

Reasons for restorative therapy and the longevity of restorations in adults

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The aim of this study was to obtain information on the restorative dental care of adults in Finland. A random sample of private dentists was drawn from the register, and in spring 2000 they were sent a questionnaire requesting them to record information for each restoration placed during one ordinary working day. A total of 800 dentists were contacted and 548 responded. The dentists reported placement of 3,455 restorations. Of these, 5% were Class I, 36% were Class II, 13% were Class III, 9% were Class IV, 21% were Class V, and 16% were extensive restorations including 4 or more surfaces. Overall, composite resin was the most common restorative material, and it was used in 79% of the restorations, whereas amalgam was used in 5%, compomers in 4%, and glass ionomers (either conventional or resin-modified) in 7% of cases. In 5% of the cases, the tooth was restored with indirect restorative methods, using either gold or ceramic materials. Of the treatments, 65% were replacements of previous restorations. Secondary caries was the most common reason for replacement (36%, 52%, and 41% for composite, glass ionomer, and amalgam, respectively). Other common reasons were fractures of the tooth or restoration (23%, 11%, and 22% for composite, glass ionomer, and amalgam, respectively) and lost composite restorations (16%). The median age of failed restorations was 15 years for amalgam, 6 years for composite, and 7 years for conventional glass ionomer. Although the longevity of tooth coloured restorations was shorter than that of amalgam, comparisons with our previous studies indicate improved survival periods for tooth coloured materials. □ *Composite; dental amalgam; dental restorations; glass ionomer; longevity*

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In general, a dental restoration is presumed to be a fairly permanent replacement for lost tooth structure. Controlled clinical trials have strengthened this presumption since their results invariably show low rates of failure irrespective of the material or the treatment type. In a recent article, clinical trials on the longevity of restorations in stress-bearing posterior cavities were reviewed and annual failure rates for Class I and Class II composite restorations were estimated at between 0% and 9% (1). However, in everyday clinical practice several factors related to the patient and to the dentist may have an unfavorable effect on the restoration survival (for review, see Jokstad et al. 2) and in most cross-sectional surveys the age of failed restorations has been found to be lower than that registered in controlled clinical trials (3–5). In a recent analysis of posterior restorations using a large insurance claim database in the US, the probability of survival both for amalgam and composite restorations was much lower when the patient changed to a different dentist (6).

Our previous studies among Finnish private practitioners in 1992 and 1997 (7, 8), catering for most of the middle-aged and older adults using dental services those years, showed a major change in selection of dental restorative materials in the early 1990s. In 1992, amalgam was used in 29% of the restorations in adults and in 1997 only in 5%. The use of composites increased from 53% to 75% during the same period. It has to be kept in mind that in 1993 Finnish dentists had a recommendation from the Ministry of Health to use other restorative materials than

amalgam as the first choice material. The rationale behind the recommendation was the environmental authorities' very negative attitudes to mercury waste accumulating in food chains and the fact that alternative restorative materials already existed. Changes in selection of restorative materials have recently been noticed in a number of other countries as well (9–13).

Controlled clinical trials are a necessary part of long-term evaluation, but since these are time-consuming and costly, other methods of evaluation, such as cross-sectional studies with a large number of practitioners involved, are justifiable. These can be considered to make a useful contribution even though they probably underestimate the average lifetime of routine restorations and thus are not rated high in the hierarchy of acceptable evidence (14). The value of cross-sectional studies is that they shed light on the decisions made by practitioners in everyday clinical practice.

This survey is the third in the series conducted among Finnish dentists. The aim of the study was to collect information on the restorations provided for adults by private dental practitioners in Finland at a time when amalgam was no longer the first choice in restorations in stress-bearing areas and to analyze factors related to the restorative treatment. We hypothesized that composite restorations would be the first choice and that the survival times have improved since our previous survey (8) due to a 'learning curve'. At the time of this survey, about half of Finnish adults received dental treatment in the public

dental service, while the other half visited private practices. The costs of private care were partially subsidized for war veterans and for those born in 1956 or later (19–44-year-olds); other patients paid for private dental care themselves.

Materials and methods

The survey method was the same as that used in our earlier surveys (7, 8), with some modification in the response form, in order to minimize the demands on the participants and thus improve the response rate. A random sample of all dentists registered as private practitioners ($n = 800$) was drawn from the membership register of the Finnish Dental Association. The sample size was designed to cover about 35% of private practitioners. Dentists who were 65 years of age or older were omitted. In spring 2000 a questionnaire was sent to the dentists requesting them to record information on all patients who had had restorative treatment and on the restorations placed during one ordinary working day. The return-paid envelopes were numbered and 2 months after the initial invitation one reminder was sent to those who failed to respond.

Respondents were asked to record the material chosen for a new restoration and give the major reason for the restorative treatment from eight possible alternatives which were briefly described in the instructions. If the treatment was performed as a replacement of an old restoration, the material of the failed restoration was recorded as well as its age when known. In addition, the dentists were asked to record whether the patient had any amalgam restorations in his or her mouth at the time the entire treatment period ended.

Basic statistical analyses of the data, including cross-tabulation, were carried out, and, where appropriate, the chi-square test was used to compare the frequency differences.

Results

Replies were received from 548 dentists, while 4 questionnaires were returned because the address was unknown. Of the respondents, 68 stated that they had not done restorative treatment during the study period because of maternity leave or sick leave, because they were specialists in other fields of dentistry, or for various other reasons, and they were therefore excluded. The final data thus consisted of answers from 480 persons, giving a response rate of 66%. As background information on the respondents, region, number of years in practice, and sex were elicited. Slightly over half of the dentists worked in the southern region of Finland (51%) and 32% in the western region; the rest were working in the eastern or northern region, the more sparsely populated areas of Finland. Of the respondents, 36% were male. The proportion of dentists having worked for 10 years or less was 23%, whereas the corresponding figure for dentists having worked 11 to 20 years was 28%, and 49% for dentists having worked at least 21 years.

The dentists treated 2,748 patients older than 16 years during the study period and placed 3,455 restorations (on average 7.2 restorations per dentist). Owing to missing information on various estimates, the number of restorations varies in different analyses. Mean age of the patients was 51.7 years and median age 51 years (range 17–94 years).

Restorative materials used

Overall, composite resin was the most common restorative material, and it was used in 79% ($n = 2,712$) of the restorations, whereas amalgam was used in 5% ($n = 155$), glass ionomers (either conventional or resin-modified) in 7% ($n = 229$) and compomers in 4% ($n = 152$) of the cases. In 5% of the cases, the tooth was restored using indirect restorative methods; gold onlays and inlays comprised 3% ($n = 71$), and ceramic restorations 2% ($n = 63$) of the restorations, respectively.

The reason for the restorative therapy had a statistically significant influence on the selection of the restorative material ($P < 0.001$). If the reason for treatment was either fracture of the tooth or filling or marginal leakage or if the restoration was totally lost, then the proportion of composite restorations was higher than the mean (87% vs 79%). In addition, if the reason was secondary caries, the proportion of amalgam restorations was higher than the mean (6% vs 5%). The age of the patient also had an influence on material selection ($P < 0.001$): tooth-colored materials other than composites, i.e. glass ionomers and compomers, were used more commonly in the age group 60 years or older than in the younger patients (17% vs 9%), and amalgam was less often used in patients younger than 30 years (2% vs 5%). Most dentists provided only direct restorations and the proportion providing indirect restorations, either gold or ceramic, during the study period was 10% ($n = 49$).

The majority of restorations covered either 1 or 2 surfaces, particularly first restorations (Fig. 1). The difference in the distribution of first and replacement

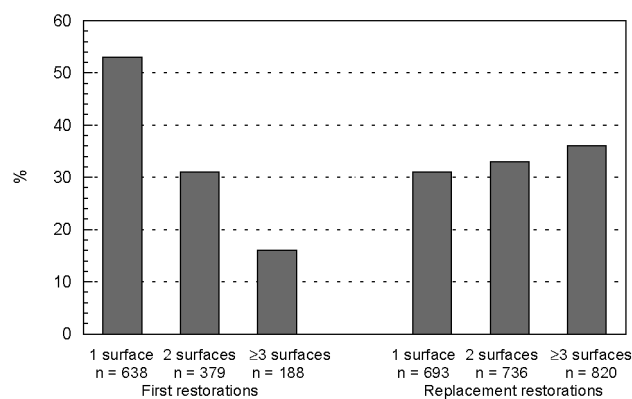


Fig. 1. Distribution of first and replacement restorations according to size of the restoration.

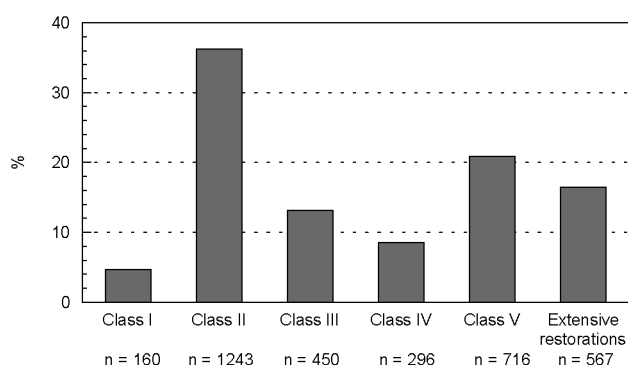


Fig. 2. Distribution of restorations placed according to Black's classification.

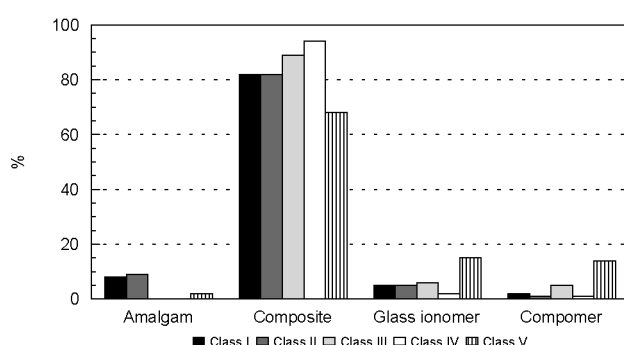


Fig. 3. Percentage distribution of the amalgam ($n = 155$), composite ($n = 2,693$), glass ionomer ($n = 228$), and compomer ($n = 151$) restorations in different cavity types. Extensive restorations (more than 3 surfaces) are not included in this figure.

restorations was statistically significant ($P < 0.001$). Classified according to Black's classification, the most common cavity type was a Class II cavity (36%), whereas extensive restorations with 4 or more surfaces comprised 16% of cases (Fig. 2). Composite was predominant in all cavity types (Fig. 3). In extensive cavities covering 4 or more surfaces, composite was used in 67%, gold in 12%, ceramics in 6%, and amalgam in 4% of restorations (not shown in Fig. 3). Of amalgam restorations, the majority

were inserted in Class II cavities (69%) or were extensive restorations (14%).

Reasons for restorative therapy

The age of the patient had a significant effect on the main reason for treatment ($P < 0.001$). In young adults (17–29 years), the main reason for restorative treatment was primary caries, whereas in patients aged 30 years or older, secondary caries, fractures of the tooth, or restoration and loss of the restoration were the most common reasons for treatment (Table 1). On the other hand, the patient's age had no effect on the proportion of marginal leakage, pain, or aesthetic reasons (each given as a reason in 3% to 6% of treatments). No statistically significant differences were noticed between the dentists who had worked 10 years or less and their more experienced colleagues as regards the reasons for restorative treatments.

Replacement of restorations

Of all treatments, 65% were replacements ($n = 2,249$). Regionally, there was a tendency for higher frequency of replacement restorations in the southern and western regions of the country compared to the northern and eastern regions (66% vs 61%; $P = 0.02$). The reasons for the replacement of restorations could be analysed separately for amalgam, composite, and glass ionomer restorations. Secondary caries was the most common reason for replacement for all materials (Table 2). The other common reasons were fractures of the tooth or restoration for all materials and loss of the filling for composite restorations.

The ages of 53% ($n = 1,186$) of failed restorations were reported, including 379 amalgam (43%), 660 composite (56%), and 59 glass ionomer (66%) restorations. The mean age of failed amalgam restorations was 15.5 years, s (standard deviation) 7.2 years (median 15 years), the mean age of failed composite restorations was 7.0 years, s 5.4 years (median 6 years), and the mean age of failed glass ionomer restorations was 7.4 years, s 3.5 years (median 7 years).

Table 1. Percentage distribution of the reason for treatment in different age groups

Age of the patient	Reason for restorative treatment							
	Primary caries %	Secondary caries %	Lost filling %	Fractures %	Leakage %	Pain %	Aesthetics %	Other %
17–29 years ($n = 195$)	54	20	4	10	5	4	3	0
30–39 years ($n = 424$)	32	27	6	15	5	8	6	1
40–49 years ($n = 890$)	20	29	10	21	8	5	4	4
50–59 years ($n = 929$)	18	26	10	24	5	4	4	8
60 years or more ($n = 991$)	23	27	13	17	5	5	4	6
Total ($n = 3434$)	24	27	10	20	6	5	4	5

Table 2. Percentage distribution of the reasons for replacement of previous amalgam, composite, and glass ionomer restorations

The reason for replacement of restoration	Previous material		
	Amalgam (<i>n</i> = 876) %	Composite (<i>n</i> = 1,175) %	Glass ionomer (<i>n</i> = 89) %
Secondary caries	41	36	52
Fractures (tooth or restoration)	22	23	11
Lost filling	10	16	11
Marginal leakage	7	9	14
Pain/sensitivity	6	5	1
Aesthetic reasons	3	5	0
Other (e.g. endodontic reasons)	11	6	11
	100	100	100

Proportion of amalgam bearers

A majority of the adult patients treated had one or more amalgam restorations at the end of the entire treatment period. The proportion of patients having any amalgam restoration was lowest among the younger patients: 69% of 20–29-year-olds. Among the patients between 30 and 69 years (10-year intervals), 90% to 94% had amalgam, whereas among the oldest patients (70 years or more) the proportion of amalgam bearers had decreased to 86%.

Discussion

The response rate of 66% for private practitioners was higher than in our previous surveys (7, 8) and may be considered fairly good, taking into account the effort required of a busy practitioner to record the data. Random samples of dentists are seldomly used as respondents in surveys on restorative treatment and often end up with fairly low response rates (15). Thus, a survey in Norway in which every fourth dentist was invited resulted in a response rate of 31% (16) and in Iceland, where all dentists were invited, the response rate was 51% (13). The profile of the respondents was compared with that of the membership register of the Finnish Dental Association (98% of practising dentists are members) with reference to working sector, sex, and number of years in practice. The comparison showed that the distribution of the respondents was well representative of private practitioners in Finland, except younger male dentists, who were slightly underrepresented. In general, the willingness of Finnish dental practitioners to respond to enquiries and surveys has been fairly good. However, it was already apparent from our previous survey that young dentists are less willing to participate in volunteer surveys (8).

This study was the third in a series of similar surveys performed by the authors in Finland (7, 8). While by no means a longitudinal study, the random sample method in each survey allows comparisons between the consecutive surveys, which overall covers an 8-year period. To our knowledge, no similar survey series are available from other countries. In contrast to the survey of 1992, when amalgam was still used in a majority of posterior stress-

bearing restorations, composite restorations in 2000 heavily dominate in all types of restorations. The difference in this respect from our survey in 1997, however, is small and the results show no major differences in the selection of restorative materials in dental care of adults between 1997 and 2000.

The distribution of materials in different Black's cavity types was in clear contrast to that revealed for restorations in a study by Wilson et al. (17). While in the UK over 60% of Class II restorations were of amalgam, in our survey the respective proportion is less than 10% (figures not shown). In Finland, composites are extensively used in all types of restorations with the exception of Class V cavities, in which glass ionomer and compomer are inserted in about one-third of restorations. The results may reflect the national differences in the provision and remuneration of dental health care.

In dental care of adults in Finland, the use of direct restorations has been common even in extensive cavities covering several surfaces. The reasons may be economic, as most adults born before 1956 have paid for their dental care themselves, and for younger adults national sickness insurance subsidies have covered ordinary, direct restorations only. There has also been a lack of tradition among dentists in providing indirect restorations. Extensive restorations prepared of amalgam are known to be durable even in stress-bearing large restorations (18). Now, for several reasons, amalgam has lost its position as first-choice material (19). Our results show, however, that no other changes have taken place in the restorative treatment methods than the change from one material (amalgam) to another (composite) and the use of indirect treatment methods, i.e. insertion of gold crowns and ceramic restorations has increased only slightly compared to our previous surveys (7, 8). This calls for further follow-up studies, since data on the longevity of large composite restorations is scarce and studies on their cost-effectiveness are few (20).

The data were collected in a way which does not reveal whether failed restorations were in need of total replacement, but the relatively large proportion of restorations covering only one surface may indicate that some of the failed restorations were in fact only partly replaced. However, replacement restorations were on average larger

than first restorations and the difference in the distribution was statistically significant.

We hypothesized that the age of the failed composite and glass ionomer restorations would be longer than those in our previous surveys, and our findings confirmed this hypothesis. Whereas 3 years earlier the median ages of failed composite and glass ionomer restorations were less than 5 years for both, now failed composites were 6 and failed glass ionomers 7 years old. It is likely that the longer experience dentists have with the tooth-colored materials, the better results they achieve. The figures are still considerably lower than those reported for amalgam restorations, but there is an improvement and the median ages in our survey are among the highest reported in recent cross-sectional studies for tooth-colored restorations (3–5, 21). The median ages of failed amalgam restorations were as high as 15 years, but this is not comparable since so few new amalgam restorations are placed.

Comparisons with our previous surveys (7, 8) show that aesthetic reasons seem to comprise a minor part of restorative therapy in all age groups, and the proportion of restorations for aesthetic reasons is constant through different age groups and different surveys. A comparison of the proportion of adults still having amalgam restorations shows that in adults younger than 30 years 3 out of every 10 patients did not have any amalgam restorations, while 4 years earlier only 1 in 10 patients was without amalgam. In older age groups the proportion of amalgam bearers has remained stable, which means that old amalgam restorations are still fully valid and probably serviceable for many more years. This suggests that most people are not worried about amalgam and have not wanted their functionally valid amalgam restorations to be replaced.

According to the results of our survey, composite resin has become the main restorative material used in Finnish adults. Low use of other materials and crown therapy indicates wide indications for use of composite. However, total replacement of amalgam with composite is rare in Finnish adults.

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