

REPLACEMENTS OF AMALGAM RESTORATIONS – A STUDY

¹SHAFQAT ALI SHAH, BDS, FCPS

²MISRI KHAN, BDS, MCPS

³MOHAMMAD SALEEM, BDS, MCPS

ABSTRACT

The aim of this study was to register various reasons for replacement or repair of amalgam restorations of patients visiting a dental institution hospital in Peshawar, Pakistan, and to compare the results of the present study with the international studies carried out on this subject.

A cross sectional study on 123 patients, aged 10-60 years, visiting for the replacement or repair of their 210 amalgam restorations was carried out over a period of 10 months. These patients were examined clinically and radiographically to find out the reasons of the failed amalgam restorations which needed replacement or repair while the teeth were still vital and restorable.

In 123 patients, 210 amalgam restorations were examined. Seven reasons were found responsible for replacement or repair of restorations; Secondary caries (37.61%), marginal degradation (22.38%), dislodgment of fillings (20.47%), poor anatomy restored (14.76%), fracture of filling's material (11.42%), macroleakage gap (5.71%) and fracture of teeth (3.80%) were found in 210 restorations. The failed restorations with single reason (85.72%) and combined reasons (14.28%) were also assessed in this study. Secondary caries was the most prevalent reason for replacement or repair, followed by marginal degradation. The results also showed that the failed restorations with one reason were dominant over the restorations with multiple reasons in this study.

Key words: *Amalgam restoration, amalgam replacement, amalgam repair, secondary caries, failed restoration.*

INTRODUCTION

Dental amalgam is used as a permanent restorative material for more than a century in the dental practice.¹ The dental amalgam is considered as very good permanent filling material because of its adequate mechanical properties, reliability, longevity, low cost and ease of manipulation,² but still a great percentage of amalgam restorations failed due to one or more than one reason. It is still the material of choice not only for treating primary caries in posterior teeth, but also for replacing or repairing the failed amalgam restorations.³

Replacement and repair of restorations represents the major workload, especially for adult patients.⁴ According to a study, the practice of amalgam restorations in posterior teeth accounts for at least 22% of all

procedures in a general dental practice and earn about 15% of income from the practice.⁵ Another study shows that the replacing restorations occupy 72% of a dental practitioner's time.⁶ While according to Jokstad A et al, 50% of the practice time is spent on replacing the defective amalgam restorations.⁷

Many patients attend the dental clinics for placement and replacement of restorations with amalgam because of primary and secondary caries respectively.

The longevity or age of amalgam restorations ranged from 0 to 38 years. In previous studies, the longevity of amalgam restorations were assessed. After two years from the date of placement of amalgam fillings nearly 13% of amalgam restorations and after eight years 24 to 50 percent of the restorations were

¹ Lecturer, Department of Operative Dentistry, Khyber College of Dentistry, Peshawar

³ Assistant Professor, Department of Science of Dental Materials, Khyber College of Dentistry, Peshawar

Correspondence: ²Dr Misri Khan, Assistant Professor, Department of Operative Dentistry, Khyber College of Dentistry, Peshawar, Pakistan. Mobile: 0092 -333-9119307, E-mail: drmisrikhan@gmail.com

replaced.^{8,10,11} The median life time for amalgam filling is between 5 to 14 years as reported in different studies, irrespective of technical quality of restoration and several practice characteristics and the annual failure rates ranged from 0.16 to 2.83 percent for amalgam restorations.^{7,10,12,27}

Evidence in the dental literature clearly shows that, in general, about one-third of all the permanent amalgam restorations present at any one time are being replaced for one reason or another, with great frequency the world over.^{10,24,25}

The replacement of amalgam restorations means the complete removal of the existing amalgam restoration and its replacement with amalgam or another restorative material while the amalgam repair means the replacement of the defective or fractured part of amalgam restoration with new amalgam or any other restorative material. Traditionally the ideal approach to treat defective amalgam restorations is replacement, however, repair is an alternative approach to restorations which are only partially defective. The replacement of restorations are done in cases of secondary caries, partially lost restoration, tooth fracture and cosmetically unacceptable restorations; for repair the cases considered are loss of very small part of the restoration, marginal ditching and refurbishment. When compared with replacement, various advantages of repairing of restorations are “consuming lesser time”, “more conservative” and “lesser distressing for patients”.^{20,30}

There are many factors which contribute to the restoration's replacement or repair, including operator's knowledge, skill and experience; patient's caries risk and material's characteristics. In many parts of the world, many people replaced their amalgam restorations because of inferior esthetic and fear of mercury poisoning.^{34,35,36}

METHODOLOGY

This cross sectional study was carried out on 123 patients aged 10 to 60 years, who visited the Department of Operative Dentistry, Khyber College of Dentistry, Peshawar for the replacement or repair of their existing failed restorations. These restorations were examined and assessed. They needed either replacement or repair depending on the conditions and extension of defects of the failed restorations. A total of 210 amalgam restorations in 123 patients were examined over a period of ten months. These patients were examined clinically and radio-graphically to find out

the reasons of the failed amalgam restorations which needed replacement while the teeth were still vital and restorable. The data were recorded on a preset Proforma and the analysis was done using the descriptive statistics.

Examination was carried out on dental chair using examination instruments and other examination aids i.e. Radiographs and Thermal tests, after getting a thorough history of the patient. In 123 patients 210 defective filled teeth were recorded. Eighty teeth out of 210 were radio-graphed to explore the defects (e.g. secondary caries, overhanging fillings) in hidden areas (i.e. proximal areas of the teeth and under the filling materials) so as to find the reasons for the replacement of restorations. The examination of patients involved the sequential assessment of all restorations for the evidence of caries (secondary or recurrent), marginal ditching or degradation (ditched amalgam), dislodgement of the restorations, poor anatomy of the restorations, fracture of bulk of restorative materials, macro-leakage space and fracture of the tooth.

The criteria for replacement or repair of restorations were the same as described by Deligeorgi et al and Mjor.^{28, 29} The patients aged 10 to 60 years old with failed amalgam restorations in their posterior and vital teeth were included in this study. The failed restored teeth, diagnosed clinically or radiographically, that had exposed pulp, severely periodontally involved and badly broken down or unrestorable structures were excluded from this study.

Data analysis was done using SPSS version 13.0 Software. The mean and standard deviation (\pm SD) were calculated and presented for ages of the patients. The gender distribution was assessed as proportions. The frequency of the presenting complaints and the reasons for replacement of the restorations were measured.

RESULTS

In this cross sectional study, the analysis of data of patients of different gender and age groups reporting for replacement of restoration were carried out. The total number of patients examined in this study was 123, of which 71(57.7%) were males and 52 (42.3 %) were females (Table 1).

The ages of patients that presented for replacement or repair of amalgam restorations were in the range of 10 to 60 years; with the mean age 29.26 years

TABLE 1: GENDER WISE DISTRIBUTION

Gender	Frequency	Percentage
Males	71	57.7
Females	52	42.3
Total	123	100

TABLE 2: EVALUATION OF AGE-GROUPS OF PATIENTS

Age-group (years)	No of patients	Per-cent-ages	Mean	Standard deviation (SD)
10 to 15	10	8.13	12.90	1.09
16 to 20	38	30.89	18.26	1.29
21 to 25	25	20.32	22.78	1.41
26 to 30	15	12.19	27.01	1.27
31 to 35	16	13.00	31.62	1.59
35 to 40	8	06.50	34.60	1.48
41 to 45	4	03.25	35.90	0.50
46 to 50	5	04.06	40.46	1.78
51 to 55	0	00.00	00.00	0.00
56 to 60	2	01.62	39.80	1.41
Total	123	100	29.26	9.93

± 9.93 years S.D. The most dominant age-group of patients visiting the dental institute hospital for replacement or repair of their restorations was 16 to 20 years old followed by 21 to 25 years old in this study. (Table 2)

TABLE 3: REASONS-WISE ANALYSIS OF FAILED RESTORATIONS

Reasons for replacement or repair of amalgam restorations	Frequency of reasons of replacement or repair in failed amalgam restorations	Percentages of reasons of replacement or repair in failed amalgam restorations
Secondary caries	79	32.72
Macroleakage space (Marginal Gaps)	12	4.91
Marginal degradation	47	19.26
Fracture of filling materials	24	9.83
Fracture of teeth	8	3.27
Dislodgment of filling materials	43	17.62
Poor anatomy restored	31	12.70
Total	244	100

The reasons of replacement or repair of amalgam restorations were counted in 210 failed amalgam restorations. The sum of all the reasons was 244 in numbers. The most prevalent among the reasons was the secondary caries (79/244, 32.72%), followed by marginal degradation. (Table 3)

The frequencies of failed restorations were assessed for each reason of replacement or repair individually. The restorations with secondary caries (79/210, 37.61%) were the most frequent in all failed restorations followed by restorations with marginal ditching (47/210, 22.38%), dislodgment of fillings (43/210, 20.47%), poor anatomy restored (31/210, 14.76%), fractured fillings (24/210, 11.42%), macroleakage space(12/210, 5.71%) and fractured teeth (8/210, 3.80%). The prevalence of restorations with presence of single reason for replacement or repair were far more than that of the restorations with combined reasons (Fig 1).

The frequencies of restorations with one, two and three reasons were calculated. The restorations with one reasons were in the majority (180/210, 85.72%) as compared to the restorations with two and three reasons (Table 4)

The restorations with reasons for replacement or repair are divided in groups (Table 5)

The secondary caries was present in most of the restorations with one, two and three reasons for replacement or repair. Reasons-wise distribution also show the secondary caries was the most prevalent reason for replacement or repair.

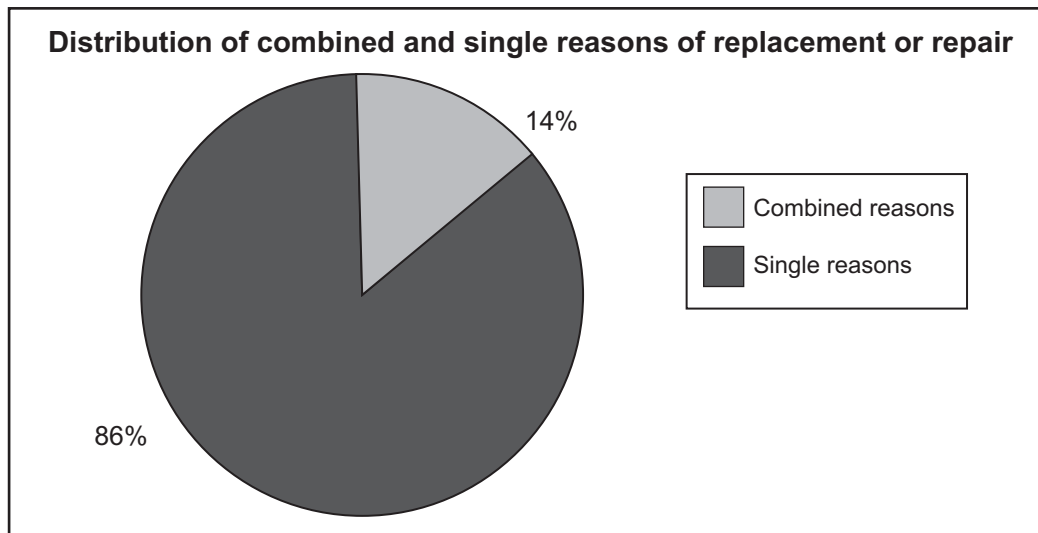


Fig 1: Distribution of single and combined reasons

TABLE 4: DISTRIBUTIONS OF RESTORATIONS FOR COMBINED AND SINGLE REASONS

Restorations with reasons for replacement or repair	Frequency of restorations	Percentages of restorations
Restorations with one reason	180	85.72
Restorations with three reasons	04	01.90
Total	210	100

TABLE 5: GROUPING OF FAILED RESTORATIONS WITH REASONS FOR REPLACEMENT OR REPAIR

Groups	Failed restorations need replacement or repair
Group 1	Restorations with one reason for replacement or repair
Group 2	Restorations with two reasons for replacement or repair
Group 3	Restorations with three reasons for replacement or repair

TABLE 6: ANALYSIS OF RESTORATIONS WITH ONE, TWO AND THREE REASONS FOR REPLACEMENT OR REPAIR

Groups	Reasons present in failed restorations	Frequency of restorations	Percentages of restorations
Group 1	i. Secondary caries	49	23.33
	ii. Dislodgement of filling	43	20.47
	iii. Marginal ditching	33	15.71
	iv. Poor anatomy restored	26	12.38
	v. Macroleakage space	12	05.71
	vi. Fractured filling	14	06.66
	vii. Fractured teeth	03	1.42
Group 2	i. Secondary caries+Marginal ditching	10	04.76
	ii. Secondary caries+Fractured filling	06	02.85
	iii. Secondary caries+Poor anatomy restored	05	02.38
	iv. Secondary caries+Fractured tooth	05	02.38
Group 3	i. Secondary caries+Marginal ditching+Fractured filling	04	01.90
Total		210	100

DISCUSSION

A total of 123 patients were examined in whom 210 restorations were found to be defective. Seven reasons were assessed in these defective restorations responsible for replacement or repair. Most of the cases presented with a single reason for the replacement or repair of restorations while some of the cases presented with multiple reasons e.g. it was found that secondary caries alone was present in some cases while in other cases secondary caries and marginal ditching both were present at a time.

In this study “secondary caries” was examined with the help of visual examination, tactile stimulation using the probe and radiographs, while the macroleakage space (marginal gape), marginal degradation, fracture of tooth and material, dislodged filling and poor anatomy were assessed with visual examination and tactile stimulation using the explorer. According to Mjor A I and Odont microleakage space is the crevice at the tooth-restoration interface of less than 35 to 50 micrometer (which does not predispose a patient to the development of secondary caries) while in cases of the macroleakage space the size of the crevice exceeds 250 to 400 micrometer (which is responsible for development of secondary caries because the gap between the tooth and filling allows bacteria and their toxins to cause decay under the old restoration) which can be easily detected by visual examination and using the explorer.³⁷

In the present study, out of 123 patients examined, the males, 71 (57.7%) were slightly greater in numbers than the females, 52 (42.3%) (**Table 1**). According to a study²¹ out of 324 patients males were 152 (41.1%) and female 218 (58.9%) which is in contrast to this study, because more number of male patients were taken in the sample. Another study shows minor differences were found in the longevity of amalgam restorations between males and females patients.²²

In one study the age range and mean age of the population were 18-77 years and 34.78+14.52, respectively and resulting in 1.2 restorations per patient.²¹ While in this study the patients that presented for replacement or repair of amalgam restorations were in the range of 10 years to 60 years with mean age of the sample was 29.26 years ± 9.93 years S.D. (**Table 2**) and resulting in 1.70 restorations per patient, which is almost similar to the above mentioned international study.²¹

In this study, the most prevalent age-group needed replacement or repair was 16-20 years, followed by 21-

25 years while the least number of patients examined were in age-groups 50 to 60 years. According to study³³ by MJ Tyas, the 41-50 and 51-60 year age groups received the most replacement restorations, which is not in agreement with this study, but it is not far from another international study²³ in which the largest number of failed restorations were found in patients of age group 31- 35 years old. This difference may be due to the convenient and smaller sample size in this study and the presence of more number of filled teeth in this age-group.

In the present study, the failed restorations presented with seven reasons for replacement or repair of restorations assessed were secondary caries (79/210, 37.61%), marginal ditching (47/210, 22.38%), dislodgement of fillings (43/210, 20.47%), poor anatomy restored (31/210, 14.76%), macroleakage space (12/210, 5.71%), fracture of fillings (24/210, 11.42%) and fracture of teeth (8/210, 3.80%). According to a study¹⁷ the most frequent reasons were registered as secondary caries (34.0%), marginal ditching (7.2%), fracture of teeth (10.2%), fracture of fillings (15.5%) which are in consistent with this study with differences in their percentages. The difference in percentages could be related to differences in the dentist’s skill, material’s properties, patient population, caries susceptibility, oral hygiene and diet.

In this study “the most frequent reason” for the replacement of amalgam restoration was secondary caries which is nearly in accordance with international studies with different percentages.^{10,12,17,18,19} Again the differences in percentages were due to the differences in the restorative technique, amalgam’s properties and care by patients and the sample sizes.

The second most frequent reason for the replacement of amalgam restorations was marginal ditching or degradation in this study. Various literatures revealed that the marginal ditching (or fracture) was the second most frequent reason for the replacement of the amalgam restorations.^{4,7,13,14} while this study (regarding the prevalence of margin failure) was less compared to previous studies.^{10,14,31} In amalgam restorations the differences might be related to cavity design which did not provide “Butt joint” to restorations and improper condensation and margination of amalgam.

Dislodgement of amalgam restoration was found to be the “third most frequent reason” for replacing amalgam restorations in this study (Table 4). The dislodgment could be due to deficient retentive cavities,

fracture of fillings and fracture of teeth e.g. the fracture of thin amalgam, weak walls of the cavity.

Poor anatomy restored assessed the “5th reason” for the replacement or repair also contributed significantly for the replacement or failure of amalgam restorations. The poor anatomy restored could be due to the factors related to the experience and skill of the dentists, no or improper use of wedge and matrix, carving and restorative techniques. The frequencies of dislodgement and poor anatomy restored in this study are in contrast to the study of Mjor²², which showed dislodgment of filling and poor anatomy of the restorations as the least common reasons for replacement restoration accounting for 3.5 % of the cases.

There difference in the opinions were found when reviewing the literature about the microleakage space whether it was responsible for the secondary caries or not^{38,39,40} but the study³⁸ by Jorgensen KD, Wakumoto S support this study that the macroleakage space can do cause the secondary caries because the gap between the tooth and filling allows bacteria and their toxins to cause decay under the old restoration.

This study demonstrated the fractured fillings as one of the least common prevalence of reason in failed restorations which is in consistent with that of previous studies^{7,17,32}. This failure could be related to the fact that amalgam thickness was less than 1.5 mm under heavy occlusal load, improper location and designing of axial wall and axiopulpal line angle.

Regarding tooth fracture, as the least common reason, this study coincides with that of a previous study²¹ and in conflict with some international studies^{7,13,14} with different percentages. These differences might be due to inappropriate resistance form, cavity preparation without cusp reduction and improper occlusion of the restoration, bad oral and dietary habits, malocclusion etc.

The majority of restorations were presented with only one (single) reason (180/210, 85.72%) as compared with that of combined (multiple) reasons (30/210, 14.26%) in this study (Table 4) which is supported by a previous study¹⁷ in which the majority of restorations were presented with only one reason (87.9% ,1787/2033) while the combined reasons were present in minority of cases (12.10% , 246/2033).

Among the combined reasons the two, three, four and five reasons were declared in , 10.5%, 1.1%, 0.4% and 0.1% respectively of total cases¹⁷ which shows almost the similarity to this study (Table 6) in which

among the combined reasons (30/244, the restorations with two and three reasons were also assessed as 12.38% (26/210) , 1.90% (04/210) respectively in the total sample but the failed restorations had more than three reasons were grossly carious and unrestorable tooth structures which were excluded from the study.

Among the combined reasons (Table 6), the most prevalent combinations of reasons was “secondary caries + marginal ditching” followed by “secondary caries + fractured fillings”, “secondary caries + fractured teeth” and “secondary caries + poor anatomy”. The above mentioned findings in this study shows almost similar results to that of a previous study¹⁷ with little differences in percentages which may be due to the great differences in sample size and in quality of services provided by the dentists (i.e. meticulous restorative techniques), material’s properties and care by patients

It is clearly understood from this study that the clinical success of amalgam restorations is dependent upon many factors, namely proper selection of amalgam, improper cavity preparation, wrong manipulation of amalgam and badly restored anatomy and of course bad oral hygiene of patients.

LIMITATIONS of this study,

The sample size was small and was taken from only one of the dental hospitals which does not represented the whole population of patients with restored teeth in the province. This study did not include all the variables related to replacement or repair of the amalgam filled restorations and carried out research work only on a few variables. Due to the lack of good clinical evidence, researchers were unable to make diagnosis of all variables to assess the reasons of replacement or repair of restorations e.g. micro-leakage space, differential diagnosis of replaceable and repairable restorations; cracked teeth and filling materials, recurrent or residual caries etc. This is not a high level design study such as a randomly controlled trials or prospective cohort. The patients taken in the sample were treated by various categories of dentists like specialists, general practitioners, house officers and untrained persons. Regarding the category of dentists, no comparison was carried out between their qualities of treatment.

Acknowledgement

The authors appreciate the help provided by Zahida Aziz, MSc in the preparation of the draft.

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