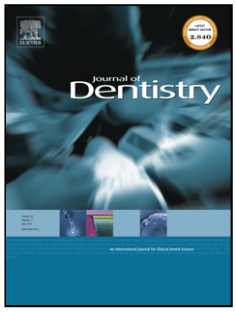

Title: An update on the reasons for placement and replacement of direct restorations

Authors: Dena Eltahlah, Christopher D. Lynch, Barbara L. Chadwick, Igor R. Blum, Nairn H.F. Wilson

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Title: An update on the reasons for placement and replacement of direct restorations.

Authors: Dena Eltahlah,

Specialist Trainee in Paediatric Dentistry,

University Dental Hospital,

Cardiff.

Christopher D Lynch

Professor/ Consultant in Restorative Dentistry,

University Dental School & Hospital, University College Cork

Wilton, Cork,

Ireland.

Barbara L Chadwick

Professor/ Consultant in Paediatric Dentistry,

School of Dentistry,

Heath Park,

Cardiff.

Igor R Blum

Director

Maurice Wohl Centre

London.

Nairn HF Wilson

Emeritus Professor of Dentistry,

Kings College London Dental Institute,

London.

Address for correspondence :Professor Chris Lynch , University Dental School & Hospital , Wilton , Cork , Ireland , Email: chris.lynch@ucc.ie

Abstract

Aim: The aim of this study was to review patterns of restoration placement and replacement. A previous study had been carried out in the late 1990s and this study sought to update the literature in this important aspect of dental practice.

Method: Studies based on the protocol of Mjör (1981) were selected. Such studies involved participating dentists completing a proforma each time a patient presented for a new or replacement restoration.

Results: Twenty-five papers were included in this study, of which 12 were included in the original review. The pre-1998 review reported on the placement of 32,697 restorations of which 14,391 (44%) were initial placements and 18,306 (56%) were replacements. The new studies included in the post-1998 review reported on an additional 54,023 restorations, of which 22,625 (41.9%) were initial placements and 31,398 (58.1%) were replacements. Therefore, across all studies considered, information is available on 86,720 restorations, of which, 37,016 (42.7%) were new placements and 49,704 (57.3%) were replacements. Comparing review periods, there was a reduction in the placement of amalgam restorations from 56.7% (pre-1998 review) to 31.2% (post-1998 review), with a corresponding increase in the placement of resin composites from 36.7% to 48.5%. The most common use of amalgam was seen in Nigeria (71% of restorations), Jordan (59% of restorations) and the UK (47% of restorations). The most frequent use of resin composite was seen in Australia (55% of restorations), Iceland (53% of restorations) and Scandinavia (52% of restorations). Secondary caries was the most common reason for replacing restorations (up to 59% of replacement restorations).

Conclusion: In the years subsequent to the initial review, replacement of restorations still accounts for more than half of restorations placed by dentists, and the proportion of replacement restorations continues to increase. Trends towards the increased use of resin composites is noted in recent years.

Clinical Significance: Further research is required in this area to investigate changes in the approaches to the restoration of teeth, especially with increased understanding of the concept of restoration repair as an alternate to replacement.

Keywords: restorations, replacement, caries, fracture, repair, operative dentistry

Introduction

Despite many advances in prevention, oral health education, improved oral hygiene practices and the availability of fluoride, the management of caries, via the placement of restorations, remains a significant component of the day-to-day work of the dental team. Despite efforts to reduce the effects of caries, population-based studies reveal that the prevalence of caries remains stubbornly high. An example of this is seen within the United Kingdom population, where 84% of dentate adults were found to have at least one restoration(1). Of these adults each had, on average, 7.2 filled teeth. Such figures are of concern when one considers the dental maintenance requirements of these patients, particularly as each restoration will require periodic intervention and management, let alone when one considers that the longevity of dental restorations in primary dental care settings is poor. Analysis of the survival of dental restorations from within a large database of dental treatments within UK dental practice reveals that further intervention is required(2):

- within 11% of fillings after 1 year of placement
- within 20% of fillings after 3 years of placement

- within 50% of fillings after 10 years of placement

It is easy to appreciate that all restorations will ultimately suffer deterioration and degradation leading to the need for further intervention(3). Reasons for this can include marginal defects, secondary caries, fracture of the restoration or adjacent tooth substance and, in the case of tooth-coloured restorations, unacceptable appearance(4). However, the decision to intervene in an existing restoration may be highly subjective on the part of the operator: factors such as the age of the patient, the size and location of the restoration can influence the rate at which existing restorations receive further intervention, as can changing dentist(5). As such, there is potential for over-treatment. The risk of iatrogenic effects with over-treatment, notably the needless replacement of existing restorations, are significant, and often associated with the inevitably unnecessary loss of intact, healthy tooth tissue. Over the course of a lifetime, many such interventions cause great harm to a tooth, descending the so-called “restorative death spiral”(6). If a patient has a number of teeth irretrievably slipping down this spiral, the effects on the dentition may be many and varied, including a progressive deterioration in dental attractiveness and loss of occlusal function, possibly influencing quality of life. Also, lifetime cost of dental care may be substantially increased.

Almost 20 years ago, a review(3) of studies with similar methodology reported that replacement restorations accounted for 56% of restorations placed by dentists. This review included studies performed between 1981 and 1998, and aggregated their findings. Since then there have been many changes in the approaches to the restoration of teeth. These include:

- enhanced understanding of when it is necessary or, more precisely, not necessary to intervene in existing restorations;
- a greater understanding of the concept of restoration repair where, in the presence of secondary caries or fracture, it is possible to perform a localized repair rather than unnecessarily removing the restoration in its entirety;
- an increased use, matched by predictability, in the use of adhesive dentistry techniques, particularly the application of resin composites (composites) in posterior teeth.

As such, it was considered useful to expand the previous review to include studies completed since 1998, and to investigate, in particular, if patterns of placement/ replacement restorations have changed. Therefore, the aim of the present study was to review relevant papers with a similar methodology published since 1981 and to consider the effects, if any, of recent changes in the approach to the restoration of teeth and management of already-restored teeth.

Methods

For the purposes of this review, studies based around the protocol of Mjör 1981(4) were selected. Such studies involved participating dentists completing a proforma each time a patient presented for a new or replacement restoration over a period of time. Dentists were asked to record all restorations placed, and indicate the main reason for the initial placement or replacement from a set of options.

Studies that did not include the selected methodology were excluded. Also, studies were excluded if they reported on reasons for placement only, restorations for anterior teeth only, or if it was not possible to separate data pertaining to different types of restoration.

Studies were identified using searches of electronic databases, as well as hand-searching of the literature, including the reference lists of related and similar studies. The search was last updated in September 2017.

The data sought was extracted from the reports of the selected studies and collated for analyses and comparison.

Results

Studies included

The original review included 12 papers (4, 7-17) (Table 1). A review of the literature identified one additional paper from this period that was not included in the 'original' review (18). This paper was added to this current review.

Twelve additional papers (19-30) were identified and added to the post-1998 review (Table 2). In some cases, two papers reported different aspects of the same study. Not all the papers reported data to the same level of detail. However, a decision was made to include these papers, as their exclusion would have skewed the answers to some of the key research questions (e.g. the overall ratio of placements: replacements).

Placement: replacement ratios

The original review reported on the placement of 32,697 restorations, of which 14,391 (44%) were placements and 18,306 (56%) were replacements. These numbers are slightly different to those reported in the original review paper, as we found a discrepancy in numbers in one of the papers (16). This paper was in press at the time the review was written, and presumably amended prior to publication. The placement: replacement ratios ranged between 1:0.6 to 1:2.8 (Fig.1).

The studies included in the post-1998 review reported on an additional 54,023 restorations, of which 22,625 (41.9%) were placements and 31,398 (58.1%) were replacements. The placement to replacement ratios ranged between 1:0.4 to 1:2.2 (Fig.1).

Across all the studies in the original and post-1998 review, information was available on 86,720 restorations. Of these 37,016 (42.7%) were new placements and 49,704 (57.3%) were replacements. The overall placement to replacement ratio was therefore 1: 1.3.

Patterns of restorative material use

Within the overall review (1981 – present), the distribution of restorative materials was:

- 35,367 (40.9%) amalgams,
- 38,085 (44%) composites,
- 11,605 (13.4%) glass-ionomers/ resin modified glass Ionomer/ compomers
- 1,512 (1.7%) 'other' restoration types (temporary, indirect, not specified)

These were further considered by grouping the studies into those published in the original review and those published after 1998. The patterns of restorative materials used are summarized in Table 3. The post-1998 review featured a reduction in the placement of amalgam restorations from 56.7% in the original review to 31.2% in the post-1998 review, with a corresponding increase in the placement of resin composites from 36.7% to 48.5%

The pattern and reasons of materials used for placements and replacements were also considered and is reported in Table 4. Overwhelmingly, the material of choice for placement and replacement restorations in the original review was amalgam (58.6% placement, 57.3% replacement), followed by composite (37.8% placement, 40.3% replacement). However, in the post-1998 review, the order was reversed: composite accounted for 38.8% of placements and 47% of replacement restorations, while the corresponding proportions for the amalgam was 34.1% and 37%.

When considering Tables 3 and 4, it is important to note that not all papers reported the same level of detail. For example, in Table 4, only 9 papers from the original review and 5 papers from the post-1998 review had details about different types of restorations placed and replaced. Therefore, the total number of restorations in Tables 3 and 4 are not the same.

Table 5 considers material selection by country/ geographical region in the post-1998 review. The most common use of amalgam was seen in Nigeria (71% of restorations), Jordan (59% of restorations) and the UK (47% of restorations). The most frequent use of composite was seen in Australia (55% of restorations), Iceland (53% of restorations) and Scandinavia (52% of restorations).

Reasons for placement and replacement of restorations

Restoration placement

When considering the reasons for initial placement of restorations, primary caries, followed by non-carious defects, predominated throughout in both the original and the post-1998 reviews.

In the original review, the most common reasons for restoration placement were:

- primary caries, ranging between 55%-100% for amalgam and between 38%-100% for resin composite.
- non-carious defects, ranging between 0-13% for amalgam and 0-59.1% for resin composite.

Glass-ionomer/ modified glass-ionomer use was reported in only 4 out of the 10 papers and, in contrast to amalgam and resin composite, non-carious defects were the most common reason for initial placement of these materials ranging between 34.2%-71%. Primary caries was the second most common reason with a range of 29%-65.8%.

In the post-1998 review, the most common reasons for initial restorations placement were:

- primary caries, ranging between 48.8%-100%.
- non-carious defects ranging between 0-29.9%

(Only two papers included in the updated review reported details of reasons for initial placement of restorations and did not differentiate between amalgam and resin composite).

Restoration replacement

In the original review, the most common reasons for replacement of amalgam was secondary caries (ranging from 25%-67%) followed by bulk/marginal fracture (15-45%). For resin composite, the most common reason for replacement was secondary caries (20-44%), followed by bulk/marginal discoloration (13-37%) and poor anatomic form (0-40%).

In the post-1998 review, only 9 out of the 13 papers recorded details of reasons of replacements of different restorations. For amalgam, secondary caries was again the most common reason (28.5-57%) followed by bulk/marginal fracture (11.5-29%) then tooth fracture (0-24%). For resin composite, secondary caries was the most common reason (29-59%) followed by bulk/marginal fracture (9.1-38%) then bulk/marginal discoloration (0-18.2%)

Discussion

The results of this study provide information on the placement of 86,720 restorations, including information on 54,023 restorations in the updated review section. Practitioner-generated information on such large numbers of restorations is relatively rare and provides valuable insight into reasons for operative intervention and the selection of restorative materials in clinical practice.

The percentage of restoration replacements increased since the time of the original review: 58% of restorations in the updated review were, compared to 56% in original review. This increase in percentage replacement restorations indicates that replacement restorative procedures form an increasing part of the day-to-day work of dentists. The reasons for this increase are considered to be many and varied; however, in the absence of any evidence of reductions in the longevity of initial placement restorations, the principal reason may be found to be related to increased longevity of patients and their wish to retain more teeth, ideally throughout life. In an ageing population the management of failed and failing restorations becomes all the more complex, with associated financial burdens for patients and providers of oral health care(31). A trend towards more replacement than initial placement restorations may therefore add to the cost of oral healthcare, unless preventive strategies are effective and there is a significant reduction in the need for less expensive initial placement restorations, together with some reduction in the need for replacement restorations – an unlikely scenario given, for example, the tendency for root caries in older patients to affect multiple teeth and the need for restorations to manage non-carious lesions increasing (32).

<u>Decision-making</u>

Previous investigations have highlighted factors associated with increased restoration replacement rates, including, in addition to the age of the patient, the size and location of the restoration and changing dentist(2). The subjective element in restoration replacement decision-making continues to be cause for concern. For example, the influence of changing dentist on restoration replacement was highlighted by the Bogacki study which, following analysis of an insurance database in Northwest USA showed that over 5 years the probability of survival of amalgam and posterior resin composite restorations was comparable (in the region of 93%) as long as the patient remained with the same dentist(33). However, on changing dentist, the probability of survival of both materials fell to approximately 60%. This has been mirrored within similar studies of NHS funded dental care in the UK(2). As concluded in a recent review of criteria for the replacement of restoration, further research in the area, spanning the risk assessment of defective and failing restorations and new diagnostic tools and processes, together with work to enhance the evidence base of restoration repair vs replacement, would be of immense value(34).

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<u>Secondary caries</u>

This updated review has highlighted that secondary caries remains the most common reason for replacing existing restorations. It is important to realize that “secondary caries” (i.e. caries adjacent to, or at the margins of a restoration) is, in fact, new caries(35). Treatment of what is typically a relatively small, localised lesion, adjacent to a restoration, can avoid the needless removal of remaining sound restoration, and in the process saving sound tooth tissue, which would otherwise be lost, with associated benefits to the dentine-pulp complex. It is suggested that dental school educators and providers of Continuing Education/ Continuing Professional Development

programmes consider increased provision of education in this most common of aspects of operative dentistry to encourage practitioners to shift, if not already doing so, to considering the

replacement of a restoration as a last resort rather than as a prudent action to be taken if in any doubt about clinical acceptability: “as a last resort take it out, rather than, if in doubt take it out”(34)

Restorative materials

Comparison of the original and post-1998 review periods provides insights into patterns of restorative materials use. The use of amalgam as a restorative material decreased from 57% in the original review to 31% in the post-1998 review. In comparison, the use of resin composite increased from 37% to 48%.

The placement of resin composites in posterior teeth is supported by an ever-increasing evidence base (36-38). The findings of the present review confirm that the selection of resin composites for the restoration of posterior teeth is now commonplace in countries such as Iceland, Sweden, Finland, the US and Australia. This is to be welcomed as the benefits of using composite to restore posterior teeth are now well-recognised, including permitting a minimally invasive form of treatment, enhanced marginal seal and the reinforcement of undermined and vulnerable areas of tooth tissue. Some countries would appear to be committed to the ongoing use of amalgam, including Jordan, Nigeria and the UK. The continued use of amalgam in the first two countries may be related to the developing nature of their healthcare services, along with relatively high caries rate. The reasons for the continued, high use of amalgam in the UK is contrary to trends in other developed economies. This atypical usage of amalgam in countries with well-established oral healthcare systems would appear to be related to the commissioning and funding of National Health Service dental care, and entrenched attitudes of established practitioners(39). The slow, apparently reluctant shift to evidence-based, minimal interventive operative dentistry, utilising state of the art composites techniques in the restoration of posterior teeth in the UK is increasingly difficult to defend in terms of acting in the best interests of patients.

As in all reviews, the findings of this review are dependent on the accuracy and quality of the studies included in the review. While arguments could be made concerning the representativeness of the findings, these, it is suggested may largely be countered by having considered 25 studies providing information on 86,720 restorations. In time, it is to be hoped that with the increased use of electronic record systems that studies of the type reviewed may be more common and much bigger. With the availability of ‘big data’ trends in service provision and such things as the selection of restorative materials will be greatly facilitated.

Apart from the present review having highlighted the need for further research into when to intervene in restorations which are exhibiting signs of deterioration, there is a pressing need for a suitably designed randomised control trial to compare the outcome of repairing *vs* replacing defective restorations, the outcome of which could provide the evidence-base to hopefully drive “as a last resort take it out, rather than, if in doubt take it out” or “think repair before replace”.

Conclusion

Replacement of restorations continues to account for more than half of restorations placed, and the proportion of replacement restorations has increased. With the exception of typically developing countries, the use of composite exceeds the use of amalgam for the restoration of posterior teeth

Opportunity to collect 'big data' on restoration placement and replacement and much -needed randomized controlled investigations on the repair *vs* replacement of failing restorations would greatly facilitate new understanding of immediate relevance to the commonest procedures in the clinical practice of dentistry.

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Figures

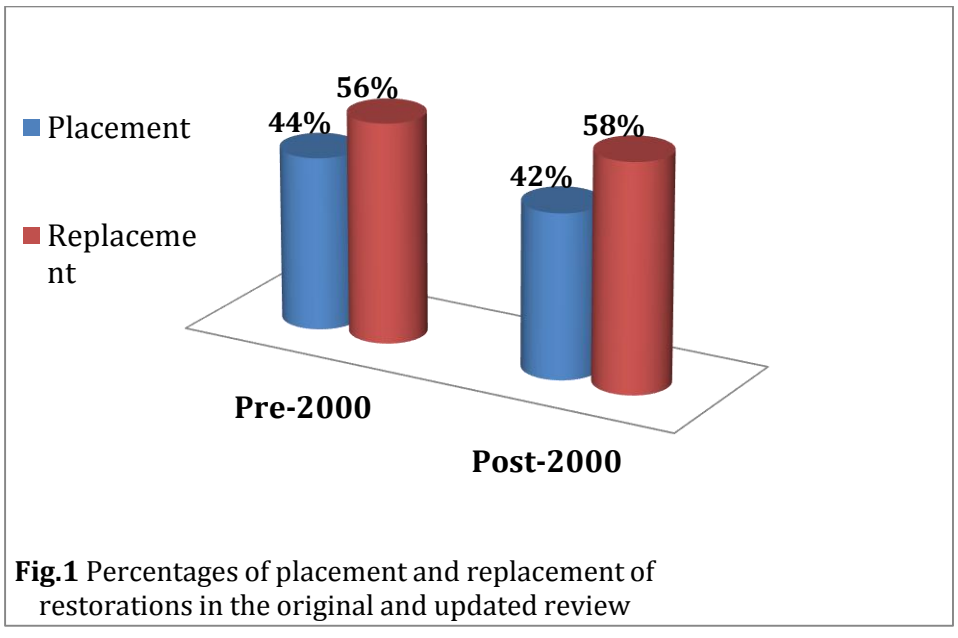

Fig.1 Percentages of placement and replacement of restorations in the original and updated review

Tables

See accompanying document

Table 1: Original review: details of the restorations surveyed according to material and placement: replacement ratio

Author(s) Year of publication	*Clinicians (Characteristics) Country*	*Materials (where reported)*	*Number of restorations n (%)*	*Overall number of placement and replacement where reported*		*Placement : replacement ratio*
				Placement	*Replacement*	
Mjor IA (4) 1981	General Practitioners (Private practice) Sweden	Amalgam	3527 (64.3%)	1023 (29%)	2504 (71%)	1:2.4
		Composite	1960 (35.7%)	416 (21.2%)	1544 (78.8%)	1:3.7
		Total	5487 (100%)	1439 (26.2%)	4048 (73.8%)	1:2.8
Qvist & others (7,8) 1986	General Practitioners (postgraduate courses) Denmark	Amalgam	1032 (70.9%)	491 (47.6%)	541 (52.4%)	1:1.1
		Composite	424 (29.1%)	165 (38.9%)	259 (61.1%)	1:1.6
		Total	1456 (100%)	656 (45.1%)	800 (54.9%)	1:1.2
Qvist & others (9,10) 1990	General Practitioners (postgraduate courses) Denmark	Amalgam	2317 (54%)	904 (39%)	1413 (61%)	1:1.6
		Composite	1974 (46%)	752 (38.1%)	1222 (61.9%)	1:1.6
		Total	4291 (100%)	1656 (38.6%)	2635 (61.4%)	1:1.6
Mjor & Toffenetti (11,12) 1992	General Practitioners Italy	Amalgam	1935 (65.4%)	1148 (59.3%)	787 (40.7%)	1:0.7
		Composite	1025 (34.6%)	530 (51.7%)	495 (48.3%)	1:0.9
		Total	2960 (100%)	1678 (56.7%)	1282 (43.3%)	1:0.8
Mjor & Um (13) 1993	General Practitioners South Korea	Amalgam	760 (64.7%)	471 (62%)	289 (38%)	1:0.6
		Composite	415 (35.3%)	245 (59%)	170 (41%)	1:0.7
		Total	1175 (100%)	716 (60.9%)	459 (39.1%)	1:0.6
Pink & others (14) 1994	General Practitioners USA	Amalgam	1825 (54%)	812 (44.5%)	1013 (55.5%)	1:1.2
		Composite	1553 (46%)	741 (47.7%)	812 (52.3%)	1:1.1
		Total	3378 (100%)	1553 (46%)	1825 (54%)	1:1.2
Wilson & others (15) 1997	General Practitioners (university affiliated) United Kingdom	Amalgam	1076 (45.2%)	377 (35%)	699 (65%)	1:1.9
		Composite	876 (36.8%)	342 (39%)	534 (61%)	1:1.6
		Glass ionomer	427 (18%)	149 (34.9%)	278 (65.1%)	1:1.9
		Total	2379 (100%)	868 (36.5%)	1511 (63.5%)	1:1.7
Deligeorgi & others (16) 1998	Students United Kingdom	Amalgam	695 (51%)	290 (41.7%)	405 (58.3%)	1:1.4
		Composite	465 (34.1%)	221 (47.5%)	244 (52.5%)	1:1.1
		Glass ionomer	202 (14.8%)	168 (83.2%)	34 (16.8%)	1:0.2
		Total	1362 (100%)	679 (49.9%)	683 (50.1%)	1:1
Deligeorgi & others (16) 1998	Students Greece	Amalgam	514 (43.6%)	321 (62.5%)	193 (37.5%)	1:0.6
		Composite	601 (51%)	354 (58.9%)	247 (41.1%)	1:0.7
		Glass ionomer	63 (5.3%)	48 (76.2%)	15 (23.8%)	1:0.3
		Total	1178 (100%)	723 (61.4%)	455 (38.6%)	1:0.6
Burke & others (17) 1999	Vocational dental practitioners and trainers United Kingdom	Amalgam	4871 (53.9%)			1:1.3
		Composite & Compomer	2690 (29.8%)			1:1.1
		Glass ionomer & modified glass ionomer	1470 (16.3%)			1:0.7
		Total	9031 (100%)	4423 (49%)	4608 (51%)	1:1
		Total	**32,697 (100%)**	**14,391 (44%)**	**18,306 (56%)**	**1:1.3**

*empty cells indicate that data was not reported.

Table 2: Post-1998 Details of the restorations surveyed according to material and placement: replacement ratio

Author(s) Year of publication	Clinicians (Characteristics) Country	Materials (Where reported)	Number of restorations n (%)	Overall number of placement and replacement where reported		Placement : replacement ratio
				Placement	Replacement	
Mjor & Moorhead (18) 1998	General Practitioners USA	Amalgam	780 (38.3%)	392 (50.3%)	388 (49.7%)	1:0.99
		Composite	832 (40.9%)	411 (49.4%)	421 (50.6%)	1:1.02
		Glass ionomer	81 (4%)	38 (46.9%)	43 (53.1%)	1:1.1
		Other	342 (16.8%)	115 (33.6%)	227 (66.4%)	1:1.97
		Total	2035 (100%)	956 (47%)	1079 (53%)	1:1.1
Mjor & others (19,20) 1999 & 2000	General Practitioners (Private & Salaried) Norway	Amalgam	7165 (32%)	2006 (28%)	5634 (72%)	1:2.8
		Composite	9180 (41%)	2293 (25%)	7004 (75%)	1:3
		Glass ionomer	1791 (8%)	1003 (56%)	609 (44%)	1:0.6
		modified glass ionomer	3583 (16%)	1648 (46%)	1522 (54%)	1:0.9
		Other	672 (3%)	215 (32%)	457 (68%)	1:2
		Total	22391 (100%)	7165 (32%)	15226 (68%)	1:2
Burke & others (21) 2001	General Practitioners UK	Amalgam	1710 (53.5%)			
		Composite	1008 (31.5%)			
		Glass ionomer	213 (6.7%)			
		Compomer	265 (8.3%)			
		Total	3196 (100%)	1097 (34.3%)	2099 (65.7%)	1:1.9
Mjor & others (22) 2002	General Practitioners Iceland	Amalgam(all prim + perm)	2435 (29.2%)			
		Composite	4449 (52.7%)			
		Glass ionomer	839 (9.5%)			
		modified glass ionomer	588 (7.1%)			
		Other	84 (1.4%)			
		Total	8395 (100%)	4398(52.4%)	3997 (47.6%)	1:0.9
Frost (23) 2002	General Practitioners UK	Amalgam	167 (21.4%)	55 (32.9%)	112 (67.1%)	1:2
		Composite	89 (11.4%)	53 (59.6%)	36 (40.4%)	1:0.7
		Glass ionomer	430 (55.2%)	196 (45.6%)	234 (54.4%)	1:1.2
		Not specified	93 (12%)	60 (64.5%)	33 (35.5%)	1:0.6
		Total	779 (100%)	364 (46.7%)	415 (53.3%)	1:1.4
Al-Negrish (24,25) 2002 & 2001	General Practitioners Jordan	Amalgam	3166 (58.6%)	1734 (54.8%)	1432 (45.2%)	1:0.8
		Composite	2239 (41.4%)	1380 (61.6%)	859 (38.4%)	1:0.6
		Total	5405 (100%)	3114 (58%)	2291 (42%)	1:0.7
Palotie & Vehkalahti (26) 2003	General Practitioners (Public dental services) Finland	Amalgam	143 (4.7%)			
		Composite	2076 (67.9%)			
		Glass ionomer & modified glass ionomer	640 (21%)			
		Temporary	137 (4.5%)			
		Unreported	60 (1.9%)			
		Total	3056 (100%)	2074 (67.9%)	982 (32.1%)	1:0.5
Forss &Widstrom (27) 2004	General Practitioners (Private practice) Finland	Amalgam	155 (4.5%)			
		Composite	2712 (78.5%)			
		Glass ionomer & modified glass ionomer	229 (6.6%)			
		Compomer	152 (4.4%)			
		Indirect restorations	134(3.9%)			
		Unreported	73 (2.1%)			
		Total	3455 (100%)	1206 (34.9%)	2249 (65.1%)	1:1.9
Tyas (28) 2005	General Practitioners Australia	Amalgam	767 (28.2%)			
		Composite	1481 (54.5%)			
		Glass ionomer	406 (14.9%)			
		modified glass ionomer	44 (1.6 %)			
		Unreported	18 (0.7%)			
		Total	2716 (100%)	1256 (46.2%)	1460 (53.8%)	1:1.2
Udoye & Okechi (29) 2008	General Practitioners Nigeria	Amalgam	320 (71.1%)			
		Composite	100 (22.2%)			
		Glass ionomer	30 (6.7%)			
		Total	450 (100%)	324 (72%)	126 (28%)	1:0.4
Sunnegardh-Gronberg & others (30) 2009	General Practitioners (Public dental health) Sweden	Amalgam	7 (0.3%)	0	7 (100%)	
		Composite	1936 (90.3%)	624 (32.2%)	1312 (67.8%)	1:2.1
		Glass ionomer & modified glass ionomer	152 (7.1%)	34 (22.4%)	118 (77.6%)	1:3.5
		Other	50 (2.3%)	13 (26%)	37 (74%)	1:2.8
		Total	2145(100%)	671(31.3%)	1474 (68.7%)	1:2.2
		Total	**54,023**	**22,625 (41.9%)**	**31,398 (58.1%)**	**1:1.4**

Table 3. Patterns of restorative materials used (percentages calculated in columns)

Material	*Original review*	*Post-1998*	*Total*
Amalgam	18,552 (56.7%)	16,815 (31.2%)	35,367 (40.9%)
Resin composite	11,983 (36.7%)	26,102 (48.5%)	38,085 (44.0%)
Glass-ionomer/ Modified GIC	2,162 (6.6%)	9,443 (17.5%)	11,605 (13.4%)
Other	0	1,512 (2.8%)	1,512 (1.7%)
Total	32,697 (100%)	53,872 (100%)	86,569 (100%)

Table 4. Patterns of restorative materials used for placement and replacement (percentages calculated in columns).

Material	*Original review*		*Post-1998 review*		*Total*	
	Placement	*Replacement*	*Placement*	*Replacement*	*Placement*	*Replacement*
Amalgam	5,837 (58.6%)	7,844 (57.3%)	4,187 (34.1%)	7,573 (37%)	10,024	15,417
					25,441	
Resin Composite	3,766 (37.8%)	5,527 (40.3%)	4,761 (38.8%)	9,632 (47%)	8,527	15,159
					23,686	
Glass-ionomer/Modified GIC	365 (3.6%)	327 (2.4%)	2,919 (23.8%)	2,526 (12.3%)	3,284	2,853
					6,137	
Other/Not specified	0	0	403 (3.3%)	754 (3.7%)	403	754
					1,157	
Total	9,968 (100%)	13,698 (100%)	12,270 (100%)	20,485 (100%)	56,421	

Table 5. Pattern of use of restorations in different countries post-1998

	Amalgam	*Composite*	*GIC/Modified GIC*	*Other*
USA 1998	780 (38%)	832 (41%)	81 (4%)	342 (17%)
Scandinavia 1999, 2000, 2003. 2004, 2009	7470 (24%)	15904 (52%)	6547 (21%)	993 (3%)
UK 2001	1877 (47%)	1097 (28%)	908 (23%)	93 (2%)
Jordan 2001	3166 (59%)	2239 (41%)	0	0
Iceland 2002	2435 (29%)	4449 (53%)	1427 (17%)	84 (1%)
Australia 2005	767 (28%)	1481 (55%)	450 (17%)	0
Nigeria 2008	320 (71%)	100 (22%)	30 (7%)	0