Dental diseases and loss of teeth in a group of Finnish alcoholics: a radiological study

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A total of 85 Finnish alcohol-dependent subjects and 53 controls were studied with panoramic radiography. The aim was to study the possible associations between prolonged alcohol consumption and dental health. The mean number of teeth, caries lesions, endodontic treatments, periapical lesions, marginal bone loss, and periodontal infrabony pockets was studied. The subjects met the diagnostic criteria of alcohol dependence as set out in DSM-IV and ICD-10. The control group comprised social drinking volunteers with an AUDIT score ≤ 8. For the final results the subjects were divided into groups on the basis of sex and age. The social backgrounds of the subjects were similar, except for employment and smoking. The results show significantly fewer teeth and more caries in the alcoholic group. There was a tendency for the alcoholics <45 years of age to have more endodontically treated teeth than the controls, but no difference in the number of periapical lesions in endodontically treated teeth was found. Horizontal bone loss and the presence of calculus were more frequent in alcoholic men than in alcoholic women. Significantly more horizontal bone loss was observed in the group of alcoholic nonsmokers than in nonalcoholic nonsmokers. In the nonsmoking groups alcoholics had significantly more periodontal destruction than the nonsmoking controls. We conclude that radiological dental health among individuals dependent on alcohol is weakened by more caries, more horizontal bone loss, and more numerous vertical infrabony pockets than social drinkers. □ *Alcohol dependence; alcoholism; oral health; panoramic radiography*

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Alcohol abuse has become a major problem in the industrialized world. Chronic alcohol consumption causes malnutrition (1) and impairs the general health (2). This study is a part of a larger longitudinal study in which a group of Finnish people dependent on alcohol voluntarily participated in a program including placebo-controlled naltrexone medication and psychological therapy for 8 months.

It has been shown that the poor oral health of alcoholics can be explained mainly by their social situation (3, 4), but it has been suggested that alcoholism itself is a determinant of dental diseases (5). Chronic alcoholics are known to have more caries and missing teeth (4–7) and more periodontal problems (8, 9). Dental radiological findings in chronic alcoholics have not been studied previously, to our knowledge.

The purpose of this study was to describe the radiological dental health in a group of chronic alcoholics and to analyze the possible association between periodontal and periapical lesions and chronic alcohol consumption. In addition, the possible association between smoking and periodontal findings among alcoholics was analyzed.

Materials and methods

Subjects

The group of alcoholics consisted of 85 volunteers aged 46.8 ± 7.7 years (range, 30–64 years): 63 men (age, 46.9 ± 8.0 years), and 22 women (age, 46.6 ± 7.3 years). The participants in the group of alcoholics were diagnosed as alcohol-dependent in accordance with the DSM-IV (10) and ICD-10 (11) criteria. Both DMS-IV (for mental illnesses) and ICD-10 (for physical diseases) are used daily by clinicians when classifying diagnoses of diseases. The participants had at least 1 month of continuous alcohol consumption (at least 24 g ethanol/day) before the study. Subjects with moderate or severe alcohol withdrawal symptoms on admission to the study, any regular substance-related addiction other than alcohol and nicotine, severe psychiatric disorder requiring constant medication, use of disulfiram (at least 6 months before the study), acute hepatitis or liver cirrhosis, hyperthyroidism, or pregnancy were excluded from the study. The control group comprised 53 volunteers with a mean age of 43.6 ± 9.3 years (range, 26–67 years). Of these control subjects, 38 were from the Helsinki Telephone Corporation and 18 were from a private dental office (N. Enberg). The volunteers in the control group were classified as social drinkers on the basis of the the criteria of the Alcoholic Use Disorder Item Test (AUDIT) questionnaire (12). The required AUDIT-score of the control group was ≤ 8, and alcohol consumption was not allowed to exceed >30 g of ethanol/day on any occasion.

Table 1. Sex and age distribution of the subjects

	Alcoholics			Controls		
	<45 years old	≥45 years old	Total	<45 years old	≥45 years old	Total
Sex, *n* (%)						
Male	27 (31.8)	36 (42.3)	63 (75.4)	18 (34.0)	12 (22.6)	30 (56.6)
Female	9 (10.6)	13 (15.3)	22 (25.9)	12 (22.6)	11 (20.7)	23 (43.4)
Total	36 (42.5)	49 (57.6)	85 (100)	30 (56.6)	23 (43.4)	53 (100)
Age, mean ± *s**						
Male	39.2 ± 3.7	52.7 ± 4.3	46.9 ± 8.0	36.6 ± 4.6	53.3 ± 7.4	43.3 ± 10.2
Female	40.1 ± 3.0	50.8 ± 5.9	46.6 ± 7.3	37.7 ± 4.2	50.9 ± 4.7	44.0 ± 8.3
Total	39.4 ± 3.6	52.2 ± 5.0	46.8 ± 7.7	37.0 ± 4.8	52.2 ± 6.3	43.6 ± 9.3

* *s* = standard deviation.

For the final results, the subjects were divided into groups by age (<45 and ≥45 years), to eliminate the effect of age on dental health (Table 1). The social background, general health, medication, and smoking habits were recorded for all, except one control participant (Table 2). To analyze the effect of smoking and chronic alcohol consumption on periodontal health, the subjects were dichotomized by the presence or absence of regular smoking. All participants gave their informed consent, and the study was approved by the Ethical Committee of the National Public Health Institute.

Methods

Panoramic radiographs were taken with a PM 2002 CC panoramic apparatus (Planmeca Co., Helsinki, Finland).

Table 2. Sociodemographic characteristics of the alcoholic (*n* = 85) and control (*n* = 52) groups

Character	Alcoholics, total	Controls, total	
Marital status, *n* (%)†			
Single	9 (10.6)	5 (9.6)	
Married	66 (77.6)	42 (80.8)	
Divorced or widow	10 (11.8)	5 (9.6)	NS
Living conditions, *n* (%)†			
Alone	15 (17.6)	7 (13.5)	
Together with mate	34 (40.0)	18 (34.6)	
Together with family	34 (40.0)	24 (46.2)	
Alone with children	2 (2.3)	3 (5.8)	NS
Professional education, *n* (%)†			
No professional education	11 (12.9)	3 (5.9)	
Professional courses	23 (27.1)	10 (19.6)	
School professional graduate	18 (21.2)	11 (21.6)	
College graduate	21 (24.7)	15 (29.4)	
University graduate	12 (14.1)	12 (23.5)	NS
Employment, *n* (%)†			
Unemployed	12 (14.1)	0 (0.00)	
Employed	63 (74.1)	48 (92.3)	
On pension or student	10 (11.8)	4 (7.7)	<0.01
Longest period in the same job, *n* (%)†			
7–12 months	1 (1.2)	0 (0.00)	
2–5 years	4 (4.7)	7 (13.5)	
>5 years	80 (94.1)	45 (86.5)	NS
Time since last dental visit (months; mean ± *s*)*	24.9 ± 36.1	15.5 ± 15.0	<0.05
Smoking, *n* (%)†	46 (76.7)	14 (23.3)	<0.000
Previous alcohol consumption (g; mean ± *s*)*	255.2 ± 222.5‡	6.4 ± 6.5§	<0.000
Previous alcohol treatments, *n* (%)†			
None	54 (63.5)	52 (100)	
Detoxification (but currently drinking)	9 (10.6)		
Ambulatory treatment	12 (14.1)		
Institutional therapies	10 (11.8)		

* Student *t* test, *P* value ≤0.05 considered significant.
† Chi-square test, *P* value ≤0.05 considered significant.
‡ Amount of alcohol (g) consumed during last alcohol-involved occasion before clinical examination.
§ Amount of alcohol (g) consumed during last alcohol-involved occasion.

Table 3. Inter-examiner (J. Wolf and N. Enberg) agreement of assessments for the diagnosis on the basis of radiographs by kappa statistics and by percentage of agreement ($n = 50$)

Object	Determination of agreement	
	Kappa value*	95% confidence intervals
Dental caries	0.35	0.122–0.585
Periapical lesions	0.78	0.604–0.960
Vertical infrabony pocket (3–6 mm)	0.73	0.376–1.083
Furcation lesions	0.52	0.197–0.833

* Correlation analysis (Pearson correlation coefficients).
$r = 0.99$, P value ≤ 0.001.

Trimax T 16 intensifying screens and Trimax GTU X-ray film (3M, St. Paul, Minn., USA) were used. The films were processed in an RP X-Omat processor (Eastman Kodak, Rochester, N.Y., USA). The quality of radiographs was immediately evaluated by a dentist. The radiographs were analyzed by one dentist (N. Enberg), using Mattson's binoculars.

The inter-examiner agreement was estimated for caries, periapical lesions, vertical infrabony pockets (3–6 mm), and furcation lesions in 50 panoramic radiographs by two dentists (J. Wolf and N. Enberg) (Table 3). Inter-examiner agreement was estimated by calculating a kappa value, including the 95% confidence intervals (13).

The panoramic radiographs were studied for:

Number of teeth. The mean number of teeth per person was registered. A jaw was considered edentulous when no teeth, impacted teeth, or roots were observed.

Caries. The number of decayed teeth was registered. Caries was considered present when the lesion reached the dentin proximally or occlusally or was found at restored surfaces. Inferior restorations or crowns were registered if overhangs or underfillings were observed.

Periapical findings. The presence of condensing osteitis and periapical radiolucent lesions was recorded. Endodontically treated teeth with periapical lesions were registered separately.

Endodontically treated teeth. The mean number of endodontically treated teeth, including pulp amputations and root-filled teeth, was registered.

Periodontal status. Horizontal bone loss was examined by measuring the distance between the cementoenamel junction (CEJ) and alveolar bone. A healthy horizontal bone level was considered to be 2 mm. The results were divided into three categories: 1 = bone level at the cervical third of the root, 2 = bone level at the middle third of the root, and 3 = bone loss reaching the apical third of the root. Dental calculus was registered as present or absent.

Vertical infrabony pockets were determined by measuring the distance from the bottom of the bone pocket to the edge of the alveolar bone. Infrabony pockets were divided into three categories: 1 = 1- to 3-mm pocket, 2 = >3- to 6-mm pocket, and 3 = >6-mm pocket. The deepest value for each tooth was registered. Furcation lesions were registered if the bone loss was observed apically from the furcation area in any multi-rooted teeth. The horizontal and vertical bone losses were also compared between alcoholic and nonalcoholic smoking and nonsmoking subjects.

Statistical methods

Statistical differences of means were compared by using the Student unpaired two-tailed t test. The chi-square test was used to determine the relationship between quantitative variables. The Fisher exact test was used instead of the chi-square when 20% of the cells were expected to have counts less than 5. P values ≤ 0.05 were considered statistically significant (SAS statistical software system, release 6.12).

Results

Edentulous jaws were observed significantly more often in men than in women. Four (18.8%) alcoholic women had an edentulous jaw, including only one person in the <45-year age group, compared with none in the nonalcoholic female group. The total number of persons in the alcoholic group with at least one edentulous jaw was nine (10.6%), compared with only one (1.8%) in the control group.

The mean number of teeth in alcoholics and controls in the different age and sex groups are presented in Table 4. Significantly fewer teeth were found in the alcoholic groups of <45-year-old men and ≥45-year-old alcoholic women, compared with the control groups. The mean number of teeth in the female control group was also significantly higher than in the female alcoholic group. Finally, when the groups of all female and male alcoholics and all female and male controls were compared, the group of alcoholics had significantly fewer teeth than the controls. Alcoholic men also had fewer teeth than the male control group, but the difference was not significant.

Dentin caries lesions were observed more frequently at a significance level of $P < 0.05$ in the group of alcoholic men <45 years of age and in the total group of alcoholics than among the controls. Caries among women did not show any significant differences (Table 4). With regard to

Table 4. Dental and periapical findings in panoramic radiographs in alcoholic ($n = 85$) and control ($n = 53$) groups

	Alcoholics			Controls			*P* value*		
	<45 years	≥45 years	Total	<45 years	≥45 years	Total	<45 years	≥45 years	Total
Mean no. of teeth									
Male	27.6 ± 2.5	22.4 ± 7.5	24.0 ± 7.0	29.1 ± 1.8	23.6 ± 8.1	26.9 ± 5.8	<0.05	NS	NS
Female	25.4 ± 6.0	20.2 ± 9.6	24.6 ± 6.4	27.2 ± 3.1	26.6 ± 2.6	27.0 ± 2.9	NS	<0.05	<0.05
Total	27.1 ± 3.7	21.8 ± 8.1	22.4 ± 8.6	28.3 ± 2.5	25.0 ± 6.2	26.9 ± 4.7	NS	NS	<0.001
Mean no. of decayed teeth									
Male	1.4 ± 1.6	1.1 ± 0.1	1.2 ± 1.4	0.3 ± 1.2	1.0 ± 1.6	0.6 ± 1.4	<0.05	NS	NS
Female	0.2 ± 0.7	0.5 ± 0.7	0.4 ± 0.7	0.2 ± 0.6	0.6 ± 1.2	0.4 ± 0.9	NS	NS	NS
Total	1.1 ± 1.5	0.9 ± 1.1	0.9 ± 1.3	0.3 ± 1.0	0.8 ± 1.4	0.5 ± 1.2	<0.01	NS	<0.05
Mean no. of teeth with periapical lesions									
Male	0.7 ± 1.7	0.7 ± 1.1	0.5 ± 0.8	0.2 ± 0.5	0.3 ± 0.6	0.3 ± 0.6	NS	NS	NS
Female	0.2 ± 0.7	0.1 ± 0.3	0.1 ± 0.5	0.2 ± 0.9	0.2 ± 0.4	0.3 ± 0.7	NS	NS	NS
Total	0.6 ± 1.5	0.9 ± 1.1	0.4 ± 0.7	0.2 ± 0.7	0.8 ± 1.4	0.3 ± 0.6	NS	NS	NS
Mean no. of endodontically treated teeth									
Male	2.4 ± 3.6	2.8 ± 3.1	2.0 ± 2.7	0.8 ± 1.6	4.0 ± 3.6	1.5 ± 1.9	NS	NS	NS
Female	1.0 ± 1.1	1.8 ± 2.2	1.5 ± 1.8	1.2 ± 1.9	2.5 ± 1.7	1.6 ± 1.8	NS	NS	NS
Total	2.1 ± 3.2	1.7 ± 1.8	1.9 ± 2.5	1.0 ± 0.7	2.4 ± 1.9	1.6 ± 1.9	NS	NS	NS

* Student *t* test; *P* value ≤0.05 is considered significant.

inferior restorations no differences were found between the groups.

No significant differences were found in number of periapical lesions in the groups of alcoholic men and women compared with the control groups of men and women, respectively. The differences between age and sex groups were minor and not significant (Table 4).

The mean number of endodontically treated teeth was similar in the entire group of alcoholics, compared with the controls. However, there was a tendency for the alcoholics less than 45 years old to have more endodontically treated teeth than the controls. This tendency was particularly obvious in the group of alcoholic men <45 years of age (Table 4). The number of endodontically treated teeth with periapical lesions did not result in any differences between the alcoholic and nonalcoholic groups.

Calculus was observed significantly more frequently in the ≥45-year-old alcoholic males (61.1%) than in the controls (8.3%). No such difference could be registered for the women in any of the groups (<45 years, ≥45 years, total female group). However, when the total groups, alcoholics and controls, were compared, the alcoholics had a significantly higher number of teeth with calculus (40%) than the controls (12.5%) (Table 5).

Table 5. Numbers and percentages of teeth with horizontal bone loss, calculus, and infrabony pockets observed in panoramic radiographs in the alcoholic ($n = 85$) and nonalcoholic ($n = 53$) groups. Presented vertical infrabony pockets are divided into two categories by depth: 1–3 mm and >3 mm

	Alcoholic group			Nonalcoholic group			*P* value*		
n (%)	<45 years	≥45 years	Total	<45 years	≥45 years	Total	<45 years	≥45 years	Total
No. of teeth with calculus per person									
Male*†	7 (25.9)	22 (61.1)	29 (40.0)	0 (0.0)	1 (8.3)	1 (1.8)	NS	<0.01	NS
Female†	2 (22.2)	3 (23.1)	5 (22.7)	3 (16.7)	3 (27.3)	6 (23.1)	NS	<0.05	NS
Total*	9 (25.0)	25 (51.0)	34 (40.0)	3 (42.9)	4 (17.4)	7 (12.5)	NS	<0.05	<0.001
Total no. of teeth with horizontal bone loss									
Male*	10 (37.0)	30 (83.3)	40 (63.5)	4 (22.2)	8 (66.7)	12 (40.0)	NS	NS	<0.05
Female†	3 (33.3)	10 (76.9)	13 (59.1)	4 (33.3)	10 (91.0)	14 (53.5)	NS	NS	NS
Total*	13 (36.1)	40 (81.6)	53 (62.3)	8 (26.7)	18 (78.3)	26 (46.3)	NS	NS	NS
No. of infrabony pockets 1–3 mm									
Male†	4 (14.8)	17 (47.2)	21 (33.3)	1 (5.6)	3 (25.0)	4 (13.3)	NS	NS	<0.05
Female†	2 (0.2)	7 (53.8)	9 (40.9)	1 (7.6)	1 (9.1)	2 (8.6)	NS	<0.05	<0.01
Total*	6 (16.7)	24 (49.0)	30 (35.3)	2 (6.6)	4 (17.4)	6 (10.7)	NS	NS	<0.001
No. of infrabony pockets >3 mm									
Male†	0 (0.0)	7 (19.2)	8 (10.7)	0 (0.0)	3 (25.0)	3 (10.0)	NS	NS	NS
Female†	0 (0.0)	1 (7.7)	1 (4.5)	1 (9.1)	0 (0.0)	1 (3.8)	NS	NS	NS
Total*	0 (0.0)	9 (16.3)	9 (9.4)	1 (3.3)	3 (13.0)	4 (7.1)	NS	NS	NS

* Chi-square test, *P* value ≤0.05 is considered significant.
† Fisher exact test, *P* value ≤0.05 is considered significant.

A tendency towards more horizontal bone loss was observed in the total group of alcoholics (62.3%) compared with the controls (46.3%) (Table 5). The difference was especially obvious in the group of male alcoholics (63.5%) compared with the control men (40.0%). In the group of women bone loss was minor and not significant. Cervical bone loss (category 1) was observed equally in all the sex and age groups among alcoholics and controls. Horizontal bone loss to the middle third of the root (category 2) and to the apical part of the root (category 3) was registered, but no differences were found.

When the alcoholic group was studied as a whole, the alcoholics had significantly (35.3%) more infrabony pockets (1–3 mm) than the controls (10.7%). In the groups ≥45 years of age >3-mm pockets were found mainly among the female alcoholics (53.8%) compared with the control women (9.1%) (Table 5). Deep infrabony pockets were more frequently observed in the group of alcoholics; the results were, however, not significant. The furcation lesions were also observed mainly in the older age groups of alcoholics, but the differences were minor.

Significantly ($P < 0.001$) more horizontal bone loss was observed in the group of alcoholic nonsmokers ($n = 38$; 47.4%) than in nonalcoholic nonsmokers ($n = 4$; 10%). Interestingly, when the total amount of periodontal destruction was evaluated (number of both individuals with vertical infrabony pockets and individuals with horizontal bone loss), there was no difference between alcoholics ($n = 30$; 63,8%) or the controls ($n = 8$; 61.5%) in the smokers group. However, in the nonsmoker groups alcoholics had significantly ($P < 0.02$) more periodontal destruction ($n = 27$; 71.1%) than the nonsmoking controls ($n = 18$; 45.0%).

Discussion

This survey was done to evaluate the possible effects of long term alcohol consumption, often associated with smoking, on dental, periodontal, and periapical health as diagnosed in panoramic radiographs. Our data indicate that the association between alcoholism and dental disease is positive, considering the fact that the social backgrounds of the two studied groups were similar and that the social security system in Finland is well organized. However, 14.1% of the alcoholics were unemployed, compared with none of the control group, most probably because of alcohol dependence or its medical and social consequences.

To eliminate the effect of age on dental health, the subjects were divided into groups by age (<45 and ≥45 years) for the final results. The cut-off point was selected in accordance with the introduction of a new social-security law, including guidelines for dental care, in Finland. Further, the cut-off point was selected to eliminate the possible reasons for tooth extractions; for example, in younger age groups dental caries is a more frequent reason for tooth extractions than periodontal bone destruction, which is seen in the older groups of patients.

The subjects in the alcoholic group consisted of alcohol-dependent persons who had not received treatment for alcohol dependence previously. The subjects also fulfilled both the DSM-IV and the ICD-10 criteria and had at least a period of 1 month of continuous alcohol consumption before the study. The fact that those in the control group visited the dentist significantly more often than the subjects in the alcoholic group may affect the results but may not be the result of alcoholism alone. Sakki et al. (14) found that among 55-year-old citizens in Oulu, Finland, the time from the last dental visit was longer among manual workers and men than among their controls but that lifestyle had no significant association with the time since the last dental visit. Therefore, the association between oral health and alcoholism is more complex than can simply be explained by social behavior.

The specificity of the diagnoses of dental caries, using panoramic radiographs as in our study, is known to be low (15, 16). Our results are in agreement with previous studies that more caries and fewer teeth are recorded in alcoholics (4–7). The primary reason for the lower number of teeth and the higher number of edentulous jaws among alcoholics is most probably caries (17, 18). The results presented here, in the group of <45-year-old alcoholics, support the previously presented theory. The group of <45-year-old alcoholic men had more decayed and endodontically treated teeth than their nonalcoholic controls.

The panoramic radiograph is a method of choice in epidemiologic studies. This method is especially tolerated by old and frail subjects; it is quick and easy and is thus well suited for screening alcoholics. The panoramic technique has been shown to be suitable for diagnosing periapical lesions (16, 19, 20) and marginal bone loss (22, 23). In our study periapical lesions were more frequently observed in teeth, with or without previous endodontic treatments, in the alcoholic group, although the differences were not statistically significant. Walsh et al. (24) concluded that bone level observation from panoramic radiographs showed a close correlation with the community periodontal index of treatment need (CPITN) (25). The fact that dental restorations had been well carried out in both groups, without any differences in overhangs or inferior fillings between the groups, might have had an impact on the minimal number of >3-mm infrabony pockets in both groups. On the other hand, the alcoholics did have a significantly higher number of 1- to 3-mm infrabony pockets. The combination of the total horizontal bone loss and the registered number of vertical infrabony pockets might well suggest enhanced loss of periodontal bone support in the alcoholic group.

Calculus was also significantly more frequent in the group of ≥45-year-old male alcoholics. The primary reason for this phenomenon could be that the alcoholics seldom visited the dentist. Periodontal disease is positively associated with smoking (26, 27), and chronic alcohol users

easily become dependent on nicotine (28). A study by Faddy et al. (29) indicates that sex has no significant effect on smoking and periodontal disease. There was a significantly higher number of nonsmoking persons with periodontal destruction, including both horizontal bone loss and vertical infrabony pockets, in the alcoholic group than in the control group. This finding is supported by the results of Shizukuishi et al. (9), which claimed that excessive use of alcohol may contribute to the development of periodontal disease. However, the probable indirect effect of alcohol and tobacco smoking on periodontal diseases is more complex and likely to be synergistic.

The limitations of this study are related to the sizes of the study groups and the fact that alcohol misuse is a multi-factorial disease. Consequently, it has different aspects, many of which are evidently also associated with oral health. Oral health in alcoholics might also be explained by the social situation (30), malnutrition (31, 32), unemployment, lifestyle, and dental health behavior. Moreover, two subjects in the alcoholic group used continuous medication that might have decreased the salivary flow rate, causing a reduction in the protective functions of saliva (33) and therefore impairing dental health.

We conclude that the registered dental and periodontal health of chronic alcoholics evaluated from panoramic radiographs is poor, as expressed by more caries, a more frequently registered horizontal bone loss, and a higher number of vertical infrabony pockets than in social drinkers. Obviously, there was also a tendency for a larger number of endodontically treated teeth and significantly more caries among alcoholics even less than 45 years of age. Our data also suggest that poor dental health among alcoholics may be related to the social situation and that poor prevention of dental disease may be a consequence of alcoholism.

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