



## **Comparative Study on Color Stability of Denture Reline Polymers when Using Microwave and Chemical Disinfection**

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### **Authors' contributions**

*The work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

This study investigated the color stability of reline resin after two methods of disinfection i.e microwave disinfection and chemical disinfection. A stainless steel mold with a breakaway compartment (10 mm in diameter by 0.7 mm thickness) was made to fabricate specimens of various resins. Each material was mixed according to manufacturer's instructions and applied into the mold. Prior to color stability testing, specimens were cleaned in distilled water for 20 minutes to kill any microorganisms that may had contaminated the discs during fabrication. And then specimens were immersed in Sodium Perborate Monohydrate 200 ml of solution for 15 days and microwaved for 15 days so that it is comparable to chemical disinfection soaking. The color stability of each specimen was measured again using spectrophotometer and values were obtained. The data of  $\Delta E$ ,  $\Delta L$ ,  $\Delta b$ ,  $\Delta a$  were analysed by 2 way repeated measures ANOVAs test. Significant statistic changes in color parameters  $\Delta L$ ,  $\Delta a$ ,  $\Delta b$  of the reline resin DPI, Ufi Gel Hard And Kooliner were observed when dentures were disinfected by Sodium Perborate Monohydrate 2% solutions. The color stability of the reline resin was influenced by time, regardless of disinfection or non disinfection. This can be attributed to bleaching (whitening) effect of reline material. Discoloration

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of resin based materials may be caused by intrinsic or extrinsic factors. Intrinsic factors are related to internal alterations in material resulting from physicochemical reactions or residual monomer oxidation with time. Thus the initiator, quantity and type of monomer and the polymerisation efficiency can affect the color stability of resin based materials. The color stability deviation value  $\Delta E$  significantly increased to maximum for chemical disinfectant, least for Control group and intermediate for microwaved group. Ufi Gel showed the highest deviation  $\Delta E$  and Control Group showed the lowest deviation according to results.

**Keywords:** Color stability of reline resin; microwave disinfection; chemical disinfection; spectrophotometer; dentures; sodium perborate.

## 1. INTRODUCTION

The fit of dentures continuously break down with time in the supporting tissue. Hard chairside reline resins are utilized for transitory or lasting enhancement of denture fit [1]. Schou et al. and Blair et al. commented that denture stomatitis was a common condition among elderly and was related to continuous denture wearing and poor hygiene [2]. Continuous swallowing or aspiration of microorganisms from dental plaque, which may deteriorate the oral health of patient [3,4]. Dental prostheses brought into a dental office for relining or modifications are sullied with pathogenic microorganisms [5]. Concern about transmission of these organisms between the workplace and research facility has prompted restored enthusiasm for sanitization and disinfection [6]. Current built up strategies have not been ended up being totally viable in averting or taking out the event of denture stomatitis [7]. Therefore, elective disinfection techniques are being sought after, including the utilization of microwave energy and chemical disinfection. Microwave energy has been prescribed for cleaning complete dentures to counteract or treat denture stomatitis and to control cross-contamination [8,9]. The specimens were immersed in 200 ml of water and irradiated with 430 W for 2 minutes [10]. The disinfection method was repeated in different interval which was divided from Day 0 to 15 which is equivalent into 1 year of disinfection required under natural conditions. Specimens were submitted to daily chemical disinfection by immersing into 3.8% Sodium Perborate Monohydrate solution for 15 days and for each soaking, fresh Sodium Perborate Monohydrate solution was used and distilled water was changed daily [11]. This cycle was repeated for 15 days, so that period of chemical disinfection was comparable with that of microwave disinfection and control groups.

Albeit chemical disinfection has been generally suggested, it is conceivable that specific parts of

the disinfectant arrangements may infiltrate the material and not be totally disposed of by rinsing [12,13] Although the disinfectant arrangements utilized in this examination have been shown for denture biofilm control, patients ought to be educated concerning the likelihood of reline materials recoloring in long haul, paying little mind to the utilization or not of disinfectant arrangements [14,15]. Esthetics is an important aspect in denture relining as color of relining material and denture base should match [16]. Despite the wide utilization of both the materials for purification, no similar investigation between the previously mentioned two techniques has been done [17]. However, past examinations have not been reliable or express regarding the approach utilized.

## 2. METHODOLOGY

This *in vitro* study was conducted to compare the Color Stability of Denture Reline Polymers using Microwave and Chemical Disinfection. A stainless steel mold with a breakaway compartment (10 mm in diameter by 0.7 mm thickness) was made to fabricate specimens of various resins.(ADA specification no. 19). 10 specimens of each resin were prepared under aseptic conditions. Each material was mixed according to manufacturer's instructions and applied into the mold, which were placed on an acetate sheet and glass slab was placed over the material, and light pressure was applied to remove the excess material from the mold. Specimens were divided into three test groups.

**Table 1. Grouping of Samples according to material used**

| Group | Material used       |
|-------|---------------------|
| G1    | Kooliner Sample     |
| G2    | Ufi Gel Hard Sample |
| G3    | DPI Sample          |



Fig. 1. Stainless Steel Die (ADA Specification no. 19)



Fig. 2. Example of Grouping of Sample of each material



Fig. 3. Materials used, die and armamentarium

Table 2. Grouping of samples according to microwave disinfectant method used

| Group         | Non microwaved    | Microwaved           |
|---------------|-------------------|----------------------|
| G1 (Kooliner) | Control Group G1C | Microwaved Group G1M |
| G2 (Ufi Gel ) | Control Group G2C | Microwaved Group G2M |
| G3 (DPI)      | Control Group G3C | Microwaved Group G3M |

Table 3. Grouping of Samples according to Chemical Disinfectant method

| Group       | Chemical disinfectant      |
|-------------|----------------------------|
| Kooliner G1 | Chemically disinfected G1D |
| Ufi gel G2  | Chemically disinfected G2D |
| DPI G3      | Chemically disinfected G3D |



**Fig. 4. Sample placed in microwave for 2 min at 430 W**



**Fig. 5. Spectrophotometer Color Guide 45/0 used for Sample testing**

Prior to color stability testing, specimens were cleaned in distilled water for 20 minutes to kill any microorganisms that may have contaminated the discs during fabrication. And then specimens were immersed in Clinsodent (Sodium Perborate Monohydrate) 200 ml of solution for 15 days. In test group (G1C, G2C, G3C) Specimens were submitted to daily chemical disinfection by immersing into 3.8% Sodium Perborate Monohydrate solution for 15 days and for each soaking, fresh Sodium Perborate Monohydrate solution was used and distilled water was changed daily. The specimens were immersed in 200 ml of water and irradiated with 430 W for 2 minutes. The microwave cycles were also repeated for 15 days, so that period of chemical disinfection was comparable with that of microwave disinfection and control groups.

The color stability of each specimen was measured again using spectrophotometer and values were obtained. The data of  $\Delta E$ ,  $\Delta L$ ,  $\Delta B$ ,  $\Delta a$  were analysed by 2 way repeated measures ANOVAs test.

All the procedure were done by single operator to avoid any bias. All the experimental groups were then examined under spectrophotometer according to the CIE L\*A\*B\* color order system of Commission International Del' Eclairage [18,19].

### 3. RESULTS

For DPI Group Descriptive statistics of different colour stability parameters ( $\Delta L$ ,  $\Delta a$ ,  $\Delta b$  and  $\Delta E$ ) were attained in Control group, microwave treatment and chemical treatment at 15<sup>th</sup> day after immersion with DPI. All parameters

appeared significant when compared across control, chemical and microwave group. Chemical disinfectant and Control group showed the highest and lowest deviation respectively. In case of Kooliner Group the value as compared with control were non-significant. Other multiple comparison values were found significant. Chemical disinfectant and Control group showed the highest and lowest deviation respectively. For UFI Gel hard Group chemical disinfectant and control group showed the highest and lowest deviation respectively. Significant statistic changes in color parameters  $\Delta L$ ,  $\Delta a$ ,  $\Delta b$  of the reline resin DPI, Ufi Gel Hard And Kooliner were observed when dentures were disinfected by Sodium Perborate Monohydrate 2% solutions. Significant statistic changes in color parameters  $\Delta L$ ,  $\Delta a$ ,  $\Delta b$  of the reline resin DPI, Ufi Gel Hard And Kooliner were also observed when dentures were microwaved. The color stability of the reline resin was influenced by time, regardless of disinfection or non disinfection. Significant statistic changes in color deviation  $\Delta E$  was observed for both the treatment i.e Microwaved and Chemical Disinfectant. The color stability deviation value  $\Delta E$  significantly increased maximum for chemical disinfectant, least for Control group and intermediate for microwaved group. The results showed that microwaved specimens have higher color change than specimens did not microwave after 15 days of time interval. Ufi Gel showed the highest deviation  $\Delta E$  and Control Group showed the lowest deviation according to results.

### 4. DISCUSSION

Prostheses debased with pathogenic microorganisms fill in as a potential wellspring of

contamination transmission among patients and dental staff [20,21]. To avoid cross-defilement, prostheses ought to be totally purified before being sent to the research center and before insertion [12,17]. Several techniques for cleansing have been prescribed to guarantee disease control in dental practice. Many people do not clean their dentures satisfactorily and may misuse chemical cleansers leading to the deterioration of acrylic dentures. This in vitro assessed the color stability of Kooliner GC, UFI Gel hard and DPI when drenched in chemical disinfectant (Sodium Perborate monohydrate), when microwaved in comparison with control group where samples are only immersed in water without the use of any disinfection method at different intervals of time to check the color stability. The invalid speculation that there would be no impact of denture chemical and microwave sterilization on shading security of relining material was evaluated. There was a perceptible color stability change in control group with time.  $\Delta L$  displayed a huge diminishing after some time for Control aggregate, which shows a fading (brightening) impact of reline material. Discoloration of resin based materials may be caused by intrinsic or extrinsic factors. Intrinsic factors are related to internal alterations in material resulting from physicochemical reactions or residual monomer oxidation [5]. Thus the initiator, quantity and type of monomer and [22] the polymerisation efficiency may affect the color stability of resin based materials. Furthermore, extrinsic factors that may influence the color change include adsorption, absorption and surface roughness of the denture [6]. The discoloration of polymeric materials may originate from a wide array of sources including superficial absorption and endogenous irreversible discoloration attributed to changes in chemical structure of the material surface or outer layer with time. There is superficial diffusion of hydrophilic colorings, and internal or bulk discoloration derived from incomplete conversion of photo initiators and unconverted C=C bond [23,24]. The increase of color change of the UFI gel could be attributed to the initiator, quantity and type of monomer and the polymerisation efficiency can affect the color stability of resin based materials few relining material demand less chemical disinfection concentration as compared to other hence according to this study we were able to know that UFI Gel due to highest number of unconverted C=C bond react fast and causes color change with highest deviation. The susceptibility to color change of the resin UFI gel, Kooliner and DPI

evaluated in this study could be attributed to both intrinsic and extrinsic factors. According to UFI Gel showed the highest  $\Delta E$  with time and It was also noticed that Chemical disinfectant showed the highest  $\Delta E$  and Control group the lowest due to less affect by extrinsic and intrinsic factors [25] Hence, Concentration of chemical disinfection and residual molecule present in the relining material type combination is accountable for color stability variation. The results of present study are in agreement with these findings. Therefore, further studies should consider the evaluation of other concentrations according to relining material used. The dentist should check for the concentration quantity for disinfection. And manufacturer should also mention about the concentration of chemical disinfection to be used for disinfection of relining material. The color stability of the reline resin was influenced by time, regardless of disinfection or non-disinfection. This could be credited to extraneous components like water assimilation and adsorption and furthermore to hydrophilic nature of material and characteristic variables which cause inner adjustments in material coming about because of physicochemical responses or lingering monomer oxidation [26]. Although the disinfectant arrangements utilized in this examination have been shown for denture biofilm control, patients ought to be educated concerning the likelihood of reline materials recoloring in long haul, paying little mind to the utilization or not of disinfectant arrangements.

## 5. CONCLUSION

Hence, the microwave disinfection method should be considered a better method for disinfection as compared to Chemical disinfection because of absence staining agent present. Chemical disinfection may have accelerated the content of residual monomer, which took place with time.

## CONCENT AND ETHICAL APPROVAL

As per university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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