ORIGINAL ARTICLE

Replacement of Resin-Based Composite Restorations in Permanent Teeth

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ABSTRACT

Objective: To determine the reasons for replacement of composite resin restorations and evaluate the association between the reasons for replacement of restorations with gender, duration of failure and different class of cavities.
Study Design: Cross-sectional study.
Place and Duration of Study: Operative Department of Fatima Jinnah Dental Hospital, Karachi, from January to May 2009.
Methodology: Patients were selected randomly who had presented with post restoration complaint after composite filling. Specially designed proformas were used to get the information such as the name of the patient, age, gender, teeth in need for replacement of restorations, age of the replaced restorations, and the reasons for replacement. The criteria for replacement of composite restorations were secondary caries, discoloration, improper proximal contact, fractured restoration and gingival irritation due to overhang. The significance of results was obtained by applying chi-square test.
Results: A total of 413 patients ranging in age from 17 to 63 years were examined; 263 were males while 150 were females. Secondary caries (52.3%) was the most frequent reason for replacement of restorations in permanent teeth followed by discoloration (16.9%) and fracture of fillings (12.6%). Chi-square test shows significant relationship between gender and reasons for replacement (p < 0.001). Highly significant difference was found between different class of cavities and reasons for replacement of composite fillings (p < 0.001). The median longevity of the replaced composite restorations was about 3 years.
Conclusion: Secondary caries was the most common reason for replacement of composite fillings. The median longevity in this sample was calculated to be 3.0 years.

Key words: *Secondary caries. Discoloration. Improper proximal contact. Fracture of composite restoration. Longevity.*

INTRODUCTION

Over the past decade, the use of resin-based dental composite fillings has increased significantly and has become a well-established dental procedure for the direct restoration of anterior and posterior teeth.[1] Failure and longevity of restorations have been attributed to the material used, the technical quality of the restoration, and the degree of patient's compliance.[2,3] Long-term success of resin composite posterior restorations depends on cavity size, restoration type, placement technique and tooth type.[4] As composite restorations serving less than five years is considered a failure.[5] Used properly, resin composite has demonstrated the ability to perform as well as amalgam in anterior and posterior restorations for up to 10 years.[6]

Common causes of composite failure are secondary caries, discoloration, fracture of restorations, improper proximal contacts and overhang fillings. Various studies result showed secondary caries was the most common reason for replacement of restorations.[4,5] Discoloration, bulk and marginal fracture of restorations were other causes for replacement of restorations.[5] Drake *et al.* revealed in their study that secondary/recurrent caries (54%) was the most common reason for replacement of composite restorations.[4] Deligeorgi *et al.* described that the principal reason for restoration replacement was secondary caries, accounting for 54% in Manchester and 33% in Athens.[5] Friedl *et al.* reported that the mean age of restorations at failure was 3.6 years.[6]

The aim of this study was to assess the reasons for replacement of composite resin restorations together with their longevity and also the distribution of reasons in gender and in different class of cavities.

METHODOLOGY

A total of 413 patients of either gender were selected from the Dental Department of Fatima Jinnah Dental Hospital, Karachi, from January to May 2009. Patients coming to dental department with post composite restoration complaints were selected randomly from the OPD. Specially designed proformas were used to get the detailed history of the patients such as the name of the patient, age, gender, arch of teeth, number of the teeth, class of cavity required replacement of restorations,

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age of the replaced restorations, and the reasons for replacement. The reasons for replacement of composite restorations were secondary caries, discoloration, improper proximal contact, fractured restoration and gingival irritation due to overhang. The duration of the restoration, which included the time since when the restorations were placed, was noted down. This helped in calculating the time duration in which the restorations failed. The time durations were based on patients' history and gave the average time figures for the restorations. However, some patients presented with previous dental records which showed the time when the restoration was placed. Exclusion criteria were allergies against the composite materials used, participation in another clinical study, negative reaction of the chosen tooth to the vitality test and the presence of any tooth sensitivity or pain prior to the replacement of restoration.

The teeth and the restorations were examined carefully by using a mirror and probe. Intra-oral radiographs were taken to examine that a restoration had failed. The reasons for taking radiograph for failed composite restoration were secondary caries, over hangs, and fractured filling.

The criteria of composite failure were stated as secondary caries, discoloration, fracture of filling, gingival irritation due to overhang filling and improper proximal contact.

The data were computerized and analyzed using SPSS for window version 11. Mean and standard deviation were calculated for continuous variable like age and frequency (percentages) were for categorical variables. Chi-square test was used to determine the association between variables such as gender of patient, class of cavities, and duration of restorations failure with reasons for replacement.

RESULTS

A total of 413 composite resin restorations were replaced during this study, 64% in males and 36% in females. The differences between males and females for replaced restorations were highly significant ($p < 0.001$) as shown in Table I. The average age was 34 (±9.94) years Table II. There were 148 maxillary and 265 mandibular teeth involved. Most restorations were replaced in class II (37%) followed by class III 28%, while class I were 27% and class IV were only 8% as shown in Table II.

Secondary caries (52.3%) was accounted more than one-half of the replacement of composite. Discoloration was found in (16.9%) while filling fracture was the causative factor in (12.6%). Discoloration problem was reported more in female than male. Gingival irritation due to over-hang was noticed in 5.6% cases and improper proximal contact in (12.6%) were cited as reasons for replacement. Comparison between teeth and reasons of failure showed significant results with $p < 0.001$ as shown in Figure 1. Secondary caries was common in lower first molars (32.4%) followed by lower second premolars (18.1%). The differences between different class of cavities and reasons for replaced restorations were also highly significant [($p < 0.001$) Table I].

The age for 413 replaced composite restorations was recorded. The median age of a composite restoration was about 3 years (Table II). All these durations of the restorations were based on patients' history. Cross tabulation between duration and reasons for replaced restorations showed highly significant association [($p < 0.001$) Table I]. Secondary caries was common in class I after four years, and discoloration was common in class III cavities of female than male after 2.5 years.

Table I: Reasons for composite failure in gender, different class of cavities and duration of replacement.

	Secondary caries	Fractured restorations	Discoloration	Gingival irritation due to overhang	Improper proximal contact	Total	Chi-square test p-value
Gender							
Male	159	31	21		52	263	
Female	57	21	49	23		150	< 0.0001
Total	216	52	70	23	52	413	
Class of cavities							
Class I	113	–	–	–	–	113	
Class II	73	2	2	23	52	152	< 0.0001
Class III	30	18	68	–	–	116	
Class IV	–	32	–	–	–	32	
Total	216	52	70	23	52	413	
Duration							
Six months	2	31	4	23	52	112	
One year	22	21	–	–	–	43	
Two years	82	–	34	–	–	116	< 0.0001
Three years	3	–	30	–	–	33	
Four years	87	–	–	–	–	87	
Five years	20	–	2	–	–	22	
Total	216	52	70	23	52	413	

Class I*: Cavity on occlusal surface of posterior teeth;   Class II*: Cavity on proximal surface of posterior teeth;   Class III*: Cavity on anterior teeth without involvement of incisal edge; Class IV*: Cavity on anterior teeth with involvement of incisal edge.
*Duration of restorations as replacement = Six month: Replaced the filling due to reason after six months;   One year: Replaced the filling due to reason after one year; Two years: Replaced the filling due to reason after two years;   Three years: Replaced the filling due to reason after three years;   Four years: Replaced the filling due to reason after four years. Five years: Replaced the filling due to reason after five years.

Table II: Percentage of distribution of teeth in different arches and in different class of cavities with mean of age and duration.

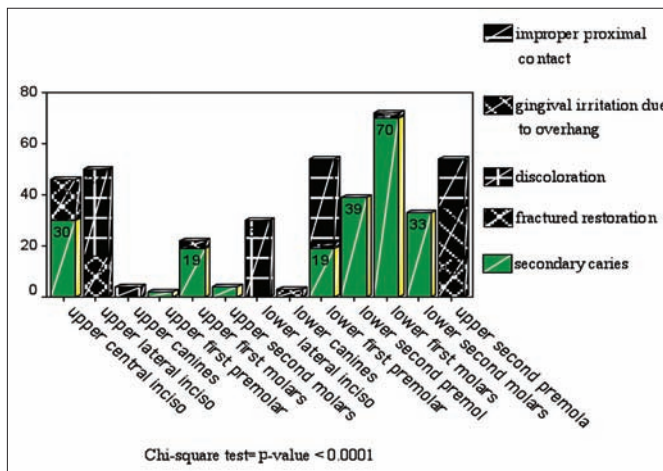|	Frequency and percent of teeth
Maxillary arch	148 (35.8%)
Mandibular arch	265 (64.2%)
Class I	113 (27.4%)
Class II	152 (36.8%)
Class III	116 (28.1%)
Class IV	32 (7.7%)
Age	
Minimum	17
Maximum	63
Mean	33.73
Standard deviation	9.947
Durationof longevity	
Mean	3.0145
Median	3.0

Figure 1: Distribution of teeth with reasons of composite failure.

DISCUSSION

A number of earlier studies, reported that secondary caries was the most common reason for the replacement of composite restorations.[6]

In the present study, secondary caries was the most common reason for replacing resin composite restorations (52.3%), followed by discoloration (16.9%). This result agrees with the findings by several other studies. Drake *et al.* reported that the most common reason for replacement of composite restorations was secondary caries (54%).[4] Secondary caries is the main reason for the failure of amalgam and resin composite restorations in permanent teeth including class II restorations.[5] Mjor and Toffenetti also reported the similar result that secondary caries was the most common reason for replacement of resin-based composite restorations (44%), followed by discoloration (21%), and fracture of filling (14%).[7]

Bernardo *et al.* described in their study that developing secondary caries was significantly higher in composite restorations for both arches. The overall risk of secondary caries was 3.5 times greater in composite restorations than in amalgam restorations.[8] In the present study, the common cause for replacing class I restorations was secondary caries, and class II restorations were secondary caries, improper proximal contacts and gingival irritation. Class III restorations were replaced due to discoloration, while class IV was replaced due to filling fracture or loss. The distribution of the replaced composite restorations in relation to the type of cavity in this study showed that the restorations were more common in classes I, II and class III which is similar to many other studies.

Crim *et al.* and Garcia-Godoy concluded that intraoral thermal changes compromise the bond between restorative material and tooth structure and create a potential for microleakage.[9] As defined by Kidd microleakage is the clinically undetectable passage of bacteria, fluids, molecules, or ions between a cavity wall and the restorative material applied to it.[10] Therefore, the microleakage at the tooth-restoration interface is a major reason for discoloration at the margins of the cavities and restoration, secondary caries and fracture of fillings.[11]

The high incidence of secondary caries associated with the resin composite restorations may be explained on the basis of microbiological findings.[12] A significantly higher proportion of streptococcus mutans was found at the cavity margins of the resin composite restorations than for the other materials.[11]

Secondary caries may arise, when remnants of infected dentine incompletely removed during cavity preparation or from oral microorganism which gain entry via leaky gap at the tooth-restoration interface.[13] Resin shrinkage due to polymerization has been reported as one of the factors associated with marginal leakage and gap formation at the tooth-restoration interface.[14] The polymerization shrinkage can create significant stress in the surrounding tooth structure and may lead to bond failure.[15] This problem can be minimized by using different restorative techniques and different materials such as nanocomposite.[16]

Condon and Ferracane also described, when composite is placed in a confined setting, such as a class I preparation, less of the polymerization shrinkage can be expressed at the free surfaces.[17] As it is constrained by its adhesion to the wall of the cavity, this unresolved polymerization shrinkage leads to internal stress, which can exceed the strength of the bond with the surrounding tooth structure and cause the interface to fail. The resulting marginal gap may provide a site in class I cavities for secondary caries to develop.[15,17] The same result was reported in this study that more recurrent caries occurred in class I cavities within 2 years due to high C-factor.

Deligeorgi *et al.* described the principal reason for the replacement of restorations of amalgam and composite

has remained secondary caries as diagnosed clinically.[18] Material failures (marginal degradation, discoloration, bulk fracture and loss of anatomic form) accounted for the replacement of more restorations of composite than amalgam.[5] Al-Negrish also recorded in his cross-sectional study the secondary caries (36.4%) is the main reason for replacement, followed by discoloration 14.4%, and composite fracture 11.3%.[19] Another study concludes that although secondary caries is still the main reason for restoration replacement, the development of new technologies for detecting and monitoring these lesions at an early stage should allow for testing new interventions to arrest or remineralize these lesions, which would delay the need for re-restoration.[20]

Lioumis and Lagouvardos *et al.* reported that the most common reasons for replaced resin composite restorations were secondary caries, discoloration and loss of filling. Discoloration is also a significant clinical problem with the resin composite materials after a year.[21] Mjor reported that the inadequate acid-etching of the enamel prior to placing with the resin-based composite restorations was one of the reasons of discoloration. Other similar studies also reported that inadequate fabrication of the restoration in addition to the inherent problems associated with polymerization shrinkage was another cause of discoloration.[22] The increase in etched surface area results in a stronger enamel to resin bond, which increases the retention of the restoration and reduces marginal leakage and marginal discoloration.[21]

The median longevity of the failed composite restorations in this study was about 3 years. Mjor and Toffenetti found in their study that the median longevity of composite restorations was 3.3 years.[7] Lioumis *et al.* in their study reported that 22.7% of composite restorations served more than 5 years.[21] While another study in the same area by Lagouvardos *et al.* found that 14.5% of composite restoration served for more than 5 years.[21]

Qvist *et al.* in their study reported that median longevity for failed clases III and V composite restorations was less than 2 years for permanent teeth and less than 1 year for deciduous teeth. He also found that the longevity of composite resin restorations replaced due to secondary caries was approximately 6 years.[23] Jokstad *et al.* in their study found that the restoration ages were influenced by the type and size of the restoration, the restorative material used and also the oral hygiene of the oral cavity. Cavity size, shape and careful handling of the material in different restorative techniques are prerequisites for longevity of the restoration.[24] For composites, many other studies have shown median survivals around five to seven years with failures mainly from caries, marginal fractures, discoloration and color

mismatches.[2,3] The quality, longevity and the esthetic appearance of tooth-colored restorations are mainly depend upon the properties of the material, etching and bonding of the cavities, placement technique, and the oral hygiene of the patient. The oral hygiene of the patient may also be important in the development of secondary caries and discoloration.[25] It is difficult to point out a single reason for the low median age of the replaced composite restorations.

With excellent high quality resin restorative and bonding materials available, and by using the correct placement techniques, nobody should doubt the potential long-term clinical success composite restorations.

In order to obtain more reliable results, it is necessary to conduct further clinical studies. It would be advisable to evaluate a great number of teeth for longer period. It is important to include other variables such as; poor anatomical form, erosion of the restoration and lost of filling.

CONCLUSION

In this study, the most prevalent reason for the replacement of composite restoration was secondary caries, filling discoloration and loss of filling. The median longevity for replaced resin composite restorations was about 3 years. The occurrence of secondary caries was more frequent in class I and discoloration in class III.

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