Dental and periodontal health in adults with eating disorders: A case-control study

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ABSTRACT

Objectives: This study evaluates dental and periodontal health in anorexia nervosa and bulimia nervosa patients.
Methods: Seventy females with eating disorders (36 anorexia nervosa) attending a public hospital Psychiatry and Addiction unit were compared with age-matched controls (n = 70). Full-mouth examination and oral hygiene behaviours were recorded for all participants.
Results: More frequent dental attendance and toothbrushing were observed in patients with eating disorders than in controls ($p < 0.01$), while lower plaque index and bleeding on probing were observed in controls than in patients ($p \leq 0.03$). Percentages of sites with gingival recession > 2 mm were higher in patients with eating disorders than in controls (2.3 ± 4.1 versus 0.0 ± 0.1, $p < 0.01$). The BEWE score > 2 was significantly more frequent in bulimia nervosa patients than in anorexia nervosa patients (76.5% versus 41.7%, $p < 0.01$). Regarding periodontal parameters, mean plaque index, bleeding on probing and clinical attachment loss were increased in anorexia nervosa patients compared to bulimia nervosa patients.
Conclusions: The present data suggest different oral health approaches in eating disorder patients according to diagnosis type.
Clinical significance: Periodontal and dental health should be considered rigorously in patients with eating disorders. Personalized oral hygiene recommendations and treatments can be delivered according to the type of eating disorder.

1. Introduction

Eating disorders (ED), which affect more than 13% of adolescents and young adults [1], are serious conditions related to persistent eating behaviours that negatively impact social, mental and physical health [2]. Several factors may cause ED including genetics, brain biology, personality traits, and cultural ideals [3]. Anorexia Nervosa (AN) and Bulimia Nervosa (BN) are the two main types of ED defined in the Diagnostic and Statistical Manual of Mental Disorders-5 [4]. AN is characterized by the restriction of energy intake, leading to a significantly low body weight in the context of age, gender, developmental trajectory, and physical health. AN patients feel an intense fear of gaining weight or becoming fat and undue influence of body shape and weight on self-evaluation [4]. BN is characterized by recurrent episodes of binge eating with a perceived lack of control over eating during these episodes, inappropriate compensatory behaviour such as vomiting, over-exercising and purging to prevent weight gain, and undue influence of body shape and weight on self-evaluation [4]. ED can affect people of both genders at any life stage, however they are most often reported in adolescents and young females. The lifetime prevalence by age 20 is estimated 0.8% for AN and 2.6% for BN [1].

There is strong evidence that ED individuals are in poorer health

than non-ED individuals because of biological and behavioural factors such as malnutrition and addictions [5,6]. However, there is a paucity of data on periodontal and dental health when AN and BN types are considered. A high risk of dental caries and erosive tooth wear (both occlusal and cervical) has been shown in ED patients [7]. Considering periodontal health, few clinical studies have been published, and controversial results have been reported with either no difference in periodontal parameters between ED patients and controls [8,9], or a higher prevalence of gingivitis, periodontitis and gingival recessions [10,11]. In addition, there is no data on the relationship between oral hygiene behaviours, dental health and periodontal health in ED patients. It is well accepted that gingival inflammation combined with poor plaque control and horizontal toothbrushing movement may lead to gingival recession [12–14]. Since EDs are often associated with self-harm, it is important to carefully control oral hygiene behaviours in such patients [15]. Lastly, multiple cervical restorations have been suggested to contribute to gingival inflammation and generalized gingival recessions [15]. Due to erosive tooth wear, patients with ED often need multiple treatments for non-carious cervical lesions using adhesive techniques that can be considered as local risk factors for periodontal inflammation and gingival recessions.

A case-control study was designed to evaluate dental and periodontal health in patients with either anorexia nervosa or bulimia nervosa. Our hypothesis was that oral features of ED patients may differ, and may lead to tailor-made prevention according to the type of diagnosis established.

2. Materials and methods

2.1. Study population

Consecutive adult patients with ED referred to the department of Psychiatry and Addiction at Paul Brousse Hospital (Villejuif, France) between October 2014 and June 2017 were considered for inclusion. In and out female patients younger than 65 years old with an ED diagnosed for at least 5 years were eligible for the study. The M.I.N.I. (Mini-International Neuropsychiatric Interview) questionnaire was used to identify the ED types such as AN, BN, eating disorders not otherwise specified such as binge eating disorder, sub-threshold AN and sub-threshold BN [16]. Only patients who suffered from one of the two main types of ED, AN and BN, were considered for inclusion. The females included in the control group were non-ED volunteers recruited by announcement on the web. Eligible participants were excluded if they: 1) were not affiliated with national social insurance; 2) did not speak French and/or were unable to read and/or understand the information form; 3) were dental professionals or dental students; 4) were diabetics, pregnant or breastfeeding; 5) had received any systemic or local treatment that could interfere with their periodontal status such as antibiotics, anti-inflammatory drugs, scaling and root planning and orthodontic treatment, 3 months before the clinical examination; 6) had fewer than 10 teeth.

The Ethics Committee of Paris Ile de France approved the study protocol (CPP number 13588), and all the participants gave their informed consent. This study was registered at clinicaltrials.gov under number NCT0296015.

2.2. Data collection

Semi-structured interviews based on medical and lifestyle data were conducted by the examiners (A.P. and A.K.) at chairside. Age, medications, and smoking were recorded. Self-reported oral health behaviours included dental visit frequency ($\geq$ twice/year, once/year, more than once every three years, or once every three years or less), and toothbrushing frequency (once a day, twice a day, or > twice a day). Height and weight were assessed the day of the examination by nurses in the Psychiatry and Addiction department (Paul Brousse Hospital) for

ED patients, and by the examiners in the Odontology department (Rothschild hospital) for controls. Body weight was measured to the nearest 0.1 kg with subjects in indoor clothing and no shoes. Height was measured to the nearest 0.5 cm with a wall-mounted stadiometer in the same conditions. Body mass index (BMI) was then calculated. In ED patients, the duration of the disease, the presence of food restriction phases, hyperphagia episodes and self-induced vomiting during the last two years were recorded.

Dental examination records included the number of missing teeth, the DFMT score (Decayed Missing Filled Tooth) evaluating dental caries [17], and the BEWE score (Basic Erosive Wear Examination) evaluating erosive tooth wear [18]. The BEWE is a partial scoring system recording the most severely affected buccal, occlusal or lingual surface in a sextant, and the cumulative score guides the management of the erosive tooth wear. Criteria for grading erosive wear were as follows: 0) No erosive tooth wear; 1) Initial loss of surface texture; 2) distinct defect, hard tissue loss < 50% of the surface area; 3) hard tissue loss $\geq$ 50% of the surface area. Apart from enamel, dentin is often involved in a BEWE score of 2 or 3. Examiners (A.P. and A.K.) were trained by a senior clinical examiner (P.C.) for examination and scoring the buccal, occlusal, and lingual dried surfaces for each tooth (excluding third molars) under good lighting, without magnification.

A classical full-mouth periodontal examination was performed at 6 sites per tooth, except third molars, using a manual periodontal probe (HuFriedy PCP UNC 15 probe, Chicago, IL, USA). Plaque control was evaluated using a dichotomized plaque index (PI) [19], and gingival inflammation using bleeding on probing (BOP) [20]. Probing depth (PD), and gingival recession (REC) were measured in millimetres. Clinical attachment level (CAL) was calculated as the sum of PD and REC. Prior to the study, the two examiners were trained and calibrated to a gold standard (P.B.). Examiner reliability for the periodontal parameters was acceptable if the ICC value was $\geq$ 0.9.

The sample size calculation was based on the prevalence of sites with attachment loss > 2 mm in French women previously established at 19.62 $\pm$ 2.09, for the age group 35–39 [21]. To detect a 75% difference of prevalence between the eating disorders group and the control group, with a two-sided test, an alpha error of 5%, and a beta error of 20%, 64 participants were needed per group (software epiR package 0.9–96). To secure the matching (no more than 2 years difference between each case and matched-control), it was decided to include 70 participants per group.

2.3. Data analysis

Frequencies, distributions, means, and standard deviations across ED patients and controls were calculated. Because participants were matched for age, McNemar's Chi-squared tests and paired t-tests were used to test differences between ED patients and controls. If any difference between ED patients and controls was detected for oral parameters, comparisons were made according to ED types (AN versus BN versus controls) with analyses of variance (ANOVA). In the case of a significant difference, multiple comparisons were conducted with posthoc analyses. Lastly, disease duration, behavioural and biological variables were compared between AN and BN patients with Student's t-tests and Chi-squared tests. P values $\leq$ 0.05 were considered statistically significant. Missing data were dropped from the analyses. All the analyses were performed using R software (version 2.14.0, the R Core Development Team, 2010). The reporting of the study was made according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (Supplemental data).

Table 1

Comparison of general and oral characteristics between eating disorder patients and controls.

	All n = 140	ED patients n = 70	Controls n = 70	*p* value[*]
Self-reported data (Mean ± SD or n (%))				
Age (years)	31.1 ± 7.3	32.1 ± 9.1	30.2 ± 4.7	**0.1**
Smoking				
Current smokers	48 (34.3)	29 (41.4)	19 (27.2)	**< 0.01**
Former smokers	8 (5.7)	0 (0)	8 (11.4)	**< 0.01**
Never smoked (Ref)	84 (60.0)	41 (58.6)	43 (61.4)	–
Psychotropic medication(s) (≥1 per day)	52 (37.1)	49 (70.0)	3 (4.3)	**< 0.01**
Micronutrient(s) (≥1 per day)	40 (28.6)	39 (55.7)	1 (1.4)	**< 0.01**
Frequency of dental attendance				
Once in 3 years and less	21 (15.0)	9 (12.9)	12 (17.2)	**< 0.01**
Once from 1 year to 3 years	30 (21.4)	8(11.4)	22 (31.4)	**< 0.01**
At least once a year (Ref)	89 (63.6)	53 (75.7)	36 (51.4)	–
Frequency of tooth brushing				
Less than twice a day	17 (12.1)	7 (10.0)	10 (14.3)	**0.77**
Twice a day	88 (62.9)	33 (47.1)	55 (78.6)	**< 0.01**
More than twice a day (Ref)	35 (25.0)	30 (42.9)	5 (7.1)	–
Clinical data (Mean ± SD or n (%))				
Body mass index (kg. m^{-2})	20.0 ± 3.7	17.6 ± 2.7	22.3 ± 3.0	**< 0.01**
Number of remaining teeth	27.0 ± 1.8	26.9 ± 1.9	27.1 ± 1.7	0.58
DMFT	6.3 ± 6.5	7.9 ± 7.5	4.7 ± 4.8	**< 0.01**
BEWE				
≤2	99 (70.7)	29 (41.4)	70 (100.0)	NA
3–8	20 (14.3)	20 (28.6)	0 (0)	
9–13	8 (5.7)	8 (11.4)	0 (0)	
≥14	13 (9.3)	13 (18.6)	0 (0)	
Plaque index (% of sites)	62.3 ± 25.5	71.5 ± 26.8	53.0 ± 20.4	**< 0.01**
Bleeding on probing (% of sites)	26.0 ± 23.1	30.2 ± 26.3	21.8 ± 18.7	**0.03**
CAL > 2 mm (% of sites)	14.3 ± 19.2	28.6 ± 18.1	0 ± 0	**< 0.01**
PPD > 3 mm (% of sites)	1.8 ± 5.4	0.5 ± 1.7	3.1 ± 7.3	**< 0.01**
REC > 2 mm (% of sites)	1.2 ± 3.1	2.3 ± 4.1	0.0 ± 0.1	**< 0.01**

McNemar's Chi-squared test and paired t-test, Non-ED vs ED participants.

CAL: Clinical Attachment Level, PPD: Periodontal Probing Depth, REC: Gingival Recession. NA: Not applicable.

Bold value signifies the statistical significance.

3. Results

3.1. Dental and periodontal parameters in eating disorder patients versus controls

Seventy-one ED women and 71 non-ED women were eligible. Because of non-matching reasons, one ED and one non-ED women were excluded. Finally, 70 ED women (cases) and 70 non-ED women (controls) were included in the study (Supplemental Fig. 1).

The description of the sample is reported in Table 1 for both general and oral characteristics. The mean age was 31.1 ± 7.3 years. Body mass index was in the normal weight range for the controls, while it was under the threshold of 18.5 kg/m2 (underweight) for the ED patients. ED patients were more often current smokers than controls (41.4% versus 27.2%, *p* < 0.01). No former smoker was found in the ED group. As expected, the intake of psychotropic medications and micronutrients was dramatically increased in ED patients compared to controls (70% versus 4.3% and 55.7% versus 1.4% respectively, *p* < 0.01). The frequency of dental attendance and toothbrushing were higher in ED patients than in controls: more than 75% of ED patients reported having visited the dentist at least once a year, and nearly 63% brushed their teeth at least twice a day, versus 51.4% and more than 85%, respectively, for controls.

Regarding the oral health parameters, ED patients were more susceptible to dental caries as assessed by a higher DMFT score than controls (7.9 ± 7.5 versus 4.7 ± 4.8, *p* < 0.01). Periodontal data indicated that the mean percentages of sites with dental plaque and bleeding on probing were higher among ED participants than among controls (71.5 ± 26.8 and 30.2 ± 26.3 versus 53.0 ± 20.4 and 21.8 ± 18.7, *p* < 0.01 and *p* = 0.03 respectively). ED patients presented more than 2% of sites with gingival recession of 3 mm and more, while none had gingival recession exceeding 2 mm among controls.

Consequently, ED patients exhibited significantly higher percentages of sites with CAL of 3 mm and more than controls (28.6 ± 18.1 versus 0 ± 0, *p* < 0.01). Interestingly, the frequency of PD of at least 4 mm, defining periodontal pockets, was lower in ED patients than in controls (0.5 ± 1.7 versus 3.1 ± 7.3, *p* < 0.01).

3.2. Dental and periodontal variables in controls and patients according to the type of ED diagnosis

Differences in oral parameters according to the ED diagnosis types, AN versus BN, are presented in Table 2. Patients with AN brushed their teeth more frequently than patients with BN, though the latter nevertheless brushed their teeth more frequently than controls. No difference was found for dental caries, while the prevalence and severity of erosive tooth wear was significantly different between AN and BN patients. A BEWE score ≥3 was observed in 76.5% of the BN patients compared with 41.7% of the AN patients (*p* < 0.01). Regarding periodontal parameters, the worst plaque control was observed in the AN group with a plaque index of almost 80% in comparison with approximately 60% in BN (and 50% in controls). The mean percentage of sites with bleeding on probing, characterizing the extent of gingival inflammation, was higher in AN patients compared with BN patients (41.3 ± 27.2 versus 18.5 ± 19.5, *p* < 0.01) and controls (41.3 ± 27.2 versus 21.8 ± 18.7, *p* < 0.01). Interestingly, the plaque index and the gingival index in BN did not differ from controls (*p* = 0.08 and *p* = 0.73 respectively). Although the mean percentages of sites with PD ≥4mm and REC ≥3mm were not different among the ED patients according to diagnosis type, AN patients had significantly more sites with CAL ≥3mm than BN patients (33.9 ± 18.6% versus 22.9 ± 15.8%, *p* < 0.01).

Table 2
Comparison of oral characteristics between eating disorder patients according to diagnosis type and controls.

	Anorexia nervosa patients n = 36	Bulimia nervosa patients n = 34	Controls n = 70	All groups [1]	Anorexia nervosa vs Controls [2]	Bulimia nervosa vs Controls [2]	Anorexia nervosa vs Bulimia nervosa [2]
Self-reported data (Mean ± SD or n (%))				*P value*			
Frequency of dental attendance							
Once in 3 years and less	4 (11.1)	5 (14.7)	12 (17.2)				
Once from 1 year to 3 years	6 (16.7)	2 (5.9)	22 (31.4)	**0.02**	0.1	0.05	0.69
At least once a year (Ref)	26 (72.2)	27 (79.4)	36 (51.4)				
Frequency of tooth brushing							
Less than twice a day	1 (2.8)	6 (17.7)	10 (14.3)	**< 0.01**	**< 0.01**	**< 0.01**	**< 0.01**
Twice a day	17 (47.2)	16 (47.1)	55 (78.6)				
More than twice a day (Ref)	18 (50.0)	12 (35.2)	5 (7.1)				
Clinical data (Mean ± SD or n (%))				*P value*			
Number of remaining teeth	27.1 ± 1.3	26.7 ± 2.4	27.1 ± 1.7	0.5	–	–	–
DMFT	8.2 ± 7.3	7.5 ± 7.8	4.7 ± 4.8	**0.01**	**0.02**	0.08	0.91
BEWE							
≤2	21 (58.3)	8 (23.5)	70 (100)	**< 0.01**	**< 0.01**	**< 0.01**	**< 0.01**
3–8	6 (16.7)	14 (41.2)	0 (0)				
9–13	3 (8.3)	5 (14.7)	0 (0)				
≥14	6 (16.7)	7 (20.6)	0 (0)				
Plaque index (% of sites)	78.8 ± 19.7	63.7 ± 31.1	53.0 ± 20.4	**< 0.01**	**< 0.01**	0.08	**0.02**
Bleeding on probing (% of sites)	41.3 ± 27.2	18.5 ± 19.5	21.8 ± 18.7	**< 0.01**	**< 0.01**	0.73	**< 0.01**
CAL > 2 mm (% of sites)	33.9 ± 18.6	22.9 ± 15.8	0.0 ± 0.0	**< 0.01**	**< 0.01**	**< 0.01**	**< 0.01**
PPD > 3 mm (% of sites)	0.8 ± 2.2	0.2 ± 0.6	3.1 ± 7.3	**0.02**	0.09	**0.03**	0.89
REC > 2 mm (% of sites)	2.8 ± 3.6	1.8 ± 4.6	0.0 ± 0.1	**< 0.01**	**< 0.01**	**< 0.01**	0.37

Bold value signifies the statistical significance.
[1] Analyses of variance and Chi-squared test, controls vs anorexia nervosa vs bulimia nervosa.
[2] Post-hoc analyses. CAL: Clinical Attachment Level, PPD: Periodontal Probing Depth, REC: Gingival Recession.

4. Discussion

The present report reveals a higher frequency and severity of erosive tooth wear in BN patients than in AN patients, whereas higher frequency and severity of gingivitis was found in AN patients compared with BN patients. Overall, poorer periodontal and dental health was observed more in ED patients than controls.

We observed a significantly different oral disease profile among patients as a function of ED diagnosis type. AN patients presented worse periodontal conditions with higher dental plaque accumulation, gingival inflammation and clinical attachment loss than BN patients. AN patients also reported brushing their teeth more frequently than BN patients ($p < 0.01$). We assume that AN patients are less efficient than BN patients in controlling plaque, thereby inducing gingivitis [22,23]. On the other hand, BN patients exhibited worse dental status with higher frequency and severity of erosive tooth wear than AN patients and controls. BN patients reported vomiting significantly more frequently than AN patients, 26/29 versus 7/32, respectively (supplemental data). Erosive tooth wear is a chemical-mechanical process resulting in the cumulative loss of hard dental tissue not caused by bacteria, and is characterized by the loss of the natural surface morphology and contour of the teeth [24]. The shift of pH in the oral environment associated with inadequate oral hygiene behaviour such as technique, timing, duration, and frequency is evoked in the pathogenic pathway, leading to erosive tooth wear in ED patients [7]. However, a large case-control study in patients with dietary erosive tooth wear showed no association between erosive tooth wear and toothbrushing timing (OR = 1.41, 95% CI: 0.82–2.42) [25]. In our study, BN had more erosive tooth wear, vomited more often, but brushed less often than AN patients. Thus, the potential synergic effect of toothbrushing with acidic attack of the tooth requires further investigation, especially in BN and AN patients. Lastly, a hypothesis commonly put forward to explain the high frequency of toothbrushing in ED patients is the need to remove the unpleasant taste of gastric acid after self-induced vomiting [26]. Qualitative studies have also shown that compulsive toothbrushing could be a distraction technique from eating, a self-harm behaviour or

aim to induce vomiting [27,28]. ED patients who perform self-harm behaviours have a longer history of treatment than those who do not [29]. In our study, it is noteworthy that the duration of ED is significantly higher in AN than in BN patients, 16.3 ± 9.8 years versus 12.1 ± 5.0 years, p = 0.03 (supplemental data).

When we considered combined AN and BN patients, more than 40% claimed to brush their teeth at least 3 times per day, whereas around only 7% of controls brush their teeth as often. Comprehensive oral hygiene procedures repeated more than 3 times a day have been reported by ED patients in surveys [30,31]. These obsessional-like behaviours might have adverse effects on the periodontium. A recent meta-analysis concluded that high toothbrushing frequency and horizontal, traumatic toothbrushing methods are both risk indicators for gingival recession [32]. In the present study, although no data on toothbrushing methods are available, the outcomes confirm that compulsive toothbrushing and gingival recession are significantly more frequent in ED patients than in non-ED controls. Our results also showed a lower frequency of sites with PD > 3 mm in ED patients than non-ED controls. Nevertheless, ED patients visited a dentist more regularly than non-ED patients. Consequently, we cannot exclude that the regular sub-gingival debridement of PD > 3 mm benefits ED patients and explains the differences observed. Besides, periodontitis in ED patients remains a controversial outcome in the literature, since three clinical studies did not observe periodontitis in ED patients [26,33,34] and only one concluded on a higher frequency of periodontitis cases in ED patients than in a control group [11]. However, all these studies used partial periodontal parameters and various definitions of periodontitis.

Taken together, our results demonstrate the higher risk of both gingivitis and gingival recession and confirm the higher risk of dental caries and erosive tooth wear in ED compared to non-ED individuals [7,34,35].

The present study has several strengths. To our knowledge, it is the first to have used full-mouth periodontal examinations to evaluate periodontal health in ED patients. The use of the M.I.N.I. questionnaire, with a threshold discriminating between AN and BN subtypes, limited

inclusion bias. Taking into account the low lifetime prevalence estimates of AN (< 1%) and BN (< 3%) [1], the sample size was adequate for comparing the oral health of ED patients according to diagnosis types. Lastly, dental professionals and dental students were excluded from the study to avoid selection bias. However, we acknowledge several limitations. First, no information was available on toothbrushing methods, proximal cleaning, and periodontal phenotype. Second, all the patients attended a Psychiatric hospital Unit where they were monitored for potential nutrient deficiencies and more than a half were receiving vitamin and micronutrient supplements. We can assume that ED patients may be different to those who are not diagnosed or being treated in general practice. Third, the control group included females responding online for a free dental examination. They may be more dentally aware than females in the general population. Last, the clinical significance of the BEWE score 9–13 category might be low because of a reduced sample size (n = 3 for AN patients compared to n = 5 for BN patients).

5. Conclusions

Besides the recognized impact of ED on dental health, the present findings support the detrimental impact of ED on the periodontium, with frequent gingival recessions and gingivitis. However, no increase in periodontal pockets frequency was observed. Anorexia nervosa patients are more periodontally affected than BN patients. They should be considered at higher risk for gingivitis and gingival recessions than BN patients. Given that gingivitis and gingival recessions are largely silent diseases and conditions, AN patients may be less aware of the oral impact of their ED than BN patients. Tooth brushing frequency should be rigorously controlled in ED patients, especially in AN types. We propose to adapt the prevention of oral diseases according to the ED diagnosis type. Dental professionals should: 1) inform young females in particular, regarding dental and periodontal risks associated with ED; 2) investigate ED in young females with either gingival recessions or erosive tooth wear.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jdent.2019.03.005.

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