ORIGINAL RESEARCH

A Cross-sectional Retrospective Study of Survival of Amalgam Restoration in a Nigerian Teaching Hospital

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ABSTRACT

Background: This is a cross-sectional retrospective study on survival of amalgam restoration in a Teaching Hospital in Nigeria. There has been no study on this particular subject in Nigeria despite the fact that there is an alarming increase in dental caries and the preferred choice of treatment for over 5 decades has been amalgam restoration.

Materials and methods: It is a retrospective study of dental records of the dental center over a period of 12 years setting certain criteria that must be met by such records. Those that fulfilled these criteria were then recalled for examination.

Results: Two hundred and ninety-four amalgam restorations were placed with primary placements forming 75.69 of all restorations carried out while replacements were 24.31%. Fractured restoration was the commonest cause of failure of restoration accounting for 66% of all replacement. Ditching formed 15.5%, recurrent caries 11.6%, dislodged restoration 5.3%. While cervical overhanging amalgam was 1.6%. 25%, 50%, 75% cumulative failure rate occurs at 4.2 and 6.9 and 9.2 years respectively. While at the same time 73.2 and 19.2% of the restorations lasted for 5 and 10 years respectively.

Conclusion: Primary placement is the preoccupation of the dentist's in Nigeria while replacement rate is low. However, while recurrent caries is the major cause of restoration failure in economies country in Europe and America, it is not the case in this study.

Keywords: Amalgam, Cross-sectional study, Retrospective study, Restoration.

INTRODUCTION

The treatment records of patients attending the Dental Center University College Hospital, Ibadan, Nigeria between 1979 and 1992 were scrutinized and these who had attended the conservative dentistry clinic continuously for at least 5years period were retrieved. These records were examined for accuracy to remove ambiguities and the patients were recalled to compare the records of teeth and the treatment recorded. This record was used to determine the time of survival of each restoration placed or replaced over the 12-year period and the replacement rate of amalgam restoration.

The treatment of dental caries since early 18th century has been a great concern to the dentist. The demand for treatment in the developed countries has been increasing although over the last decade, the dentists are preoccupied with replacement of such fillings and battling with large restorations that are failing or almost failing.[1]

During examination of patients for dental treatment, not only do the newly carious teeth require attention, previous amalgam restorations may need replacement because of various factors,[2] although some restorations do not meet the precise criteria for success but yet capable of further survival and may not necessarily require replacement.[1,3]

Due to the focused interest in analysis of reasons for replacement and longevity of amalgam restorations, generalized statements has been made in some instances inferring that the insertion of a restoration in a tooth is the beginning of a vicious circle referred to as 'count down' to extraction.[4]

Longevity of amalgam restoration could also be dependent on the tooth it is being placed, the type of dentition where the restoration is placed[2,5] and is also affected by patients cooperation, time, access and operators ability[2] and the dietary habit of the patient.[6]

Due to the fact that records showed many amalgam restorations lasted over 10 years, the best choice of study is a cross-sectional retrospective study based on dental records. However, variables like brand of materials, the clinical conditions at the time of treatment and the quality of original restorations can not be controlled.[4]

Various factors affect the placement and replacement of amalgam restorations such as ability to interpret correctly when a carious lesion should be treated, development of secondary caries, mechanical failures of the restorations,[3] thus clinical assessments of failure, must necessarily differ according to the diagnostic criteria applied and this will reflect the interpretative variability of different operators.

Some authors also advanced the hypothesis that restorative dentistry is palliative rather than therapeutic, i.e. that it prolongs the life of the dentitions rather than saves it.[7,8] However, due to the ease of manipulation, adequate mechanical properties, low cost,[4] minimal need of equipment, ease of mixing and insertion, amalgam has been established as the commonest material for dental restorations.

A survival rate of 145 amalgams over 21 years was carried out and it was discovered that half of the restoration failed by 11 years.[9] In another study of 148 amalgam restorations over 20 years and 93 amalgam restorations over 15 years, results indicated that half of amalgam restorations were lost in 8 years.[10] A study carried out in a teaching hospital showed that about half of the amalgam restorations placed failed in slightly over 8 years and by 10 years all the restorations have failed.[11] Analysis showed that class I restorations survived better than class V with 50% failure in class I occurring over 10 years while that of class V was slightly over 8 years. Over 60% of class I amalgam restorations were still surviving while about 40% survived over the same period.

MATERIALS AND METHODS

The materials were the record files of patients that attended the dental centre of a University Teaching Hospital in the South West region of Nigeria between 1979 and 1992. All records indicating that a patient had attended the restorative clinic were set aside and numbered serially. The records were then carefully perused to note, if any amalgam restorations were placed at any time during the period of study and such patients were separated from the former pool. The third stage involved the separation of patients who had attended the clinic regularly for a minimum period of 5 years.

A regular attender was described as someone in the study who had attended the clinic at least once every 18 months within that 5 years period. This criteria was set because it was documented that patients only attended the clinic when there is severe pain.[6]

In order not to miss out any record, all files produced by the first stage was serially numbered and it was this number that was used through all the three stages of sorting.

The dental school/center used the British annotating charting system and this was employed in the recording. Anywhere there is ambiguity in the charting, that particular tooth was eliminated from the study and when there is any medication that the patient had gone to any other clinic for

restorative procedure. The particular tooth is eliminated from the study unless if the patient could give full information and data as regards the tooth treated. However, in cases where a patient could not indicate which and when the tooth was treated, then the patient is excluded from the study. All the patients in this study were recalled for cross-sectional examination and out of the total of 413 patients that were selected from the third stage, only 277 responded out of which twelve were eliminated because they have attended other clinics for treatment and the treatment could not be accounted for.

RESULTS

All the amalgam restoration placed during this period were 2,094 out of which 1258 was class I (60.08%) 770 was class II (36.77) while 66 were class V (3.15) restorations (Table 1).

A subdivision of class II was also carried out which showed that mesio-occlusal (MO) cavity was 310 (14.80% of total and 40.26% of class II restoration placed), disto-occlusal cavity (DO) was 346 (16.52 of total amalgam restoration placed and 44.94% of all class II restorations) while MOD was 114 forming 5.45% of total restorations placed and 14.80% of all class II restoration.

Table 2 shows that replacement rate was 24.31% (509 amalgam) while primary placement was 75.69% (1585 amalgam). For the replacements carried out, fractured restorations was 336 amalgam (16.04% of all restorations but it accounted for 66% of all replacements); ditching was 79 amalgam (3.77% of all restoration but 15.5% of all replacements), recurrent carries was 59 amalgam restorations (accounting for 2.82% of all restorations but 11% of all

Table 1: Total amalgam restoration placed according to classes

Classes		Number of restoration	%
I		1258	60.08
II	MO	316	36.77
	DO	346 } = 770	
	MOD	114	
V		66	3.158
Total		2094	100%

Table 2: Reasons for placement and replacement of amalgam

Criteria for placement	Number of amalgam restoration	%
Primary placements	1585	75.69
Replacements	509	24.31
Total	2094	100.00%

Table 3: Frequency analysis of criteria specified for placement/replacement for all amalgam restorations

Criteria		
Primary caries	1553	74.16
Fractured restorations	336	16.04
Marginal/defective restoration (ditching)	79	3.77
Recurrent caries	59	2.82
Dislodged restoration	27	1.29
Cervical abrasion	27	1.29
Others*	13	0.63

*Includes
• Cervical overhanging amalgam   (8)
• Fractured cusp   (3)
• Attrition   (2)

Table 4: Analysis of criteria given for replacement of amalgam restoration		
Fractured restoration	336	66.0
Ditching	79	15.5
Recurrent caries	59	11.6
Dislodged restoration	27	5.3
Cervical overhanging	8	1.6
	509	100.0

replacements); dislodged amalgam restorations was 27 (1.29% of all restorations but accounted for 5.30% of all replacements) while overhanging amalgam restorations amounted to 8 restorations 90.39% of all amalgam restorations but 1,57% of all replaced amalgam (Tables 3 and 4).

Table 3 shows the frequency analysis of criteria specified for placement and replacement for all amalgam restoration placed. Primary caries was the most reason cited in placement of amalgam in this study (74.16%) while replacement represents 25.84%. However, if primary placement is being considered, the figures would changed to 75.69% due to inclusion of cervical abrasion, fractured cusp and attrition. Fractured restoration amounted to three hundred and thirty six restorations (16.04%), ditching was 79 restorations (3.77%), recurrent caries was fifty nine restorations (2.82%), dislodged restoration was twenty seven restorations (1.29%) while other criteria amounted to 13 restorations (0.63%). The 'other' restorations were made up of attrition, fractured cusps and cervical overhang of amalgam restorations.

The frequency analysis of cumulative failure rate shows that the number of years by which 50% failure occurs is slightly less than 7 years (6.9 years), 25% of the total amalgam would be lost by 4.7 years while 75% of the restorations will be lost by 9.2 years. Also 73.2% of the total number of restorations lasted for 5 years, 19.2% for 10 years (Table 5).

For class I restorations 25% were lost in 5.6 years, 50% in 7.6 years while 75% were lost in 10 years. 17.1% of the restorations were lost in 5 years, 74.8% in 10 years (Table 6).

Twenty-five percent of class II restorations in this study were lost in 2.3 years, 50% in 5.7 years while 75% were lost in 8 years. Also 42.7% of these were lost in 5 years, 90.5% were lost in 10 years (Table 7).

Table 5: Cumulative failure (pooled data)				
Year of failure	Number failed	Cumulative total	Cumulative	Cumulative % for Crabb's study
1	134	134	6.39	5.3
2	113	247	11.80	13.0
3	100	347	16.57	21.9
4	81	428	20.44	31.0
5	134	562	26.84	35.2
6	258	820	39.16	39.6
7	252	1072	51.19	43.1
8	255	1327	63.37	47.5
9	208	1535	73.30	51.4
10	156	1691	80.75	56.1
Over 10 years or more (survival)	403	403	19.25	43.9
Total	2094	2094	100%	

Table 6: Cumulative failure for class I				
Year of failure	Number failed	Cumulative total	Cumulative	Cumulative % for Crabb's study
1	36	36	2.86	3.0
2	37	73	5.80	7.8
3	32	105	8.35	13.4
4	40	145	11.53	20.1
5	70	215	17.09	23.8
6	164	379	30.13	27.5
7	160	539	42.85	29.0
8	167	706	56.12	34.9
9	130	836	66.45	38.3
10	105	941	74.80	40.5
Surviving more than 10 years	317	317	25.20	59.5
Total	1258	1258	100%	100%

Table 7: Cumulative failure able for class II

Year of failure	Number failed	Cumulative total	Cumulative	Cumulative % for Crabb's study
1	93	93	12.08	6.0
2	70	16.3	21.17	14.5
3	65	228	29.61	24.5
4	40	268	34.81	34.2
5	61	329	42.73	39.1
6	92	421	54.68	44.3
7	82	503	65.32	48.7
8	76	579	75.19	53.6
9	69	648	84.16	57.3
10	49	697	90.52	62.8
Surviving more than 10 years	73	73	9.48	37.2
Total	770	770	100	100%

Table 8: Cumulative failure for class V

Year of failure	Number failed	Cumulative total	Cumulative	Cumulative % for Crabb's study
1	5	5	7.58	6.4
2	6	11	16.67	15.5
3	3	14	21.21	26.0
4	1	15	22.72	37.0
5	3	18	27.27	39.7
6	2	20	30.30	42.9
7	10	30	45.45	47.0
8	12	42	63.64	48.4
9	9	51	77.27	53.0
10	2	53	80.30	58.9
Surviving more than 10 years	13	13	19.70	41.1
Total	66	66	100	100

Table 9: For cumulative % of failed amalgam restorations at 25, 50 and 75% failure rates

	At 25%	At 50%	At 75%
Allan study A	3.0 years	5.4 years	8.4 years
Allan study A'	4.0 years	6.8 years	12.4 years
Robinson R	6.6 years	10.2 years	18.4 years
Crabb H	3.6 years	8.4 years	Unknown
This study pooled data	4.7 years	6.9 years	9.2 years
Class I	5.6 years	7.6 years	10.0 years
Class II	2.3 years	5.7 years	8.0 years
Class V	4.5 years	7.3 years	9.3 years

In class V restorations, 25% of the amalgam restorations were lost in 4.5 years, 50% in 7.3 years and 75% in 9.3 years while 27.3 and 80.3% of the restorations were lost in 5 and 10 years respectively (Tables 8 and 9).

DISCUSSION

This is a cross-sectional retrospective study of regular attenders at University College Hospital, Ibadan using records of patients who had attended the conservative dentistry clinic between 1979 and 1992. The list of all patients who had attended regularly for at least a period of 5 years was compiled and the patients recalled.

An author defined regular attenders as those seeking GDS care once every year with the proviso that not more than 18 months elapsed between two consecutive courses.[12]

A study[6] conducted in Nigeria showed that extreme and severe pain was the main reason for patients going to the dentist, therefore regular attendance for the purpose of this study would be taken as once in 18 months visit to the dentist but not more than 24 months.[6]

In this study, this problem is solved because those that were recalled were asked pertinent questions concerning dentists visited and treatments received during the patient's absence from the clinic. All patients who could not satisfactorily provide answers as to the type of treatment,

when and why it was carried out were eliminated from this study.

Several studies on restorations have been carried out especially those involving multiple operators while single operators has been involved in some studies, however, it is known that there is always the problem of single operator bias.

The single operator ability bias in other studies that has been carried out was to some extent smoothed out in this study. The various operators involved in this study included clinical students of varying abilities and different dentists.

Operators in this study just as it was practised in some other studies[9,10] did not use rubber dam as a means of isolation in the past four decades.

Operators involved in this study did not use rubber dam throughout as is done in other survey cotton wool isolation technique during operations has been the method of isolation in the past three decades. The mode of teaching and instructions to the students has been relatively constant while most of the dentists working at the center were either previous undergraduate/postgraduate students of the school or dentists undergoing residency training program.

The use of rubber dam, however, is an aid found more useful in pediatric dental patients' management as it forces cooperation from the patient.[13,14]

This study showed that replacement rate of 24.13% for all the restorations was 24.31, 13.43% for class I, 42.73% for class II and 16.67% for class V while in another study[15] a replacement rate of 11.5 and 9.8% for class I and II respectively.

Primary caries was the most frequent reason seen in this study for placement of amalgam restorations (74.16%), however, this is much higher than those seen in other surveys[8,15-17] which ranged between 29 and 59%.

For the pooled data, the cumulative failure rate seems to be better within the first 6 years than that seen in Crabbs'[11] study but deterioration was faster than Crabbs after 6 years.

The reason could not have been due to the operators not using rubber dams but may be due to the type of alloy used. It has been recorded that the low copper type of amalgam alloy is more predisposed to formation γ_2 phase.[18,19]

However, for class II restorations, the failure rate seen in this study tallied with that of Crabb for the first 4 years before spiraling badly. This may not be unconnected with the fact that students placed more MO and DO fillings than dentist because these formed part of the prerequisites needed to qualify for their final clinical examinations.

Secondly, because of the dietary habits of the patients, especially female[6], a constant and regular subjection of class II restorations to breaking of bones and hard nuts usually led to the fracture of such restorations at the isthmus.

For the pooled data of all amalgam restoration placed, the cumulative failure rate seen in this study is slightly better than the study carried out by Crabbs up till the 6th year. This is also the case with class I and V amalgam restoration. It is necessary to point out that no records were kept as to the type of amalgam alloy used in this study. It is also not impossible that as low copper γ_2 phase amalgam alloys are becoming unfashionable or being phased out, these alloys found their way into the developing countries. They will inevitably be cheaper and because there is no direct control of the importation machinery system in the hands of experts it will be easier to import these alloys.

This study found out that 25% of the amalgam restorations failed in 4.7 years and 75% failure in 9.2 years. Crabb[11] in his study recast the works of Robinson[9] and Allan[10] on a cumulative failure graph and the 25 and 75% failure rate from the graph produced was found to be comparable to this study.

A, A' were used to represent the Allan study, H for Crabb's study. The median longevity or cumulative failure of amalgam restorations of this study at 50% was 7.6 years which is better than A, A' studies, that at 75% is better than the result obtained in A study only while 25% failure rate is better than A, A' and H studies.

No other study had compared the cumulative percentage failure rate at 25, 50 and 75% for each class of amalgam restorations. In this study, it was found out that the cumulative failure rate at 25% for class I, II and V were 5.6, 2.3 and 4.5 years respectively. The cumulative percentage of failure at 50% for I, II and V were 7.6, 5.7 and 7.3 years respectively while that at 75% for class I, II and V were 10, 8, 9.3 years respectively.

The fact that class I restoration have a median longevity that is more than the other classes in spite of the dietary habits in this environment could contained within the four cavity walls whereas class II restorations would easily fracture at the isthmus under the same kind of occlusal load.

Evaluation of the success of treatment is directly related to the age of the amalgam restoration needing replacement. There is a big variation or different in clinical judgment by operator with regards to with presents a failed amalgam restoration and most of the variation in replacement rates could be explained by factors unique to an individual dentist (for example personality variables, treatment preference, economics or attitude toward patients).

There is variation to the rate and survival time reported by various authors either in clinical, longitudinal retrospective or cross-sectional studies. The failure rate at the end of 5 and 10 years varied between 16% and 60% and 42% and 80% respectively. Although a study reported 14% failure rate at the end of 4 years[8] while another one

reported 4 and 7% failure rate for class I and II amalgam restorations respectively.

This study has a cumulative failure rate of 26.84 and 80.75% at 5 and 10 years respectively and when compared to other studies, the percentage of restorations surviving at 10 years lies at the lower range of 16 to 83% obtained from other studies. It would be expected that if the failure is due to material or operator defects or mistakes the restoration would have failed very early in its life span.

CONCLUSION

Due to the high percentage of primary caries, there is the need to embark on a program to deliberately reduce the incidence of caries.

There must be an onus on dentist to check the type of amalgam alloy being used now so as to avoid those with high γ_2 phase. The supervising dentist should pay closer attention to isthmus preparation and there is the need for oral hygiene education especially females to change their dietary habits. Primary oral health policy at the various tiers of government should be formulated and implemented to stem the prevalence of dental caries.

Finally, the properties of amalgam and the low cost will still make it the best restorative materials in the developing countries for several years to come.

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