & Bartlett Learning; 2020. 540 p.
30. Johnson LL, Shneider DA, Austin MD, Goodman FG, Bullock JM, DeBruin JA. Two per cent glutaraldehyde [Internet]. Vol. 64, The Journal of Bone & Joint Surgery. 1982. p. 237–9. Available from: http://dx.doi.org/10.2106/00004623-198264020-00014
31. Shetty S, Kamat G, Shetty R. Wettability changes in polyether impression materials subjected to immersion disinfection. Dent Res J . 2013 Jul;10(4):539–44.
32. Surapaneni KM, Vishnu Priya V, Mallika J. Effect of pioglitazone, quercetin, and hydroxy citric acid on vascular endothelial growth factor messenger RNA (VEGF mRNA) expression in experimentally induced nonalcoholic steatohepatitis (NASH). Turk J Med Sci. 2015;45(3):542–6.
33. Zhao Y, Dang M, Zhang W, Lei Y, Ramesh T, Priya Veeraraghavan V, et al. Neuroprotective effects of Syringic acid against aluminium chloride induced oxidative stress mediated neuroinflammation in rat model of Alzheimer's disease. J Funct Foods. 2020 Aug 1;71:104009.
34. Dave PH, Vishnupriya V, Gayathri R. Herbal remedies for anxiety and depression-a review. Research Journal of Pharmacy and Technology. 2016;9(8):1253–6.
35. Balaji V, Priya VV, Gayathri R. Awareness of risk factors for obesity among College students in Tamil Nadu: A Questionnaire based study. Research Journal of Pharmacy and Technology; Raipur. 2017 May;10(5):1367–9.
36. Manohar J, Gayathri R, Vishnupriya V. Tenderisation of meat using bromelain from pineapple extract. Int J Pharm Sci Rev Res. 2016;39(1):81–5.
37. Mohan SK, Veeraraghavan VP, Jainu M. Effect of pioglitazone, quercetin and hydroxy citric acid on extracellular matrix components in experimentally induced non-alcoholic steatohepatitis. Iran J Basic Med Sci. 2015 Aug;18(8):832–6.
38. Surapaneni KM, Priya VV, Mallika J. Pioglitazone, quercetin and hydroxy citric acid effect on cytochrome P450 2E1 (CYP2E1) enzyme levels in experimentally induced non alcoholic steatohepatitis (NASH). Eur Rev Med Pharmacol Sci. 2014;18(18):2736–41.
39. Bolla SR, Mohammed Al-Subaie A, Yousuf Al-Jindan R, Papayya Balakrishna J, Kanchi Ravi P, Veeraraghavan VP, et al. In vitro wound healing potency of methanolic leaf extract of Aristolochia saccata is possibly mediated by its stimulatory effect on collagen-1 expression. Heliyon. 2019 May;5(5):e01648.
40. Selvaraj K, Sivakumar G, Priya Veeraraghavan V, Dandannavar VS,

Veeraraghavan GR, Rengasamy G, et al. Asparagus Racemosus -A Review [Internet]. Systematic Reviews. Available from: https://www.sysrevpharm.org/articles/asparagus-racemosus--a-review.pdf

41. Ansari S, Bari A, Ullah R, Mathanmohun M, Veeraraghavan VP, Sun Z. Gold nanoparticles synthesized with Smilax glabra rhizome modulates the anti-obesity parameters in high-fat diet and streptozotocin induced obese diabetes rat model. J Photochem Photobiol B. 2019 Dec;201:111643.
42. Jayaraman S, Devarajan N, Rajagopal P, Babu S, Ganesan SK, Veeraraghavan VP, et al. β-Sitosterol Circumvents Obesity Induced Inflammation and Insulin Resistance by down-Regulating IKKβ/NF-κB and JNK Signaling Pathway in Adipocytes of Type 2 Diabetic Rats. Molecules [Internet]. 2021 Apr 6;26(7). Available from: http://dx.doi.org/10.3390/molecules26072101