Comparative Evaluation On Number Of Increments Of Composites Used For Restoring Mesio-Occlusal Cavities Of Maxillary And Mandibular Molars - A Retrospective Study

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Abstract: Dental composites are generally composed of matrix monomers such as Bis-GMA and UDMA and silica is commonly used as filler. Modifying the composition and size of filler particles, have improved wear resistance of composites. With advances in adhesives and bonding strategies, the interface of tooth-restoration is improvised but still microleakage due to polymerization shrinkage present. A major drawback of composite resin restorations is the incremental layering technique of placing composite restorations greatly reducing the polymerization shrinkage stresses. This study was done to evaluate the number of increments of composite used for restoring mesio-occlusal cavities of maxillary and mandibular molars in the South Indian population. A total of 142 case sheets of patients who underwent class II mesio-occlusal composite restorations in maxillary and mandibular molars were reviewed, analyzed, and comparatively evaluated. The statistical analysis was done using SPSS software (Version 23). In our study, the patients selected were in the age group of 18-65 years. Class 2 composite restorations were mostly done in the age group of 31-40 years followed by 18-30 years respectively. In the selected cases, 74 (52.1%) were male and 68 (47.8%) were female patients. Maxillary right first and second molars were the most commonly treated teeth. Out of 142 teeth, 39 teeth (27.4%) used 1 increment, 81 teeth (57%) used 2 increments and 22 teeth (15.4%) used 3 increments of composite for restoration of class II cavities. Two increments of composites were used in most cases of mesio-occlusal cavities of all posterior teeth. The association between age, gender and number of composite increments did not have any statistically significant difference in maxillary and mandibular class II cavities (p > 0.05). From this study we observed that all the teeth were restored in a conservative approach.

Keywords: Class 2 Cavity, Class 2 Composites, Composite Restorations, Increments, Mesio-Occlusal Cavity.

INTRODUCTION

Dental polymer composites have three major components such as inorganic fillers, an organic polymer matrix, and a coupling agent (Braga, Ballester and Ferracane, 2005). Bis-GMA and UDMA are commonly employed monomers, and silica acts as filler (Atai, Watts and Atai, 2005). Diluant co-monomers such as TEGDMA improve handling properties. Glass/ceramic fillers would improve optical properties and wear resistance (Ferracane, Bertassoni and Pfeifer, 2017). Fillers are added to achieve increased strength, reduced polymerization shrinkage, and heat generation. The monomer influences the viscosity, reactivity, polymerization shrinkage, mechanical properties, water uptake and swelling behaviour of composites (Papadogiannis et al., 2011). (Kumar and Ashok kumar, 2017).

Sufficient polymerization and depth of cure are parameters directly influencing the longevity of the restoration (Miletic, 2017). Insufficient monomer conversion would lead to initiator leaching, less biocompatibility, reduced mechanical and wear properties and colour instability (Schneider and Moraes, 2018). High monomer conversion, on the other hand, leads to high polymerization shrinkage and heat generation (Marovic et al., 2013).

Factors responsible for polymerization shrinkage include restorative procedure, light intensity, cavity design, polymerization characteristics, type of monomer used and filler loading (Santhosh, Bashetty and Nadig, 2008).
Clinical signs associated with polymerization shrinkage stress include inadequate adaptation at tooth/ restoration interface, micro-cracking, post-operative sensitivity, microleakage and secondary caries (Drummond, 2008). Restorative composite formulations such as silorane-based composites minimize polymerization shrinkage by photo cationic ring opening (Yoshida et al., 2008). It is a chemical combination of siloxane and oxirane and less shrinkage than methacrylates (Ilie et al., 2007). Modulating filler content and elastic properties also help in reducing the polymerization shrinkage (Masouras, Silikas and Watts, 2008).

The main elements to reduce shrinkage stress include, use of a small volume of material, a lower cavity configuration factor and minimal contact with opposing cavity walls during polymerization. Incremental laying technique would help by reduced polymerization material volume and each successive layer compensates for previous increment (Rudrapati et al., 2017). Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Deogade, Gupta and Ariga, 2018; Ezhilarasan, 2018; Ezhilarasan, Sokal and Najimi, 2018; Jeevanandan and Govindaraju, 2018; J et al., 2018; Menon et al., 2018; Prabakar et al., 2018; Rajeshkumar et al., 2018, 2019; Vishnu Prasad et al., 2018; Wahab et al., 2018; Dua et al., 2019; Duraisamy et al., 2019; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Gheena and Ezhilarasan, 2019; Malli Sureshbabu et al., 2019; Mehta et al., 2019; Panchal, Jeevanandan and Subramanian, 2019; Rajendran et al., 2019; Ramakrishnan, Dhanalakshmi and Subramanian, 2019; Sharma et al., 2019; Varghese, Ramesh and Veeraiyan, 2019; Gomathi et al., 2020; Samuel, Acharya and Rao, 2020). The objective of this study was to evaluate the number of increments of composites used for restoring mesio-occlusal cavities of maxillary and mandibular in South Indian population.

MATERIALS AND METHODS
This comparative retrospective study was conducted at Saveetha Dental College in 2020. Case sheets were analyzed from June 2019 to April 2020. The patient case sheets were obtained from the database which chronologically has all the records of patient’s details, the treatment done and information regarding their follow up.

A total of 142 case sheets of patients undergoing Class II Mesio-Occlusal (MO) composite restoration in maxillary and mandibular molars were reviewed, evaluated and analysed. The age, gender, tooth number and number of increments of composite used to restore the MO cavities were checked and verified by the photographs to avoid sampling bias. The patients included in the study were in the age group of 18-65 years of age. Incomplete data were verified from concurred patient case sheets/ department. Gross incompletely filled case sheets were excluded as it affects the study. The data were tabulated in excel sheets.

STATISTICAL ANALYSIS
Statistical analysis was done using SPSS software. The independent variables assigned as age, gender, number of increments of composites and dependent variables were right and left, maxillary and mandibular molars treated with class II MO composite restoration. Chi square test was used to check the association between tooth and the number of increments used for restoration. The analysis was performed using SPSS software (SPSS Version 23.0, SPSS, Chicago, IL, USA). The result was considered to be statistically significant when p value was less than 0.05.

RESULTS AND DISCUSSION
A total of 142 case sheets were evaluated. In our study, the patients selected were in the age group of 18-65 years. The number of Class 2 composite restorations were done mostly in the age group of 31-40 years followed by 18-30 years groups respectively (Fig 1).

Two increments were mostly used in restoration of class II composite restoration amongst gender. However, Chi square showed there was no significant association between gender and number of composites turns used for restoring class II mesio-occlusal cavities of maxillary and mandibular molars (p>0.05) (Table 1), (Fig 2). Maxillary right first and second molars were the most commonly treated teeth. Two increments of composites were used in most cases of mesio-occlusal cavities in upper and lower molars, Chi square showed the association between teeth and number of composite increments did not have a statistically significant difference in maxillary and mandibular class II cavities (p > 0.05) (Table 2), (Fig 3).
Fig. 1: Bar chart depicting the frequency distribution of age groups in patients with class II MO composite restorations. X axis represents the age group. Y axis represents frequency of Class II MO composite restorations. The highest frequency of patients treated for class II MO composite restorations were found in the age group of 31-40 years, followed by 18-30 years and 41-50 years.

Table 1 shows the association between gender and number composite turns used for restoring mesio-occlusal class II composite restoration, Chi square test, p=0.422 (p>0.05) - statistically not significant.
Fig 2: Bar chart indicating the association between gender of patient and number of composite turns used for restoring mesio occlusal cavities in maxillary and mandibular molars. X axis represents the gender, Y axis represents the number of class II composite restoration done. In both genders, 2 composite increments (red color) was most commonly used followed by 1 composite increments (blue color) and then 3 composite increments (green color), however, Chi square test, $p = .422$, showed no statistical significant difference ($p > 0.05$).

<table>
<thead>
<tr>
<th>No. of Composite Increments</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooth number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maxillary right first and second molars</td>
<td>26</td>
<td>41</td>
<td>16</td>
<td>.215</td>
</tr>
<tr>
<td>Maxillary left first and second molars</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mandibular right first and second molars</td>
<td>6</td>
<td>21</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Mandibular left first and second molars</td>
<td>3</td>
<td>12</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
Table 2 represents association between Tooth number and Number of Composite Increments used for restoring mesio occlusal class II composite restoration, chi square showed, p=0.215 statistically not significant (p>0.05).

Dental caries is commonly seen in all age groups and the rate of caries formation and progression varies with every individual. Proximal caries may often go unnoticed and lately diagnosed when the patient reports with sensitivity or pain. With the advancements in caries diagnostic techniques and the radiographs, the caries can be detected at the earliest and appropriate treatment and follow up can be started. Treating the caries at the earliest, helps to avoid painful root canal treatment, which involves meticulous cleaning and shaping of the root canal system (Ramamoorthi, Nivedhitha and Divyanand, 2015). The Cleaning and shaping of root canals should be judicious to maintain as much cervical dentin as possible (Ramanathan and Solete, 2015), (Teja and Ramesh, 2019). The remaining dentin thickness mainly decides the longevity of the tooth as well as the restoration. Various irrigants have been studied for their interactions, antimicrobial properties and substantivity (Siddique et al., 2019), (Noor, S Syed Shihhaab and Pradeep, 2016). The inflammatory pulp should be removed completely to achieve success in root canal treatment (Ramesh, Teja and Priya, 2018). In case of apical periodontitis, the root canal should be packed with intracanal medication, before proceeding with obturation (Manohar and Sharma, 2018).

The traumatic injuries affecting teeth include fractures, luxation, avulsion and subluxation (Jose, P. and Subbaiyan, 2020), (R, Rajakeerthi and Ms, 2019). Following trauma, the teeth might even be cracked, and more prone to decay. Care should be taken to check the vitality of pulp at regular recall visits before any invasive
procedures. The traumatised teeth undergo necrosis and canals undergo calcification in many cases (Janani, Palanivelu and Sandhya, 2020). (Kumar and Delphine Priscilla Antony, 2018).

Advances in Bonding systems and strategies have led to resin composites that offer excellent esthetics, good polishability and increased wear resistance. Due to polymerization shrinkage stresses occurring as a result of volumetric contraction, there is a marginal gap leading to microleakage, staining, secondary caries and sensitivity (Rudrapati et al., 2017).

According to Nadig et al, the microleakage was less in incremental techniques when compared to bulk fill technique. Among all techniques, split horizontal incremental technique showed less microleakage followed by centripetal and oblique placement technique at occlusal margin of Class II restoration (Bugalia et al., 2011).

Khier and Hassan studied the efficacy of 3 placement techniques in marginal sealing of Class V composite restorations extending onto root and concluded that oblique and occlusal gingival incremental techniques exhibited high degree of microleakage at occlusal and gingival margins (Khier and Hassan, 2011).

There were studies comparing different incremental placement techniques. This is the first study to evaluate the number of increments used to restore mesio-occlusal cavities of maxillary and mandibular molars and the association of age and gender with class II (MO) composite restorations. In a critical review by Arvind Shenoy, he studied that composites were viable alternatives to amalgam for posterior restorations but are more technique sensitive and longevity and mechanical strength were less than amalgam (Shenoy, 2008).

Bicalho et al, studied shrinkage and shrinkage stresses using incremental filling techniques and concluded that by using low shrinkage composites applied in medium increment sizes of approximately 2mm, provided best balance compared to bulk or 1 mm increment placement (Bicalho et al., 2014). Misilli et al, did a study to evaluate marginal microleakage in composite restorations with different placement techniques such as bulk, oblique, centripetal, split horizontal. All techniques showed similar results when margins were located on enamel. Incremental techniques showed lesser microleakage especially at occlusal margin of restoration compared to bulk placement (Misilli and Yilmaz, 2018).

Sarfi et al, proposed that siloranes exhibit significantly less microleakage as compared to nanofill composites irrespective of layering technique used. The limitation of the study includes a very small sample size and population which cannot be generalized to a larger one. Early caries detection leads to minimal intervention techniques (Sarfi, Bali and Grewal, 2017),(Ravinthar and Jayalakshmi, 2018). White spot lesions can be treated by remineralising agents and resin infiltration techniques (Rajendran et al., 2019),(Nasim and Nandakumar, 2018). Apart from composites. Glass ionomer cements and its resin modified form are also used as a base in case of deep proximal restorations (Nasim et al., 2018). Our institution is passionate about high quality evidence based research and has excelled in various fields ((Pc, Marimuthu and Devadoss, 2018; Ramesh et al., 2018; Eziharasans, Apoorva and Ashok Vardhan, 2019; Ramadurai et al., 2019; Sridharan et al., 2019; Vijayashree Priyadharshini, 2019; Mathew et al., 2020)

CONCLUSION
Within the limitations of this study, there was no significant association seen between age, gender, and number of increments of composites, used for restoring mesio-occlusal cavities of maxillary and mandibular molars. Most cases used two increments of composites, that accounts for the conservative cavity preparation designs in composite resin restorations. Hence, the incremental layering technique, with increment sizes of not more than 2 mm should be used to minimize polymerization shrinkage stresses. From this study we observed that all the teeth were restored in a conservative approach.

REFERENCES

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