

A CLINICAL STUDY OF PLACEMENT AND REPLACEMENT OF COMPOSITE RESTORATIONS IN JORDAN

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الهدف من هذه الدراسة السريرية هو دراسة أسباب ترميم الحشوات التجميلية وأعمار الحشوات المعاد ترميمها. لقد تم فحص ومعالجة ٧٤٢ مريض تتراوح أعمارهم بين ١٨-٥٠ عاماً، ٣١٢ كانوا ذكوراً، بينما ٤٣٠ كانوا إناثاً. كان مجموع ما تم ترميمه ٩٥٨ سناً. التسوس الأولي (٦٣%) كان من أهم الأسباب للترميمات الأولية. يعتبر التسوس الشفوي (٤٤%) وتلون الحشوات (٢٨%) من أكثر الأسباب لإعادة ترميم الحشوات التجميلية. ٤٦% من الحشوات المعاد ترميمها كان أعمارها ما يقارب ٣ سنوات، بينما ٢١% من هذه الحشوات كان أعمارها يتراوح ما بين ٣ - ٧ سنوات.

This study investigated the reasons for placement, replacement and the age of failed composite resin restorations. A total of 742 patients ranging in age from 18 to 50 years were examined; 312 were males while 430 were females. The total number of restorations placed were 958. Primary caries was the most common reason for the placement of new composite resin restorations (63%). The main reasons for replaced resin composite restorations were secondary caries (44%), and discoloration (28%). The median longevity of the replaced resin composite restorations was about 3 years (46%). Among the replaced restorations, 21% were between 3 - 7 years old.

Introduction

Composite resins are the materials of choice as tooth-colored restorative materials for conservative aesthetic restorations on anterior teeth, mainly for Class III, IV and V carious lesions or traumatic injuries of the incisal edge.

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.¹ Styles of practice, attitude, and professional values may affect clinical judgment. The latter influences clinician's decisions regarding restorations failure and affect the longevity of failed restorations. The effects of the clinician's beliefs and opinions with regard to longevity of restorations have not been studied empirically.¹

Many restorations judged to be clinically unsatisfactory often continued to function adequately for several more years before being replaced. In contrast to this observation, other restorations judged to be satisfactory were sometimes replaced soon after such assessments were made.²

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A number of studies have attempted to determine the primary reasons for the placement and replacement of restoration.^{3,7} Primary caries has consistently been found to be the most common reason for placement of restorations. York and Arthur⁸ reported that 51.9% of composite resin restorations were placed due to primary caries. Qvist et al⁵ reported that 38% of all tooth-colored restorations were placed due to primary caries. These differences may be explained by differences in the patient populations.^{8,9}

Secondary caries has consistently been found to be the most common reason for replaced resin composite restorations, followed by discoloration and bulk and marginal fracture.⁶ Mjor³ reported poor anatomical form as the most common reason for replacement of tooth-colored restorations. This reason has changed markedly over the years to secondary caries and bulk fracture.⁹ In a recent study by Mjor 1997, poor anatomic form represent only 9% as a reason for replaced resin composite restorations.¹⁰ Drake et al¹⁰ reported that the most common reason for replacement of anterior restorations was recurrent caries (54%). The replacement of dental restorations accounts for some 75 % of all operative work, and caries

At the margins of restorations (secondary caries) is frequently a reason given by dentists for replacing restorations.¹²

The aim of this study was to assess the reasons for placement and replacement of composite resin restorations in Jordan together with their longevity.

More specifically, the authors examined the distribution of restorations according to:

- The total number of restorations by sex
- The class of cavity
- Reasons for placement and replacement
- Age of restorations as replacement
- Locations and type of restored teeth

Materials and Methods

A total of 742 patients 18 - 50 years of age were examined. Of this number, 312 (42%) were males while 430 (58%) were females. All patients were examined and treated at the University of Jordan Hospital, Department of Conservative Dentistry in 1995. Light-cure composite resin (Z100 3M) material was used for the placement and replacement of all restorations.

A special form was prepared for reporting the findings of this study. This form covered information such as name of patients, age, sex, teeth in need for placement or replacement of restorations, age of the replaced restorations, and the reasons for replacement. The criteria for placement and replacement of composite restorations were primary or secondary caries, erosion, tooth fracture, discoloration, poor anatomical form, lost filling, filling fracture, and other reasons. The teeth and the restorations were examined carefully after the field had been dried with an air-syringe using a mirror and an explorer. Furthermore, intra-oral radiographs were examined to confirm that a restoration had failed. The radiographic criteria for composite restoration failure were marginal defect, secondary caries, voids, and over hangs. Other defects can be detected, depending on the degree of composite radiopacity.

Chi-square (X^2) was used to test the relationship between variables such as sex, and age of patient and age of restorations, reasons for placement and replacement, and the type of restorations (placement or replacement).

Results

A total of 958 composite resin restoration were placed during this survey, 44% in males and 56% in females. The majority of the placements were new restorations placed for the first time, while about 32% were replaced resin composite restorations (Table I).

Eighty-one percent of the replaced restorations were made for females while 19% were made for males. The placement restorations were 44% for females and 56% for males (Table 1). The differences between males and females for placed and replaced restorations were highly significant ($P < 0.001$).

The types of placed and replaced restorations inserted are outlined in Fig. 1. Most placed and replaced restorations were Class III and Class V restorations, while Class IV was only 15%. The type of cavity differs significantly between placed and replaced resin composite restorations. There was significant difference between males and females in the placement restorations according to Black's classifications ($P < 0.0001$). It was found that the high percentage of resin composite restorations placed in females were Class III (55%). However, the high percentage of restorations placed in males were Class V (51%). The Chi-square test showed that males and females also differed significantly in the type of cavity in the replaced restorations ($P < 0.0001$). Fifty-five percent (55%) of the replaced resin composite restorations in females were Class III, while about two-thirds of the replacements in males were Class V restorations (62%).

Details of the percentages of the reasons for placement of new restorations are summarized in Fig. 2. Primary caries (63%) accounted for two-thirds of the placement restorations.

Table 1: Sex distribution of Patients (n=742), and Restorations (n=958).

| Sex | Patient | Restorations | | Restorations (P & R) |
|-------|------------|---------------|-----------------|----------------------|
| | | Placement (P) | Replacement (R) | |
| M | 312 (42%) | 364 (56%) | 58 (19%) | 422 (44%) |
| F | 430 (58%) | 283 (44%) | 253 (81%) | 536 (56%) |
| Total | 742 (100%) | 647 (68%) | 311 (32%) | 958 100% |

$X^2 = 120.5$, $P < 0.0001$

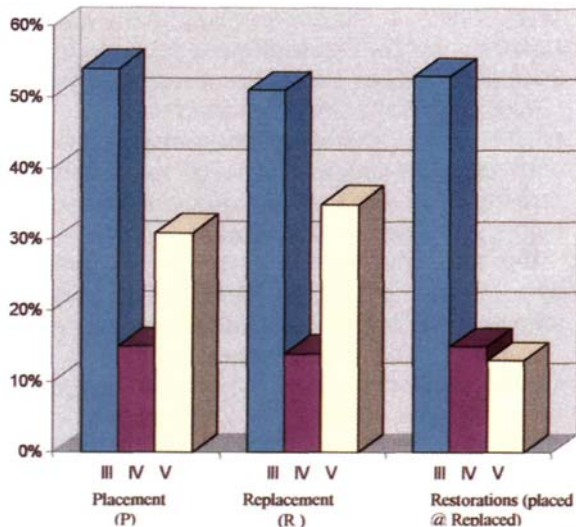


Figure 1: Percentage distribution of placement (n=647), and replacement restorations (n=311) according to Black's classification.

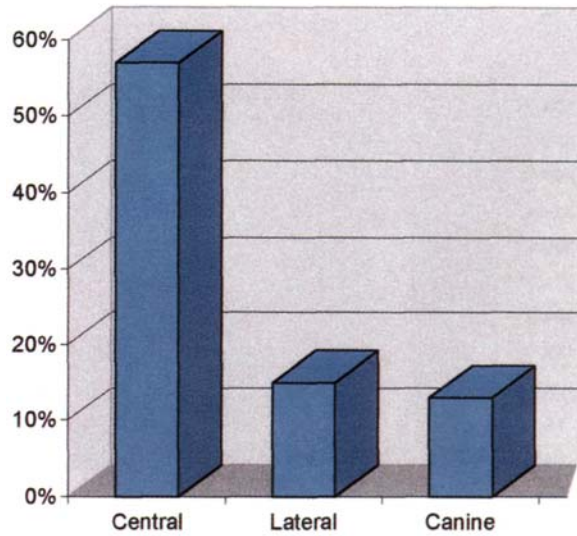


Figure 3 : Distribution of replacement restorations according to tooth type.

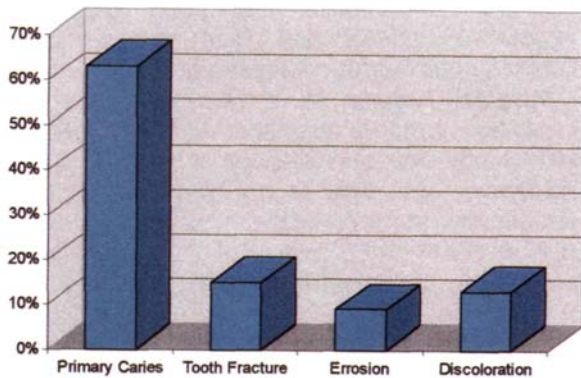


Figure 2 : Reasons for placement of restoration.

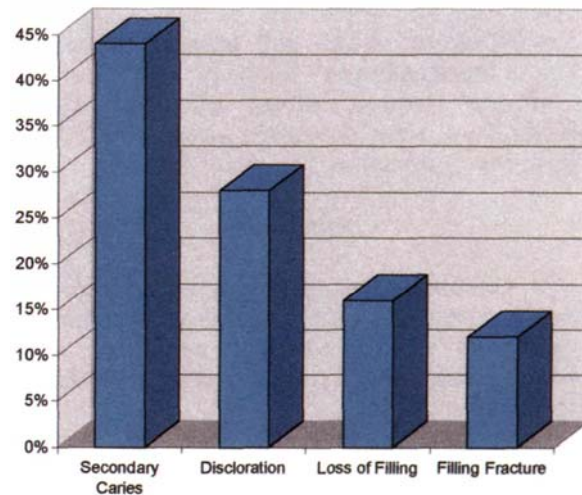


Figure 4 : Reasons for replacement of restorations, expressed as percentage for resin composite restorations.

No significant differences in the sex of patients was found in the situation of restorations in the treatment of primary caries ($p= 0.26$). More than half of the replaced resin composite restorations were in the central incisors followed by lateral incisors, while only about one of every ten restorations was in a canine (Fig. 3). There was no significant difference between males and females in the prevalence of dental caries relative to type of tooth ($p = 0.61$). The reasons for replaced resin composite

restorations are shown in Fig. 4. Secondary caries was the main reason for replacement of composite (44%). Discoloration, loss of filling and filling fracture were cited as reasons for replacement.

The longevity of replaced composite restorations were recorded for 311 failed restorations. The median longevity of a composite restoration was about 3 years (46%). Only 21% were replaced between 3-7 years. In the present study, only 3% resin composite restorations

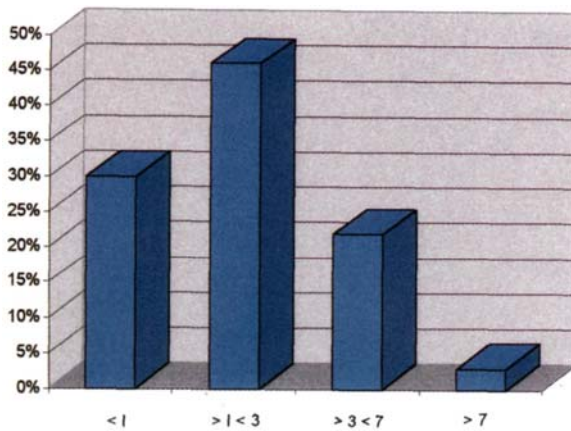


Fig 5: Percentage distribution of replaced resin composite restorations according to restoration age.

failed and was replaced in a period more than 7 years (Fig. 5). There was no significant difference between males and females relative to age of replacement ($p = 0.49$).

In the present study, all the replaced restorations were composite, and included no posterior restorations.

Discussion

A comprehensive review of earlier studies, mainly surveys, found that the most common reason for the new composite restorations was primary caries.^{46,8-13} The present study confirms these observations.

Since 1970, composite resins were the material of choice as tooth-colored restorative materials for conservative aesthetic restorations in anterior teeth, mainly Class III, IV, and V carious lesions or traumatic injuries of the incisal edge. In the present study, Class III restorations were replaced due to secondary caries and discoloration, while Class IV were replaced due to filling fracture or loss. The common causes for replacing Class V restorations were loss of filling, secondary caries and discoloration.

The distribution of the placed and replaced composite restorations in relation to the type of cavity in this study showed that the restorations were more common in Class III and Class V

cavity which is similar to many other studies. However, recent data indicate a common use of composite in Class I and Class II restorations.¹⁰

Mjor and Toffenetti,⁶ reported that two-thirds of the 1,025 restorations inserted were Class III and V restorations. Smales and Gerke¹⁴ reported that Class IV preparation showed the highest restorations' failure rates.

The traditional etched enamel/resin bond is very effective in clinical situations for bonding intra-enamel Class III and Class IV restorations.

However, Class V restorations often present a clinical problem because the gingival margins is frequently on dentin or cementum. When composite resin is placed on dentin or cementum, a high potential exists for marginal gap formation.¹⁵ This gap predisposes the restorative margin to microleakage, recurrent caries, and staining.^{15,20}

Erickson and Jensen,¹⁷ demonstrated that cervical margins on cementum displayed an appreciable increase in microleakage when the restored teeth were subjected to occlusal loading. Crim et al,¹⁶ Eakle,¹⁸ and Crim and Garcia-Godoy¹⁹ concluded that intraoral thermal changes compromise the bond between restorative material and tooth structure and create a potential for microleakage.¹⁵

Marginal leakage is a cause of failure of composite resin restorations. As a result of the lack of adhesion, microleakage of bacteria, fluid, molecules and ions occurs frequently at the restorations tooth interface.²¹ Leakage may be responsible for marginal discoloration, secondary caries, and partial or total loss of restorations.

Intra coronal restorations that involve only enamel margins (small Class III, some Class V, Class I) are the most resistant to interfacial staining, microleakage and secondary caries. For margins that approach or involve dentin (for example, on the root surfaces), the chance of good bonding is substantially reduced. This problem occurs, not because dentin bonding is not strong, but in most cases, moisture control, bonding agent placement, curing and finishing are more difficult when margins extend near to or onto root surfaces.²²

Schwartz et al²³ reported that a glass-ionomer/microfilled resin sandwich restoration may significantly reduce microleakage in restorations extending below the cemento-enamel junctions.

Since their introduction to dentistry in the early 1970s, glass-ionomer cements usage as restorative materials has increased. Several factors have contributed to their acceptance, including their bio-compatibility, good adherence to tooth structure and their ability to take up and release fluoride.²⁴ Having inadequate physical properties, glass-ionomer cement restorations should be limited to non-stress-bearing areas, e.g. Class V.²⁵ Glass-ionomers can be used in several clinical situations. They can serve as restoratives for unprepared Class V abrasion or erosion lesions, prepared Class V and Class III cavities, or Class I and Class II on deciduous teeth.²⁴

In the present study, secondary caries was the most common reason for replacing resin composite restorations (44%), followed by discoloration (28%). This result agrees with the findings by several other studies. Drake et al¹¹ reported that the most common reason for replacement of anterior restorations was recurrent caries (54%). Secondary caries is the main reason for the failure of amalgam and resin composite restorations in permanent teeth including Class II restorations.^{5,26} The most common reason for the replaced resin composite restorations is the clinical diagnosis of secondary caries.^{3,5,26,28} Secondary caries and poor appearance accounts for equal proportions of the failures for resin composite restorations.²⁹

The resin composite restorations failed due to secondary caries and bulk fractures. Secondary caries was associated mainly with the resin composite restorations.⁹ The high incidence of secondary caries associated with the resin composite restorations may be explained on the basis of microbiological findings.³⁰ A significantly higher proportion of streptococcus mutans was found at the cavity margins of the resin composite restorations than for the other materials.⁹

Kidd and Beighton³¹ in their study in 1996 showed many associations between the number of bacteria in the plaque and those in the underlying dentin. There were more bacteria in the plaque over frankly carious cavities than in restorations where no outer lesion was obvious. Similarly, there were more micro-organisms in the plaque over soft lesions than over hard lesions. Soft dentin beneath tooth-colored restorations is heavily infected.³¹ Cavitation alone

does not imply that a restoration is required, because where a surface is accessible to a toothbrush, plaque control alone can arrest the caries lesions.^{31,32} Kidd and Beighton³¹ reported that only frankly carious lesions at the margin of the filling constituted a reliable diagnosis of secondary caries.

Recurrent caries may arise from remnants of infected dentine incompletely removed during cavity preparation or, more commonly from oral microorganism which gain entry via leaky filling margins.³⁴ All composites shrink during curing. It is important to minimize the effect of composite shrinkage by incrementally placing and curing materials.²²

In addition to secondary caries, bulk fracture and marginal fractures accounted for the replacement of every fifth composite restoration.¹⁰ Lioumis et al¹³ and Lagouvardos et al⁴ reported that the most common reason for replaced resin composite restorations were secondary caries, discoloration and loss of filling.

Secondary caries was the most common reason reported for replacement of resin-based composite restorations (44%), followed by discolorations (21 %).⁶ Discoloration is still a significant clinical problem with the resin composite materials. Mjor⁶ reported that the relatively high proportion of margin discoloration suggests inadequate acid-etching of the enamel prior to placing the resin-based composite restorations, and/or inadequate fabrication of the restoration in addition to the inherent problems associated with polymerization shrinkage. 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.³⁵⁻³⁶

The median longevity of the failed composite restorations in the present study was about 3 years. Mjor and Toffenetti⁶ in 1992 found that the median longevity of restorations was 3.3 years. Lioumis et al¹³ in their study reported that 22.7% of composite restorations served more than 5 years. While another study in the same area by Lagouvardos et al⁴ found that 14.5% of composite restoration, served for more than 5 years.

The corresponding median longevity for failed resin composite restorations (mainly Class III

and V was less than 2 years for permanent teeth in young individuals and less than 1 year for deciduous teeth⁵. The longevity of composite resin restorations replaced due to secondary caries was approximately 6 years. Those replaced due to primary caries, involving removal of an existing restorations was 3-4 years.⁸ Jokstad et al⁷ in their study in 1994 found that the restoration ages were influenced by the type and size of the restoration, the restorative material used, and possibly also the intraoral location of the restorations. Cavity form and careful handling of the material are prerequisites for longevity of the restoration.

For anterior composites, comparable study findings have shown median survivals around five to seven years with failures mainly from caries, bulk fracture and losses, marginal fractures and staining, and color mismatches.^{2,3,5,17,38}

The quality, longevity and the esthetic appearance of tooth-colored restorations are primarily dependent upon the integrity of the bond of the restorations with the enamel and dentin.³⁹

It is difficult to single out specific reasons for the low median age of the restorations replaced, but operative technique and material quality and handling may play important roles.⁶

Several factors apart from the properties of the material, play a role in the degradation of composite material, including the technique of the operator, etching with acid, how the material is handled, degradation due to light, and the oral hygiene of the patient.³

The success or failure of restorations depends on three main factors: the dentist, patient, and dental material, all of which are closely related. The oral hygiene of the patient also may be important in* the development of secondary caries and discoloration. The dentist may abuse the material since many general practitioners rely on their clinical amalgam experience when they start using composite resin.

Conclusion

Composite resin was the most commonly used restorative material for anterior teeth in this study. The most prevalent reason for the placement of new restorations was primary caries. Secondary caries, filling discoloration

and loss of filling were the main reasons for failure of composite restorations. The median longevity for replaced resin composite restorations was about 3 years.

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