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EVALUATION OF ANTI-CANDIDAL EFFECT OF HEAT CURE DENTURE BASE RESIN MODIFIED WITH ALUMINIUM OXIDE POWDER: AN IN VITRO STUDY

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Abstract:

Background: Denture stomatitis is a common condition in geriatric denture wearing patients, if failed to manage may lead to clinical failure of dentures due to non usage of dentures by the affected patients.

Aim: This study was done to evaluate anti-candidal effect of heat cure denture base resin modified with aluminium oxide powder.

Material and method: 48 samples each were processed using normal acrylic resin (group A) with conventional water bath technique, modified acrylic resin with 5%, 10% and 15% aluminium oxide powder (group B,C and D) processed by conventional water bath technique and evaluated for anti-candidal effect and microbial assay was calculated for the reference C. albicans strains by agar diffusion method for the incubation period of 24 h.

Result: group C and D displayed more anti-candidal effect compared to control group.

Conclusion: Anti-candidal effect of aluminium oxide modified heat cure denture base resin is more than conventional denture base group. This property can be employed in heat cure denture bases to control candidal growth in denture patients.

Key words: anti candidal, Aluminium oxide filler, denture base resin, heat cure resins.

Introduction

One of the difficulties encountered during prosthodontic care is the treatment of denture stomatitis. This prevalent and longstanding problem is common in geriatric patients wearing complete or partial dentures, and is directly related mainly to the adhesion of Candida albicans to the rough denture surface.[1-5] Denture-induced stomatitis is an inflammatory reaction of the denture bearing mucosa that affects approximately 65% of complete denture wearers.[6] It has a multifactorial etiology and candida albicans is reported as the primary etiologic agent.[7,8] So far no potential antimicrobial agent that could be incorporated in the denture has been developed.

Many investigators have suggested different antifungal modalities to overcome this chronic problem with geriatric denture patients. They incorporated antifungal medications like nystatin in denture conditioners and were successful in reducing denture stomatitis.[9,10] Some investigators tried to obtain antifungal

property by controlling the adhesion of Candida albicans on the acrylic resin surface. Some studies showed that coating the acrylic resin surface with 2 oktyl cyanoacrylate, silane-SiO_2 nano composite films or hydrophilic monomers will prevent the adhesion of Candida albicans on the acrylic resin surface.[11–13]

Recent advances in the processing of ceramics have made thermally conducting ceramics, such as sapphire (aluminium oxide), silicon nitride, boron nitride and aluminum nitride widely available. These ceramic powders have the advantage of being white, and therefore are less likely to alter the finished appearance of the denture base material than are metal powders. Alumina particles are thermodynamically stable particles over a wide temperature range. They are corundum like structure with oxygen atoms adopting hexagonal close packing with alumina ions filling two-thirds of the octahedral sites in the lattice [14]. Many studies have shown improved properties on addition of aluminium oxide fillers to heat cure denture base resins. [15-18] To the best of our knowledge, there is not much significant research work on the anticandidal effects of alumina on denture base resins. Hence this study was planned to evaluate the anti-candidal effect of heat cure polymethylmethacrylate reinforced with aluminium oxide powder.

Method

Preparation of samples

A metal die of 5 mm diameter and 1 mm thickness was manufractured. With the polyvinylsiloxane impression material (Aquasil Ultra Heavy, Dentsply/ Caulk, USA), an impression of the die was made and master cast was poured with improved dental stone i.e. die stone (Kalrock). Modeling wax (DPI-dental products of India limited, Mumbai) was placed in each of the compartment. Waxed samples were invested in the dental flask (KAVO, Germany) using dental stone (Gold stone, Asian chemicals, Rajkot, India) following manufacturer's instructions. Dewaxing was carried out and mold was allowed to cool. A standard mold measuring 5 mm diameter and 1 mm thickness was obtained for the fabrication of 48 specimens which were divided into 4 groups of 12 each.

Group-A: Unmodified heat cure denture base resin (Control group).

Group-B: Modified heat cure denture base resin with addition of 5%by wt. aluminium oxide powder.

Group-C: Modified heat cure denture base resin with addition of 10%by wt. aluminium oxide powder.

Group: Modified heat cure denture base resin with addition of 15% by wt. aluminium oxide powder.

The material used for preparing specimens was conventional heat polymerized denture base material (DPI-dental products of India limited, Mumbai) in a powder and liquid form. Group-A was conventional heat cure denture base resin without any additive. Three concentrates (5%, 10% and 15% by wt.) aluminium oxide powder (5 -22microns, Spraymint technologies, Bangalore) were mixed with polymer of conventional heat polymerized denture base material of group B and C respectively. Alginate separating media was applied on the die stone mold with the help of a brush and dried. The monomer and polymer were mixed according to manufacturer's instructions for all the 4 groups. When the resin had reached dough stage, it was packed into the molds and the flask was kept in bench press unit (KAVO-EWL, Germany) for bench curing for 30 mins and curing was done according to manufacturer's instructions. Finishing and polishing was carried out using acrylic bur and sandpaper. Specimens were stored in distilled water at 37^{o} C for 7 days. Before microbial assay, all samples were subjected to U-V ray sterilization for 15 min.

Microorganisms

One standard strain organism candida albicans was used. The samples were inoculated in brain heart infusion broth containing Candida albicans) for 24 h. The inoculated samples were sonified with normal saline and inoculated into sarbastose dextrose agar medium for 24 h and the agar diffusion of candida albicans and the colonies were counted.[18]

Results

The CFU per 1 mL of broth against C. albicans was demonstrated as the mean viable cells (CFU) after 24 hr incubation [Table 3]. When compared to the control group, other 3 modified denture base resins test groups showed anti candidal effect. Highest effect was seen in group-D.

Discussion

The purpose of this study was to measure the antifungal effect of modified heat cure denture base resins with aluminium oxide fillers against Candida albicans adhered to acrylic resin as a possible method to treat and prevent denture stomatitis for complete denture wearers. It was found that modified heat cure denture base resins with aluminium oxide powder have an antifungal effect on the acrylic resin, the material of the complete denture.

The only significant difference in reducing the number of Candida albicans, considered the most pathogenic factor causing denture stomatitis was with 10% and 15% aluminium oxide modified denture base resins. The results indicated that modified heat cure denture base resin can be effective in producing antimicrobial environment against Candida albicans.

Denture stomatitis is a common infection of the oral mucosa in denture wearers and *Candida albicans* is the most significant etiological agent of denture stomatitis. *C. albicans* is an stubborn infection which is difficult to eliminate once it has been colonized as a complex biofilm formation.[20] Dentures create an environment that favors the localization and development of potentially virulent organisms. In addition to isolating the underlying mucosa from the self-cleansing action of the oral musculature, anaerobic and acidic conditions develop at the tissue-contacting surface of a denture promoting yeast proliferation.[21] C. albicans readily forms biofilms on prosthetic surfaces, including denture acrylic. Many studiea are conducted to overcome this problem, but with not so satisfactory results.[9-13]

Aluminum oxide, commonly referred to as alumina, possesses strong ionic interatomic bonding, giving rise to its desirable material characteristics. It can exist in several crystalline phases, which all revert to the most stable hexagonal alpha phase at elevated temperatures. This is the phase of particular interest for structural applications. Alpha phase alumina is the strongest and stiffest of the oxide ceramics. Its high hardness, excellent dielectric properties, refractoriness, and good thermal properties make it the material of choice for a wide range of applications.[13] The reason for the use of ceramic filler as opposed to metal filler is the lower filler density [the density of sapphire is considerably less than that of cobalt and chromium, thus the light weight of acrylic resin denture bases is retained. Furthermore, these ceramic powders have the advantage of being white, and therefore are less likely to alter the finished appearance of the denture base material than are metal powders.[22]

Studies have stated that aluminium oxide powder has antimicrobial effect when tested on bacterias.[23-25] and stated it may be due to release of metal ions which acts as bactericidal. This may be mechanism of action for antifungal action too, but could not confirm it. Hence further studies are needed to study exact mechanism of anti candidal action of alumina. During the specimen preparation some variability might be introduced in the selection of the materials, storage of the specimens, finishing and polishing of the specimens. In vitro static load tests differ from the dynamic oral conditions. No cyclic loading in a moist environment was performed in the present study, and these are the limitations of the study.

Conclusion

Within the limitations of this in vitro study, the modified denture base resin reinforced with aluminium oxide showed 10^5 less candida albicans adhesion than the control group after 24 hrs incubation period.

Table I:
Different Groups And Description About Each Group

Groups	Description
Group-A	Unmodified heat cure denture base resin processed with water bath technique (Control group)
Group-B	Modified heat cure denture base resin with addition of 5% by wt. aluminium oxide powder processed with water bath technique
Group-C	Modified heat cure denture base resin with addition of 10% by wt. aluminium oxide powder processed with water bath technique
Group-D	Modified heat cure denture base resin with addition of 15% by wt. aluminium oxide powder processed with water bath technique

Table II:
Anti-Candidal Activity Of Different Groups

Group	Colony Forming Unit (CFU)/ml of broth
Group A	105
Group B	103
Group C	102
Group D	10

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