AN IN-VITRO COMPARATIVE STUDY OF THE PROPERTIES OF DENTAL STONE MODELS DISINFECTED BY INCORPORATION TECHNIQUE AND IMMERSION TECHNIQUE

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Contents:

Introduction

Review of literature

Aim of the study

Materials

Methodology

List of references
INTRODUCTION

“Dimensional accuracy is crucial for the quality of prosthodontic treatment. 

Disinfection is critical for a healthy clinical practice”

Gypsum products are not directly used as restorative material in dentistry, but in spite of that they still considered as a very important adjunctive materials that utilized in a wide range of dental laboratory procedures (Hishmati RH et al 2002). The cast (working model) is a replica of teeth and/or oral structures on which an indirect restoration or an appliance is fabricated, so that it must have a reasonable properties in order to withstand the different laboratory steps without being distorted or broken (Hersek N et al 2002).

The increase of 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 towards infection control in the dental clinics and the dental laboratories. The potential route of transmission from patients to the dental technician is through contaminated impressions, models and prostheses.

Gypsum products are widely used as materials for the preparation of models in dentistry. Dental casts are transferred several times between the dental laboratory and the dental office. The potential contamination of these models by infectious human pathogens such as Mycobacterium tuberculosis, HIV and HBV has led to the development of more rigorous infection control procedures. It has been established that bacteria and viruses can be transmitted from patients to the gypsum models during the fabrication of the prosthesis, if the plaster is poured into contaminated impressions or through contamination of bite blocks and trial bases (Mitchell et al, 1997).
The usual solution to this problem has been to rinse the impressions under running water and to place them in an appropriate disinfection solution (ADA Council on Scientific Affairs and Council on Dental Practice, 1996). This should be done upon removal of the impression from the patient’s mouth or in the dental laboratory prior to casting the model. However, two problems may arise. One is the risk that infectious organisms may still contaminate the gypsum models during the subsequent dental procedures such as jaw registration and the try-in procedures. The second is the dimensional changes that may arise due to the impressions being soaked in the disinfectants (Adobo et al, 1999, Tan et al, 1993, Hall, Munoz- Viveros and, Naylor, 2004 and Martin, Martin and Jedynakiewicz, 2007).

The disinfection of plaster models can be carried out through spraying or immersion in a disinfecting solution (Adabo GL et al 1999, Ivanovski 1995). However, immersion of casts has been related by some authors as being deleterious to the final quality of the cast (Mansfield SM and White JM 1991) as spraying them with disinfecting solutions has not presented any harmful effects to the surfaces of the plaster casts (Stern 1991). However, due to the porosity of plaster, spraying may not disinfect the whole surface of the cast efficiently.

Since the disinfection process must be effective without causing alterations on the final quality of the casts, the incorporation of disinfecting solutions in plaster has been regarded as a promising alternative (Matheus GL et al 2009).
REVIEW OF LITERATURE

Hiroshi egusa (2008) investigation howed that patient-derived dental impressions and gypsum casts are contaminated with numerous microbes, including Candida, MRSA, and P aeruginosa, which are known pathogens responsible for nosocomial and/or life-threatening infection in the immunocompromised host.

According to Twomey et al, 2003) The problem with spray disinfection is the inability of the solution to completely cover and maintain contact with all of the surfaces of the cast for the required amount of time. Depending on the angle of the spray dispenser, the undercut areas and interproximal surfaces may be missed in the application of the solution. ADA infection control guidelines recommend the use of disinfectants that require contact time of less than 30 minutes. The ideal disinfectant must be an effective antimicrobial agent and one that causes no adverse response in the dimensional accuracy and surface texture features of the impression material and the resultant gypsum cast.

Taylor et al (2002) study reveals that Disinfectants that are most commonly used include: sodium hypochlorite, glutaraldehyde, iodophor and phenol. The ability of certain disinfectants to destroy pathogens depends on the duration of exposure to the disinfecting agent, and the nature of the infectious pathogens.

Abdelaziz, Combe and Hodges, 2005 tried to reduce cross-contamination by the incorporation of disinfectants into the gypsum at the time of mixing the material, thereby disinfecting the cast. They attempted to add disinfectants to the dental stone powder. These disinfectants include sodium hypochlorite, glutaraldehyde, calcium hypochlorite, phenol and iodophor. When attempts had been made to disinfect dental models by mixing disinfectants with dental stone it was assumed that the process would affect the dimensional accuracy of the resultant models. They evaluated the dimensional accuracy of gypsum mixed with 0.525% sodium hypochlorite or 0.1% povidone iodine as
a water substitute. They showed that there was no significant effect on the dimensional accuracy of the resultant casts.

According to Hanan Abdul Adel (2013) study was done to evaluate the antimicrobial efficiency of three recommended chemical disinfectants (chlorhexidine digluconate mouth wash, iodine and ethanol) incorporated into gypsum casts. Dental plaster (AL-Ahliya gypsum) specimens incorporated with three disinfectant solutions (chlorhexidine digluconate, iodine and ethanol) at different concentrations were prepared. Agar diffusion test was employed to assess the antimicrobial action of these disinfectants against Streptococcus mutans, Staphylococcus aureus. The data collected were analyzed with ANOVA test (p<0.05) and LSD test. The disinfectant solutions demonstrated antimicrobial activity against all the microorganisms tested. Clear microbial inhibition zones were observed at higher concentrations of the disinfectants used in this study. The disinfectant agents analyzed were effective against the bacterial pathogens tested.

Wassel (2007) his study investigated the effect of a commonly used immersion disinfectant upon three different impression materials and any subsequent effects on the abrasion resistance, hardness and surface detail reproduction of gypsum casts. Results were (1) None of the disinfected alginate specimens could reproduce the 50 μm line. (2) Casts produced from the disinfected alginate were significantly less hard than from disinfected Position Penta and President (P <0.001). (3) Disinfection significantly affected the abrasion resistance of casts.

According to Zarakani (2013) Replacement of distilled water with sodium hypochlorite had no adverse effect on setting time, setting expansion or compressive strength of dental stone casts and thus can be used as a suitable method for disinfection of casts in dental laboratories.
AIM OF THE STUDY

The Purpose of this study is to analyse and compare the anti-microbial properties and Compressive strength

- Dental stone models after incorporating disinfectant solution during stone models preparation and
- Dental stone models after immersion in disinfectant solution

KEYWORDS

Infection control
Disinfection
Gypsum models
2% glutaraldehyde
Dimensional accuracy
Microbial study
Growth, culture, colonies
Disinfection:

This is the process by which virtually all recognized pathogenic micro-organisms are eliminated, but not essentially all microbial forms, on inanimate objects (Bergman, 1989). Disinfection is generally less lethal to pathogenic organisms compared to sterilization. The disinfection procedure leads to a reduction in the level of microbial contamination and covers, depending on the disinfectant used and the treatment time, a broad range of activity that may extend from sterility at one extreme to a minimal reduction in microbial contamination at the other extreme (ADA Council on Scientific Affairs and Council on Dental Practice, 1996).

Sterilization:

According to the Glossary of Prosthodontic terms sterilization is the process of completely eliminating microbial viability.

Dental casts:

According to the Glossary of Prosthodontic terms a dental cast is a positive life size reproduction of a part of the oral cavity formed when a material is poured into a matrix or impression of the desired form.

MATERIALS

STANDARDIZED GYPSUM MODELS

- STONE (TYPE III)

DISINFECTANTS

- 2% glutaraldehyde
METHODOLOGY

GROUP I - EVALUATION OF REDUCTION IN MICROBIAL CONTAMINATION

1. Making of the primary impression with Alginate followed by intentional contamination

2. Preparation of cast models with Dental stone.

3. Disinfection of Dental stone cast models with 2% Glutaraldehyde by two methods
   - GROUP I A- Incorporation technique
   - GROUP I B- Immersion technique

4. Microbial study of both GROUP I A and GROUP I B disinfect Dental stone cast models

GROUP II - EVALUATION OF COMPRESSIVE STRENGTH

5. Preparation of Dental stone specimens.

6. Disinfection of Dental stone specimens with 2% Glutaraldehyde by two methods.
   - GROUP II A- Incorporation technique
   - GROUP II B- Immersion technique
   - GROUP II C- Control group

7. Testing the Dental stone specimen for dry Compressive strength.

8. Statistical analysis and comparison of two disinfection techniques

9. Results
CONCLUSION

The results in a nutshell within the limitations of this study can be stated as follows.

Incorporation of 2% Glutaraldehyde during type III Gypsum product model preparation achieved higher level of disinfection with favourable dry Compressive strength when compared to 10 minutes of Immersion of type III Gypsum model. Therefore 2% Glutaraldehyde solution can be recommended in use for Incorporation disinfection of Dental stone.
REFERENCES


