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Effect of mouthrinses on discolouration of CAD-CAM manufactured temporary restorative materials

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ABSTRACT

Aim: The main aim of this study was directed to evaluate the in vitro effect of mouth rinses on colour stability of Computer-aided design and computer-aided manufacturing (CAD-CAM) temporary restorative materials.

Materials And Methods: In this study CAD-CAM manufactured polymethylmethacrylate (PMMA) blocks were used. A total of 8 samples of PMMA blocks with shade A2 (10 mm in diameter and 2 mm in thickness) were constructed in standardized manner and were collected from the CAD-CAM department of Saveetha dental college. The blocks were mounted and preoperative values for color stability were recorded using spectrophotometry. Samples were divided into four main equal groups. In total, 4 different mouthrinses for each group. Color changes were measured with a digital spectrophotometer after 7 days and specimens were prepared. The data was collected, tabulated and subjected to statistical analysis using SPSS Statistics Version 23.

Results And Discussion: Significant discolouration was observed in all groups after the immersion in mouthrinses. It shows that Herbal mouthrinse and distilled water(control) have good colour stability whereas listerine mouthrinse has the least colour stability.

Conclusion : The CAD-CAM blocks were susceptible to color changes following immersion in the tested mouthrinses. Discoloration effect of the tested mouthrinses on various CAD-CAM materials was comparatively different.

Keywords: *Spectrophotometer, Mouthrinse, CAD-CAM PMMA blocks, Color stability, Innovative technique*

INTRODUCTION

In dentistry, the use of computer aided designing and computer aided manufacturing has enormously increased in recent times due to various technological advances (1). New occurrences of CAD/CAM materials, such as hybrid composite resins material have been introduced especially for aesthetic restorations(2). These materials overcome the contraindications associated with the application of direct composites in clinical dentistry with their standardized manufacturing process and the lack of polymerization defects that occur at the time of its application (3). Over the years, the mechanical properties of CAD/CAM hybrid composite blocks have improved through the alteration of the resin matrix and the incorporation of filler particles (4). Hybrid composite blocks have different microstructures as well as variable filler contents and hence differences in their mechanical properties(5). Recently, reinforced CAD/CAM hybrid composite blocks were developed to restore the posterior teeth, which are subject to high masticatory forces (6).

Tooth colored restorative materials present a challenging problem as a result of discoloration(7). The color of tooth-colored restorative materials may be influenced by plaque accumulation, stains from solutions, surface roughness, and chemical degradation, as a result of exposure and consumption of different beverages, food or the use of mouth rinses (8). Prevention of dental caries and/or gingivitis is basically maintained by routine and proper oral hygiene(9). The routine mechanical dental plaque removal in addition to the use of chemical therapeutic agents are considered the usual daily practice for proper oral hygiene maintenance (10). Chemical plaque control agents are prescribed by dentists for patients susceptible to periodontal disease and/ or dental caries such as those receiving fixed prosthodontics treatments (11).

Mouth rinses together with the mechanical means of oral hygiene helps in preventing and control of caries, periodontal diseases, through cessation of plaque, moreover for diminishing oral malodor (12). Alcohol and non-alcohol based mouth rinses are varieties used popularly by patients as a means for regularly maintaining oral hygiene on a daily basis(13). Chlorhexidine digluconate (CHX) is one of the frequently prescribed antibacterial agents that reduces periodontal disease and dental caries (14). It is presented in many forms as gel, spray, or mouth rinse(15). CHX administration has been associated with side effects such as enamel and restorative materials staining, formation of calculus, and temporary unpleasant taste (16). Listerine is another mouth rinse which is frequently prescribed and used as an anti-plaque agent to treat gingivitis(17). Initially it contained four essential oils - peppermint, eucalyptus, thyme, and wintergreen, they were later replaced by menthol, eucalyptol, thymol, and methyl salicylate (18).

Recently devices were introduced to measure color following the scientific approach to tooth color matching(19). A simple, inexpensive instrument to measure color on three axes or stimuli such as the human eye is the colorimeter (20).

While other devices developed to measure color by reflection or transmission of an observed object are the spectrophotometer which is used to measure changes in the color of the restorative materials more accurately(21). Other electronic instruments were introduced such as CCDs and fiber optics (22).

Color stability of restorative materials could be affected by both alcohol containing and alcohol free mouth rinses as reported by some studies (23). The main aim of this study was directed to evaluate the in vitro effect of mouth rinses on color stability of CAD-CAM temporary restorative materials.

MATERIALS AND METHODS

In this study CAD-CAM Polymethyl methacrylate (PMMA) blocks were used. A total of 8 samples of PMMA blocks with shade A2 (10 mm in diameter and 2 mm in thickness) were constructed in standardized manner and were collected from the CAD-CAM department of Saveetha dental college. The blocks were mounted and preoperative values for color stability were recorded using spectrophotometry.

Samples were divided into four main equal groups. In total, 4 different mouthrinses for each group (group 1- Listerine , group2- chlorhexidine, group3- herbal mouthwash) and group4- control distilled water. Group 1 block is immersed in 10ml listerine mouthrinse, group 2 block is immersed in 10ml of 0.2% CHX, group 3 is immersed in herbal mouth rinse and group 4 is distilled water. The specimens were immersed in a 20 ml solution at room temperature for 24 hours. Color changes were measured with a digital spectrophotometer after 7 days and specimens were prepared.

The data was collected, tabulated and results were statistically analyzed. The mean and standard deviation of surface hardness of preoperative and postoperative values were compared. For inter group comparison Krusal-Wallis test and Mann-Whitney U test was done with the use of SPSS software. The level of significance was set at $P \leq 0.05$. Statistical analysis was performed with SPSS Statistics Version 23.

RESULTS

The pre values of color properties are observed in all four groups which are given as Roughness average (Ra), Root Mean square roughness (Rq) and arithmetic mean value of the single roughness depths of consecutive sampling length (Rz)(figure 1). Significant discolouration was observed in all groups after the immersion of CAD-CAM block in the mouth rinse except that of the distilled water (control). CAD-CAM block immersed in listerine mouthrinse was found to be more discolored (0.012) whereas distilled water showed less discolouration of 0.023 (figure 2). It shows that Herbal mouthrinse and distilled water(control) have good color whereas listerine mouthrinse have the least color stability. Kruskal wallis test showed that after immersion of the blocks in the mouthrinse , we observed that there is no significant difference i.e: 0.2(P value>0.05)

TABLE 1: Mean and standard deviation comparing all four groups of mouthwash immersed CAD-CAM blocks.

CAD-CAM blocks	Mean	Standard deviation
Preoperative	2.50	1.291
Postoperative	2.50	1.291

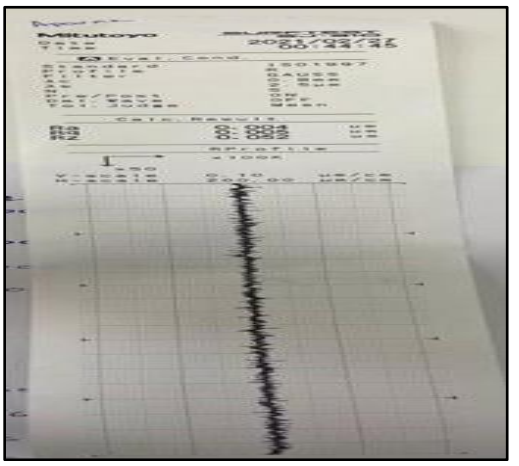

FIGURE 1: The prevalues of colour properties as observed in all four groups which are given as Ra,Rq and Rz (figure1)

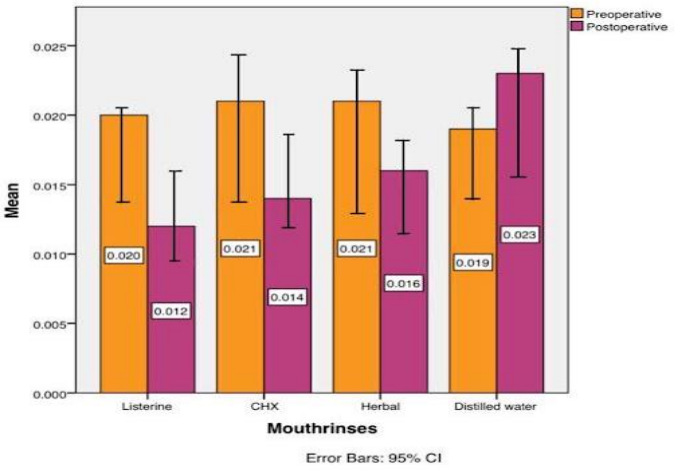

FIGURE 2: The results of this graph shows the colour stability of CAD-CAM materials before and after immersing it in mouthwashes . X axis denotes the Mouthwashes used for this study and Y axis denotes the mean preoperative and postoperative values of colour stability of PMMA blocks. Preoperative value and postoperative value of group 1- listerine immersed PMMA block was 0.020 and 0.012 respectively, Preoperative value and postoperative value of group 2- CHX immersed PMMA block was 0.021 and 0.014 respectively, Preoperative value and postoperative value of group 3- herbal mouthrinse immersed PMMA block was 0.021 and 0.016 respectively, Preoperative value and postoperative value of group 4- distilled water(control) immersed PMMA block was 0.019 and 0.023 respectively. 0.2(P value>0.05) which is statistically non - significant.

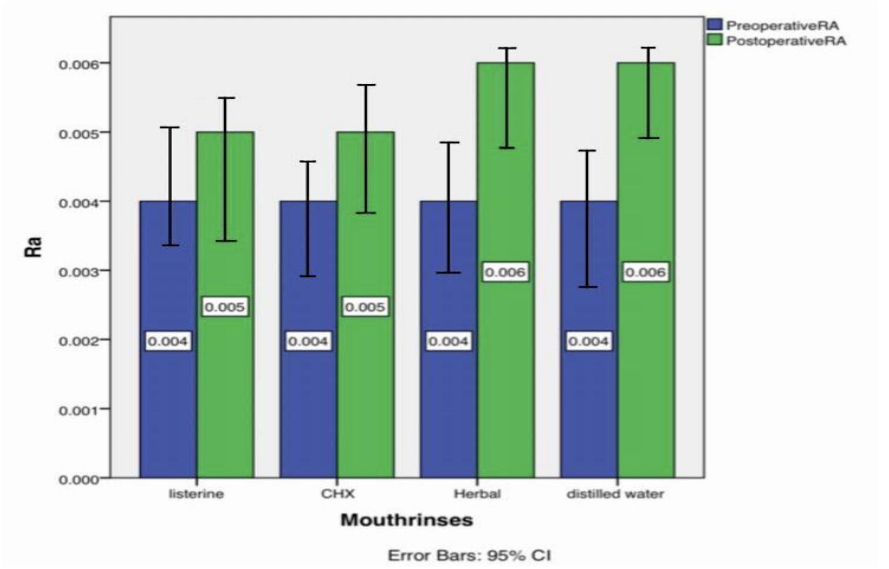

FIGURE 3: shows the descriptive statistics of Ra of preoperative and postoperative measurement of PMMA blocks immersed in different mouthrinse solutions. X axis represents the mouthwash used and y axis represents mean value of preoperative and postoperative Ra. It is observed that after the immersion of the PMMA block there is an increase of Ra in CHX, Listerine, herbal and Distilled water P value = 0.2>0.05, which is statistically insignificant.

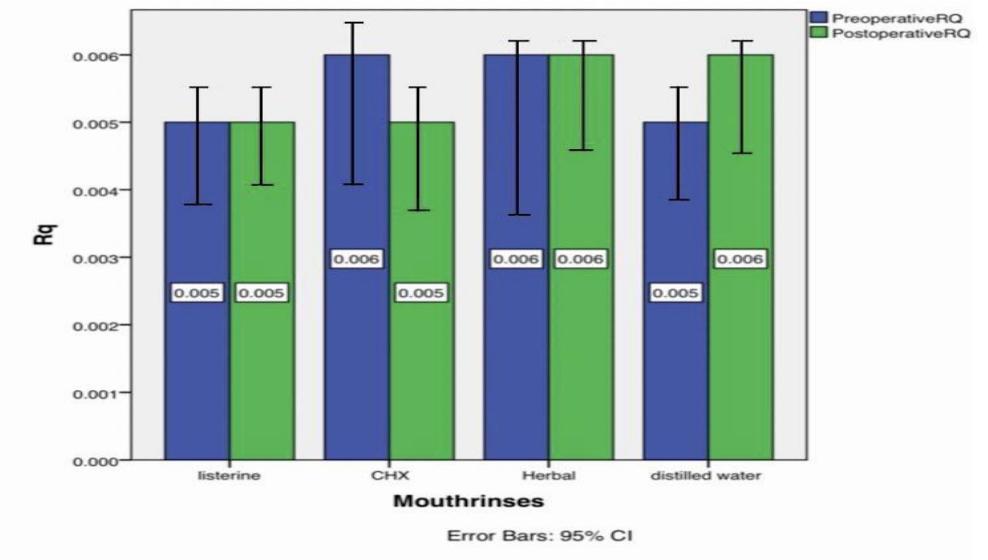

FIGURE 4: shows the descriptive statistics of Rq of preoperative and post operative measurement of PMMA blocks immersed in different mouthrinse solutions. X axis represents the mouthwash used and y axis represents mean value of preoperative and postoperative Rq. It is observed that after the immersion of the PMMA block in CHX, distilled water there is an increase of Rq, whereas in Listerine and herbal mouthrinse there is the same in Rq before and after immersion. P value = 0.12>0.05, which is statistically insignificant.

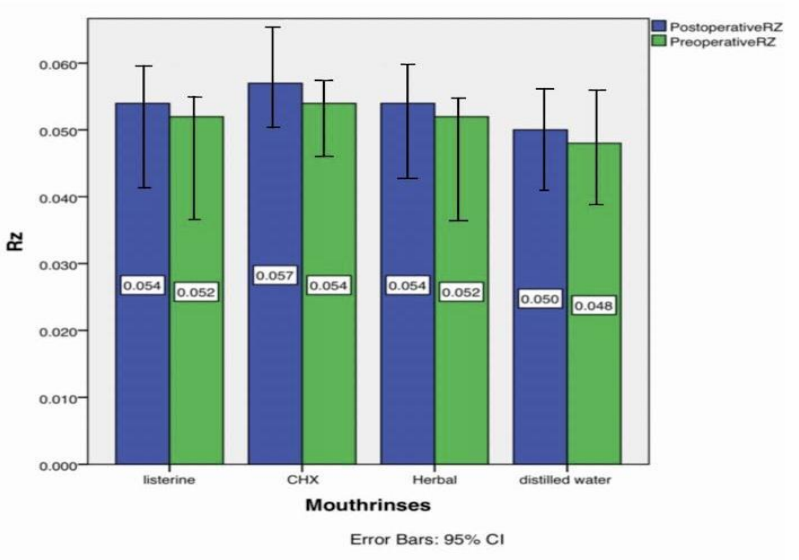

FIGURE 5: shows the descriptive statistics of Rz of preoperative and post operative measurement of PMMA blocks immersed in different mouthrinse solutions. X axis represents the mouthwash used and y axis represents mean value of preoperative and postoperative Rz. It is observed that after the immersion of PMMA block in CHX, Listerine, herbal and Distilled water there is decrease of Ra than before immersion. P value = 0.18>0.05, which is statistically insignificant.

DISCUSSION

CAD/CAM composite blocks is a widely used material in dentistry for esthetic restorations. While the reinforced hybrid composite blocks were studied for their potential for improving the mechanical properties to withstand high biting forces, the loss of color stability of the esthetic restorations could be a serious problem(24). Maintaining color and translucency stability in all esthetic restorations is an important factor in the success of the treatments (23). The esthetic restorations are always at risk of discoloration in the oral environment, as they come into contact with various beverages and foods (25). Therefore, evaluation of color stability is essential, even in the reinforced hybrid composite blocks(26). In this study, the color and translucency changes of regular and reinforced hybrid composite blocks were evaluated (27).

The current study assessed the effect of 4 mouthrinses on color stability(28). For many years, the tooth shade guide has been used to determine the appropriate tooth color.

Although inaccurate and subjective, this method was easy to use (29). Later, scientific methods have been introduced that overcame deficiencies with the visual guide(30). A spectrophotometer is an instrument that detects color changes(31). The spectrophotometry data can be translated into quantitative values (32). The various advantages of the spectrophotometer is the accuracy and ability to analyze the major components of a series of spectra and its ability to convert data into various color measuring systems (33).

Researchers have proved that the ability of mouthwash solutions to change the color of restorative materials is based on the type of restorative materials and its capability of resin matrix to absorb water, in addition to the type of filler and filler content in resin composite restorations (34). Previous studies show a significant difference existed between groups A and B following immersion in CHX and Listerine mouthrinses(35).

This finding agreed with a previous study that examined the color stability of resin composites (36). Similar to the present study, Festuccia et al(37). reported that greater discolorations of two resin composites occurred with Listerine compared to Plax alcohol-free and Periogard CHX (38).

One of the potential limitations of the current study was that Further research should compare the color stability of PMMA with different types of mouthrinses under clinical conditions(39). However the photospectrometer is expensive and difficult to use(40).

Our team has extensive knowledge and research experience that has translate into high quality publications (Neelakantan et al. 2013; Aldhuwayhi et al. 2021; Sheriff et al. 2018; Markov et al. 2021; Jayaraj et al. 2015; Paramasivam et al. 2020; Li et al. 2020; Gan et al. 2019; Dua et al. 2019; Mohan and Jagannathan 2014)

CONCLUSION

The CAD-CAM blocks were susceptible to color changes following immersion in the tested mouthrinses. Discoloration effect of the tested mouthrinses on various CAD-CAM materials was comparatively different. Clinically aesthetic stability of CAD/CAM hybrid blocks require initial color match and translucency of a restoration that are as important as the mechanical properties of reinforced hybrid composite resin blocks. Where both esthetic and strong mechanical properties are required, care should be taken to apply the hybrid composite blocks. Further study of the correlation between preoperative and postoperative values of CAD-CAM hybrid blocks are necessary to improve our understanding of these materials.

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