# Clinical experience with glass ionomer for proximal fillings

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Forsten L. Clinical experience with glass ionomer for proximal fillings. Acta Odontol Scand 1993;51:195–200. Oslo. ISSN 0001–6357.

The aim of this study was to evaluate, with the aid of a questionnaire handed out to a selected group of dentists, the use of glass ionomer cement (GIC) in different types of proximal preparations. The aim was to evaluate the experience of complications associated with the use of GIC. Very few had *often* observed secondary caries or gingival inflammation in association with GIC fillings, compared with about 70% of the dentists in association with posterior composites. Tunnel fillings had been made by 60% of the dentists, simple proximal fillings in primary molars by 80%, and sandwich restorations by 80%. Few dentists with at least 2 year's experience with tunnel fillings had observed biologic complications, but ridge fractures had *often* been observed by 10%. Among the dentists with at least 2 years' experience with proximal fillings in primary molars, 40% mentioned more complications with these than with amalgams. Biologic complications were also not a great problem with GIC/composite sandwich restorations, but wear or dissolution of the proximal GIC surface was *often* seen by 17% of the dentists. □ *Cariology; dental materials; dental restoration; dentistry, operative*

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The advantages of using glass ionomer cement (GIC) are mainly biologic: adhesion to enamel and dentin (1, 2), anticariogenic effect (1–4) due to long-term fluoride release (5), and inhibition of bacteria (6, 7). The use of glass ionomer is, however, limited by its inadequate bending strength. Especially in occluso-proximal fillings in posterior teeth, fracturing of the GIC is the main problem, but the dissolution of the material also reduces the longevity of the fillings. These disadvantages can be compensated for in three ways. First, the GIC can be used in small cavities in teeth with a limited lifetime, such as primary molars (8, 9). Secondly, the stress-bearing parts of the filling can be reduced to a minimum by using micro-conservative preparation techniques, such as tunnel preparation (10–12). Thirdly, when much of the tooth structure has been lost, the GIC filling can be strengthened occlusally with composite or amalgam, making a 'sandwich' restoration (13). In the last case it should be sufficient to replace only the lost enamel with a stronger material.

There are only a few clinical studies on the performance of these three ways of using GIC. Criticism has been directed towards both the tunnel (14, 15) and the sandwich (16) methods. However, carefully standardized clinical follow-up studies do not always give a correct picture of the problems in routine clinical work. The use of GIC has increased rapidly in, for example, Finland and Sweden during the past 10 years. Partly due to the debate about the safety of using amalgam, the public has demanded alternatives. GIC, as a more biocompatible material than composite, has been the alternative used by many dentists.

The purpose of this study was to evaluate the success and problems experienced by practitioners in the Nordic countries when using GIC in posterior teeth.

## Materials and methods

The questionnaire (Table 1) was handed out at the start of 19 continuing educational

Table 1. Questionnaire

| | | | |
|---|---|---|---|
| 1. How often have you noticed in posterior restorations | Never | Seldom | Often |
| 1) Caries in association with GIC fillings? | | | |
| 2) Caries in association with composite fillings? | | | |
| 3) Gingival inflammation with GIC fillings? | | | |
| 4) Gingival inflammation with composites? | | | |
| 2. For how long have you been making tunnel fillings? | | | |
| 1) >5 years; 2) 2–5 years; 3) 0.5–2 years; 4) Never | | | |
| 3. Have you observed complications with tunnel fillings? | Never | Seldom | Often |
| 1) Pulpal symptoms | | | |
| 2) Residual caries | | | |
| 3) Secondary caries | | | |
| 4) Marginal ridge fracture after placement | | | |
| 5) Other complications, which? | | | |
| 4. For how long have you used GIC for proximal fillings in primary molars? | | | |
| 1) >5 years; 2) 2–5 years; 3) 0.5–2 years; 4) Not at all; 5) I have no young patients | | | |
| 5. Have you observed more complications using GIC in primary molars than when using amalgam? | | | |
| No Yes, which? | | | |
| 1) Pulpal symptoms 2) Secondary caries | | | |
| 3) Lost fillings 4) Fractured fillings | | | |
| 6. For how long have you been making GIC/composite 'sandwich' restorations as shown in the diagram? | | | |
| 1) >5 years; 2) 2–5 years; 3) 0.5–2 years; 4) Not at all | | | |
| 7. Have you observed complications with this type of 'sandwich' restoration? | Never | Seldom | Often |
| 1) Pulpal symptoms | | | |
| 2) Secondary caries | | | |
| 3) Proximal caries on adjacent tooth | | | |
| 4) Proximal wear or dissolution of GIC | | | |
| 5) Other complications, what? | | | |

GIC = glass ionomer cement.

courses held by the author in Finland, Sweden, and Norway during 1991. Altogether 768 participants received the questionnaire, and 630 (82%) returned it filled out. Of these 630 dentists, 356 were Finnish, 198 Swedish, and 76 Norwegian. The courses were usually, with the exception of four, attended by both private practitioners and dentists in the public service. One course in Finland and three in Sweden were attended only by dentists employed by the public service. The questionnaire was written in Fin-

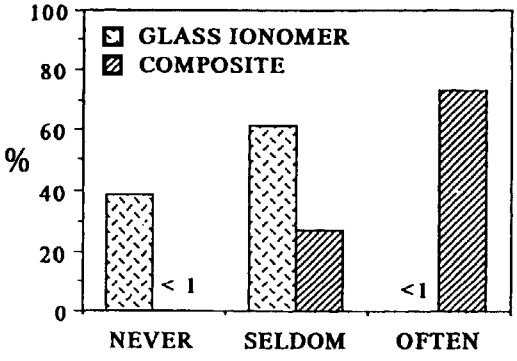


Fig. 1. Frequency (%) of dentists ($n$ = 630) observing caries in association with glass ionomer cement and composite fillings.

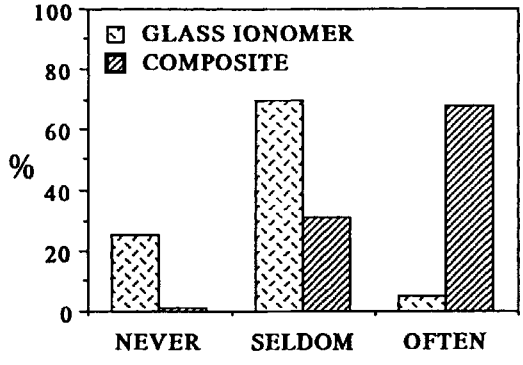


Fig. 2. Frequency (%) of dentists ($n$ = 630) observing gingival inflammation in association with glass ionomer cement and composite fillings.

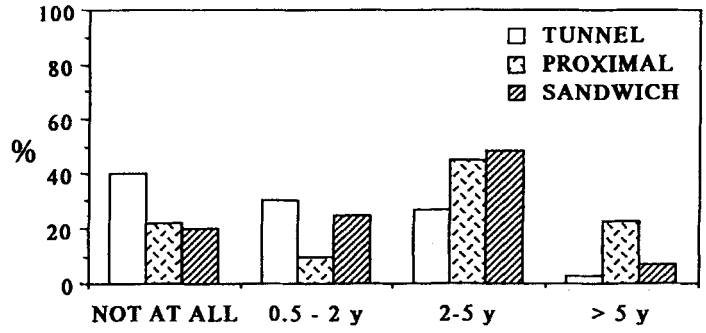


Fig. 3. Frequency (%) of dentists ($n = 630$) using glass ionomer cement in tunnel preparations, in proximal cavities of primary molars, and in 'sandwich' restorations for different periods of time.

nish for the Finnish dentists and in Swedish for the Swedish and Norwegian dentists.

## Results

The answers in the questionnaires revealed that most practitioners had *never* or only *seldom* observed caries (Fig. 1) and gingival inflammation (Fig. 2) in association with glass ionomer fillings. In association with composite fillings, in contrast, most dentists had *often* seen both caries and gingival inflammation.

According to the answers, tunnel fillings are today made by many dentists (Fig. 3). To judge from the verbal information, tunnel preparations are mostly made on permanent teeth. Of those dentists who had at least 2 years' experience with this method, very few had noted biologic problems (Fig. 4). Ridge fracture had usually been a problem only when the first tunnels were made, according to additional written comments. Problems other than those listed in Fig. 4 were mentioned by a few dentists: incomplete filling of the tunnel (5), dissolution of the material (2), and gingival inflammation (1).

The use of GIC on proximal surfaces in primary molars seems, according to the answers, to be quite popular (Fig. 3). Two hundred and fifty-nine dentists had made simple GIC fillings in primary molars for more than 2 years. Of these dentists 40% had observed more complications in association with GIC than with amalgam. The complications were mostly lost and fractured fillings, observed by 77% and 75%, respectively, of the dentists; 11% mentioned pulpal symptoms, and only 1% secondary caries.

GIC/composite sandwich restorations, as shown by a schematic drawing in the questionnaire (Fig. 5), had been made by almost 80% of the dentists (Fig. 3). Seven per cent

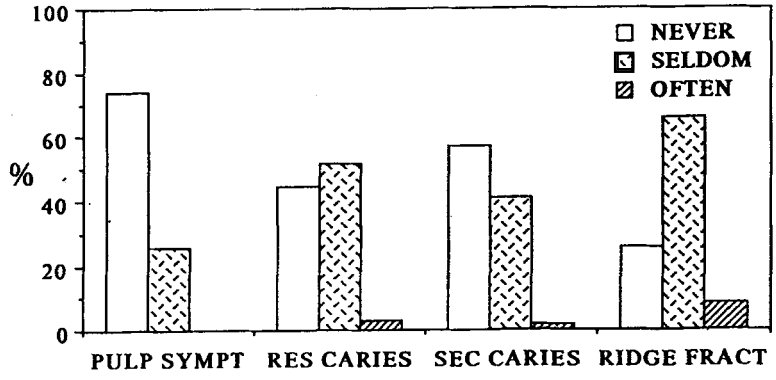


Fig. 4. Frequency (%) of dentists ($n = 170$) observing complications with tunnel fillings. Method in use >2 years.

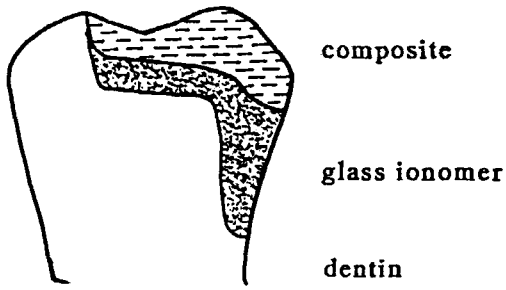


Fig. 5. Schematic drawing of the 'sandwich' restoration in the questionnaire.

had more than 5 years' experience with the method.

Biologic problems, such as pulp symptoms, secondary caries, or proximal caries (in the adjacent tooth), had been observed *often* only by a few dentists of those who had used the method at least 2 years (Fig. 6). A physical problem observed *often* by more than 17% of the dentists was proximal dissolution or wear of the GIC surface. Furthermore, 20 dentists mentioned occasional fracturing of the occlusal composite layer, 7 mentioned debonding between the GIC and the composite, and 1, marginal defects.

## Discussion

The questions in the questionnaire seemed quite clear, since they aroused no demand for clarification. The dentists were asked to give the answers before or during the first break, to reduce the influence of the lectures. The questionnaire was not designed to reveal the frequency of dentists generally using GIC and may therefore have been filled out by some dentists who do not use GIC at all. A questionnaire should be as simple as possible, and because of this no distinction was made between 'own' and 'others' fillings. Furthermore, the main purpose of the study was to get a picture of the frequency of complications, and therefore it was not considered important to know who had made the fillings.

In association with the questions about clinical complications the words *never*, *seldom*, and *often* were used. *Never* and *seldom* represent almost the same amount of experience. However, *never* was used because, if possible, a firm decision was desired. *Seldom* was used because it was assumed that many persons do not want to make a firm decision. However, *never* was registered surprisingly often.

The number of answers received can be considered to be representative for the group of dentists concerned, since the results were almost the same as those of a preliminary report with less answers (17).

Owing to the physical properties of glass-ionomer cement and composite it would be expected that secondary caries would be a greater problem in connection with composite fillings than with GICs. Furthermore, the fluoride release (5) should reduce the risk of caries in association with GIC. Earlier in vitro and in vivo studies confirm this assumption (1–4). The results of the present

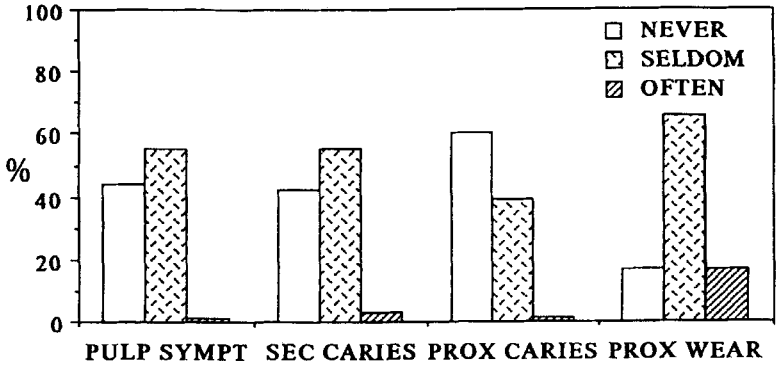


Fig. 6. Frequency (%) of dentists ($n$ = 320) observing complications with 'sandwich' restorations. Method in use >2 years.

study were very univocal in the same direction. Although the background for expecting less gingival inflammation in association with GIC than with composite fillings is not as clear as for the risk of caries, there are studies showing a tendency of less plaque and/or gingival inflammation in association with GIC fillings (6, 7). This problem also received a univocal answer in the study.

The great number of dentists making tunnel fillings shows the interest in using tooth-saving preparation methods in the Nordic countries. It was surprising to learn that so few dentists had *often* observed complications with this new method. More problems would have been expected with a method that had not been included in the undergraduate curriculum for most of the dentists who attended the courses. This result did not confirm the often-mentioned objection that this method is technically very difficult (14, 15). The small number of noted, not listed problems indicates that the risk of unexpected drawbacks with this method is small. An incorrect technique, such as enlargement of the proximal opening, failing to use a triple-angled excavator, fitting the matrix band tightly from the beginning, inserting the material without a syringe, and so forth, will jeopardize the result. Many years' personal experience with students doing their first tunnels on extracted teeth has not shown many technical problems as long as accurate instructions are followed.

Use of GIC in proximal cavities of primary molars as an alternative to amalgam seems to be increasing rapidly. This is understandable owing to the anticariogenic effect of GIC, which is especially desirable in young patients. Furthermore, the negative attitude of some parents to amalgam in Sweden and also in Finland and Norway increases the need for an alternative. Less than half of the dentists had experienced more problems with the GIC fillings than with the earlier use of amalgam in primary molars. The possible reasons for failures should be analyzed in more detail. Three-quarters of the dentists had observed lost or fractured fillings. According to verbal information from many practitioners in general and within the group attending the courses, one obvious reason was the extension of the limits beyond the possibilities of GIC. Stress-bearing restorations were made too large. Furthermore, these dentists mentioned possible manipulation problems, such as insufficient cleaning of the cavity preventing adhesion of the GIC, leaving the filling too high after condensing, and so forth.

Both with the tunnel method and with the proximal fillings in primary molars, the practitioners often mentioned in the questionnaire better success after getting used to the methods.

According to the answers, the type of sandwich restoration in which the GIC part is thick and extends proximally to the surface has been made by many dentists. The listed and, in addition, mentioned biologic problems are experienced *often* by very few dentists. The wear and/or dissolution of the proximal GIC was *often* noted by 17% of the dentists. This can be expected because GIC is less resistant than composite. However, this is not a biologic problem and can, furthermore, be reduced by a better handling technique, such as making the two different parts at different sessions.

The information obtained in this study gives only a crude picture of the situation. The results are based on data collected by means of a questionnaire during continuing educational courses for probably GIC-interested dentists. The attitude of their observations may therefore have been too positive. The information is, furthermore, based on overall impressions, and there is no systematic registration of the numbers of different restorations and complications. Although this study does not justify any definite conclusions, it is my opinion that the results indicate that there are no great biologic dangers involved in the described methods. Furthermore, the results confirm the anticariogenic and bacteriostatic properties of glass ionomer material. They may also give impulses to controlled prospective studies.

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Received for publication 4 January 1993