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Digital Analysis of Mouth Rinses Staining Characteristics On Provisional Acrylic Resins

KEYWORDS

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Introduction

Provisional restorations are vital and often challenging part of implant dentistry. Besides the fact that provisional restorations need to maintain an acceptable function and esthetic appearance until a permanent restoration can be placed, they serve as placeholders to prevent migration of neighboring teeth and extrusion of opposing teeth[1]. They are also important for determining the best restorative design for the given scenario and providing a template for soft-tissue contouring and maturing. Colour stability is one of these substantial qualities of these materials, and the inservice discolouration is considered as a major shortcoming of provisional restorative materials[2]. Dietary factors and medications are commonly reported among the agents that cause discolourization of the restorative materials. Mouthrinses are mostly used as an important caries and gingivitis control method, and a breath refreshener[3]. Because of their antiinflammatory, antiseptic, and analgesic properties, they are occasionally administered after tooth preparation in order to reduce the local inflammation and tenderness, and to hasten the mucosal healing; however, extrinsic staining of teeth has emerged as an unpleasant effect of some common brands of mouthrinses.

In the present study, the aim is to assess the staining potentials of three commercially available mouth rinses on a provisional acrylic material by application of a digital system for colour analysis.

Materials and method

In this study, the staining potentials of Colgate plax, Chlorhexidine gluconate rinse, and Listerine rinse was investigated. A total of 30 test material cylinders 13 mm in diameter and 1 mm thickness were produced with the help of 13X1mm split steel molds, and 10 specimens were used for each of the test solutions. In each session, all materials were placed on a black cardboard surface in order to acquire digital images (Fig 1). A digital camera which was fixed on a tripod, with 40 cm. object–camera distance was oriented perpendicular to the test samples to acquire the digital image. The image was taken at 11:00 AM, under daylight on a clear day, was saved in TIFF format, and was later resolved on a 24-bit resolution screen for further analysis that was provided by a commercial graphic software (Adobe Photoshop 6.0).

It is possible to quantify colour by using instrumental measurements expressed in the coordinates of a colour order system. CIELAB units, which – when analysed mathematically- compares the colour parameters of different objects, have been used for colour quantification. In CIELAB system, the colour space consists of three coordinates L*, a*, and b*. The L* refers to the lightness coordinate, and its value ranges from 0 for perfect black to 100 for perfect white. The a* and b* are the chromaticity coordinates in the red-green axis and yellow-blue axis, respectively. Positive a* values reflect the red colour range and negative values indicate green colour range. Similarly, positive b* values indicate yellow colour range while negative values indicate the blue colour range. The differences in the lightness and chromaticity coordinates (ΔL*, Δa*, Δb*) as a result of UV light exposure are determined first, and the total colour change (ΔE*ab) can be calculated using the following relationship.

$$\Delta E^*ab = (\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2})1/2$$

During the analyses, fixed circular areas which were 74 pixels in diameter were selected in the middle third portion of each sample. The L*, a*, b* values of these areas were measured three times by application of the histogram function of the software, and the mean values were recorded. (FIG 2)

Each of the acrylic samples was immersed separately in vials, each containing 20 mL of the test or control solutions for 24 h, which was the equivalent time to 1 year of 2 min daily mouthrinse use. All vials were kept at 37 C throughout the study and were shaken occasionally to provide homogenity. At the end of the test period, the samples were removed and were dried with tissue paper. The post-treatment digital images of the test materials were obtained and were analysed to determine the L*, a*, b* values of each specimen as mentioned previously.

The total colour change (ΔE*) of each single test specimen was then calculated using the previously mentioned relationship : $\Delta E^*ab = (\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2})1/2$

Statistical analyses of the mean ΔE values among the groups were achieved by analysis of variance (ANOVA). The level of significance was set as 0.05 in all tests.

RESULTS

ΔE values obtained were 2.1 for chlorhexidine gluconate,

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1.88 for benzydamine hydrochloride(Listerine) and 2.2 for Colgate plax. Statistical analyses of the mean Δ E values among the groups will be achieved by analysis of variance (ANOVA). The level of significance was set as 0.05 in all tests. The summary statistics of the comparison of the Δ E values of the different groups is presented in Table 1.

Results of ANOVA test shows a statistically significant difference between the groups (P < 0.0001). The pvalue corresponing to the Fstatistic of oneway ANOVA is lower than 0.05, suggesting statistically significant difference between the groups(Table 2). The results though show a statistically significant difference between the different mouthwashes however observation of the mean values shows that the samples immersed in Colgate plax show greatest color change among the three mouthwashes.

DISCUSSION

Provisional restorations are an important and challenging part of implant dentistry Provisional restorations need to maintain an acceptable function and esthetic appearance until a permanent restoration can be placed[4]. They serve as placeholders to prevent migration of neighboring teeth and provides a template for soft-tissue contouring. The prognosis of a fixed prosthodontic restoration depends on the quality of provisional restoration. Color stability of provisional materials is a concern, particularly when the provisional restoration is in the esthetic zone and must be worn for extended periods of time as in the case of immediate loading and hybrid prosthesis. Ideally, provisional materials should not change in color or appearance subsequent to fabrication. Materials available for fabricating provisional restorations include auto polymerizing polymethyl methacrylate, polyethylene methacrylate, polyvinyl methacrylate, urethane methacrylate, bis-acryl, and microfilled resin[5,6].

The staining potentials of various mouthrinses have already been established. Up to date, the staining properties of mouthrinses have been established by using spectrophotometric analyses. Digital shade analysis systems have been administered as an alternative method for colour analysis[7].

Provisional restorative materials were immersed in different mouthrinses for 24 h in this study. This period (24 h) is set as the proper length of time to determine the effect of 1-year use of two times daily mouthrinse. Each sample was then evaluated for color change. Johnston and Kao evaluated the assessment of appearance match by visual observation and clinical colorimetry and stated that the average color difference between compared teeth rated as a 'match' in the oral environment was 3.7 (ΔE*)[8,9]. Seghi et al. also presumed that an acceptable color difference can often be two or three times greater than the detectable limits. The upper limit of acceptability in subjective visual evaluations has been confirmed by Ruyter et al. who suggested that a perceptible discoloration must be referred to as acceptable up to the value ΔE* = 3.3. However, presuming that an acceptable color difference can be two or three times of the detectable limits, color differences less than 3.7 CIELAB units are generally stated as clinically acceptable[10]. Considering that provisional restorations shall be aesthetically acceptable during in service period, a Δ E value of 3.7 is recorded as the cut-off point. All test solutions produced clinically acceptable value on the provisional material, with Δ E values under 3.7.

Most alcohol-containing mouthrinses have shown color changes in the provisional resin (avoid spacing between words). Alcohol has been attributed to the softening of the polymer matrix, which results in its partial removal from the surface. The partial removal of the resin matrix may result in the degradation of the filler-matrix interface, which can contribute to the decrease in hardness values, and this may be effect the increase color changes. As a result, it may be suggested that mouthrinses with alcohol content may compromise the color stability of the provisional restorations and the clinician should warn the patients regarding the possible effects of alcohol-containing mouthrinses on their provisional prostheses especially if their prostheses are expected to function over an extended period of time[11]. The fact that benzydamine hydrochloride contains more alcohol content should relate to more color change in the samples immersed in this mouthrinse and less color change in the samples immersed in colgate plax. But this was not observed in the study as tea tree oil specimens exhibited more color change as compared to benzydamine hydrochloride specimens. Thus, the color change may be attributed to the type of colorant used in the two mouthrinses.

Hence, benzydamine hydrochloride may be a suitable mouthwash to be used in combination with both acrylic resin and bis-acryl composite provisional resins. In clinical conditions, effective patterns of mouthrinses on provisional materials may be different depending on many factors that could not be replicated in vitro. Studies are therefore necessary to determine the effect of mouthwash on other properties as well as on other types of provisional acrylic resin and also to evaluate the effects of mouthrinses in vivo.

CONCLUSION

Color change of a commercially available provisional restorative material was evaluated after 24 h immersion in three different mouthrinses. ΔE values obtained were 2.1 for chlorhexidine gluconate, 1.88 for benzydamine hydrochloride and 2.2 for Colgate Plax. Within the limitations of the current study, it is concluded that Listerine mouthwash with benzydamine hydrochloride as content exerts the least perceptible change in color of provisional resin material.

Tables and Figures

Treatment →	A	B	C	Pooled Total
observations N	10	10	10	30
sum $\sum x_i$	24.7100	19.2700	21.0900	65.0700
mean $\bar{x}$	2.4710	1.9270	2.1090	2.1690
sum of squares $\sum x_i^2$	63.7341	37.8933	46.1213	147.7487
sample variance s^2	0.2973	0.0844	0.1825	0.2280
sample std. dev. s	0.5453	0.2906	0.4272	0.4775
std. dev. of mean $SE_{\bar{x}}$	0.1724	0.0919	0.1351	0.0872

Table 1

Colgate Plax -A

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Listerine
Chlorexidine Gluconate - C

source	sum of squares SS	degrees of freedom ν	mean square MS	F statistic	p-value
treatment	1.5337	2	0.7668	4.0772	0.0284
error	5.0782	27	0.1881		
total	6.6119	29			

Table 2

The pvalue corresponing to the Fstatistic of oneway ANOVA is lower than 0.05, suggesting statistically significant difference between the groups.

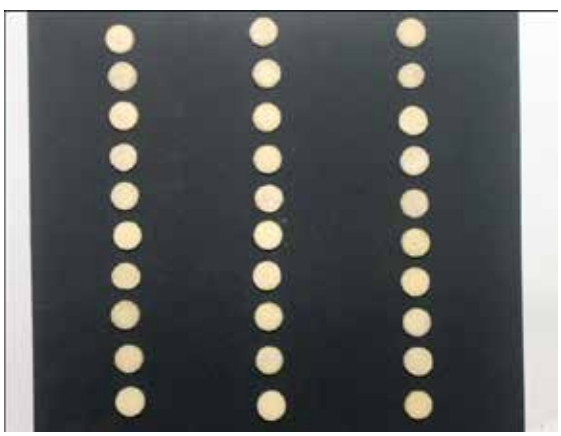

Fig 1: Photograph of test samples

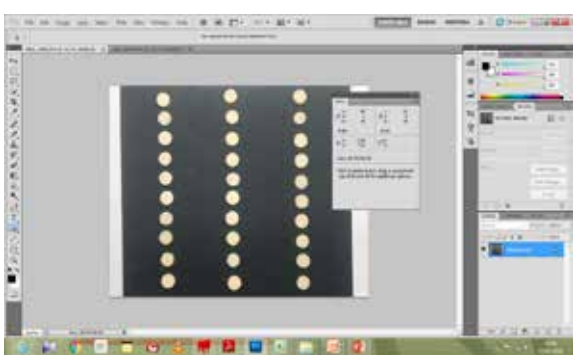

Fig 2 Software analysis of samples to evaluate CIELAB values

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