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Comparative evaluation on the number of increments of composites used for restoring disto-occlusal cavities of maxillary and mandibular molars - A retrospective analysis

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ABSTRACT

Over time and with the advancement of dental materials, a shift in the paradigm of how lost tooth structure can be restored has occurred. It is not very surprising to notice that many of the traditional amalgam restorations have been replaced with dental composites in the name of aesthetics. The factors that usually contribute to the failure of the composite restorations are secondary caries, pulpal irritation, post-operative sensitivity and marginal discoloration, all indicating microleakage being the cause. Microleakage, in turn, is caused by polymerization shrinkage, which is inherent to the material because of its composition. Amongst a few strategies to minimise polymerization drinking shrinkage is the use of the incremental technique. The aim of the present study was to evaluate and compare the number of increments of composites used for restoring disto-occlusal cavities of maxillary and mandibular molars in the South Indian population. It is a retrospective analysis. Data from 86,000 patient records were sieved and a total of 101 case sheets that presented with disto-occlusal composite restorations in maxillary and mandibular molars were included. The number of increments used to restore the cavity was assessed and tabulated in Microsoft Excel along with details like age, gender and tooth number. Frequency analyses and Chi-Square test was performed. Two increments of composite resin were reported to be used maximum in the restoration of the DO cavities in molars. The association of the number of increments to tooth number is found to be significant ($p < 0.05$). Within the limitations of the study, the number of increments of composite used to restore a DO cavity was more in a mandibular first molar. Thus to conclude that all the teeth were restored in a conservative approach.

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INTRODUCTION

With time and advancements of the dental materials, a shift in the paradigm to preserve as much as tooth structure as possible has become both possible and essential. Hence, from extension to the preservation, the idea has gradually drifted to preserve to extend. Along with the change in the ideology of restoration of the carious/lost tooth structure, aesthetics has also redefined the concept of tooth restoration.

The introduction of resin by Bowen changed the face

of dental materials. (Bowen and Marjenhoff, 1992) Currently used composite resins have a resin matrix (usually polymer matrix), inorganic fillers and coupling agent as their major and initiator-activator complex, coloring agents and stabilisers as minor components. (Braga *et al.*, 2005) The addition of diluent monomers and fillers have made the traditionally viscous composite resin amenable and also improved the physical properties like strength, heat generation, wear-resistance and reduced polymerisation shrinkage. (Dulik *et al.*, 1981; Condon and Ferracane, 1997; Ferracane, 2011)

All over the world, the use of dental amalgam as a restorative material has reduced exponentially with a permanent ban on the use of the material attributable to its toxicity in many nations. (Dodes, 2001) However, in India, dental amalgam is still being used but has been decreasing over the years not because of concerns over mercury toxicity but due to increasing demands for esthetic restorations.

Most of the older amalgam restorations that got replaced by composite resin fail. Hodge reported an overall failure rate at 8 years to be around 14-16% (Collins *et al.*, 1998; Siddique *et al.*, 2019) with the cause being secondary caries, pulpal irritation, post-op sensitivity and marginal discoloration, which indicate the inherent property of matrix (polymerisation shrinkage). (Mahajan *et al.*, 2015; Ravinthar and Jayalakshmi, 2018) The secondary caries is seen to affect the pulpal health adversely necessitating an endodontic therapy based on the diagnosis and radiographs. (Kumar and Antony, 2018; Rajakeerthi and Nivedhitha, 2019; Janani *et al.*, 2020).

Jose *et al.* (2020) Endodontic therapy with a proper following of the protocol, as mentioned by various authors, need to be done in order to provide comfort to the patient from the symptoms of inflamed or infected pulp. (Ramamoorthi *et al.*, 2015; Ramanathan and Solete, 2015; Noor *et al.*, 2016) Use of remineralising agents, in combination with the restorative materials, can be used as suggested. (Nasim *et al.*, 2018; Nasim and Nandakumar, 2018; Rajendran *et al.*, 2019).

Factors that are responsible for polymerisation shrinkage include restorative procedure, light intensity, cavity design, polymerisation characteristics, type of monomers used and filler loading. (Santhosh *et al.*, 2008) Generally, volume dilatometry or non-volume dilatometric methods are used to determine the % of material shrinkage. (Watts and Cash, 1991)

The aim of the present study was to evaluate and compare the number of increments of composites used for restoring disto-occlusal cavities of maxillary and mandibular molars in South-Indian population. (Manohar and Sharma, 2018; Ramesh *et al.*, 2018; Teja and Ramesh, 2019)

MATERIALS AND METHODS

It was a retrospective analysis. There were 2 reviewers to analyse the data that was retrieved. 86,000 patient data were collected between June 2019 and March 2020 for analysis. Data of the patients in whom Class II LCR restorations were performed were sieved through. Both male and female patients, within the age groups of 18 to 75 years, were included. A total of 332 case sheets were obtained where Class II disto-occlusal restorations were done. A total of 101 cases, after the removal of duplication, were obtained such that the DO restorations of maxillary and mandibular molar teeth were exclusively included. Sampling bias was minimized by verifying the photographs and the age groups. All the data was entered in Microsoft excel. Incomplete data was verified from the concerned patient's case sheet or the operator and filled accordingly or otherwise excluded from the study.

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS (SPSS Inc., version 23, Chicago, IL, USA). The independent variables assigned as age, gender, Maxillary and mandibular molars and dependent variables as a number of increments used in Class II DO cavities. Chi-square test was used to check the association between the teeth and the number of increments. The result was considered to be statistically significant when the p-value was less than 0.05.

RESULTS AND DISCUSSION

A total of 101 case sheets were evaluated. The current study indicated towards the restoration of disto-occlusal caries more frequently among the younger age group (Table 1). The most commonly restored tooth was mandibular first molar followed by maxillary first and second molars. 2 increments of the composite resin was used in 50 cases (49.5%) of the DO restorations of upper and lower molars. Association between tooth number and increments used for disto-occlusal class II composite restoration is found to be significant (Table 2 and Figure 1). However, no association between gender with the number of increments of composite used was found between maxillary and mandibular molars (Figure 2).

In the present study, we observed that there is a significance between the teeth and number of incre-

Table 1: Frequency distribution table of Age of the patient who underwent Class II DO composite restoration, Age group of 18-30 years and 31-40 years had more class II composite restoration than other age groups

Age Groups		Frequency	Percent
Valdid	18-30 Years	33	32.7
	31-40 Years	32	31.7
	41-50 Years	21	20.8
	>51 Years	15	14.9
	Total	101	100.0

Table 2: Number of composite increments used for restoring Disto-occlusal cavities of individual posterior teeth, chi-square test, p=0.44, statistically significant (p<0.05)

	No. of composite Increments	1	2	3	Chi-Square Value	P-value
Tooth number	Maxillary right and left the first molar	1	8	5	18.070	.044
	Maxillary right and left the second molar	9	4	1		
	Maxillary right and left the third molar	1	1	0		
	Mandibular right and left the first molar	13	33	14		
	Mandibular right and left second molar	5	3	2		
	Mandibular right and left the third molar	0	1	0		
	Total	29	50	22		

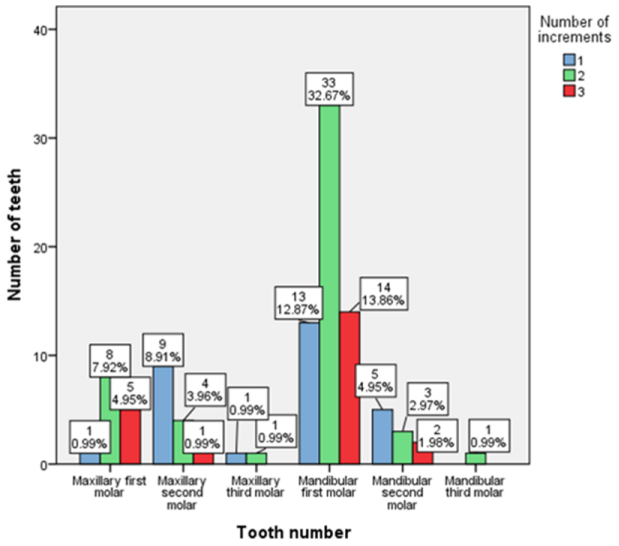

Figure 1: Bar graph denotes the number of increments of composite resin used for Class II DO Composite restoration for different posterior teeth

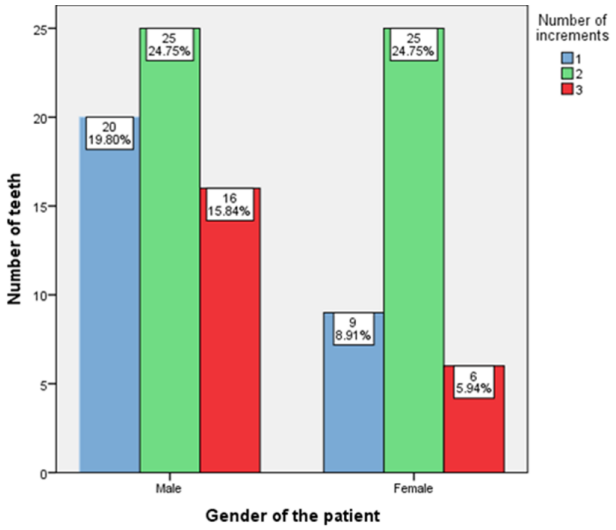

Figure 2: Bar graph denotes the number of increments of composite resin used for Class II DO Composite restoration for patients belonging to different genders

ments of composite used to restore DO cavities in molars (p-value <0.05; Chi-square test). [Figure 1] In the graph, X-axis denotes the type of the tooth where DO cavities were restored using increments of composite and Y-axis denotes the number of teeth. Also, blue denotes one increment of composite used for restoration, and green denotes two increments of composite used for restoration and red denotes three increments of composite used for restoration. It can be inferred that the mandibular first molar is the most commonly restored tooth. Also, 2 increments of the composite are most commonly used to restore the DO cavities of the posterior teeth. Chi-square test, p =0.044, statistically significant

(p<0.05)

From Figure 2, In the graph, X-axis denotes the gender of the patient and Y-axis denotes the number of teeth restored. Also, blue denotes one increment of composite used for restoration, and green denotes two increments of composite used for restoration and red denotes three increments of composite used for restoration. It can be inferred that 2increments of the composite are most commonly used to restore the DO cavities of molars in both males and females. Chi-square test, p = 0.103, statistically non-significant (p>0.05)

Table 1 shows that 33 patients (32.7%) of the 101 patients with DO composite restorations belong to the age group of 18-30 years. The finding can be correlated to the fact that young people ate comparatively more aware than the older people when it comes to getting decayed teeth restored. The former are more pro-active and interested in altering their look or getting more comfort.

Table 2 shows that the most commonly restored tooth is the mandibular first molar (59.4%) followed by the maxillary first and second molar (13.9% each). Table 2 also shows that 49.5% of the teeth were restored using 2 increments of composite resin, 28.7% with 1 increment and 21.8% with 3 increments. The incremental placement of composite resin effectively reduces the polymerisation shrinkage of the composite resin (Giachetti, 2006) though the substantial volumetric shrinkage lies in the range of 2 to 6 %. The methods to manage polymerisation shrinkage are classified broadly as composition related methods, technique related methods, material related methods, methods that reduce C-factor of the cavity, use of suitable base that acts to break stress concentration, sealing of margins with low viscosity resins and avoiding bulk restorations. (Malhotra *et al.*, 2010) The incremental layering technique is an effective way of reducing polymerisation shrinkage as it reduces polymerisation material volume compensating for the previously polymerised layers. (Chandrasekhar, 2017)

No previous study was found in the literature that dealt with the number of increments of the composite placed to restore a tooth. However, the type and comparative analysis of numerous incremental techniques with polymerisation shrinkage have been found. Centripetal build-up and incremental build-up of composite significantly reduce microleakage when margins are placed in enamel. (Szep *et al.*, 2001) Bulk restorations must be avoided. The incremental technique shows lower microleakage (Nadig *et al.*, 2011). Also, amongst all incremental techniques, split horizontal shows the least microleakage followed by centripetal and oblique technique when Class II restorations are considered. (Nadig *et al.*, 2011; Katona and Barrak, 2016) Approximately <2mm medium-sized increments must be placed to restore a cavity as an increased number of increments rescue polymerisation shrinkage stresses and the shrinkage itself. (Bicalho, 2014)

Table 2 and Figure 1 shows the association of the number of increments with the type of tooth in concern. 50 teeth (49.5%) of cases have been restored using 2 increments. Among the 50 teeth, 33 teeth with 2 increments (66%) belong to the category of the mandibular first molar. This can be associated with the size of the tooth and the depth of the cavity. It is advised to use GIC or RMGIC or even a flowable composite (low-viscosity composite) as a base to reduce polymerisation shrinkage as it acts as a stress breaker and GIC also provides pulpal protection. (Davidson, 1994; Burke and Shortall, 2001), Figure 2 shows the number of increments used for restoring class 2 DO cavities across gender.

The conclusions made by Shenoy (2008) in a critical review on amalgam restorations are that amalgams are superior to composite restorations in terms of longevity. Composite resins although are a viable alternative to amalgam, the former are more technique sensitive but advantageous as they offer a better initial seal due to bonding to enamel/dentin and demand for aesthetics are met successfully. In later days, problems related to microleakage can occur. To overcome the disadvantages of each other, an amalgam-composite combined restoration can be tried. (Kaur and Samra, 2012)

The limitations of the present study were small sample size and no information on the layering technique utilised by the operator. Also, the nature of the restoration is a direct composite restoration or bilayered restoration was not assessed.

The future scope of the study can be to find the association of the width of the cavity with the survival rates of composites and type of composite used with the survival rate of the composites.

CONCLUSION

Within the limitations of this study, there was a significant association seen between the type of tooth and number of increments of composite used to restore disto-occlusal cavities of maxillary and mandibular molars. No association was found between gender and the number of increments used. Most of the cases reported the use of two increments of composite indicating the conservative

cavity preparation concept. The incremental layering technique must be propagated as they ensure minimal polymerisation stresses. From this study, it can be inferred that all the teeth were restored in a conservative approach.

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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