Swedish dentists' decisions on preparation techniques and restorative materials

Hans Sundberg, Ingegerd Mejàre, Ivar Espelid and Anne Björg Tveit

Swedish National Board of Health and Welfare, Stockholm, Sweden; Eastman Dental Institute, Stockholm County Council, Stockholm, Sweden; Department of Odontology (Pedodontics) and Department of Odontology (Cariology), Faculty of Dentistry, University of Bergen, Norway

Sundberg H, Mejàre I, Espelid I, Tveit AB. Swedish dentists' decisions on preparation techniques and restorative materials. Acta Odontol Scand 2000;58:135–141. Oslo. ISSN 0001-6357.

This study aimed at mapping the preparation techniques and restorative materials that Swedish dentists are using for primary approximal and occlusal carious lesions. It involved sending a pre-coded questionnaire to a random sample of 923 dentists, with eight items concerning approximal and occlusal restorative preparation techniques and dental materials. Responses were received from 651 (70.5%) dentists. To restore a primary approximal carious lesion in an adolescent with low caries activity and good oral hygiene, the tunnel preparation was chosen by 48% of the dentists, the saucer-shaped preparation by 32%, and the traditional Class II preparation by 20%. The most common preparation technique for restoring an occlusal carious lesion was removal of the carious part only, which was chosen by 74% of the dentists. For a lower second molar with a minor occlusal caries lesion combined with a suspected dentin lesion as judged radiographically, about half of the dentists chose to restore the carious part only and 27% would seal the rest of the fissure system in addition. For a similar lesion with no obvious radiolucency in the dentin, about 1/3 chose the 'no treatment' alternative, 1/3 fluoride treatment, and the rest fissure sealing or other techniques. Composite was used most often and amalgam least often for both approximal and occlusal carious lesions. □ *Amalgam; approximal caries; composite; dental material; questionnaire; occlusal caries*

Hans Sundberg, The National Board of Health and Welfare, SE-106 30 Stockholm, Sweden. Tel. +46 8 55553427, e-mail. hans.sundberg@sos.se

In recent decades, the prevalence and incidence of caries have declined substantially among children and adolescents in Sweden (1, 2). Furthermore, the progression of approximal caries is usually a slow process (3, 4). As a result, the criteria for restorative treatment have changed (5). A similar trend has been noted in Norway and Denmark (6–8). This has been accompanied by a stronger focus on non-operative preventive strategies and concern about saving tooth substance. Consequently, the introduction of new dental materials has led to the development of new tooth substance-saving preparation techniques and cavity designs. For example, using glass ionomer cements, the tunnel preparation technique has been applied to the treatment of primary carious lesions in children and adolescents (9–13). Furthermore, with the improved physical properties of composite and the introduction of dentin adhesives, the principles of mechanical retention have been abandoned in favour of the tooth substance-saving saucer-shaped cavity design (14). There is, however, no information about the extent to which Swedish dentists have adopted these new philosophies for the treatment of primary carious lesions in young permanent teeth.

The use of amalgam has decreased in Sweden over the last 10 years (15). This was confirmed with information from the dental insurance system on the number and type of restorations performed by private practitioners (16). In Finland, patients' requirements have resulted in a similar decrease in the use of amalgam (17). Little is known, however, about the preferences of Swedish dentists, in the Public Dental Health Service as well as in private practice, as regards dental materials for primary approximal and occlusal carious lesions in young permanent teeth.

Accordingly, the aim of this study was to identify any variability among Swedish dentists in the choice of preparation techniques and restorative materials. A questionnaire including illustrations of different approximal and occlusal carious lesions in an adolescent was used for this purpose. The results regarding diagnostic criteria and their relation to the proposed need for restorative treatment have been reported in a previous paper (18).

Material and methods

A pre-coded questionnaire was sent to a random sample of 923 dentists in October 1996. The sample was drawn from the Swedish National Board of Health and Welfare's register of authorized dentists. Dentists aged 65 years or more were omitted. The responses were anonymous and reminders were not sent.

Responses were received from 651 (70.5%) dentists. Of these, 61 had ceased to practice and were therefore excluded from the analysis. Of the remaining 590 responders, 52% were employed by the Public Dental Health Service, 42% were private practitioners and 6% were not practising at the time of the study. The distribution by age is presented in Table 1. The same

Table 1. Distribution of the dentists by age.

Age group (years)	No.	%
23–34	49	8.4
35–44	197	33.7
45–54	198	33.8
55–64	141	24.1
Total	585*	100

*Of the 590 responders, 5 did not state their age.

questionnaire had been sent to a sample of dentists in Norway in 1995 (19, 20).

To assess both the stage of lesion progress at which restorative treatment was considered appropriate and the choice of restorative technique and dental material, different stages of approximal and occlusal caries were illustrated (Figs. 1–4). Pre-coded alternatives were given for both preparation techniques and restorative materials. Two items referred to each figure.

Fig. 1/item 1. The figure illustrates different radiographic appearances of approximal caries. What preparation technique would you choose for the smallest lesion that you would restore? The example refers to the distal surface of an upper second premolar of a 20-year-old patient with low caries activity and good oral hygiene. The patient sees a dentist regularly on an annual basis.

Fig. 1/item 2. What restorative material would you choose for the smallest approximal lesion that you would restore?

Fig. 2/item 1. What preparation technique would you choose for the smallest occlusal lesion that you would restore? The example refers to a lower second molar of a 20-year-old patient with low caries activity and good oral hygiene. The patient sees a dentist regularly on an annual basis.

Fig. 2/item 2. What restorative material would you choose for the smallest occlusal lesion that you would restore?

To evaluate how the clinical and radiographic appearances influenced the choice of treatment for minor occlusal carious lesions in molars, the clinical appearances of two occlusal carious lesions were combined with their radiographic appearances (Figs 3, 4). Two items referred to each figure.

Tooth A

Fig. 3/item 1. How would you treat this occlusal surface? The patient is 20 years old. You have not seen the patient before, and 2 years have elapsed since the last examination. The patient uses fluoride toothpaste on a daily basis and dietary and oral hygiene habits are considered satisfactory.

Fig. 3/item 2. If you would restore the tooth, what material would you use? The example refers to a second molar.

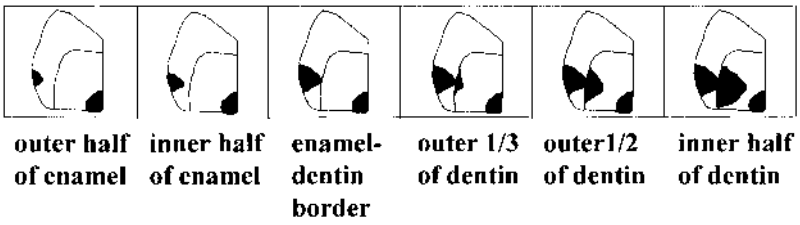

Fig. 1. Radiographic scores of approximal surfaces.

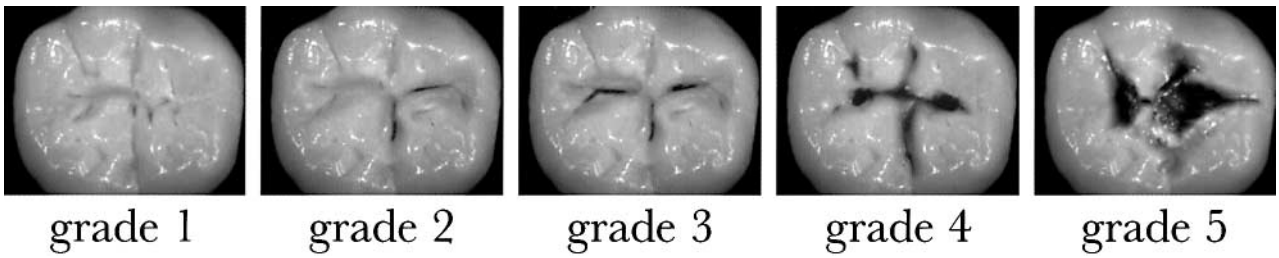

Fig. 2. Clinical appearances of occlusal caries. The following descriptions were added beneath the grades: Grade 1. Caries characterized by white/brownish discoloration in the enamel, no cavitation. No radiographic signs of caries. Grade 2. Minor loss of tooth substance with a break in the enamel surface or discoloured surface or discoloured fissures with grey/opaque enamel and/or caries confined to the enamel. No radiographic signs of caries. Grade 3. Moderate loss of tooth substance and/or caries in the outer one-third of the dentin according to the radiograph. Grade 4. Considerable loss of tooth substance and/or caries in the middle one-third of the dentin according to the radiograph. Grade 5. Considerable loss of tooth substance and/or caries in the inner one-third of the dentin according to the radiograph.

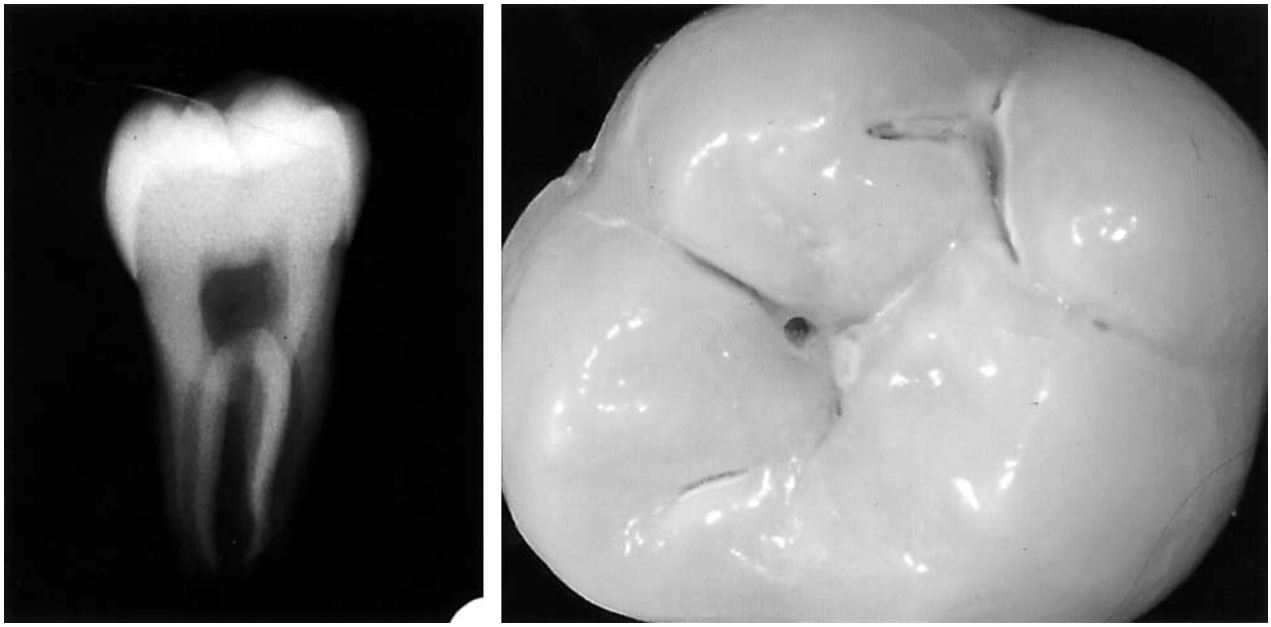

Fig. 3. Tooth A – clinical and radiographic appearance of a second molar.

Tooth B

Fig. 4/item 1. How would you treat this occlusal surface? The patient is 20 years old. You have not seen the patient before and 2 years have elapsed since the last dental examination. The patient uses fluoride toothpaste on a daily basis and dietary and oral hygiene habits are considered satisfactory.

Fig. 4/item 2. If you would restore the tooth, what material would you use? The example refers to a second molar.

Statistics

The chi-squared test was used in the bivariate analyses. When the cell counts were <5, Fisher's exact test was used. Regression analysis (ANOVA) was used to analyse the relation between age of the dentists and the dependent variables restorative techniques and dental materials. The level of significance was set at 5%. The data were processed in SPSS (Statistical Package for Social Sciences), Windows version 8.0.

Results

Preparation techniques for approximal and occlusal carious lesions

To restore a primary approximal carious lesion, the tunnel preparation technique was chosen by 48% of the dentists, the saucer-shaped preparation by 32%, and the traditional Class II preparation by 20%. Compared with the Public Dental Health Service dentists, more dentists in private practice stated they would use a traditional Class II preparation and fewer the saucer-shaped preparation (Table 2). There was a general tendency for younger dentists to choose the saucer-shaped design more often than older (ANOVA, $P < 0.010$). Using >55 years of age as the cut-off point, this was established with the chi-squared test ($P = 0.047$). The tunnel restoration was chosen equally often by the two age groups.

The most common preparation technique for restoring an occlusal carious lesion (Fig. 2) was removal of the carious part only. This alternative was chosen by 74% of the dentists; the rest would prepare the whole fissure system. No statistically significant differences were found between private practitioners and dentists in the Public Dental Health Service.

Treatment alternatives for minor/questionable occlusal carious lesions

The results for the Tooth A treatment alternatives of (Fig. 3) are given in Fig. 5. Fifty percent of the dentists stated they would prepare and restore the carious part only, and 27% would do this and in addition seal the rest. There was no difference between dentists in private practice and the Public Dental Health Service. The younger (<55 years of age) dentists in private practice more often chose the 'no treatment' alternative than the older dentists, more of whom would prepare the carious part and seal the rest. No such difference was observed for dentists in the Public Dental Health Service.

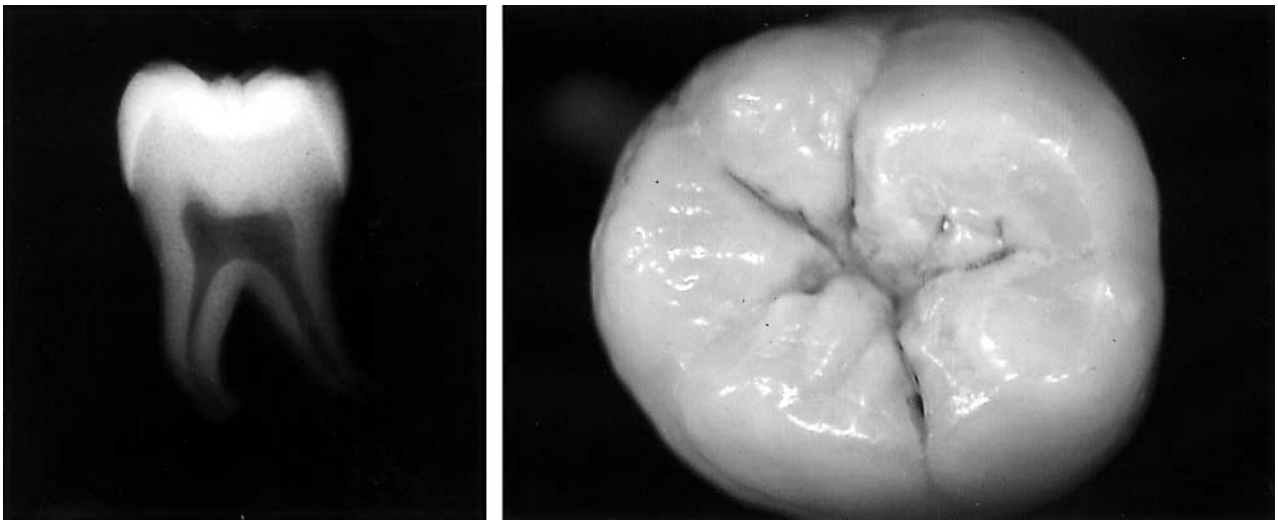

Fig. 4. Tooth B – clinical and radiographic appearance of a second molar.

The answers to the Tooth B treatment alternatives (Fig. 4) are shown in Fig. 6. About one-third of the dentists chose the 'no treatment' alternative, one-third fluoride treatment and 17% fissure sealing.

There was no difference between the geographical regions for any of the items.

Restorative materials

Overall, composite was chosen most often and amalgam least often. Irrespective of type of practice and type of carious lesion, the older age group generally chose amalgam and glass ionomer cement more often than the younger dentists, who more often chose composite.

The choice of materials to restore a primary approximal carious lesion is shown in relation to two age groups in Table 3 and the corresponding results for restoring an occlusal carious lesion of a second molar (Fig. 2/item 2) in Table 4. For both approximal and occlusal lesions, older dentists chose amalgam more often than younger and less often composite.

The choices of restorative material for molars with minor lesions (Teeth A and B, Figs 3 and 4) were similar; composite was most commonly used for fissure sealing. The results regarding Tooth B (Fig. 4) in relation to 2 age groups are given in Table 5.

There was no difference between the geographical regions for any of the items.

Preparation techniques in relation to the materials chosen for approximal cavities

There was a strong relationship between preparation technique and choice of material. Thus, the conventional Class II preparation accounted for 82% of all amalgam choices, while 87% of all glassionomer cement choices referred to tunnel preparations. As for the saucer-shaped cavity design, almost half of the dentists chose composite, one-third a combination of composite and glass ionomer cement and 12% amalgam.

Discussion

Considering that no reminder was sent, the number of drop-outs must be regarded as acceptable. The initial

Table 2. Percentage distribution of answers regarding preparation techniques for approximal caries (Fig. 1 / item 1), related to dentists in private practice and in the Public Dental Health Service

	Preparation technique			
Type of service	Traditional Class II	Tunnel	Saucer-shaped	Total (*n*)
Private	23.4	52.5	23.8	100 (244)
Public	17.1	43.1	39.8	100 (299)
Other*	25.0	53.1	21.9	100 (32)
Total	20.2	47.7	32.0	100 (575)

$P = 0.004$.
*Not practising the dental profession.

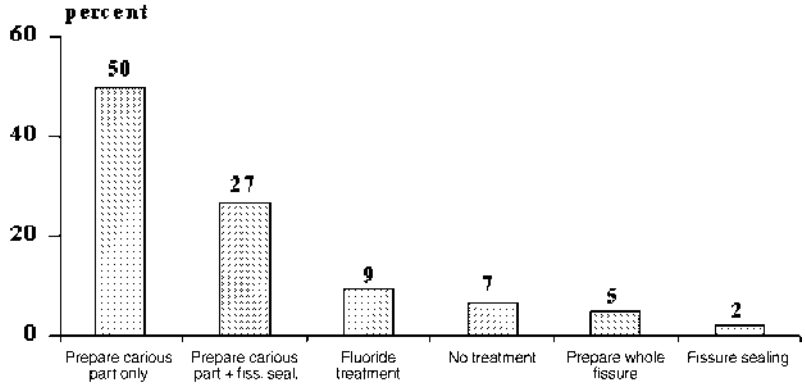

Fig. 5. Percentage distribution of answers regarding treatment alternatives for Tooth A (Fig. 3). Number of answers = 581.

sample was handled in such a way that the drop-outs could not be identified for analysis. However, a comparison between the register of authorized dentists and those who answered the questionnaire showed no difference in the distribution by age. It is therefore not likely that any age-related bias from the drop-outs influenced the results. The proportions of responding dentists in the Public Dental Health Service and in private practice were also practically the same as the national proportion between the two groups (according to statistics in 1995 from the National Board of Health and Welfare). Still, it is impossible to say whether the non-respondents represented different opinions from those responding.

In Sweden, the major part of the dental health care of children and young adults is performed in the Public Dental Health Service, while the majority of adults are treated by dentists in private practice. This implies that in private practice restorative treatment to a larger extent involves replacement of restorations and to a lesser extent restorations of small primary carious lesions.

More dentists in private practice stated they would choose the conventional Class II preparation compared with dentists in the Public Dental Health Service, more of whom chose the saucer-shaped cavity design for a primary approximal carious lesion. The latter design has been suggested for small primary approximal lesions (14) and a possible reason for the difference might be that private practitioners have less experience with adolescents and therefore encounter small primary approximal carious lesions less often. In view of this, it is remarkable that almost half of the private practitioners chose the tunnel preparation technique.

Concerning the preparation technique for occlusal caries lesions (Fig. 2 / item 1), 74% of the responders stated that they would remove the carious part of the fissure only, showing that the modern concept of saving

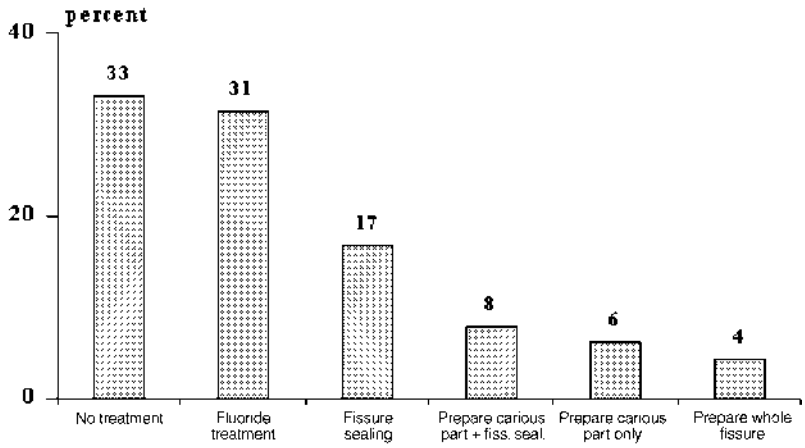

Fig. 6. Percentage distribution of answers regarding treatment alternatives for Tooth B (Fig. 4). Number of answers = 578.

Table 3. Percentage distribution of answers regarding choice of material for restoring an approximal carious lesion (Fig. 1/item 2), related to age of the dentists

	Restorative material					
Age group (years)	Amalgam	Composite	Glass ionomer cement (GIC)	Combination of GIC and composite	Other*	Total (*n*)
23–55	2.4	60.1	12.3	23.6	1.6	100 (454)
>55	4.7	45.3	18.7	28.9	2.3	100 (128)
Total	2.9	56.9	13.7	24.7	1.7	100 (582)

$P = 0.034$.
*Mostly compomer.

Table 4. Percentage distribution of answers regarding dental materials for restoring an occlusal carious lesion (Fig. 2/item 2), related to two age groups of dentists

	Restorative material						
Age group (years)	Amalgam	Composite	GIC* conventional	GIC* light-cured	Combination of GIC and composite	Other**	Total (*n*)
23–55	2.2	75.3	4.6	5.7	11.2	0.8	100 (454)
>55	5.5	58.3	8.7	6.3	17.3	4.0	100 (127)
Total	2.9	71.6	5.5	5.9	12.6	1.6	100 (581)

$P = 0.003$.
*Glass ionomer cement.
**Mostly compomer.

Table 5. Percentage distribution of answers regarding dental materials for restoring an occlusal carious lesion (Tooth B, Fig. 4/item 2), related to two age groups of dentists

	Restorative material						
Age group (years)	Amalgam	Composite	GIC* conventional	GIC* light-cured	Combination of GIC and composite	Other**	Total (*n*)
23–55	1.6	67.9	7.5	12.6	7.2	3.2	100 (374)
>55	5.0	51.0	6.0	15.0	18.0	5.0	100 (100)
Total	2.3	64.3	7.2	13.1	9.5	3.6	100 (474)

$P = 0.003$.
*Glass ionomer cement.
**Mostly compomer.

tooth substance instead of the old 'extension for prevention' principle has been adopted by a majority of the dentists. Notably, there was no difference between younger and older dentists in this respect.

Regarding the treatment alternatives for an occlusal surface with a minor/questionable carious lesion (Tooth B, Fig. 4 / item 1), about one-third chose no treatment, another one-third fluoride application, and the rest fissure sealing or other techniques. Thus, non-operative techniques prevailed, which is in accordance with the findings of Nuttall et al. (21). The disparity of treatment alternatives, irrespective of category or age of the dentists, illustrates the lack of consensus on the adequate treatment of minor/questionable primary occlusal caries lesions in young adults. A similar variation in reported treatment thresholds for occlusal surfaces was found by Nuttall et al. (22). Furthermore, our results point to a lack of knowledge concerning the fate of the increasing number of unrestored occlusal surfaces with minor/questionable carious lesions in molars in the young adult population in Sweden.

Composite and glass ionomer cements dominated as restorative materials for both approximal and occlusal caries, whereas amalgam was chosen to a very small extent. This is in agreement with previous studies (15, 20) and besides a growing public demand for tooth-coloured restorations, it is most probably the result of the debate on amalgam's possible health hazards that has been going on for several years in Sweden. Furthermore, there is a government recommendation that amalgam should not be used in children and young adults. More dentists over 55 years of age stated they would use amalgam but the frequency did not exceed 6% for any of the items. In the

pre-coded questionnaire only two alternatives were given for tooth-coloured materials. The border between different types of materials is, however, becoming more and more diffuse. In the future it might therefore be necessary to give pre-coded explanations for various new material categories to avoid confusion among respondents.

In previously reported answers to the questionnaire regarding caries diagnosis and operative treatment criteria (18), it was found that dentists in the south, centre, and north of Sweden had different diagnostic thresholds for operative treatment; dentists in the most southern region would perform restorative treatment at an earlier stage than dentists in the other two regions. A possible suggested explanation for this was different regional postgraduate educational policies. At first sight, this might be expected to apply also for preparation techniques and restorative materials. However, no regional differences could be observed, either for the alternative preparation techniques or for the choice of restorative material. One explanation could be that changes in restorative techniques and use of new materials follow other and perhaps mainly marketing principles.

An essential question is the extent to which the answers in a questionnaire reflect what the responders actually do in the clinical situation concerning choice of treatment alternatives and restorative material. To get these answers, it would be necessary to analyse representative patient files. In our view, however, such an approach is hardly practicable. For restorative materials, the present results are in agreement with those of another recent study on adults in private practice (15). Also, Wendt et al. (23) reported that the use of composite and glass ionomer cements has outnumbered amalgam in children and adolescents in Sweden.

In conclusion, the results indicate that for primary approximal carious lesions, the conventional Class II preparation is about to be replaced by more tooth-substance-saving techniques. Also for occlusal carious lesions, a tooth-substance-saving technique was most commonly used, implying removal of only the carious parts of the fissures. Composite dominated as the restorative material for both approximal and occlusal lesions and amalgam was used to only a very small extent.

References

1. Sundberg H. Changes in prevalence of caries in children and adolescents in Sweden 1985–1994. Eur J Oral Sci 1996;104: 470–6.
2. Hugoson A, Koch G, Bergendal T, Hallonsten A-L, Slotte C, Thorstensson B, et al. Oral health of individuals aged 3–80 years in Jönköping, Sweden, in 1973, 1983 and 1993. Swed Dent J 1995;55:23–6.
3. Mejàre I, Källestål C, Stenlund H, Johansson H. Caries development from 11 to 22 years of age: a prospective radiographic study. Caries Res 1998;32:10–6.
4. Mejàre I, Källestål C, Stenlund H. Incidence and progression of approximal caries from 11 to 22 years of age in Sweden. A prospective radiographic study. Caries Res 1999;33:93–100.
5. Edward S. Changes in caries diagnostic criteria over time related to the insertion of fillings. A comparative study. Acta Odontol Scand 1997;55:23–6.
6. Heidmann J, Helm S, Helm T, Poulsen S. Changes in prevalence of approximal caries in 17-year-olds and related restorative treatment strategies over a 6-year period. Community Dent Oral Epidemiol 1988;16:167–70.
7. Lövberg Gimmestad A. Sykdomsregistrering och behandlingsstrategi. Endringer i kriterierne for primärkaries. Institutt for samfunnsmedisin, Universitetet i Tromsö 1992.
8. Espelid I, Tveit AB, Haugejorden O, Riordan PJ. Variation in radiographic interpretation and restorative treatment decisions on approximal caries among dentists in Norway. Community Dent Oral Epidemiol 1985;13:26–9.
9. Strand GV, Tveit AB. Effectiveness of caries removal by partial tunnel preparation method. Scand J Dent Res 1993;101:270–3.
10. Hasselrot L. Tunnel restorations in permanent teeth. A 7-year follow-up study. Swed Dent J 1998;22:1–7.
11. Holst AL, Brännström M. Restoration of small proximal dentin lesions with the tunnel technique. Swed Dent J 1998;22:143–8.
12. Pilebro CE, van Dijken JWV, Stenberg R. Durability of tunnel restorations in general practice: a three-year multicenter study. Acta Odontol Scand 1999;57:35–9.
13. Pyk N, Mejàre I. Tunnel restorations in general practice. Influence of different clinical variables. Acta Odontol Scand 1999;57:195–200.
14. Nordbø H, Leirskar J, von der Fehr FR. Saucer-shaped cavity preparations for posterior approximal resin composite restorations: observations up to 10 years. Quintessence Int 1998;29:5–11.
15. Mjör IA. Selection of restorative materials in general dental practice in Sweden. Acta Odontol Scand 1997;55:53–7.
16. Berglund A. The use of dental amalgam in Sweden. In: Mjör IA, Pakhomov GN, editors. Dental amalgam and alternative direct restorative material. Geneva: World Health Organisation; 1997. p. 182–93.
17. Forss H, Widström E. Factors influencing the selection of restorative materials in dental care in Finland. J Dent 1996;24: 257–62.
18. Mejàre I, Sundberg H, Espelid I, Tveit AB. Caries diagnosis and restorative treatment thresholds reported by Swedish dentists. Acta Odontol Scand 1999;57:149–54.
19. Espelid I, Tveit AB, Skodje F. Restorative treatment decisions on approximal caries in Norway. Int Dent J 1999;49:165–72.
20. Espelid I, Tveit AB, Skodje F. Restorative treatment decisions on approximal and occlusal caries in Norway. J Dent Res Divisional Abstracts 1997. p. 1099.
21. Nuttall NM, Fyffe HE, Pitts NB. Caries management strategies used by a group of Scottish dentists. Br Dent J 1994;176:373–8.
22. Nuttall NM, Pitts NB, Fyffe HE. Assessment of reports by dentists of their treatment thresholds. Community Dent Oral Epidemiol 1993;21:273–8.
23. Wendt L-K, Koch G, Birkhed D. Replacements of restorations in the primary and young permanent dentition. Swed Dent J 1998; 22:149–55.

Received for publication 15 October 1999
Accepted 23 March 2000