Overextended gutta-percha and Kloroperka N-Ö root canal fillings

Radiographic findings after 10–17 years

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A representative sample, 55%, of the patients treated endodontically by undergraduate students in a teaching clinic during the years 1963 to 1969 were reexamined 10–17 years later. Gutta-percha/Kloroperka-NÖ root fillings (282), classified as having surplus material at the time of treatment, were evaluated in follow-up radiographs. In about 80% of the cases of overfilling, no excess root filling material could be traced at the reexamination. In a few cases only, the appearance of the excess material was nearly identical to that at the time of treatment, whereas the remaining overfillings (18%) showed a reduced size. Among the recorded variables only one seemed to have a major impact on the prognosis—namely, the presence or absence of an apical radiolucency at the time of treatment, indicating that infection was the important factor when failures occurred. Apical overfilling per se had little influence on the long-term healing result as judged radiographically. □ *Radiography, dental; root canal therapy*

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It is generally accepted that the root canal preparation and subsequent level of filling should reach the apical part of the root. The exact level of extension may, however, differ for pulpectomies and for nonvital teeth (1–4). In both situations apical overinstrumentation and extrusion of root filling material should be avoided.

Several follow-up studies (5–10) have concluded that apical overfilling is associated with an impaired prognosis. This opinion has been based on studies that include observation periods mostly in the range of 2–4 years. Strindberg (5), however, followed up some cases for up to 10 years, and he occasionally noticed a reduction in the volume of excess fillings over the longer periods. Ryn (11), in a survey of cases from his own clinic, stated that after a sufficiently long period of observation both root filling surplus and the most apical part of the root filling (0.5–2.0 mm) often disappeared. Nygaard Östby (12) later confirmed the occasional disappearance of gross excesses of material after root filling with gutta-percha and Kloroperka N-Ö.

These observations indicate that there is a need for long-term follow-up studies on the influence of overfillings per se.

The aim of the present study was to elucidate the following problems: 1) What are the frequency and distribution of overfillings among root fillings, using the conventional, non-standardized N-Ö technique? 2) To what extent will an overfilling persist or disappear after a prolonged period of time? 3) What is the long-term effect of overfilling on the prognosis of a root-filled tooth?

Materials and methods

A representative group of patients (n = 431) who had received root canal fillings at the School of Dentistry, University of Bergen, during the years 1963–1969 has been studied earlier (13). Patients aged 16–55 years at the time of treatment (n = 382; 89%) were asked

to come for reexamination 10–17 years later, and a 14-film series of intraoral exposures was obtained for 239 of them (55%).

Records and radiographs from the treatment period were available, and 551 roots treated by undergraduate students could be followed up. Loss of endodontically treated teeth, 17% of the original material, was explained by age-dependent, non-endodontic factors (14).

Original endodontic procedure

The students were instructed to end the preparation 1–2 mm short of the radiographic apex in pulpectomies and close to 0.5 mm short in non-vital teeth. Both files and reamers were used for cleansing and enlargement. The canals were judged to be adequately formed and cleaned when shavings of white dentin were harvested from the apical region.

The root filling materials were Kloroperka N-Ö® as sealer and conventional, non-standardized, non-germicidal gutta-percha points (de Trey®). After selection of a suitable point, the master point, which fitted the apical part of the root canal, the canal walls were coated with the sealer. The master point was placed in the canal with a slight pumping movement. Additional gutta-percha points were packed in the spaces alongside the master point.

Classification of overfillings, and radiographic diagnoses

Cases of overfillings were subdivided into four groups depending on the size of the surplus material. All fillings flush with the radiographic apex were considered as having an excess (Fig. 1). The classification had been done previously in radiographs taken at the time of root filling (15). At the reexamination 10–17 years later the excess filling material was evaluated as having disappeared, been reduced in size, or remained unchanged. The root fillings were also classified with regard to any change in apical position in their level of termination in relation to the radiographic apex.

Periapical findings were evaluated in

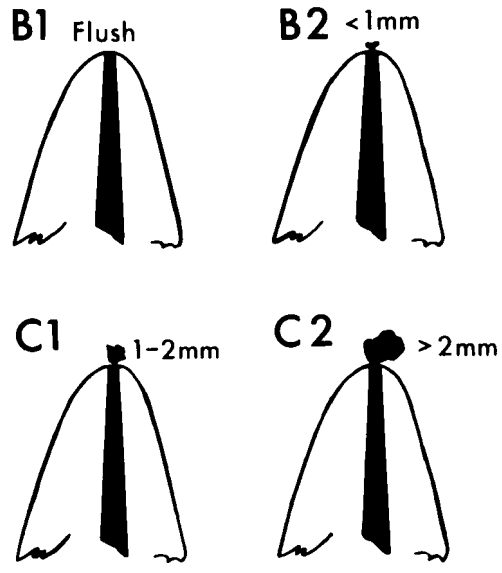

Fig. 1. Classification of overfillings as modified from Strindberg (5). Class B1: root filling flush with radiographic apex; class B2: apical overfilling not more than 1 mm; class C1: overfilling 1–2 mm; and class C2: overfilling larger than 2 mm.

radiographs taken immediately after root filling and at the follow-up examination 10–17 years later. The findings were first grouped in one of the following three diagnoses: no pathologic finding (success), increased width of the periodontal space (uncertain), and pathologic finding (failure). The uncertain group was later reevaluated and a decision made as to either success or failure. A detailed description of the diagnostic strategy and a discussion of its consistency have been presented elsewhere (16).

Reexamined group versus original material

Comparisons of the composition of the reexamined group and the original material, showing no significant differences with regard to number of teeth, tooth loss, and prevalence and distribution of root-filled teeth, are presented elsewhere (14, 17). The follow-up group and the original material were also further compared by using data elaborated earlier (13). The analyses did not show differences with regard to distribution of treatment forms, root filling levels, quality

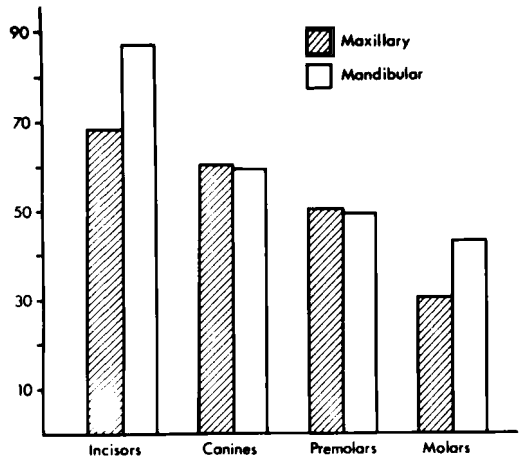

Fig. 2. The percentage of apical overfilling as observed within different tooth groups.

of the seal, and radiographic diagnoses at the time of root filling (chi-square, $p > 0.05$).

Results

The occurrence of overfillings

For the total material the frequency of overfillings was 50.7%. Overfillings were found within all types of roots. They were most frequently seen in lower incisors and were relatively rare in upper molars (Fig. 2). Within the groups some variations were observed; mesiobuccal roots of upper molars had a lower frequency of overfilling than palatal roots, and mesial roots of lower molars had a lower frequency than distal roots.

Teeth with an adequate seal of the root canal showed overfilling in 60% of the cases, as compared with 38% among roots with an inadequate seal.

Pulpectomies showed the lowest frequency of overfilling, treatment of necrotic pulps the highest value, and retreatments an intermediate value.

Roots with an apical rarefaction had overfillings in 76% of the cases, as compared with 35% for roots with no such changes (Fig. 3). Large overfillings (C2) were few and were most frequently found in teeth with apical rarefaction (Fig. 3).

The fate of the overfillings

At the follow-up examination 79% of the overfillings had disappeared, 18% were reduced in size, while 3% remained

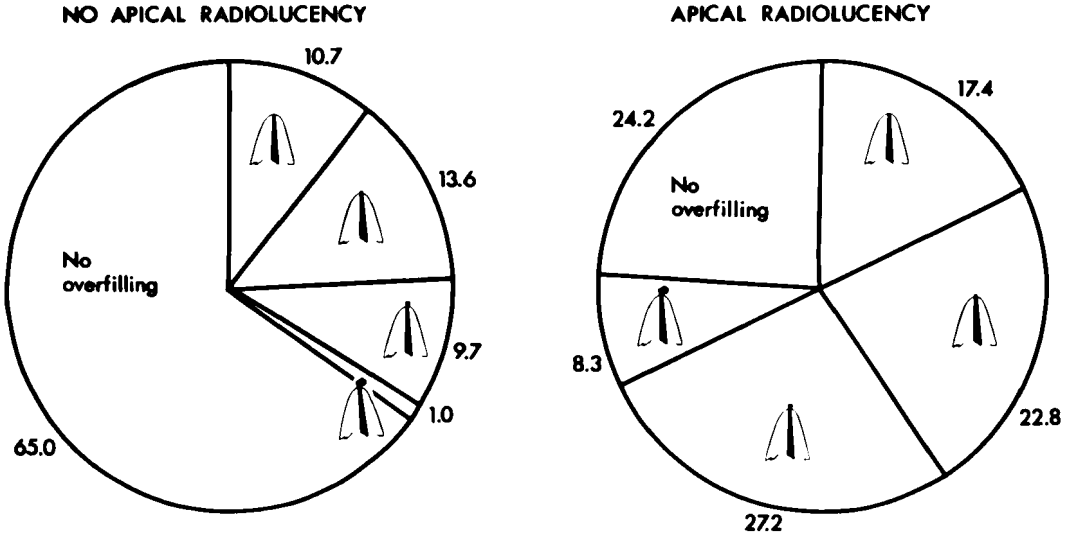

Fig. 3. Endodontically treated roots, with intact apical structure or with an apical radiolucency preoperatively, grouped (%) in accordance with the degree of overfilling immediately after treatment.

Table 1. Appearance of overfillings 10–17 years post-operatively in relation to original size. Frequencies in percentage

Original classification*	Disappeared	Reduced or unchanged
B1 ($n = 74$)	90	10
B2 ($n = 92$)	90	10
C1 ($n = 96$)	68	32
C2 ($n = 20$)	45	55

* See Fig. 1.

unchanged. The small overfillings had disappeared in 90% of the cases, which was clearly more often than the larger ones (Table 1). Examples are shown in Fig. 4.

A shortening of the apical portion of the root filling was observed in 62% of the roots filled flush with the apex or with an overfilling. With few exceptions this reduction was 2 mm or less.

The influence on healing

For the total material the frequency of success was greater (83%) in the group with no overfillings than in the group with overfillings (76%). Since the frequency of overfilling was also greater in the group with apical radiolucency, which is generally considered to be a negative prognostic factor, the material was divided into the groups 'no preoperative apical radiolucency' and 'preoperative apical radiolucency'. The prognosis (Table 2) was considerably better for the group without apical radiolucency than for the group with radiolucency (chi-square, $p < 0.001$). Within each group the presence or absence of excess filling material in the apical area did not seem to influence the success/failure ratio ($p > 0.05$) except if the largest overfillings (C2) in the radiolucency group were compared with the rest ($0.05 > p > 0.025$).

The frequency of success seemed to depend on the extent to which the extruded material disappeared. The small overfillings, which were most frequent in the non-radiolucency group (Fig. 3), also disappeared most frequently. When further grouped and analyzed in accordance with preoperative diagnoses, it became evident that healing was hardly influenced by the persistence of extruded material.

Roots with an adequately sealed canal showed 84% success, as compared with 72% for roots with inadequate seal ($p < 0.01$).

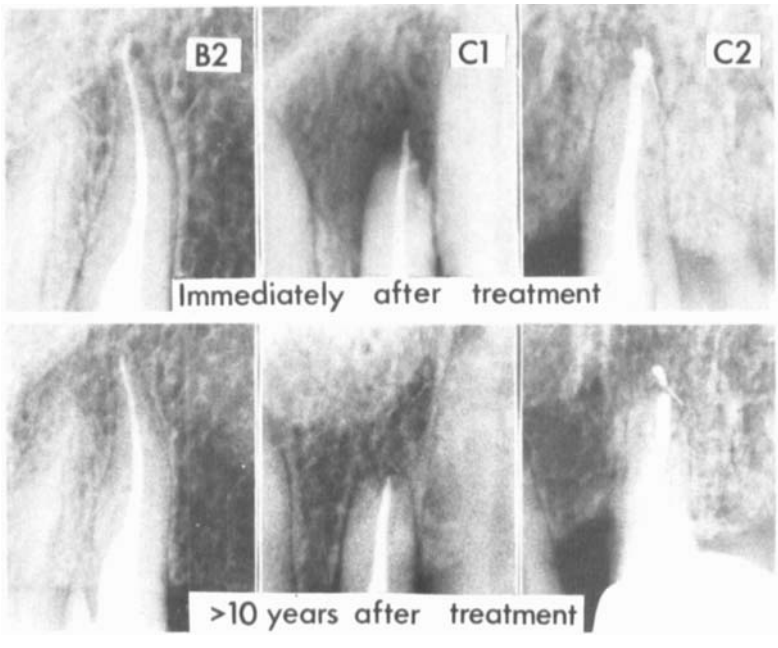

Fig. 4. Healing patterns over a period of more than 10 years. Left: canine with initial small overfilling healing completely. Middle: medium-sized overfilling disappearing, resorption of the apex and judged as completely healed. Right: larger overfilling reduced in size: complete healing of radiolucency.

Table 2. Distribution of 'Success' and 'Failure' (percentage) as a function of overfilling for the preoperative diagnoses 'no apical radiolucency' and 'apical radiolucency'

	No radiolucency						Radiolucency					
	Success			Failure			Success			Failure		
	n	%	%	*n*	%	%	*n*	%	%	*n*	%	%
Overfilling B1	54	(90%)		2	(10%)		25	(74%)		9	(26%)	
Overfilling B2	75	(86%)	89%	4	(14%)	11%	33	(70%)	71%	14	(30%)	29%
Overfilling C1	76	(90%)		2	(10%)		43	(77%)		13	(23%)	
Overfilling C2	2	(100%)		0			8	(47%)		9	(53%)	
No overfilling	121		92%	10		8%	30		60%	20		40%

Because we had already observed a positive correlation between an adequate seal and the presence of overfillings, further subdivision of the material was made. Table 3 shows that presence or absence of an apical radiolucency was the predominant factor influencing prognosis. Within the radiolucency group there were apparently more cases with an adequate seal than within the groups with intact apical structure. The difference was, however, not significant. Within the four groups presented in Table 3 no significant effect of the presence or absence of overfilling was found ($p > 0.05$).

Discussion

The observed frequency of overfillings was high, 50.7%, but within the range reported in other studies (5–8). Differences between the investigations can be explained by differences in treatment techniques and root filling materials and, above all, by different ways of classifying the apical level of root filling. Kerekes & Tronstad (9), for example, included fillings flush with the apex or 1 mm beyond in a group also consisting of fillings 1 mm short of the apex, thus making direct comparison with the present study impossible. Bergenholtz et al. (10) did not regard the flush root fillings as overfilled. Our study also showed that the occurrence of excess material is, as would be expected, dependent on tooth and root type and differs for pulpectomies and the non-vital fillings.

The extruded material was mainly Kloroperka NÖ. The root filling technique with the pumping insertion of the master point easily gives a piston effect, pressing the sealer out. Both observations made earlier (1, 12) and the radiographic appearance of the excess strongly support this.

Overfillings for roots filled with gutta-percha and the sealer Kloroperka NÖ have been reported by Nygaard Östby occasionally to disappear or be reduced (1, 12). Similar observations have been made when a solution of rosin in chloroform has been used as binding agent (5, 11). In the present, long-term follow-up study of root fillings aged more than 10 years, only 3% of the over-

Table 3. Percentage of successful cases within the group 'preoperative radiolucency' and 'no preoperative radiolucency' in accordance with the adequacy of the seal of the root filling

	No apical radiolucency		Apical radiolucency	
	Adequate seal, %	Inadequate seal, %	Adequate seal, %	Inadequate seal, %
Overfilling	87	92	74	61
No overfilling	96	87	61	60

fillings remained unchanged, whereas 79% had disappeared concomitantly with a 0- to 2-mm shortening of the length of the root filling. Among the largest overfillings in the present material, however, less than 50% had vanished. These observations indicate that the disappearance of apical excess, as observed in radiographs, is a slow process. The nature of the process is not fully known. Langeland (18), however, states that all sealers are resorbable and that components may be transported to, and settle in, the internal organs. Later, implantation studies have shown the presence of Kloroperka NÖ within vacuoles of macrophages and foreign-body giant cells and in vessels (19). This indicates phagocytosis and transportation of the material beyond the implantation site.

The frequency of success after root filling with surplus material has been reported to be lower than for non-overfilled teeth (3, 5–10). We made the same finding when the material was split in two such groups, 83% and 76%, respectively.

The true influence on the prognosis by overfillings with the Kloroperka NÖ and gutta-percha technique has been questioned. Nygaard Östby claimed that the hardened sealer and gutta-percha were well tolerated by the tissues (1, 12). Later studies have shown that Kloroperka NÖ, like other sealers, causes a rather strong inflammatory reaction in the freshly mixed state. This reaction may last for some time, but as the solvent, chloroform, evaporates, the response subsides (20). The long-term effect of overfilling must therefore be evaluated against other factors that may be of greater importance in maintaining inflammation, especially infection (10, 21, 22).

Engström et al. (23) observed a significantly greater failure frequency for large excesses (>2 mm) in a non-infected group of roots than in roots with persisting infection, as judged by bacteriologic sampling just before root filling. A relatively high incidence of periapical lesions for roots cleaned through the apex has been associated with latent or emerging root canal infection (10).

The etiologic role of bacteria in the development of periapical inflammation has clearly been shown (21, 22). If bacteriologic sampling is not done during treatment, periapical rarefaction observed preoperatively in radiographs is a good indicator that the pulp is infected (21, 22). Success and failure rates in our study were, therefore, related to such radiographic findings (Table 2). This showed a marked difference in success frequency between the group without radiolucencies and the one with periapical rarefactions but did not indicate any direct influence from the overfillings. Corresponding observations were made when, for the same two groups, the frequency of success after overfilling was correlated first with the disappearance of excess material and then with the quality of the seal. Within the radiolucency group, however, fewer cases of success were observed for the largest overfillings than for the rest of the group. Similar observations were made by Grahnén & Hansson (6). Such findings may indicate unfavorably formed root canals and sites of infection rather than a persistent harmful effect from the overfilling. Thus, our findings are in agreement with earlier studies (10, 23), indicating that failures, also in the overfilled cases, are closely related to infection.

From what has been reported in earlier studies, it may appear surprising that we found the quality of the apical seal to be of minor or no importance (Table 3). It should be observed, however, that all the root fillings had been made in a dental school clinic, where strict supervision and quality control prevented any fillings with major voids. The observer problems—that is, the possibility of sorting adequate versus inadequate seals—are obviously also greater when the defects are small.

There are toxicologic and other arguments for avoiding excess filling materials in the apical area. Our study therefore provides no argument in favor of creating an overfilling. If, however, an overfilling has already occurred, its presence may not affect the prognostic considerations.

In summary, this investigation of over-extended gutta-percha and Kloroperka NÖ root fillings has shown that the frequency of overfilling is influenced by tooth and root type, diagnosis, and treatment type; that the surplus material usually disappears or is

reduced in size after a period of time; and that the presence of excess root filling material may not influence the long-term healing result as judged in radiographs.

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