

Is the technical quality of root fillings associated with socioeconomic status? A cross-sectional study among Finnish adults

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We investigated differences in the technical quality of root fillings according to socioeconomic status. In the Finnish Health 2000 Survey, which comprised a sample of 8,028 adults aged over 29 yr, 6,115 underwent panoramic radiography. A total of 7,986 endodontically treated teeth were detected among 3,095 participants. The criterion for a technically inadequate root filling was a distance from the root filling to the root apex of over 3 mm or a filling extruding beyond the apex. Educational level, employment status, and income were the measures of socioeconomic status. Differences in the frequency of inadequate root fillings according to socioeconomic status were investigated using a multilevel logistic mixed-effects model taking into account age, gender, number of teeth, and type of root filled tooth. Almost half (46%) of the root fillings were inadequate. Among the over 64-yr-olds, higher education and higher income were associated with a higher probability of having an inadequate root filling. Among the under 65-yr-olds, socioeconomic status was not associated with root filling quality. Contrary to expectation, lower socioeconomic status was not associated with poorer endodontic treatment quality; however, higher income and higher education was associated with higher odds for inadequate root fillings among the over 64-yr-olds.

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Socioeconomically better-off subjects tend to receive better care, and benefit more from the care they receive, than the less well-off (1-3). In oral health care, there are socioeconomic differences in oral health, use of services, and in the type of care received (4-7). However, less is known about differences in the quality of oral health care received as a function of socioeconomic status.

Inadequate root fillings are associated with periapical pathology (8). The quality of endodontic treatment can be assessed radiographically. The quality of endodontic treatment depends largely on the precision and skills of the dentist, although patient- and tooth-related factors may also make endodontic treatment more difficult. For example, teeth with curved root canals can be more difficult to treat than teeth with straight canals, and likewise, multi-rooted teeth may be more difficult to treat than single-root teeth. However, overall, a dentist should be able to perform successful endodontic treatment on all uncomplicated single- and multi-rooted teeth (9,10). Thus, it can be argued that the quality of the accomplished endodontic treatment should not vary

according to socioeconomic status when acceptable patient and tooth-related factors (tooth type) are considered.

No studies have been conducted to detect socioeconomic differences in the technical quality of root fillings using nationally representative samples. Therefore, the aim of the study was to investigate differences in the technical quality of root fillings according to socioeconomic status in a nationally representative sample of Finnish adults.

Material and methods

We used Finnish data from the Health 2000 Survey, conducted by the National Institute for Health and Welfare of Finland (THL) during 2000–2001. The sample of 8,028 over 29-yr-old adults was generated by a stratified two-staged cluster sampling design (five geographical strata, 80 health centre district clusters) using people aged 30 yr or older living in mainland Finland as the target population. Of these, 7,415 (92%) participated in at least one part of the survey and 6,115 (76%) participants underwent

panoramic radiography. However, the images from 14 participants had to be excluded due to poor quality (11,12).

The Health 2000 survey protocols were accepted by the ethical boards of the National Public Health Institute and the Hospital District of Helsinki and Uusimaa.

Participation in panoramic radiography was voluntary and part of a clinical oral health examination. Trained dental nurses performed digital panoramic radiography with a PM 2002 CC Proline apparatus (Planmeca, Helsinki, Finland) using imaging values between 58–68 kV and 4–10 mA, depending on the subject's size. Three oral and maxillofacial radiologists analysed the radiographs on a Nokia MicroEmission Multigraph 445X (resolution 1,600 × 1,200 pixels) (Nokia, Helsinki, Finland) or a Samsung SyncMaster 900NF monitor (resolution 1,280 × 1,024 pixels) (Samsung, Seoul, South Korea) using DIMAXIS software (Planmeca, Helsinki, Finland) (12).

By means of the panoramic radiography, a total of 120,635 teeth in 6,101 participants were assessed. A total of 7,986 root filled teeth, detected among 3,095 participants, formed our final sample. A tooth was defined as root filled when any radiopaque material or a root canal post appeared in the pulp chamber and in any of the root canals. The technical quality of root fillings was assessed by measuring the distance from the end of the filling to the radiographic apex. For an adequate root filling, the gap in the root canal should be no more than 3 mm. Inadequate root fillings included short fillings (with a gap >3 mm) and overfilled root canals (root filling material seen outside the radiographic apex). The recording for each multi-rooted tooth was according to its most severe finding: if any of the roots was overfilled, the tooth was recorded as being overfilled (8,12,13).

The observations were calibrated using a random set of 50 panoramic radiographs at training stage before the assessment of panoramic radiographs in the actual study. The calibration in the training stage showed rather good agreements for the presence of root filled teeth 98% (κ : 0.96), short root fillings 65% (κ : 0.3), and overfilled roots 97% (κ : 0.7). Based on these findings at the training stage, the diagnostic criteria were further detailed and guidelines were prepared for the three specialists in the actual study (12).

In this study, we used a dichotomized outcome measure of root filling quality with two levels: (i) technically adequate root filling, and (ii) short root filling or overfilled root.

We used information on type of root filled tooth as a tooth level variable. We categorized teeth into 16 groups: third upper molar, second upper molar, first upper molar, second upper premolar, first upper premolar, upper canine, lateral incisor, and central incisor, and correspondingly for the lower teeth. In descriptive tabulations, categorization to upper molars, upper premolar, upper anterior, lower molars, lower premolars, and lower anterior was also used. The number of teeth present in each participant was also counted. All teeth, but not implants, fixtures, or interosseous root (remnants), contributed to the tooth count.

We used three measures of socioeconomic status: education, employment status, and household income. Based on the highest basic and vocational educational level achieved, participants were divided into three groups: low, middle, and high (11). The information on general education and on higher and vocational education was combined into a variable describing level of education. Persons

who had no vocational training beyond a vocational course or on-the-job training and who had not taken the matriculation examination (final examination in upper secondary school), were classified as having a low level of education. Completion of vocational school was defined as middle level of education. Also, those who had passed the matriculation examination (of upper secondary school) but who had no vocational training beyond a vocational course or on-the-job training were also classified as having a middle level of education. The high education level group was comprised of participants holding degrees from higher vocational institutions, polytechnics, and universities (11). Based on the self-reported employment status, working-aged (under 65 yr) people were categorized as: (i) unemployed or temporarily laid-off, or as having (ii) other employment status: full-time or part-time employment, being retired, student, conscript/non-military service, or other. Based on household income per household consumption unit, participants were categorized into three equal-size groups (low, middle, high income) separately for the working-aged (under 65 yr old) and for the over 64 yr old. The first adult in a household was given a consumption unit weight of 1.0, other adults (>17 yr old) a weight of 0.7 and those under 18 yr old a weight of 0.5 (14).

In addition to basic descriptive tabulations of the number of teeth present and the root filling quality by age, sex, socioeconomic status, and tooth type, a multilevel (tooth and individual level) mixed-effects logistic regression analysis was performed. The participant identifier variable was used as a random effect variable in addition to an intercept (that is, a random intercept model). Analyses were performed separately for each of the three socioeconomic variables (income, education, and employment), and separately for working-aged (under 65 yr) and older adults (over 64 yr). This stratification considered differences in socioeconomic status in people of different ages, as well as employment/retirement status, and overcame considerable collinearity between the socioeconomic variables. In addition to one socioeconomic variable at the time, age (continuous, centred, divided by standard deviation), gender, number of teeth (continuous, centred, divided by standard deviation), and tooth type were used as independent variables (fixed effects). Statistical analyses were performed using the 'glmer' function from package lme4 (15) in RSTUDIO (16).

Results

Both among the under 65-yr-olds (Table 1) and the over 64-yr-olds (Table 2), those with higher income or higher educational level had more teeth on average than those with lower income or lower educational level. Also, those who were not unemployed had more teeth on average than those who were unemployed. In addition, men and the younger participants had a higher average number of teeth present than women or the older participants.

Root filled teeth occurred rather similarly according to income, education, and employment status among the under 65-yr-olds (Table 1). In the older age group, those with higher income or higher educational level had more root filled teeth than those with lower income or educational level, and thus, were over-represented in

Table 1

Number of participants, mean number of teeth present, number of root filled teeth, and proportions of root filled teeth with a short or overfilled root filling among under 65-yr-olds

	Total sample		Participants with 1 or more root fillings			
	n (persons)	Mean no. of teeth	n (persons)	Mean no. of teeth	Total no. of root filled teeth	%* (95% CI)
<i>Total</i>	4741	23.1	2589	24.6	6449	44 (43–45)
<i>Education</i>						
Low	1416	17.6	751	21.6	1887	44 (41–46)
Middle	1717	24.3	956	25.4	2330	43 (41–45)
High	1590	26.7	870	26.3	2203	46 (44–48)
Missing data	18	25.7	12	24.3	29	59 (40–78)
<i>Income</i>						
Low	1528	21.6	784	23.6	1844	41 (38–43)
Middle	1673	22.8	888	24.6	2175	43 (41–45)
High	1415	25.0	839	25.6	2233	47 (45–49)
Missing data	125	23.0	78	24.4	197	51 (44–58)
<i>Employment status</i>						
Other	4292	23.3	2328	24.7	5841	39 (35–43)
Unemployed	432	21.0	250	23.5	581	44 (43–46)
Missing data	17	26.5	11	25.5	27	56 (36–76)
<i>Age (yr)</i>						
30–34	647	28.8	196	28.1	361	32 (27–37)
35–39	708	28.2	312	27.7	616	35 (31–39)
40–44	703	26.7	449	26.7	1132	39 (37–42)
45–49	801	22.8	510	24.6	1304	43 (41–46)
50–54	801	20.4	500	23.3	1296	47 (44–50)
55–59	558	17.3	331	22.1	900	48 (45–51)
60–64	523	15.1	291	20.4	840	54 (51–58)
<i>Gender</i>						
Men	2272	23.3	1203	24.8	2982	45 (43–46)
Women	2469	22.9	1386	24.4	3467	43 (42–45)
<i>Tooth type (of root filled teeth)</i>						
Upper molar			770		953	66 (63–69)
Upper premolar			966		1245	42 (40–45)
Upper anterior			972		1558	18 (16–20)
Lower molar			1040		1324	65 (63–68)
Lower premolar			782		953	42 (38–45)
Lower anterior			311		416	33 (28–37)

*Proportion of root filled teeth with an inadequate root filling.

this subsample (Table 2). The youngest (30–34 yr, Table 1) and the oldest (80 yr or older, Table 2) had less root filled teeth than the other age groups. Among the under 65-yr-olds, root fillings occurred most frequently in the upper anterior teeth and least frequently in the lower anterior teeth. Among the over 64-yr-olds, there were smaller differences in the root filling occurrence by the tooth type.

Those who had at least one root filled tooth had more teeth on average than those without root filled teeth (Tables 1 and 2). Particularly, the older participants who had at least one root filled tooth had many times more teeth present, on average, than the total sample average. In addition, among those with lower income or lower education, the difference in average number of teeth was greater between the total sample and the subsample than it was among those with higher income or education.

Almost half (46%) of the root filled teeth had a short or overfilled filling. Inadequate root fillings were more common among the over 64-yr-olds (Tables 1 and 2). The proportion of inadequate root

fillings increased steadily from 30% to 50% with age from 30 to 50 and remained at that level in the older age groups. Among the over 64-yr-olds, women had a higher proportion of inadequate root fillings than men. Root filling quality was strongly associated with the type of root filled tooth. Molars had the highest proportion of inadequate root fillings, followed by premolars. Lower anterior teeth had a higher proportion of inadequate root fillings than upper anterior teeth. The frequencies of inadequate root fillings by tooth type were rather similar in both age groups, although the older participants had a very high rate of inadequate root fillings in upper molars (81%, Tables 1 and 2).

Education and income were associated with root filling quality: the higher the level of education or income, the higher the proportion of inadequate root fillings (Tables 1 and 2). Among the over 64-yr-olds, these differences were steeper than among the 30–64-yr-olds. Even so, unemployed participants had a higher proportion of inadequate root fillings than those with other employment statuses (Table 1).

Table 2

Numbers of participants, mean number of teeth present, number of root filled teeth, and proportions of root filled teeth with a short or overfilled root filling among over 64-yr-olds

	Total sample		Participants with 1 or more root fillings			
	<i>n</i> (persons)	Mean no. of teeth	<i>n</i> (persons)	Mean no. of teeth	Total no. of root-filled teeth	%* (95% CI)
<i>Total</i>	1360	9.0	506	18.1	1537	52 (49–54)
<i>Education</i>						
Low	980	7.0	284	17.0	752	49 (45–53)
Middle	239	11.9	124	17.9	409	51 (46–56)
High	137	18.1	96	21.9	371	58 (53–64)
Missing data	4	6.8	2	11.5	5	60 (0–100)
<i>Income</i>						
Low	506	5.9	123	15.5	334	44 (39–50)
Middle	454	8.5	168	17.6	488	49 (45–54)
High	343	14.0	194	20.2	642	58 (54–62)
Missing data	57	9.2	21	18.4	73	47 (35–58)
<i>Age</i>						
65–69	413	12.0	188	19.7	555	51 (46–55)
70–74	379	9.3	149	18.1	447	54 (50–59)
75–79	222	7.7	69	17.5	219	49 (43–56)
80–84	241	5.9	76	15.3	231	52 (45–58)
85–	105	4.9	24	16.7	85	52 (41–63)
<i>Gender</i>						
Men	530	10.0	218	18.2	702	49 (46–53)
Women	830	8.1	288	18.0	835	54 (50–57)
<i>Tooth type (of root filled teeth)</i>						
Upper molar			149		185	81 (75–86)
Upper premolar			199		287	57 (51–63)
Upper anterior			213		376	31 (26–36)
Lower molar			135		175	67 (60–74)
Lower premolar			236		319	51 (45–56)
Lower anterior			131		195	44 (37–51)

*Proportion of root filled teeth with an inadequate root filling.

Tables 3 and 4 show the results from the multilevel mixed-effects regression analyses. The results are reported as the odds ratio (OR) of having an inadequate root filling separately for the under 65-yr-olds (Table 3) and the over 64-yr-olds (Table 4), and for each socioeconomic variable. Among the under 65-yr-olds, neither education, income, nor unemployment were associated with root filling quality. However, the age of the participant and the tooth type were associated with the root filling quality. Among the over 65-yr-olds, those with a high education or income had higher odds of having an inadequate root filling than those with a low education or income (OR 1.49 and 1.56, respectively). In addition, the tooth type and number of teeth were associated with the root filling quality, while the age of the participant was not associated among the over 65-yr-olds. The models explained about 30% of variation in root filling quality.

Discussion

Our observation that almost half (46%) of the root fillings were either short or overfilled among Finnish adults aged over 29-yr in the year 2000 is in line with findings from other studies investigating the quality of root fillings (17,18). Contrary to expectation, the results showed

that lower socioeconomic status was not associated with higher odds of technically inadequate root fillings. Higher income and higher education were associated with higher odds of inadequate root fillings among the over 64-yr-olds. As expected, the type of root filled tooth was strongly associated with the quality of root fillings.

To the best of our knowledge, this study is the first study examining socioeconomic differences in root filling quality using nationally representative cross-sectional data. It is not known how well root filling quality can be assessed by means of panoramic radiography in this kind of large epidemiological study. However, the panoramic radiographies are probably somewhat less accurate than intraoral radiography in periapical and root filling diagnostics (19–21). Moreover, it is not known whether the use of digital panorama radiographs leads to over- or under-detection of short fillings or overfilled roots, and whether the inaccuracy in detecting the quality of root fillings is of systematic or unsystematic nature. In this study, inter-examiner agreement in the detection of short root fillings was suboptimal (κ : 0.3) in the training stage. Based on the findings at the training stage, further specified and detailed written guidelines were prepared for systematic and structured assessment of radiographies in the actual study. Thus, we could expect the actual inter-examiner agreement to be higher in the actual study than in the training stage.

Table 3

Odds ratios (OR) and 95% confidence intervals (95% CI) of having an inadequate root filling from multilevel logistic regression analysis explaining variations in root filling quality among the under 65-yr-olds

	OR	95% CI		OR	95% CI		OR	95% CI
<i>Employment status</i>			<i>Income</i>			<i>Education</i>		
Unemployed	0.97	0.76–1.24	High	1.11	0.93–1.32	High	0.95	0.80–1.14
Other	Ref.		Middle	0.97	0.81–1.15	Middle	0.92	0.77–1.10
			Low	Ref.		Low	Ref.	
<i>Tooth type</i>								
Lower central incisor	Ref.			Ref.			Ref.	
Lower lateral incisor	1.25	0.71–2.21		1.31	0.74–2.33		1.25	0.71–2.21
Lower canine	0.77	0.43–1.38		0.74	0.41–1.34		0.75	0.42–1.34
Lower first premolar	1.38	0.87–2.18		1.37	0.86–2.18		1.36	0.86–2.16
Lower second premolar	1.45	0.95–2.21		1.46	0.96–2.24		1.45	0.95–2.20
Lower first molar	6.04	3.97–9.19		6.06	3.96–9.27		6.02	3.95–9.15
Lower second molar	4.80	3.09–7.45		4.90	3.13–7.65		4.80	3.09–7.45
Lower third molar	3.35	1.68–6.66		3.46	1.72–6.95		3.34	1.68–6.64
Upper central incisor	0.33	0.21–0.52		0.34	0.22–0.54		0.33	0.21–0.52
Upper lateral incisor	0.42	0.27–0.65		0.43	0.28–0.67		0.42	0.27–0.65
Upper canine	0.48	0.30–0.77		0.49	0.30–0.80		0.47	0.29–0.76
Upper first premolar	1.94	1.26–2.97		1.98	1.28–3.04		1.93	1.26–2.95
Upper second premolar	1.30	0.85–1.97		1.30	0.85–1.98		1.29	0.85–1.97
Upper first molar	5.19	3.38–7.97		5.21	3.38–8.04		5.18	3.37–7.95
Upper second molar	5.85	3.68–9.31		5.75	3.59–9.19		5.84	3.67–9.29
Upper third molar	8.21	2.69–25.02		9.61	2.98–31.02		8.10	2.66–24.68
Number of teeth present*	1.04	0.91–1.19		1.02	0.89–1.17		1.06	0.92–1.21
Age [†]	1.67	1.53–1.82		1.66	1.52–1.82		1.67	1.53–1.82
<i>Gender</i>								
Women	0.94	0.82–1.08		0.92	0.80–1.06		0.94	0.81–1.07
Men	Ref.			Ref.			Ref.	
Marginal R ^{2‡}	0.20			0.20			0.20	
Conditional R ^{2‡}	0.31			0.31			0.31	
n (teeth)	6422			6252			6420	
n (persons)	2578			2511			2577	

Adequate root filling quality was used as a reference category.

*Represents 8.9 teeth increase in number of teeth due to scaling.

[†]Represents 9.5 yr increase in age due to scaling.

[‡]Marginal R² describes the proportion of variance explained by the fixed effects and conditional R² describes the proportion of variance explained by both the fixed and random effects.

Nevertheless, it is likely that the inaccuracy in detecting the quality of root fillings using digital panoramic radiographs or suboptimal inter-examiner agreement have not caused considerable systematic bias in the association of socioeconomic status and root filling quality. Moreover, in this study, the 3 mm criteria of short root filling were used instead of the more commonly used 2 mm criteria (22). However, we do not know how this has affected the accuracy of detecting the quality of root fillings or the studied socioeconomic differences in root filling quality.

Furthermore, a major limitation arises from the cross-sectional study design and the fact that findings related to socioeconomic differences in root filling quality were based on a subsample of those who had at least one root filled tooth. The resulting limitation is that the socioeconomically better-off, those with higher number of teeth, and those aged 40–70 yr were over-represented (Tables 1 and 2). Although we were able to use age and tooth type information, which were major factors behind root filling quality, there remain many other determinants of root filling quality which we

could not control for. For example, we have no information about the conditions under which the studied fillings were made, or when and by whom. It is also not known what socioeconomic status the participant had during the endodontic treatment. Moreover, there is no available information about how people in different socioeconomic statuses deal with their inadequate root fillings, or how the treatment of inadequate root fillings differs by socioeconomic status. For example, it is not known whether those in a higher socioeconomic status are more likely to have the inadequate root fillings re-treated, or whether those in a lower socioeconomic status are more likely to have teeth extracted in the case of inadequate root fillings. Factors such as these could affect the distribution of inadequate root fillings according to socioeconomic status.

In Finland, there is only a limited number of specialists in endodontics and, thus, most endodontic treatments are done by general dentists both in private and public sectors in Finland. The use of dental services has been increasing for many decades in Finland (23,24). Traditionally, most adults have used private dental

Table 4

Odds ratios (OR) and 95% confidence intervals (95% CI) of having an inadequate root filling from multilevel logistic regression analysis explaining variations in root filling quality among the over 64-yr-olds

	OR	95% CI		OR	95% CI
<i>Income</i>			<i>Education</i>		
High	1.56	1.04–2.36	High	1.49	0.99–2.24
Middle	1.07	0.71–1.62	Middle	1.20	0.83–1.74
	Ref.		Low	Ref.	
<i>Tooth type</i>					
Lower central incisor	Ref.			Ref.	
Lower lateral incisor	0.58	0.23–1.47		0.57	0.23–1.42
Lower canine	0.66	0.28–1.57		0.65	0.28–1.52
Lower first premolar	0.79	0.36–1.75		0.89	0.41–1.92
Lower second premolar	0.63	0.29–1.38		0.71	0.33–1.52
Lower first molar	1.61	0.65–4.00		1.73	0.71–4.26
Lower second molar	1.80	0.72–4.50		1.95	0.79–4.81
Lower third molar	0.94	0.29–3.07		0.94	0.29–3.00
Upper central incisor	0.25	0.10–0.61		0.25	0.10–0.59
Upper lateral incisor	0.30	0.13–0.68		0.31	0.14–0.68
Upper canine	0.21	0.09–0.48		0.21	0.09–0.47
Upper first premolar	1.21	0.54–2.70		1.32	0.60–2.89
Upper second premolar	0.71	0.32–1.58		0.72	0.33–1.59
Upper first molar	3.86	1.59–9.40		4.28	1.78–10.27
Upper second molar	2.15	0.81–5.67		2.36	0.90–6.15
Upper third molar	6.38	0.54–75.68		6.64	0.55–79.65
Number of teeth*	1.45	1.11–1.90		1.45	1.11–1.90
Age [†]	1.11	0.91–1.35		1.05	0.87–1.27
<i>Gender</i>					
Women	1.25	0.91–1.71		1.30	0.95–1.78
Men	Ref.			Ref.	
Marginal $R^{2‡}$	0.15			0.15	
Conditional $R^{2‡}$	0.31			0.32	
<i>n</i> (teeth)	1464			1532	
<i>n</i> (persons)	485			504	

Adequate root filling quality was used as a reference category.

*Represents 10.0 teeth increase in number of teeth due to scaling.

[†]Represents 9.5 yr increase in age due to scaling.

[‡]Marginal R^2 describes the proportion of variance explained by the fixed effects and conditional R^2 describes the proportion of variance explained by both the fixed and random effects.

services; however, the proportion of adults using public dental services has been increasing continuously, especially during the last decades (25). Nowadays, rather equal proportions of Finnish adult population use private or public dental services (24). In Finland, oral health has continuously been improving at the population level for many decades (12,26). However, simultaneously, there have also been socioeconomic differences in oral health, for instance, in the number of teeth present and the number of decayed teeth (27,28), as well as in the use of dental services (25). Studies suggest that these differences were wider in the 1980s than in the years since (12,25). However, it is difficult to estimate how these trends in oral health, the use of dental services or their socioeconomic differences have affected our findings related to socioeconomic differences in root filling quality.

It has been stated that health care actions should not widen or cause health inequalities (2,29). In this light, our findings are favourable, even though those with higher socioeconomic status have, on average, better knowledge of health-related issues, better health literacy, and overall better abilities to cooperate with health

care professionals, including oral health care professionals (1,30). In addition, health care professionals may behave differently towards those in a lower socioeconomic status than towards those in a higher status, therefore hindering participation in decision-making and engagement in the treatment process (30). It may be that endodontic treatment quality is less prone to the common deficiencies of patient-professional engagement than longer and more socially complex treatments related to, for example, cancer (31) or human immunodeficiency virus (HIV) (32), for which considerable socioeconomic differences favouring the socioeconomically better-off have been shown.

Our findings indicated that among the older participants, high education or income was associated with a slightly higher probability of having an inadequate root filling. This finding is probably explained by the fact that endodontic treatment quality has been improving for many decades (17,18) and because new interventions are initially more likely to reach those of a higher socioeconomic status and later reach those of a lower status (inverse equity hypothesis) (33,34). As the root canal treatment is a more technically advanced and expensive treatment than its

primary alternatives (tooth extraction, pulpotomy, and no-treatment), the socioeconomically better-off have been more likely to receive endodontic treatments in Finland, particularly until at least the early 2000s, when age restrictions on subsidized dental care were abolished in Finland (25). Therefore, the proposition is plausible that the socioeconomically better-off have been more likely to receive (technically inadequate) root fillings than have people in a lower socioeconomic status for many decades in the previous century. Moreover, even though we included the variable of number of teeth present in our analyses, it is possible that those in a lower socioeconomic status have had their inadequately root filled teeth extracted, whereas those in a higher socioeconomic status are more likely to have retained those teeth as a result of their generally better oral health habits. Furthermore, in an oral health care setting, there may be some factors that hinder people in a higher socioeconomic status from receiving the higher quality care they typically receive in the health care system. For instance, the lack of competition between dental care providers may not have optimally enhanced the provision of good quality of care in Finland (35,36). As it is difficult for lay people to evaluate the technical quality of endodontic treatment, the provision of technically inadequate endodontic treatments for the socioeconomically better-off could be, in theory, used to induce demand for care among the desirable patients.

Based on our cross-sectional analysis using digital panoramic radiographies of a nationally representative sample from the Finnish adult population in 2000, it appears that lower socioeconomic status was not associated with poorer endodontic treatment quality. Among older people, lower socioeconomic status was even associated with lower odds of having an adequate root filling. Future studies should address the influence of the limitations noted in our study and achieve better control for the circumstances under which the endodontic treatments are made, when they were made and by whom, when assessing the impact of socioeconomic status on the quality of endodontic care. Finally, it must be stated that the present findings indicate room for improvement in the technical quality of root fillings in Finland.

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