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Dental health in patients affected by alcohol use disorders: a cross-sectional study

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Abstract. – OBJECTIVE: Chronic alcohol abuse represents a risk factor for oral diseases, in particular, oral cancer. Periodontal disease has been showed to be involved in the pathophysiology of cardiovascular and metabolic diseases, such as atherosclerosis and liver steatosis. The role of chronic alcohol consumption on periodontitis is still controversial. The aim of the study was to evaluate the effect of chronic alcohol abuse on oral health.

PATIENTS AND METHODS: Twenty-three alcohol use disorders (AUD) patients and twenty-three healthy social drinkers underwent an oral examination by trained oral clinicians in order to evaluate oral and dental health. A questionnaire assessing oral hygiene was administered together with the evaluation of DMFT (decayed, missing, filled teeth), SLI (Silness-Loë plaque index) and CPI (community periodontal index of treatment needs) scores.

RESULTS: Alcoholic patients showed significantly lower oral hygiene scores compared to controls. Alcoholic patients showed significantly poorer scores at DMFT, SLI and CPI tests. Moreover, among alcoholics, smokers showed a significantly poorer oral health than non-smokers.

CONCLUSIONS: Chronic alcohol abuse increases the risk of dental and periodontal diseases. Smoking represents a significant co-factor. The practice of basic oral hygiene and the access to professional dental care should be encouraged among AUD patients in order to reduce oral diseases.

Key Words:
Alcohol use disorders, Oral health, Periodontitis.

Introduction

According to National Institutes of Health (NIH) reports, about 15% of people living in the United States are considered "problem drinkers". Within this population, 5-10% of men and 3-5% of women could be defined alcoholics[1].

Chronic alcohol abuse produces toxic effects on several organs and apparatus, including mouth and dental system[2]. In particular, several oral conditions such as periodontal disease, xerostomia, dental caries, loss of teeth, excessive gingival bleeding due to liver diseases, reduced effect of local anesthetics and oral cancer, have been reported in patients affected by alcohol use disorders (AUD)[3,4].

Periodontal disease is characterized by inflammation of the tooth-supporting tissues. The etiology of this disease is multifactorial, and the dental biofilm represents the first etiologic factor[5]. An imbalance between potentially pathogenic microorganisms and the efficacy of host response can modify the oral environment. A lot of factors such as social, behavioral, local and systemic factors can modify the host protective response and act as risk factors[6]. The role of impaired oral

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health and periodontitis has been associated to the progression of cardiovascular and metabolic diseases[7].

Alcohol seems to increase periodontitis risk through multiple mechanisms: impaired neutrophil function (contributing to bacterial overgrowth), increased bacterial penetration (leading to periodontal inflammation), stimulation of bone reabsorption and suppression of bone turnover, direct periodontium toxic effect and lower monocyte production of inflammatory cytokines with microbial proliferation[8]. However, due to methodological variability, results of most of the studies are still inconclusive[3,4].

The aim of the study was to investigate, among AUD patients, the effect of chronic alcohol abuse on oral health to underline the possible role of alcohol as a risk indicator for dental caries and periodontal disease.

Patients and Methods

Study Group

A total of 23 subjects affected by AUD according to the DSM-5 criteria[9] in current drinker phase and comparable for socio-economic status were enrolled in the study. These patients (mean age 48.6 ± 7.7, range 20-79, 34.8% female) were consecutively recruited from the Alcohol Addiction Unit of the Institute of Internal Medicine, Gastroenterology and Hepatology, Agostino Gemelli Hospital, Catholic University of Rome. A group of 23 healthy social drinkers comparable for socio-economic status were enrolled as the control group (mean age 47.7 ± 16.7, range 40-72, 56.5% female). The two groups were homogeneous for age (p = 0.338), gender (p = 0.138), smoking habit (p = 0.134) (Table I).

Information about alcohol consumption, including the number of drinks per day and the frequency of alcohol intake, were collected both in patients and controls according to the time-line follow-back model (TLFB)[10]. In particular, types of drinks (beer, wine and spirit) and the frequency of alcohol intake (expressed as number of days per week) were investigated to estimate the daily individual amount of alcohol consumption in pure alcohol (centiliters). The mean alcohol intake in AUD patients was 232.8 ± 117.3 grams (range 100-500) (Table I). To increase the reliability of anamnestic data, information about alcohol consumption was also collected with the cooperation of a family member or a reference caregiver both in AUD patients and in healthy control group.

All subjects underwent a dental/periodontal evaluation.

On the day of their dental examination, a questionnaire relating to the perception and assessment of the oral hygiene level was administered to the two groups. Interviews offered questions about dental care habits, frequency of dental visits, education, smoking habits and alcohol consumption (Table II).

Oral Examination

Both patients and controls were evaluated by two trained clinicians for the identification of dental and periodontal diseases.

A questionnaire exploring oral hygiene habits was administered to all patients. The questionnaire consisted of 10 questions. Each answer was coded 0-1, the total score ranging from 0 to 10 (Table II).

Dental disease was quantified using three World Health Organization-approved dental indices: DMFT (decayed, missing, filled teeth), SLI (silness-loe plaque index)[11], and CPITN (community periodontal index of treatment needs)[12].

Examiners were equally trained regarding the identification of the diseases (object of study), the detection of the dental formula, the detection of the indices of health/disease of the teeth, the periodontal apparatus, the presence/absence of deposits or biofilms of the oral cavity and the issues involved with the alcoholic correlation on the oral cavity.

Table I. Characteristics of AUD patients and control subjects (SD = standard deviation).

	AUD patients (N=23)	Control subjects (N=23)
Age: years (SD)	48.6 (7.7)	47.7 (16.7)
Male	15 (65.2%)	10 (43.5%)
Female	8 (34.8%)	13 (56.5%)
Intake (gr/ethanol/day) (SD)	232.8 (117.3)	15.2 (7.4)
Days of abstinence	1.8 (24.7)	n.a.
Smokers, N (%)	18 (78.3%)	12 (52.2%)

Table II. Dental health questionnaire (one point each positive answer).

- Do you brush your teeth at least twice a day?
- Do you use mouthwash? How many times?
- Do you use dental floss?
- Do you think it is important the health and oral hygiene?
- Do you consider essential health and oral hygiene?
- Has anyone ever taught you the correct method to brush your teeth?
- Have you ever noticed gum bleeding?
- Do you think you have a bad breath?
- Do you go to the dentist for regular visits?
- Do you have fixed or removable dentures?
- In relation to the alcohol intake, do you vomit frequently?

The examiners were calibrated in the use of the clinical evaluation measures employed in the study. They were blinded regarding the diagnosis of AUD.

All patients were examined under standardized conditions using the intraoral mirror, the dental explorer and the periodontal CPI-probe (WHO-probe, YDM Ltd., Tokyo, Japan). During the clinical examination, four intra-oral radiographs were performed with type Bitewing centering kind of Rinn XCP (Dentsply, York PA, USA).

The health/disease status of the teeth was determined through the use of the DMFT score. DMFT describes dental status and the amount of dental caries in an individual as a means to numerically express the caries prevalence. The score is obtained by calculating the number of decayed (D), missing (M), and filled (F) teeth (T). (D: Decayed; M: Missing; F: Filled; T: Teeth) (Table II). DMFT index was used to evaluate caries according to the criteria for caries assessment – WHO guidelines. A tooth was classified as carious when there was a cavity, undermined enamel, a softened floor on pit, fissure, or smooth surface[12].

All clinically detectable tooth decay was recorded. Only fully erupted teeth were used, except third molars were not included.

This procedure was followed by a comprehensive oral/periodontal evaluation including probing measurements. In the full mouth exam, plaque index, and probing pocket depth are important parameters to characterize periodontal outcome measures[13,14].

The plaque index evaluates the amount of plaque visible or detectable with the use of the probe to the load of the teeth. This study used the SLI index (Silness and Löeplaque index) as a measure of oral hygiene and dental plaque[11]. SLI index is based on recording both soft and mineralized deposits on teeth 12, 16, 24, 36, 32 and 44. A score from 0 (no plaque) to 3 (abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin) was attributed to each tooth surface (buccal, lingual, mesial and distal). The index for the patient was obtained by calculating the mean for all investigated teeth and surfaces. Plaque index was scored according to the Silness and Löe scale.

This study used the CPI index (Community Periodontal Index) as a marker of periodontal disease[15]. A standardized lightweight periodontal probe with a 0.5-mm ball tip (WHO-probe, YDM Ltd., Tokyo, Japan) was used for probing 10 standardized index teeth which were categorized from 0 (healthy) to 4 (pocket 6 mm).

For each patient, with the use of a partial mouth protocol, the periodontal probing was recorded in mm for the following tooth numbers: 17, 16, 11, 26, 27, 31, 36, 37, 46, 47, examining each element on the buccal and palatal/lingual sides and considering the deepest obtained values. Then, the arithmetic mean of the greatest values recorded was calculated, thus obtaining the mean value of pocket depth for each patient. If the index teeth were missing, next teeth were used for evaluations.

Periodontal status was scored as follows: 0 = healthy; 1 = bleeding without calculus or excessive fillings; 2 = pocket depth < 3 mm and over and under gingival calculus and excessive fillings; 3 = pocket depth 4-5 mm; 4 = pocket depth 6 mm or more.

Statistical Analysis

Statistical procedures were applied for analysis, both descriptive and inferential, whose results are reported throughout the paper. Whenever an inferential analysis was to be used, relevant checking techniques were first applied in order to evaluate the appropriateness of the analysis. For example, when a group comparison was to be made, the assumption of normality was checked for the correct application of two sample *t*-test; otherwise, a more suitable Wilcoxon rank sum test was performed. Also, for all modeling procedures such as logistic regression or log-linear models, standard model checking techniques were run to assess model adequacy and thus validate the analysis method.

The data set was first examined in order to study homogeneity in the two groups of patients and controls, comparing to age, smoking habit and gender. Comparisons were made through Wilcoxon test for age, and chi-squared tests for smoking habit and gender. Successively, some statistical tests, as applicable, were run to compare the response variables, namely oral hygiene questionnaire, DMFT, SLI, and CPI, in the two groups, in particular, (Welch) two-sample *t*-test or Wilcoxon test were used for DMFT and oral hygiene questionnaire, and chi-squared tests were used for SLI and CPI variables.

Focusing on data from AUD patients, a preliminary descriptive analysis was performed to provide a convenient summary. Then, all numerical variables for data were further investigated; in particular, correlation was tested for all pairs of variables, and (Welch) two sample *t*-test or Wilcoxon test, as applicable, were carried out for comparison purposes in smokers *vs.* non-smokers, and in males *vs.* females groups. Furthermore, some modeling procedures were applied to find out influential factors on numerical responses DMFT and oral hygiene questionnaire, and on categorical responses SLI and CPI. For this purpose, standard modeling approaches based on normality of data, including regression, analysis of variance (ANOVA) and analysis of covariance (ANCOVA), were tentatively run for both DMFT and oral hygiene questionnaire, but a severe lack of fit prevented their use for both responses. Instead, a log-linear model for DMFT turned out to be appropriate and, thus, effective in discovering the most important predictors on this response. As far as SLI and CPI responses are concerned, each of them was first dichotomized in order to create a binary-coded variable. Then, logistic regression was done for these two-valued responses; in the case of recoded SLI, a supplemental stepwise procedure was also performed.

All the computations were carried out using the free software R[16].

Results

Table I shows the main characteristics of AUD patients and control subjects.

Alcoholic patients showed significantly lower oral hygiene scores compared to controls (4.17 ± 1.47 *vs.* 5.65 ± 0.93; $p = 0.0002$). (Table III). A significantly higher DMFT score was found in AUD patients compared to controls (14.9 ± 6.6 *vs.* 7.9 ± 5.0; $p = 0.0002$) (Table III). Moreover, AUD patients showed significant differences of CPI score (0-1 *vs.* 2-3-4) ($p < 0.0001$) and SLI score (0-1 *vs.* 2-3-4) ($p < 0.0001$) compared to controls (Table III).

Among AUD patients, no differences were found between smokers and non-smokers in terms of DMFT scores ($p = 0.11$), and no differences were found in terms of oral hygiene scores ($p = 0.269$). In particular, among AUD patients, a possible dependence of binary-coded SLI on smoking habit was first found by an explorative chi-squared test ($p = 0.056$). Logistic regression, run with all possible predictors (five), showed a trend of influence of smoking on recoded SLI ($p = 0.06$). A stepwise procedure was performed to reduce the set of predictors in the model, selecting smoking, alcohol intake and age as the most important ones. A subsequent logistic regression, done with the reduced set of predictors, finally revealed a significant influence of smoking habit on two-valued SLI ($p = 0.039$).

No differences were found among male *vs.* female in terms of DMFT scores ($p = 0.722$), nor oral hygiene scores ($p = 0.174$). When a log-linear model was adopted for DMFT, a strong negative effect of smoking habit has been revealed ($p = 0.003$), despite the previous conclusion from explorative comparison based on Welch two-sample *t*-test ($p = 0.11$), together with positive effects of age ($p = 0.04$) and perhaps of gender ($p = 0.06$).

Among AUD patients, chi-squared tests suggested that binary-coded CPI was not influenced

Table III. Mean scores and standard deviation obtained by AUD patients and control subjects at oral hygiene questionnaire, DMFT (decayed, missing, filled teeth), SLI (Silness-Loë plaque index), CPI (community periodontal index of treatment needs), and statistical significance.

	AUD patients	Control group (N = 23)	*p*-value
Oral hygiene questionnaire, mean (SD)	4.2 (1.5)	5.6 (0.9)	$p = 0.0002$
DMFT, mean (SD)	14.9 (6.6)	7.9 (5.5)	$p = 0.0002$
SLI, mean (SD)	2.6 (0.5)	0.5 (0.5)	$p < 0.0001$
CPI, mean (SD)	2.8 (0.8)	0.8 (0.7)	$p < 0.0001$

by smoking ($p = 0.457$) nor by gender ($p = 0.847$); besides, logistic regression model was not applicable due to lack of fit.

Discussion

The present study shows that alcohol abuse increases the risk of dental and periodontal diseases. AUD is associated with increased risk for oral diseases such as caries and periodontitis[17]. Necrotizing gingivitis, periodontitis and stomatitis represent the most severe inflammatory periodontal diseases. Vitamin deficiencies and malnutrition seems to be involved in these dental and periodontal alterations[18,19,31]. Malnutrition is a common feature of AUD patients[20-23], and it could be a possible factor at the basis of the higher prevalence of periodontal diseases found in AUD patients. Moreover, alcohol intake can increase the host susceptibility to infections, such as periodontitis because ethanol damages neutrophils, macrophages, and T cells function, increasing the susceptibility to infections[24].

In addition to alcohol-induced effects, alcoholic patients showed a poor oral hygiene compared to controls. This observation is in line with previous observation[25], confirming that AUD represents an independent risk factor for oral uncare[19].

Among AUD patients, smokers showed lower oral hygiene and dental health compared to non-smokers. Smoking is considered an important confounder to the relationship between periodontal disease and alcohol abuse[26]. To eliminate confounding effects, multiple logistic regression analyses have been performed in the present study. Results confirm the synergistic effects of ethanol intake and smoking habit on dental plaque and oral disease.

Considering the results of the oral hygiene questionnaire, DMFT, CPI and SLI scores, the presence of dental disease in AUD patients seems to be related to a poor oral hygiene and dental care. This observation is in line with a previous Finnish study[19] demonstrating a positive significant correlation between the amount of alcohol intake and the depth of the periodontal pockets. Moreover, alcohol seems to be the primary cause of dental uncare, regardless of other diseases. In a study on patients with liver cirrhosis[18], measures of oral hygiene and periodontal conditions were worse in alcoholics with or without cirrhosis than in healthy subjects and non-alcoholic patients with cirrhosis. Furthermore, alcoholics had significantly fewer remaining teeth than patients without alcohol abuse and healthy controls[26].

Furthermore, AUD patients visit dentists or dental hygienists more irregularly than controls; this practice may result in more decayed tooth surfaces[17]. Our data are supported by a recent meta-analysis[4], showing an association between alcohol consumption and periodontitis' risk.

The present study has some limitations. First, the evaluation of dental and periodontal status by SLI index, although recommended by WHO, could underestimate milder grades of inflammation[27]. The use of CPI, as a result of different indicators, could underestimate severe stages of periodontitis[28]. In addition, the partial-mouth estimation technique, although less time-expensive, could reduce the discriminative power of the examination[29]. The small sample size, the cross-sectional study without longitudinal design, the possible underreporting of the real amount of alcohol consumed and the lacking of data about pharmacological treatment for AUD[30], represent other limitations.

Conclusions

The present study indicates that alcohol abuse is a risk factor for dental and periodontal disease. Longitudinal studies on the association of alcohol dependence/consumption with periodontitis are needed to confirm the present data. Other possible risk factors for periodontitis, as dental biofilm, smoking, diabetes, gender, aging, psychosocial factors and HIV infection[3,32] must be considered because they could represent bias. These confounders' control could be suitable to test the real association between alcohol abuse and periodontitis and could be useful to estimate the strong impact on oral health. For these reasons, the practice of basic oral hygiene and the access to professional dental care are necessary to reduce oral diseases in AUD patients.

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Conflict of Interest

The Authors declare that they have no conflict of interests.

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