

PROSTHODONTICS

THE EFFECTS OF VARIOUS DISINFECTANT SOLUTIONS ON SURFACE HARDNESS OF SHELLAC BASE PLATE MATERIAL

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ABSTRACT

There is an increasing awareness of the importance of cross-infection control in dental clinics and laboratories. It is recommended that at every stage of prosthesis fabrication the components should be disinfected. The purpose of this study is to evaluate the effects of some commonly used disinfecting solutions on the surface hardness of shellac base plate material in relation to the length of immersion time. Hardness was measured as resistance to indentation following the method specified by the British Standards Institute. The results demonstrated that immersion disinfection of shellac-base plate material up to three hours did not reveal any significant change in its hardness values.

INTRODUCTION

Dentistry is challenged to control pathogenic microbes related to dental treatment. Hepatitis B has been a global threat for several decades. Other diseases particularly AIDS are also becoming a critical challenge in dental environment¹.

As cross infection from dentist to patient to dentist has been demonstrated and as severity of diseases challenging dentistry has increased, complete microbial destruction in the dental environment has become increasingly important²⁻⁴.

Infection control in the dental office and laboratory has become a necessity to protect the dentist, the staff and the patients from bacterial and viral infections that can be transmitted through procedures associated with dental care⁵⁻¹⁰. Cross contamination between patients and dental personnel can occur not only through contaminated dentures but also through polishing agents, instrumentation and wax trial dentures^{3,11-16}.

Various methods of sterilization and disinfection have been suggested¹¹. Since the nature of many

instruments and materials used in dentistry does not allow their exposure to high heat, chemical agents must be used to sterilize and disinfect them^{3-4, 12-13}.

Council on dental therapeutics accepts four categories of chemical disinfectants².

- 1 Chlorine solutions such as 5.25% sodium hypochlorite as surface disinfectant.
- 2 Fresh 8% formaldehyde solution for disinfecting instruments in 30 minutes.
- 3 2% glutaraldehyde solution can disinfect in 10 minutes.
- 4 Iodophores with 1% available iodine can also be used for disinfecting surfaces in dental practice.

Studies have shown that immersion disinfections in various disinfectant solutions can cause changes in physical and mechanical properties of various dental materials².

Hardness of a material is an important property during its handling in the oral cavity and clinics and laboratories. Hugget¹⁷, in his studies on denture base

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acrylic resins has described a hardness measurement test where he defines hardness as resistance to indentation. Many studies are available on hardness characteristics of denture base resins¹⁸. This study evaluates the effects of some commonly used disinfecting solutions on surface hardness of two types of shellac base plate materials.

MATERIALS & METHODS

Three disinfectants and two shellac base plate materials were used. Cidex Long Life is 2% Glutaraldehyde, a disinfectant that kills microorganisms by damaging their proteins and nucleic acid. It is bactericidal, viricidal, fungicidal, sporocidal, pseudomonacidal and tuberculocidal and is reusable for up to 28 days.

Chlorhexidine is a biguanide extensively used as a topical antiseptic. It is a broad-spectrum anti-microbial antiseptic and disinfectant that acts by destroying the cell membrane and precipitating the cell cytoplasm.

Alcohol-based disinfectants

These are proven broad based germicides being bactericidal, viricidal with a claim to be effective against Hepatitis B Virus (HBV) and Human Immuno Deficiency Virus (HIV).

Shellac dental base plates

These are thermoplastic compounds made with shellac, different waxes and resinous gum.

They are supplied in blanks of various thicknesses. They are used as base plates for wax occlusal rims during bite registration stage of complete dentures.

- 1 The Cavex (pink) shellac base plate used in this study was of 1.37 ± 0.01 mm standard thickness.
- 2 The Kemdent (plastic aluminum) shellac base plate was supplied in a standard thickness of 2 ± 0.1 mm.

All materials used are listed in Table I and II.

TESTING METHODS

Hardness test

The hardness test was done by using a Wallace micro indentation tester model H6A (H.W.Wallace

and Co. Ltd. Cryoden, UK). The instrument is very sensitive and its specifications confirm to British Standards Institute specification 3990.

A Minerva ball ended clasp of 2mm diameter made by Minerva Cardiff UK was used for hardness testing of shellac as it had a large surface area necessitated by softer material. The readings were taken at 15-second intervals as recommended by British Standard Specifications.

Specimen Preparation

Square specimens of shellac base plates of both Cavex and kemdent were prepared. The dimensions were 38 x 38 mm with thickness depending upon the type of shellac used.

Six specimens each was cut out from shellac blanks with a band saw. The edges were polished on a kent-polishing machine. They were tested as control and by immersion in disinfectant from 10 seconds to 3 hours. The 3-hour immersion in alcohol-based disinfectant was not used as it dissolved the material.

RESULTS

The data obtained from the tests is listed in Table III and Table IV. The data contains the mean value, standard deviation and Coefficient of variation. To identify any significant differences a One Way analysis of variance (ANOVA) was under taken.

DISCUSSION

The objective of immersion disinfection is to obtain a germ free prosthesis. It is desired that no physical or chemical changes take place in the material during disinfection. The most concise definition of hardness is the resistance to indentation.

Alcohol-based disinfectant was used only in a 10 second treatment with Cavex and Kemdent shellac materials because longer immersion resulted in specimens being partly dissolved. A ball indenter measured the hardness. No significant difference was found in the hardness of Cavex as well as Kemdent before and after a three-hour immersion.

The 2mm ball indenter used with a 300 gm load gave an average indentation of about 10×10^{-6} m, giving a satisfactory comparative testing.

TABLE I. SHELLAC BASE PLATE MATERIALS

Material	Trade name	Type	Manufacturer
Shellac base plate material	Kemden	Plastic, aluminium standard thickness	Associated Dental Products Ltd Swindon
Shellac base plate material	Cavex	Pink Shellac standard thickness	Cavex, Holland BV Haarlem, Holland

TABLE II. DISINFECTANT SOLUTIONS

Trade name	Chemistry	Manufacturer
Cidex Long Life	2% alkaline Glutaraldehyde	Surgikos Ltd Livingston, Scotland UK.
Dermacol	Alcohol based	Unident SA Geneva, Switzerland.
Aqueous Chlorhexidine	0.5% W/V Chlorhexidine	Hales Pharmaceutical Ltd Wetherby UK.

TABLE III. WALLACE HARDNESS TEST RESULTS (INDENTATION RESISTANCE) HARDNESS MEASUREMENT FOR SHELLAC (CAVEX) TESTED IN AIR AT 20±2°C FOR CONTROL SPECIMENS AND FOR SPECIMENS STORED IN DISINFECTANT SOLUTIONS FOR 3 HOURS

Indentation at 15 seconds	Ball indenter		Load 300 gms
Group	Mean (n = 10) m x 10 ⁻⁶	S.D.*	C of V%**
Control	7.80	0.43	5.60
Chlorhexidine	7.76	0.87	11.18
Glutaraldehyde	7.75	0.74	9.60
Alcohol based disinfectant***	—		

* S.D. = Standard Deviation

** C of V% = Coefficient of variation

*** Alcohol based disinfectant dissolved the material on storage.

A one-way analysis of variance showed that no significant difference was indicated between groups.

$$F = 0.004 \text{ df } 2-27 \text{ P} = 1.0$$

TABLE IV. WALLACE HARDNESS TEST RESULTS (INDENTATION RESISTANCE) HARDNESS MEASUREMENT FOR SHELLAC (KEMDENT) TESTED IN AIR AT 21±2°C FOR CONTROL SPECIMENS AND FOR SPECIMENS STORED IN DISINFECTANT SOLUTIONS FOR 3 HOURS

Indentation at 15 seconds	Ball indenter		Load 300 gms
Group	Mean (n = 10) m x 10 ⁻⁶	S.D.*	C of V%**
Control	12.80	2.61	20.50
Chlorhexidine	13.81	2.07	15.03
Glutaraldehyde	14.27	2.39	17.00
Alcohol based disinfectant***	—	—	

* S.D. = Standard Deviation

** C of V% = Coefficient of variation

*** Alcohol based disinfectant dissolved the material on storage.

A one-way analysis of variance showed that no significant difference was indicated between groups.

$$F = 1.02 \text{ df } 2-27 \text{ P} = 0.3$$

The high coefficient of variation for Kemdent could be attributed to the random sprinkling of aluminum particles causing hardness in areas of concentration.

CONCLUSION

The study evaluated the effects of three different brands of disinfecting solutions on hardness of two different brands of shellac base plate materials. It was shown that:-

- There was no significant change in hardness of Kemdent and Cavex shellac base plate materials before and after immersion disinfection for 10 seconds and 3 hours in Chlorhexidin and Glutaraldehyde based disinfectants.
- The alcohol based disinfectant cannot be recommended for longer immersion with Cavex and Kemdent shellac base plate materials due to its solvent action.

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