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An *in vitro* evaluation of microleakage of a bulk fill composite resin in class V cavities cured by two pulse modes

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Abstract
Aim: To evaluate the effect of two curing modes on the microleakage of a bulk-fill flowable composite resin, Surefil SDR Flow.
Methodology: Extracted maxillary premolars were used for this study. Standardized class V cavities were prepared on buccal and palatal surfaces of each tooth and restored with the flowable composite, Surefil SDR Flow. Based on the curing protocol the teeth were divided into two groups. Restoration on the buccal surface of the teeth were subjected to low power polymerization, were grouped as the group I and the restorations on the palatal surfaces were subjected to soft start polymerization and were grouped as group II. All the samples were immersed in 0.5% basic fuchsin solution and was subjected to microleakage assessment. The samples were then sectioned, evaluated under a stereomicroscope and scored for microleakage. Analysis of variance (ANOVA) has been used to find the significance of study parameters between the groups.
Results: Light curing with a Bluephase curing unit in the soft start mode showed significantly less microleakage ($p<.019$) as compared to the low power mode polymerization.
Conclusion: Within the limitations of this study it was concluded that the soft start polymerization mode offered a distinctive advantage over the low power curing protocol using Bluephase curing unit

Keywords: Microleakage, polymerization shrinkage, soft start polymerization, low power polymerization, Blue phase curing unit

1. Introduction
The direct cosmetic restoration has become a vital and important part of the dental profession and one of the fastest growing areas of dentistry. Developments in filler technology and initiator systems have considerably improved physical properties of composite systems and expanded their clinical applications [2].

One major drawback of resin composite restorative materials is the polymerization shrinkage, caused by the dimensional rearrangement of monomers into polymer chains during polymerization reaction [3]. Numerous approaches have been proposed to minimize the shrinkage stress by manipulation of curing protocols and placement techniques. Some of the techniques to decrease polymerization shrinkage are: 1. Altered light curing cycles, 2.Three sited light curing techniques, 3. Incremental curing of composites-layering techniques, 4. Intermediate elastic bonding concept, 5. Stress breaking liners under composites [7]. Altering the light curing cycle by initial polymerization with low intensity light followed by final cure with high intensity light may result in improved marginal integrity without losing the material properties. The aim of the technique using low light curing intensity is to prolong the time span before gel point is reached and to increase the material flow capability. Afterwards, high light intensity is necessary to achieve complete polymerization and optimal mechanical properties [8].

Flowable restorative resins with a low viscosity are recommended as the material of choice for restoring Class V cavities. However, due to its lower filler content, they demonstrate higher polymerization shrinkage and have inferior mechanical properties [9]. The manufacturers claim that SureFil® SDR® *flow* is the very first self-leveling, bulk fill flowable composite and has excellent cavity adaptation to completely fill all the crevices.

Bluephase 20i the battery-Operated Polywave LED with halogen-like broadband spectrum from 385 to 515nm.

To the best of our knowledge, there is no reported study assessing the degree of microleakage of flowable resin, Surefil SDR on both enamel and dentin. The aim of the present study was to evaluate the effect of two curing modes on the microleakage of a bulk fill composite resin, Surefil SDR Flow.

2. Materials and Methods

Figure 1

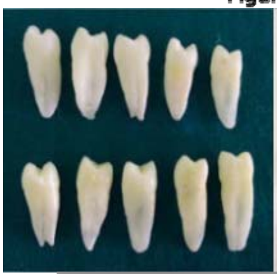


Figure 2

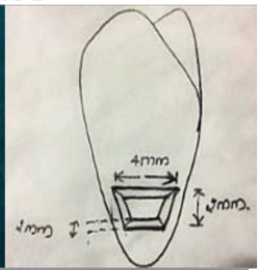


Figure 3

Figure 4

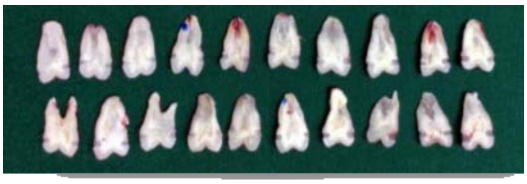


Figure 5

Fig 1: Materials and equipments
Fig 2: The tooth samples
Fig 3: Class V cavities dimension
Fig 4: The samples after immersion in 0.5% basic fuchsin dye
Fig 5: The specimens after buccolingual sectioning

2.1 Selection of teeth

Ten premolars, free of caries, cervical wear, cracks and of comparable dimension, extracted for orthodontic reasons, from subjects between the age group 15-24years were selected for the study.

Class V cavities were prepared on both the buccal and lingual surfaces, located 1mm coronal to the CEJ with all the preparation margins in enamel.

Standardised box shaped class V cavities with a uniform mesiodistal extension of 4mm, occluso cervical length of 2mm and depth of 2mm were prepared with a tungsten carbide bur (# 245 Mani Inc, Japan) in a high speed handpiece with air/ water spray. All the dimensions were evaluated using a digital sliding caliper and a periodontal probe. The cavosurface walls were finished to butt joint.

2.2 Restorative procedure

After cavity preparation, the cavity walls were etched with 37% phosphoric acid (3M-ESPE Scotchbond Multi-Purpose Etchant) for 15 seconds and rinsed with air/water spray for 15 seconds. This was followed by application and light curing of the bonding agent (Adper™ Single Bond Total-Etch Adhesive). The samples were then divided into groups based upon the curing method: Group 1: the buccal surface which received low power curing (650 mW/cm^2) and

Group 2: the palatal surface which received the soft start mode of curing (650mW/cm^2-1200mW/cm^2) using the Bluephase curing unit. Each preparation

was then restored with the flowable composite (SureFil SDR Flow) and cured according to the aforementioned protocol. All restorations were finished (FG 7612, Gold finishing bur, Prima Dental Group, Gloucester, UK) and subsequently polished (Sof-lex, 3M ESPE, St Paul, MN)

2.3 Microleakage testing

The root apices were sealed with composite resin, and the teeth were coated with two layers of nail varnish except for a window including the restoration and 1mm area around it. Samples were then immersed in a solution of 0.5% basic fuchsin dye and stored in an incubator for 24 hours.

Then each tooth was sectioned longitudinally in a bucco-lingual plane through the center of the restoration with a water cooled, slow speed diamond disk to obtain two sections of each tooth, having buccal and lingual restorations in each section.

The marginal sealing ability, as indicated by the depth of dye penetration around the enamel or dentin margins, was evaluated under a stereomicroscope (SZTP, Olympus, Japan) at 10x22 magnification and were photographed.

The dye penetration along the tooth restoration interface were scored by two investigators using a four point scale as[17]

0: no leakage;

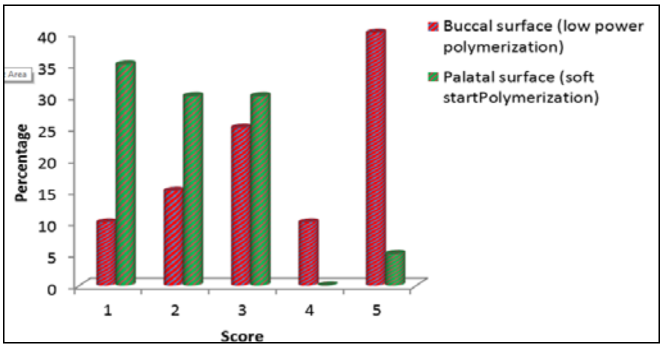
1. leakage extending to one-third of the depth of the restoration;
2. leakage extending to two-thirds of the depth of the restoration;
3. leakage extending to the floor of the restoration;
4. leakage extending beyond the floor of the restoration.

2.4 Statistical Analysis

Analysis of variance (ANOVA) has been used to find the significance of study parameters between the groups. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

3. Results

Fischer Exact test showed a statistically significant difference between the groups. Light curing with the Bluephase unit in the soft start mode showed the least leakage compared to the low power mode of curing. The low power mode of curing showed significant leakage when compared to the soft start mode of curing. (Graph 1)



Graph 1: Graphical representation of the dye leakage scores

4. Discussion

Polymerization stresses developed at the adhesive interface play an important role on the marginal adaptation of resin composite restorations, and it is still a major concern in restorative dentistry. One way to minimize polymerization shrinkage is to allow the flow of resin composite during setting by means of controlled polymerization. The rate at which polymerization occurs is the main factor related to the tensile forces along the tooth-restoration interface. This can be done by pre-polymerization at low power density followed by final cure at high power density [12]. It has been claimed that slower polymerization causes an improved flow of molecules in the material, decreasing the polymerization shrinkage stress in a restoration. It has been shown that soft start polymerization may result in lesser marginal gap, increased marginal integrity and reduced shrinkage [12, 18-21]

Microleakage evaluation is the most common method of assessing the sealing efficiency of a restorative system. The current *in vitro* study was carried out to further investigate the role of curing mode on the polymerization shrinkage of a flowable bulk fill composite resin. Cavity configuration factor (C factor) plays an important role in the polymerization shrinkage of composite resins. The class V cavities prepared in this study, with a C factor of 5, were associated with high internal contraction stresses.

All the cavities were prepared and restored by one operator to standardize the methodology. The composite material and the bonding agent were standardized in the study to truly evaluate the effects of variable intensity cycles on polymerization shrinkage. Fifth generation bonding systems are good alternatives to total etch three step adhesive systems, and superior to single step sixth generation adhesive systems, with respect to microleakage [13]. Higher bond strength values have also been confirmed with the wet bonding technique [14]. Hence, the fifth generation bonding agent, Adper Single Bond 2 based on total etch, wet bonding concept was employed in the study. Using one adhesive system and one resin composite restorative material reduced the confounding variables in the study.

Recently extracted, intact premolars, for orthodontic reasons were used to avoid variability. The above factors, viz. the combination of resin composite associated with high polymerization shrinkage and a cavity with a high C factor, posed a great challenge to the tooth restoration interface. As all of the factors were standardized, any reduction in the polymerization shrinkage could be attributed to the light curing regimen.

Friedl. K.H *et al.* investigated the adaptation of class V restorations under SEM and infrared and concluded that the correct diagnosis of gap formations at the resin-tooth interface may get obscured due to marginal swelling of the material, resulting in incorrect observations under SEM and commented that dye penetration is an important tool in assessing the marginal adaptation [15]. Various tracer dyes are available for microleakage studies and there appears to be no significant difference in tracer penetration among fuchsin, silver nitrate and methylene blue. In the current study of 0.5% basic fuchsin dye has been used to evaluate the microleakage.

Light intensity and polymerization time can modify polymer structure formation (Asmussen *et al.*, 2003). Altering the curing mode will provide an initial low rate of polymerization thereby extending the time available for stress relaxation before reaching the gel point. A low intensity light prolongs the flow time of the composite, decreasing the stress during polymerization, however a high light intensity is needed for complete polymerization and optimal mechanical properties.

In the current study which aims at comparing the different curing modes, the soft start technique presented lower leakage means compared to the low power polymerization. This can be explained by considering the chemistry of polymerization. The polymerization shrinkage has three didactical phases: The pre gel phase, the gel point and the post gel phase [16]. During the initial phase of polymerization, the early polymer is still in a fluid and flexible stage. As curing begins, the polymer flows from unbound surfaces to accommodate for shrinkage. The stress developed from shrinkage can thus be relieved by composite flow, and no stresses are developed at the tooth-restoration interface.

The gel point is the phase where resin changes from a viscous paste to an elastic solid. After gelation, flow ceases and cannot compensate for the shrinkage stresss. In this stage, stress is transferred to the tooth. Thus, post- gel polymerization results in significant stresses in the surrounding tooth structure and composite-tooth bond [17].

During the soft start polymerization, the intensity of the initial irradiation is not to promote a thorough cure of the composite. However, the intensity must have sufficient penetration capacity so that the initiators of deeper material are activated, leading to a slow but homogeneous cure [17, 18]. This allows most of the polymerization contraction to occur during the flowable stage of material, permitting the resin to flow within itself, and preventing it from pulling away from the cavity walls [20].

The above was clearly reflected in the study where the soft start mode showed distinctive less microleakage.

5. Conclusion

Within the limitations of this study it was concluded that

- The soft start polymerization mode offered a distinctive advantage over the standard curing protocol using Bluephase curing unit for the bulk fill composite resin, Surefil SDR Flow.
- The low intensity mode of curing resulted in significantly more leakage compared to the soft start method.

6. References

1. Flávio Henrique Baggio, Thalita Regina Vieira. Effect of light curing modes and ethanol immersion media on the susceptibility of a microhybrid composite resin to staining. J Appl Oral Sci. 2007; 15(2):105-9
2. Timur V Melkumyan, Kamola D. Makhamadaminova. Clinical and Experimental Evaluation of the Effectiveness of «Soft-Start» Polymerization in Dental Composite Restoration
3. Yap AU, Wang HB, Siow KS, Gan LM. Polymerization shrinkage of visible light-cured composites. Oper Dent. 2000; 25:98-103.

4. Briso AL, Mestrener SR, Delicio G, Sundfeld RH, Bedran-Russo AK, de Alexandre RS *et al*. Clinical assessment of postoperative sensitivity in posterior composite restorations. Oper Dent. 2007; 32:421-426.
5. Alomari QD, Omar R, Akpata SE. Effect of LED curing modes on postoperative sensitivity after class II resin composite restorations. J Adhes Dent. 2007; 9:477
6. Sakaguchi RL, Wiltbank BD, Murchison CF. Cure induced stresses and damage in particulate reinforced polymer matrix composites: a review of the scientific literature. Dent Mater. 2005; 21:43-46.
7. Karthick K, Shivakumar Kailasam. Polymerization shrinkage of composites- a review. JIADS, 2011; 2(2).
8. Waldman GL, Vaidyanathan TK, Vaidyanathan J. Microleakage and esin to dentin interface morphology of pre-etching versus self-etching adhesive systems. Oper Dent J. 2008; 2:120-25.
9. Ruya Yazici A, Cigdem Celik a. Effects of Different Light Curing Units/Modes on the Microleakage of Flowable Composite Resins. Eur J Dent. 2008; 2:240-246.
10. Friedl K H, Schmalz G, Hiller K A. Marginal adaptation of class V restorations with and without soft start polymerization. Oper Dent. 2000; 25:26-32.
11. Barros GK, Aguiar FH, Santos AJ. Effect on different intensity light curing modes of microleakage of two resin composite restorations. Oper Dent 2003; 28:642-646.
12. Mehl A, Hickel R, Kunzelmann KH. Physical properties and gap formation of light-cured composites with and without soft start polymerization. J Dent. 1997; 25:321-330.
13. Santos AJ, Sarmento CF, Abuabara A. Step- cure polymerization: Effect of initial light intensity on resin/dentin bond strength in class I cavities. Oper Dent 2006; 31:324-31.
14. Yoshikawa T, Burrow MF, Tagami J. Alight curing methid for improving marginal sealing and cavity wall adaptation of resin composite restorations. Dent Mat 2001; 17:359-66
15. Ciuchi B, Bouillaguet S, Delaloye M. Volume of the internal gap formed under composite restorations *in vitro*. J Dent. 1997; 25:305-12
16. Nazmiye Donmez, Seyda Herguner Siso. Microleakage of Composite Resin Restorations in Class V Cavities Etched by Er:YAG Laser with Different Pulse Modes. Journal of the Laser and Health Academy. 2013; 1:6-10.
17. Qasem Diefallah, Kefah Barrieshi. Effect of C-factor and LED curing mode on microleakage of class V resin composite restorations. Eur J Dent. 2011; 5(4):400-408.
18. Obici AC, Sinhoreti MA, de Goes MF, Consani S, Sobrinho LC. Effect of photo-activation method on polymerization shrinkage of restorative composites. Oper Dent 2002; 27:192-198.
19. Sakaguchi RL, Berge HX. Reduced light energy density decreases post-gel contraction while maintaining degree of conversion in composites. J Dent 1998; 26:695-700.
20. Oberholzer TG, Du Preez IC, Kidd M. Effect of LED curing on the microleakage, shear bond strength and the surface hardness of a resin based composite restoration. Biomater 2005; 26:3981-3986.
21. Santos AJ, Lisso MT, Aguair FH. Effect of stepped exposure of quantitative *in vitro* marginal microleakage. J Esthet Restor Dent. 2005; 17:236-242.