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Original Research

Effect Of Soft Start and Pulse Curing Modes of light emitting diodes on Postoperative Sensitivity after restoration of Cervical Abrasion with Composites - A Randomized Control Clinical Trial

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Abstract

Introduction: Postoperative sensitivity is merely a clinical manifestation of polymerization shrinkage that occurs within the composite -tooth interface. The slower rate of polymerization using slow curing models like soft start and pulse mode leads to improved ingress of the molecules in the restorative material, thus exponentially decreasing the polymerization shrinkage stress in a restoration.

Aim: To compare the effect of different Light emitting mode (LED) of curing like Soft start and pulse modes on the postoperative sensitivity after restoration of cervical abrasion with composite.

Materials and Method: All the patients were selected according to the inclusion criteria and divided into 2 groups. The sample size calculation suggested 20 cases for each individual group. The lesion was prepared by acid etching and applying bonding agent and curing it. Composite restoration was placed using incremental technique and each increment was cured accordingly, group A - soft start mode and group B - pulse mode. The patients were recalled after 1 week and 1 month to assess the postoperative sensitivity.

Result: There was no difference which was statistically significant between soft start and pulse led curing mode group as far as the postoperative sensitivity was assessed.

Conclusion: Restorations which were cured with soft start curing method did not exhibit significant difference in incidence of postoperative sensitivity when compared to pulse curing technique.

Keywords: *Cervical Abrasion; Postoperative Sensitivity; Pulse LED Curing Mode; Polymerization Shrinkage; Soft Start LED Curing Mode.*

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INTRODUCTION

Composite resins are the most widely used adhesive tooth colored restorative material used in dentistry for its aesthetic appearance, and good clinical survivability. There are inherent drawbacks like marginal discoloration, micro leakage, postoperative sensitivity and secondary caries. In order to minimize these drawbacks high clinical expertise and thorough knowledge of the material is required.

Postoperative sensitivity is one of the major clinical complain from the patient after composite restoration. It occurs in about 30% of all composite restorations [1,2]. Postoperative sensitivity is purported to be merely a clinical manifestation of polymerization shrinkage that occurs within the composite -tooth interface [3]. The other consequences of polymerization shrinkage are deboning of the restoration, enamel crack propagation and microleakage.etc,

During polymerization of composite resins, the monomers which are free flowing molecules get converted to cross-linked polymers, which are rigid assembly, this results in volumetric contraction that is known as polymerization shrinkage. The amount of shrinkage accounts for 1.5 to 4 % by volume within 24hrs after curing [3]. This polymerization shrinkage causes stresses at the margin of the restoration, when these stresses exceed the bond strength results in micro gap formation , movement of fluid with this gap causes sensitivity. [4]

Few factors influencing polymerization shrinkage are:
1. Filler content: Higher the filler content smaller the shrinkage as the fillers do not participate in polymerization reaction.
2. Degree of conversion: If the incidence of the degree of conversion is minimal then it follows as corollary the polymerization shrinkage will be minimal.
3. Water sorption: Hygroscopic expansion compensates for the polymerization contraction
4. C Factor: Smaller C factor, lesser shrinkage because lesser surface in contact with the material [5].

Polymerization shrinkage has detrimental effects on both the restoration as well as the tooth. Though it cannot be completely eliminated, it can be reduced either by modifying the composition of the resin or altering the clinical steps or technique. The composition of composite consists of resin matrix, filler and coupling agent. High molecular weight resins like *BisGMA* and *TEGDMA* and higher filler content produces less shrinkage [3]. Implementing clinical techniques like using incremental layering technique and using slow curing modes have reduced the polymerization shrinkage [6].

Incremental layering techniques and modifying the cavity design reduces the *C factor*, overcomes the limited depth cure and residual stress concentration. Using slow curing modes prolongs the pre-gel phase and stage of the resin matrix thus relieving the stresses [7]. According to literature two slow curing modes that are soft start and pulse modes reduce polymerization shrinkage. Thus the aim of this clinical study was to assess the incidence of postoperative sensitivity after composite restoration of cervical abrasion lesion was polymerized by soft start and pulse LED curing mode.

MATERIALS AND METHODS

Sample size

The sample size calculation was carried out using the G power sample size calculator and the sample size decided upon was 20 cases per individual group.

Inclusion criteria

1. Age of patients ranged from 30 to 60 years
2. Asymptomatic non carious cervical lesions
3. Lesions with less than 3 mm depth

Exclusion criteria

1. Patients with preoperative sensitivity
2. Patients with gingival recession
3. Patients using any desensitising agent

After getting approval from the University Scientific Review Board, Saveetha Dental College the patients who fulfilled the inclusion criteria were recruited for the study. The patient's informed consent was obtained after explaining the study procedure.

Asymptomatic non carious cervical abrasion lesions which were not more than 3 mm depth were selected. Isolation was done using gingival retraction cords. The lesions were prepared by acid etching for 20 seconds. Bonding agent was applied and cured using constant curing mode for 30 seconds. Composite was placed using incremental layering technique with each increment being not more than 2 mm.

Randomization and allocation concealment was done. All patients were randomly allocated into two groups based on the curing mode. Group A- Soft start mode and Group B – pulse mode.

Patients were recalled after 1 week and 1 month to assess the incidence of postoperative sensitivity if any. Clinically sensitivity was assessed using cold air stimulus test and incidence of pain while probing.
The response was recorded using Numeric Rating scale [NRS]

1: No sensitivity
2-3: Mild sensitivity
4-6: Moderate sensitivity
7-10: Severe sensitivity

Statistical analysis

Paired t test was applied to see the comparison between same groups at different time intervals and Independent t test was exercised to observe the incidence of postoperative sensitivity amongst the groups 1 and 2 at immediate post operative, 1 week and 1 month intervals. The level of significance was evaluated at 0.05 with 95 % of confidence level.

RESULTS

Table 1: Group I VS II Immediately After Restoration

Groups	Mean	Standard Deviation	P Value
I	0.2000	0.42164	0.556
II	0.1000	0.31623	0.557

Table 2: Groups I VS II After 1 Week

Groups	Mean	Standard Deviation	P Value
I	2.1000	0.99443	0.179
II	2.8000	1.2297	0.179

Independent t test, $p>0.05$, no statistically significant difference between both groups immediately after restoration and after 1 week.

DISCUSSION

Polymerization shrinkage which is inherent to resin composites can induce stresses at the interface. When this stress exceeds the bond strength it causes adhesive failure, microgap and microleakage, which is clinically presented as sensitivity. One way to minimize the incidence of polymerization shrinkage is to facilitate the flow or ingress of composite components during polymerization reaction in a controlled manner by deploying different modalities of polymerization. This can be achieved by pre-polymerization at extremely low intensity or power density of the LED and finally curing with a high-power density [8].

It has been hypothesized that slower polymerization causes an improved flow of molecules in the material, decreasing the polymerization shrinkage stress in a restoration, which is associated with less shrinkage. When deploying the slow curing modalities like soft start and pulsed curing mode, there is sequential incremental polymerization and the conversion rate of transformation of monomer to polymer is reduced so as to increase it remains in the pre-gel phase, thereby it phenomenally reduces the buildup of stress which is inherent resultant of polymerization shrinkage. Evidence based studies have assessed the postoperative sensitivity with different intensities of curing power densities [7-12]. *Chan et al.* has evaluated the soft-start polymerization modality in Class I and II composite restorations and concluded that soft start technique did not exhibit any significant difference in postoperative sensitivity or immensely reduced clinical signs of evident marginal stress [12]. A similar end result was observed in a study conducted by *Senthil Kumar* et al who had assessed microleakage in comparison of polymerization with soft start curing with constant curing mode, it was concluded that there was no significant difference amongst the two [13].

Umer et al [14] conducted a study in which it was observed that there was statistically evident significant difference in documented or observed postoperative sensitivity between soft start polymerization mode and constant LED curing technique. *Alomari et al* [15] concluded that pulsed LED curing mode resulted in decreased incidence of postoperative sensitivity after restoration of class 2 cavities with posterior composite restorations as compared to utilization of fast curing method of polymerization.

There are multiple studies which have compared either soft start mode to constant mode or pulse mode to constant mode, [16-24] but there were very few or negligible studies comparing the effect of soft start mode with pulsed mode of polymerization. The principal rationale of this study is to primarily assess the effectiveness of both the slow curing modes on reducing polymerization shrinkage.

In the present study, non-carious cervical abrasion lesions were included in the sample size primarily because it typically includes margins that are located or are inclusive of both enamel and dentin, therefore they can be assessed at one point in time, the preparation and restoration technique is relatively simple thus obviating the operator variability bias [25, 26].

Split mouth design was adopted for this study because both the groups can be tested on the same individuals, minimising variability bias and thus increasing the power of the study. Patient recruitment also seemed simplified and thus fewer patients were needed to be recruited as compared to the full mouth or whole mouth design and reducing the attrition rate.

The result of current study revealed that there were no statistically significant difference between soft start and pulse led curing modes on incidence of resultant postoperative sensitivity. The possible explanation could be that both pulse and soft start led curing modes emit similar intensities which causes same level of flow of composite and same level of conversion rates, causing similar levels of polymerization shrinkage. However the postoperative sensitivity gradually reduced with time, after 1 month no sensitivity was observed in all patients indicating postoperative sensitivity is a time dependent factor and it gets better with time.

CONCLUSION

Within the limitations of this study, it can be concluded or inferred that restoration which is polymerized with soft start curing technique did not show significant changes in incidence of postoperative sensitivity when correlated to pulsed mode curing method, indicating both slow curing modes provide similar polymerization shrinkage. Further studies are required to substantiate this result.

Conflict of Interests: Nil

Source of funding: Nil

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