

Longevity and Causes of Failure of Amalgam and Composite Restoration

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ABSTRACT

Objective: The objective of this was to determine the longevity and causes of failure of amalgam in patients reporting to tertiary care center.

Study Design: Cross-Sectional Study

Place and Duration of Study: This study was conducted at the Khyber College of Dentistry Peshawar, Bacha Khan Medical College Mardan and Kohat Institute of Dental Sciences on 100 patients for a period of ten months from January 2019 to October 2019.

Materials and Methods: Patients with faulty amalgam or composite restorations, placed at least 6 months before the time of examination, and needing replacement their tooth restorations on esthetic or functional ground were included in this study. Patients with limited mouth opening, below 10 year of age, mental and psychiatric disorder were excluded. Teeth were examined under mirrors and explorers. Proximal restorations were evaluated with dental flosses. Evaluation was also done using periapical and bite-wing radiographs when required. We ask for reasons for replacement which are; endodontic treatment/pain, caries, fracture of tooth, fracture of restoration, extraction of adjacent tooth, and insufficient approximal contact. The operator experience and duration of restoration were also recorded. Data analysis was done in SPSS 20. Data stratification was done by using Chi-Square test. A P-value of less than or equal to 0.05 was considered significant.

Results: The mean age of the participants was 29.98±8.84 years. The males were 62(62%) and females were 38(38%). The most common location of restorations was mandibular molars (n=49, 49%) followed by mandibular anterior teeth (n=18, 18%). The frequency of failed restoration was found in 28(28%) cases. The most common cause of amalgam and composite failure was combined endodontic failure and fracture of the restored teeth (n=9, 9%) followed by fracture of restoration itself (n=8, 8%) and need for root canal treatment (n=6, 6%). The most common longevity of restoration was of 2-5 years duration (n=49, 49%) followed by 6-8 years (n=17, 17%) and 1-2 years (n=16, 16%). Most commonly failed restorations were those placed by technicians (n=8, 53.30%), student in institute (n=3, 37.50%) and general dental practitioners (n=14, 25.5%). The failure for specialist (2-year degree) was 14.3% (n=1) and specialist (4-year degree) was 13.30% (n=2) and they were statistically significant (P=0.109).

Conclusion: The amalgam and composite restorations needed to be replaced due to endodontic failure, fracture of tooth, fracture of restoration itself, secondary caries, and insufficient proximal contact. The clinicians need to be vigilant to combat these issues in their practices.

Key Words: Amalgam, composite, restoration, causes of failure, reason for replacement

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INTRODUCTION

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Many alterations have been happened in the application of restorative dental materials during the last three decades. For instance there an increasing trend in the importance of aesthetic restoration of posterior teeth.¹ Though the aesthetic perspective is now giving importance in restorative dentistry recently; nevertheless, longevity of fillings should be the most important criteria in the selection of material.² In dental practice, the major concern is failure of amalgam and composite restorations and it is estimated that replacement of restorations due to failure is approximately 60% of overall operative procedure.² Though amalgam fillings still have the greater durability in term of function³ but there is concern about its application in recently because of the incorporation of mercury in its composition.⁴ The

mercury is added in order to make the material plastic, moldable and useable in direct restoration.⁵ Additionally, more tooth preparation is required enhancing large restoration retention, making amalgam restoration questionable for conservative dental practice. That's the reason that the composite restoration has been increasing worldwide for as a direct restoration in posterior teeth.^{6,7}

In a study of 7 year follow up on 1748 restorations found that overall failure was 10.1%. The amalgam restoration's survival rate was 94.4% while for composite it was 85.5%. The main reason for failure in both amalgam and composite fillings was secondary caries. For composite the relative risk due to secondary caries was 3.5 times more.⁸ Another study assessed the most common reasons for replacing amalgam in vital as well root canal treated teeth. They reported that cusp fracture and recurrent caries was common reason for amalgam restoration replacement.⁹

In dental practice the major concern is the failure of dental restorations. Majority of operative work is comprised of replacement of failed direct restorations. Dental professionals should be knowledgeable of the durability of direct restorations, and potential causes for its failure. So, the objective of this was to determine the longevity and causes of failure of amalgam in patients reporting to tertiary care center.

MATERIALS AND METHODS

This cross-sectional study was carried out after the obtaining the approval from hospital ethical review committee in Khyber College of Dentistry Peshawar, Bacha Khan Medical College Mardan and Kohat Institute of Dental Sciences. This study included 100 patients (100 restored teeth). These patients were selected consecutively from patients referring to the Department of Operative Dentistry, from outpatient department of these hospitals from January 2019 to October 2019. Verbal informed consent was taken from each patient after full explanation of the detail and purpose of the research.

Patients with faulty amalgam or composite restorations, placed at least 6 months before the time of examination, and needing replacement of their tooth restorations on esthetic or functional ground were included in this study. Patients with limited mouth opening, below 10-year age, mental and psychiatric disorder were excluded after history and intra-oral examination.

Teeth with restoration were dried with air spray and examined under mirrors and explorers. Proximal restorations were evaluated with dental flosses. Evaluation of the restored dentition was also done using periapical and bite-wing radiographs when required. Patients were asked when the restorations had been placed.

We used closed ended questions proforma design after studying previous literature.⁹ We ask for reasons for

replacement which are; endodontic treatment/pain, caries, fracture of tooth, fracture of restoration, extraction of adjacent tooth, and insufficient approximal contact. The operator experience and duration of restoration were also recorded.

Data analysis was done in SPSS version 20. Frequencies and percentages for the reasons for failure of the restorations (amalgam and composite) and duration were computed. Data stratification was done by gender, age and operator experience using Chi-Square test. A P-value of less than or equal to 0.05 was considered significant.

RESULTS

The mean age of the participants was 29.98±8.84 years. The age was ranging from 18 to 60 years. Of total hundred restorations/cases the maximum number of cases (n=65, 65%) were age 18 to 30 years followed by age group 31 to 40 years (n=26, 26%). The males were 62(62%) and females were 38(38%). Amalgam restorations were found in 47(47%) and composite were in 53(53%) cases. The most common location of restorations was mandibular molars (n=49, 49%) followed by mandibular anterior teeth (n=18, 18%).

Table No.1: Distribution of age, gender, material, location of restoration and failure of restoration categories

Parameter	Category	Frequency	Percent
Age	18-30	65	65
	31-40	26	26
	41-50	5	5
	51-60	4	4
	Total	100	100
Gender	Male	62	62
	Female	38	38
	Total	100	100
Material	Amalgam	47	47
	Composite	53	53
	Total	100	100
Location of restoration	Lower anterior	18	18
	upper anterior	12	12
	Lower molar	49	49
	Upper molar	8	8
	Lower premolar	11	11
	upper premolar	2	2
	Total	100	100
Failure of restoration	Yes	28	28.0
	No	72	72.0
	Total	100	100.0

Table No.2: Distribution of causes of restoration failure and Longevity of restoration

Parameter	Category	Frequency	Percent
Causes of restoration failure	No	72	72
	Endodontic treatment/pain	6	6
	Fracture of tooth	1	1
	Fracture of restoration	8	8
	Insufficient approximal contact	1	1
	Endodontic + restoration fracture	9	9
	both fracture of tooth and restoration	1	1
	Secondary caries	2	2
	Total	100	100
Longevity of restoration	less than 1year	7	7.0
	1-2 years	16	16.0
	2-5 years	49	49.0
	6-8 years	17	17.0
	9-12 years	11	11.0
	Total	100	100.0

In maxilla there were 12(12%) restorations in anteriors and 8 restorations in molars. The frequency of failed restoration was found in 28(28%) cases. The rest of details are shown in table 1.

The most common cause of amalgam and composite failure was combined need for endodontic failure and fracture of restoration (n=9, 9%) followed by fracture of restoration itself (n=8, 8%) and need for root canal treatment (n=6, 6%). Other causes for failure of restoration were secondary caries (n=2, 2%), insufficient approximal contact (n=1,1%), and fracture of tooth (n=1,1%). The most common longevity of restoration was of 2-5 years duration (n=49, 49%) followed by 6-8 years (n=17, 17%) and 1-2 years (n=16, 16%). The maximum longevity of 9 to 12 years was found in 11(11%) cases. Less than one-year duration was found in 7 cases. The details are shown in table 2.

The failure was more in composite (n=20,27.8%) than amalgam (n=9, 19.2%) restorations and the results were statistically significant (P=0.040). Most commonly failed restorations were those placed by technicians (n=8, 53.30%), students in institute (n=3, 37.50%) and general dental practitioners (n=14, 25.5%). The failure for specialist (2 years degree) was 14.3% (n=1) and specialist (4 years degree) was 13.30% (n=2). But these differences were not statistically significant (P=0.109). Similarly, the failure rate among different age groups (P=.249), and in various locations (P=.065) were not statistically significant. The detailed statistics are given in table 3.

Table No.3: Failure of restoration stratified by material, operator experience, Cause of failure age and location of restoration

		Failure of restoration				P-value
		Yes		No		
		N	%	n	%	
material	Amalgam	9	31.03	38	80.90	0.04
	Composite	20	27.8	33	62.2	
Operator experience	General dental practitioner	14	25.50	41	74.50	.109
	Technician	8	53.30	7	46.70	
	Specialist (4-year degree)	2	13.30	13	86.70	
	Specialist (2-year degree)	1	14.30	6	85.70	
	Student in institute	3	37.50	5	62.50	
Cause of failure	No	0	0.00	72	100.00	<0.001
	Endodontic treatment/pain	6	21.40	0	0.00	
	Caries	0	0.00	0	0.00	
	Fracture of tooth	1	3.60	0	0.00	
	Fracture of restoration	8	28.60	0	0.00	
	Extraction of adjacent tooth	0	0.00	0	0.00	
	Insufficient approximal contact	1	3.60	0	0.00	
	Endodontic + restoration fracture	9	32.10	0	0.00	
	both fracture of tooth and restoration	1	3.60	0	0.00	
Secondary caries	2	7.10	0	0.00		
Age	18-30	21	75.00	44	61.10	.249
	31-40	7	25.00	19	26.40	
	41-50	0	0.00	5	6.90	

	51-60	0	0.00	4	5.60	
Location	Lower anterior	0	0.00	18	25.00	.065 ^a
	upper anterior	5	17.90	7	9.70	
	Lower molar	17	60.70	32	44.40	
	Upper molar	2	7.10	6	8.30	
	Lower premolar	4	14.30	7	9.70	
	upper premolar	0	0.00	2	2.80	

DISCUSSION

This study was conducted to know the longevity and causes of failure of amalgam in patients reporting to tertiary cares. Our findings showed that composite restorations were more than amalgam. Most common site of failure was in mandibular molars. The frequency of failure of amalgam and composite was 28%. The most common cause of amalgam and composite failure was combined endodontic failure and fracture of restoration followed by fracture of restoration itself and need for root canal treatment. Other causes for failure of restoration were secondary caries, insufficient approximal contact, and fracture of tooth. The maximum longevity for direct restoration was 12 years. The failure was more in composite than amalgam filling.

Several factors affecting the performance of direct restorations, including the experience level of the clinician,¹⁰ the type of restorative materials used,⁵ the tooth's position in the jaw,¹¹ the type of tooth,¹¹ the design of restoration,¹² the size of restoration,¹¹ the number of restored surfaces and the age of the patient¹³. Our results showed that composite filling were more than amalgam. The reason for this may more use of composite in posterior teeth. While in anterior teeth only composite filling are placed. The other reason for greater number of composite restoration than amalgam may due to concern of mercury toxicity in amalgam filling. It is now gaining popularity to restore posterior teeth with composite resins among practitioners, and there is increasing demand for such esthetic restorations. Certainly, the composite resin is most common esthetic alternative to dental amalgam.¹⁴

Our study showed that most common site of failure was in mandibular molars. This can be due to reason that mandibular first molar erupt first of all among the permanent teeth at the age of 5 years.¹⁵ At that time children are careless and most of our parents are not aware about oral hygiene of their children, so they are prone to caries and need restoration in order to relieve pain.¹⁶

The current results showed that the failure more in composite than amalgam filling. The results were statistically significant. A Cochrane review conducted on direct composite resin fillings versus amalgam fillings for permanent or adult posterior teeth in 2014 included seven trials in the systematic review and reported that resin composites lead to higher failure

rates and risk of secondary caries than amalgam restoration.¹⁷ These results are in consistent to the current findings.

The causes of amalgam and composite failure was combined need for endodontic failure and fracture of restoration followed by fracture of restoration itself, need for root canal treatment, secondary caries, insufficient approximal contact and fracture of tooth. A study conducted in Pakistan on reasons for the failure of class I and II amalgam restorations showed that common reasons to replace amalgam fillings was secondary caries, followed by inadequate resistance form.¹⁸ These results are similar to our findings as in our study we found that fracture of restorations or restored teeth was in the list of the reason for failure amalgam. These two; fracture of restorations or restored teeth are called inadequate resistance form.

In our study the frequency of failed restorations was 28%. A study conducted by Shah et al.¹⁹ in Pakistan on replacement of amalgam restorations reported that around 47% of the restorations underwent failure. The failure of Shah et al. is higher than our may due to improvement in modern materials and increased knowledge among practitioner as the Shah et al. study was conducted in 2010. Other reason for difference may that we calculated failure for both composite and amalgam while Shah et al. only reported amalgam failure rate.

In previous studies many cause of failure of composite fillings were reported which were secondary caries, occlusal stress risk, socioeconomic factors, experience of clinical operators, cavity designs, and endodontic failure.^{10, 12, 20}

However, the current study is cross study and cannot calculate survival of restoration. The survival analysis need follow up studies, so further large scale and longitudinal studies are needed on this subject. We ask the patients about duration of restorations so recall bias can be an issue in this study.

CONCLUSION

The amalgam and composite restorations needed to be replaced due to endodontic failure, fracture of tooth, fracture of restoration itself, secondary caries, and insufficient proximal contact. The clinicians need to be vigilant to combat these issues in their practices.

Author's Contribution:

Concept & Design of Study: Muhammad Amer Khan
 Drafting: Mohammad Adnan Khan, Mamoona Shah
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Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

- Soares AC, Cavaleiro A. A review of amalgam and composite longevity of posterior restorations. *Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial* 2010;51(3):155-64.
- Moraschini V, Fai CK, Alto RM, Dos Santos GO. Amalgam and resin composite longevity of posterior restorations: A systematic review and meta-analysis. *J Dent* 2015;43(9):1043-50.
- Frankenberger R, Garcia-Godoy F, Murray PE, Feilzer AJ, Krämer N. Risk aspects of dental restoratives: From amalgam to tooth-colored materials. *World J Stomatol* 2013;2(1):1-11.
- Hurst D. Amalgam or composite fillings—which material lasts longer? *Evidence-Based Dent* 2014;15(2):50.
- Hatrack CD, Eakle WS. *Dental Materials-E-Book: Clinical Applications for Dental Assistants and Dental Hygienists*; Elsevier Health Sciences; 2015.
- Shembish FA, Tong H, Kaizer M, Janal MN, Thompson VP, Opdam NJ, et al. Fatigue resistance of CAD/CAM resin composite molar crowns. *Dent Mater* 2016;32(4):499-509.
- Lynch CD, Opdam NJ, Hickel R, Brunton PA, Gurgan S, Kakaboura A, et al. Guidance on posterior resin composites: Academy of operative dentistry-European section. *J Dent* 2014;42(4):377-83.
- Bernardo M, Luis H, Martin MD, Leroux BG, Rue T, Leitão J, et al. Survival and reasons for failure of amalgam versus composite posterior restorations placed in a randomized clinical trial. *J Am Dent Assoc* 2007;138(6):775-83.
- Pouralibaba F, Joulaei M, Kashefimehr A, Pakdel F, Jamali Z, Esmaeili A. Clinical evaluation of reasons for replacement of amalgam restorations in patients referring to a dental school in Iran. *J Dent Research Dent Clin Dent Prospect* 2010;4(2):56-60.
- Mjör IA, Dahl JE, Moorhead JE. Age of restorations at replacement in permanent teeth in general dental practice. *Acta Odontol Scand* 2000;58(3):97-101.
- Norman R, Wright J, Rydberg R, Felkner L. A 5-year study comparing a posterior composite resin and an amalgam. *J Prosthet Dent* 1990;64(5):523-9.
- Hickel R, Brühaver K, Ilie N. Repair of restorations—criteria for decision making and clinical recommendations. *Dent Mater* 2013;29(1):28-50.
- Wahl M, Schmitt M, Overton D, Gordon M. Prevalence of Cusp Fractures in Teeth Restored with Amalgam and with Resin-based Composite. *J Esthet Restorat Dent* 2013;25(5):362-3.
- Bohaty BS, Ye Q, Misra A, Sene F, Spencer P. Posterior composite restoration update: focus on factors influencing form and function. *Clin Cosmet Investig Dent* 2013;5:33-42.
- Proffit WR, Fields HW, Larson B, Sarver DM. *Contemporary orthodontics-e-book*; Elsevier Health Sciences; 2018.
- Jaradat T, Ghozlan Mt, Showeiter M, Otom A, Kana'an N. The awareness of parents of the time of eruption of first permanent molar and caries prevalence in this tooth in children in the south of Jordan. *Pak Oral Dent J* 2013;33(3):498-501.
- Alcaraz MGR, Veitz-Keenan A, Sahrman P, Schmidlin PR, Davis D, Iheozor-Ejiofor Z. Direct composite resin fillings versus amalgam fillings for permanent or adult posterior teeth. *Cochrane Database Syst Rev* 2014(3):CD005620.
- Ahmed H, Mujeeb F, Rashid S, Hossein T. Reasons for the failure of class i and ii amalgam restorations. *Pak Oral Dent J* 2015;35(3):509-11.
- Shah SA, Khan M, Saleem M. Replacement of Amalgam Restorations- a study. *Pak Oral Dent J* 2010;30(1): 237-43.
- Demarco FF, Collares K, Correa MB, Cenci MS, Moraes RRD, Opdam NJ. Should my composite restorations last forever? Why are they failing? *Braz Oral Res* 2017;31:e56.