ORIGINAL ARTICLE

A comparison of staining resistant of two composite resins

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Abstract Composite resins Amaris is claimed to have hydrophobic effect which minimizes the staining intake. This study is to investigate the colour stability of Amaris compared to Filtek Z250 in coffee solution. Sixty discs of composite resins Filtek Z250 (3M ESPE) and Amaris (Voco) with diameter of 5mm and depth of 2mm were fabricated by packing in a drinking straw and sectioned with hard tissue cutter (Exakt, Japan). The surfaces of the specimens were polished with Sof-Lex disc before each group of the samples is immersed in coffee solution. They were kept in the solution for 4 days at 37^0C and assessed at the period of 2 hours, 1 day, 2 days, 3 days, and 4 days. The staining was assessed visually and recorded using Lobene (1968) Stain Index and score was given accordingly. The colour changes of both groups were not statistically significant ($p < 0.05$) for period of 2 hours, 1day, 2 days, 3 days and 4 days All groups showed the score values increased gradually with time. Both composite resins have similar colour stability in coffee solutions.

Introduction

Concerns about aesthetic lead the people to choose tooth-coloured dental restoration especially the one that can match similarly the colour of the tooth. Composite resins (CR) are one of the tooth-coloured dental materials in dentistry that was widely used because of their excellent aesthetic properties, which can match the colour of natural tooth. The success of this restoration depends largely on their colour stability and their finishing surface (Abu-Bakr *et al.,* 2000). However, a major disadvantage is their discolouration after prolonged exposure to the oral environment. The colour changes associated with composite resins can be extrinsic, intrinsic or idiopathic in origin.

Previous studies have reported that extrinsic factors such as adsorption or absorption of staining agents such as red wine, coffee, tea, and cola may cause discolouration (Ertaş *et al.*, 2006; Garcia *et al.*, 2008). Oral habits such as tobacco use and certain dietary patterns (for example, caffeine intake) may exacerbate the external discolouration of resin-based composites (Patel *et al.*, 2004). One of the properties that contribute to a good aesthetic effect of CR is hydrophobic. Hydrophobic

molecules tend to be non-polar and thus prefer other neutral molecules and nonpolar solvents (Goss and Schwarzenbach, 2003). The presence of this property in composite resins is in form of filler which is a mixture of hydrophobic silica particles about 0.01 to 0.04 microns in diameter and glass particles about 2 to 30 microns in diameter. With these properties, less absorption of staining solutions into the composite resins will be achieved. However, not many studies had been done to examine the effectiveness of this property in composite resins against colour stability.

The aim of this study was to investigate the colour stability of Amaris, a new nanohybrid composite resin which has been claimed to have hydrophobic effect and more colour stable compared to Filtek Z250, an established microhybrid type which was widely used at HUSM dental clinics by using coffee solution. The results were hoped to give the operators an idea and widen the option in selecting types of composite resin for aesthetic and colour stability.

Materials and methods

This is an *in vitro* study that has been carried out in Multi Disciplinary Laboratory, School of Dental Sciences, Universiti Sains Malaysia. The restorative materials tested in this study were Filtek Z250 (3M ESPE) shade A2 and Amaris (Voco) comparable shade which is O2. Sixty

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samples were prepared with 30 samples for each group.

The materials were packed in a drinking straws (diameter = 5 mm) before being light-cured with QTH 75TM (Dentsply, UK) and sectioned with hard tissue cutter (Exakt, Japan) into thickness of 2 mm to fabricate a total of 60 discs (Figure 1). The samples are polished with Sof-Lex Discs from medium coarse to superfine grit (from brown to yellow colour) by the same operator to reduce variability. To avoid major discrepancies of samples preparation, each disc was assessed under stereomicroscope (ZEISS, Germany) for any roughness.

Figure 1: Composite resins after being packed in drinking straws and sectioned into discs.

All specimens were placed in deionized distilled water (DDW) at 37°C for 24 hours as baseline measurement (Sarac *et al.,* 2006). The specimens later randomly divided into two groups: a) Group 1- Amaris discs, b) Group 2- Filtek Z250 discs. Each subgroup of the samples (n=30) are immersed into coffee solutions. Each solution is prepared by using 15gm of coffee powder, 10gm sugar and 75ml of hot water. The discs were immersed after the solution was cold. They were kept in each solution for period of 2 hours, 1 day, 2 days, 3 days, and 4 days days to simulate the period of continuous exposure of 120 minutes to 5760 minutes which in real life could be weeks to months depending on intake, and stored in incubator at 37°C.

After each period, discs from each group were removed and irrigate under running water for 20 seconds and blotted dry with tissue paper before colour measurement. Stains were assessed visually and recorded using Lobene (1968) Stain Index which based on four scores:

   0 = no stain
   1 = light stain (yellow to light brown or gray)
   2 = moderate stain (medium brown)
   3 = heavy stain (dark brown to black)

For this assessment, each sample was measured by two investigators (the researcher and a lab assistant) and the inter examiner reliability was 82%. This was done after 2 hours (P1), 1 day (P2), 2 days (P3), 3 days (P4) and 4 days (P5).

Numerical Data Analysis using Independent t-Test (SPSS version 11.0.0) was done to compare differences among mean score values for each two different composite resins and staining solutions. P value <0.05 was considered statistically significant. Ethical approval was obtained from The Research and Ethic Committee, Universiti Sains Malaysia (Approval date: 02/06/2008, Ref: USMKK/PPP/ JEPeM [202.3(11)]).

Results

After immersion into coffee solution, visual comparison (Figure 2) and statistical results (Table 1) showed that there were no significant different between two types of CR during 2 hours, 1 day, 2 days, and 4 days ($p<0.05$). Generally, both groups showed the score values increased gradually with time. The result of the Independent *t*-Test used to compare the colour changes of composite resins showed that both groups were not statistically significant ($p<0.05$) for period of 2 hours, 1 day, 2 days, and 4 days. Table 1 lists the mean score values with standard deviation and p value within the two composite resins according to the period of time. As shown in Figure 3, Amaris has better resistance to staining effects by coffee, albeit not statistically significant.


Figure 2: Comparison of the effect of staining of Filtek Z250 and Amaris at baseline (Left) and after 4 days (Right) in coffee solution.

Table 1: Comparing the colour changes between composite resins in coffee solution

Time	Composite Resins	Mean(SD)	*p*-value[a]
2 hours	Amaris	0.00(0.00)	
	Filtek Z50	0.00(0.00)	
1 day	Amaris	1.00(0.00)	
	Filtek Z250	1.00(0.00)	
2 days	Amaris	1.07(0.25)	
	Filtek Z250	1.20(0.41)	0.134
3 days	Amaris	1.73(0.45)	
	Filtek Z250	2.00(0.59)	0.053
4 days	Amaris	2.53(0.51)	
	Filtek Z250	2.73(0.45)	0.112

*$p < 0.05$
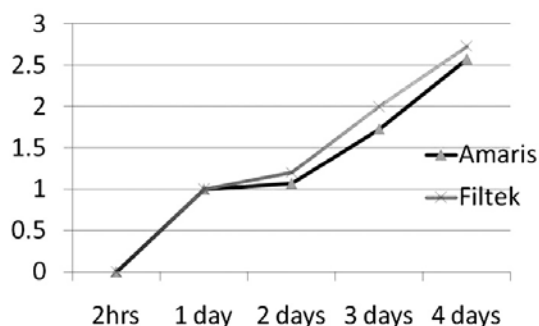
Figure 3: Graph of colour changes for Filtek Z250 and Amaris in coffee solution.

Discussion

Red wine, coffee, tea, and cola have been proven to play a significant role in causing discolouration of composite resins through the act of adsorption or absorption (Ertaş *et al.*, 2006). Staining solutions and immersion time were significant factors that affected colour stability of the composite resins after polishing. Staining also depends on the type of solutions and the composition of each solution which are different.

In this study, Amaris (Voco) which is a nanohybrid type of composite resin for all classes of restorations was chosen because the manufacturer claimed it has hydrophobic effect which may reduce the staining intake. Because Amaris is still new in market, not many studies have been found to investigate its colour stability. The control composite resin was Filtek Z250 (3M ESPE), a micro hybrid type which was chosen because of it is aesthetics and widely use among dental students and dentists in dental clinics, HUSM. The positive result of the study will help the operator and administrator to consider choosing Amaris as an option for aesthetic composite resin restoration material.

A high-gloss surface generally is considered less susceptible to staining (Shintani *et al.,* 1985). Sof-Lex discs have the reputation of providing the highest polishing effect compared to other type of polishing techniques (Tate and Powers 1996). Nowadays, there are many other polishing techniques and instruments being produced. Rough surfaces mechanically retain surface stains more than smooth surfaces (Guler *et al.,* 2005). Therefore, Sof-Lex discs were used in this study to provide better result and standardizing the finishing of all samples to avoid default.

Discolouration of composite resins can be evaluated with various instruments. In this study, Lobene (1968) Stain Index was used for assessment of staining effect. It is a subjective screening which needs at least 2 examiners to do the scoring with percentage agreement for intra examiner reliability was 80%. The score was given accordingly from the lightest to the darkest based on four scores from 1 to 4.

The discolouration of both composite resins increases with time although the difference is not statistically significant. From the plotted graph (Figure 3), Filtek Z250 has less colour stability compared to Amaris but this is not significant statistically. In previous study, Filtek Z250 was observed to manifest least colour change than nanohybrids and Quadrant LC (Ertaş *et al.*, 2006). Staining is highly influenced by each composite monomer and filler composition (Reis *et al.,* 2003). In general, the hydrophobic materials showed greater colour stability and stain resistance than the hydrophilic materials (Iazetti *et al.*, 2000). The difference of colour stability in this study might be due to the hydrophobic properties and the smaller nanoparticles in Amaris which resulted in less staining absorption into this composite resin. In contrast, a study done by Satou *et al.* (1989) found that materials with higher water sorption and higher hydrophobic property showed higher staining.

Coffee solutions showed observable colour changes after 2 hours until 4 days of CR immersion. Coffee may stain by adsorption and by absorption of its colourants into the organic phase of resin composites (van Groeningen *et al.,* 1986). The presence of sugar in coffee increased the colour difference compared to coffee without sugar for light-polymerized composite provisional material and microhybrid composites (Guler *et al.*, 2005). Therefore, sugar was added in each solution for practical reason as people consume these drinks with sugar.

The time periods chosen in this study is considered as the cumulative time for few months of years of consuming the drinks within short period of time. This is suitable for the CR which might get stained after few years placed in the mouth.

The only different simulation is this drink usually being taken hot by the people, but in this study the solutions were left until it become cold to avoid unexpected effect on the samples. The quantitative evaluation of colour difference with Lobene (1968) Stain Index confers some limitations such as insensitive due to small range of scoring and observer reliability. In order to achieve better accuracy and reliable result, it is recommended to use Spectrophotometers and Calorimeters to measure colour change in dental material. Also, the staining changes might be different *in vivo* because of the period of absorption is less and the food is always new. In this study, the solutions were changed every 24 hours to keep them fresh.

From this study, it could be concluded that Filtek Z250 and Amaris have similar colour stability in coffee solutions even Amaris showed better stability graphically. Polishing technique using Sof-lex disc from coarse grit to superfine grit was used for better polishing results and maintains the colour stability of the composite resins. The staining from the coffee solution affect the colour changes of the composite

resins either they have the hydrophobic effect or not. Amaris could be a material of choice to minimize the staining effect and added as an option material in aesthetic dentistry.

Acknowledgement

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