

# The effect of periodontal treatment on depression, body image, self esteem and anxiety in individuals: A randomized controlled clinical trial

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## Abstract

**Aim:** Depression is a multi-factorial disease characterized by a variety of symptoms. Individuals with psychiatric disorders are seem to be more prone to periodontitis. However, depression and periodontal disease can be considered bidirectional risk factors. Periodontal diseases can also be an effect on depression. The aim of this study is to determine the effect of non-surgical mechanical periodontal treatment on psychological state.

**Materials and Methods:** Two randomized groups were established from depressed patients with non-treated periodontal diseases. Test (n = 92) and control group (n = 92). Clinical periodontal and psychological measures were administered at baseline and at 6 weeks in the control and test group. Periodontal treatment was applied to the test group.

**Results:** After 6 weeks (the end of the periodontal therapy) there was a significant decrement in the results of Beck Depression Inventory ( $p^a = 0.038$ ) and a significant increment in Body Cathexis Scale ( $p^a < 0.001$ ) results in the test group. However, the results of Rosenberg Self-Esteem Scale ( $p^a = 0.820$ ) and Beck Anxiety Inventory ( $p^a = 0.071$ ) is similar between test and control groups.

**Conclusion:** Within the limits of present study, the results suggest that periodontal treatment might be useful to improve depressive patients' psychological conditions.

**Keywords:** Body image; depression; periodontal disease; self-concept

## INTRODUCTION

Depression is one of the most common diseases worldwide. One of every ten person has depression or at least depressive symptoms (1). Recent evidence suggests that the nervous system and immune system contribute to the pathogenesis of depression (2,3). Many studies on animals and human beings have shown that inflammatory conditions affect brain activity by the peripheral release of proinflammatory cytokines such as Interleukin (IL)-6 and IL-1 $\beta$  (3,4). IL-6 and IL-1 have also been shown to increase in periodontal inflammation and decrease after periodontal treatment (5). Furthermore, the increase in these cytokines in inflammatory and infectious diseases affects brain activity through both direct and the autonomic nervous system, in a way that leads to it being called "sickness-behavior". Sickness-behavior resembles depression in terms of behavioral, emotional,

and motivational situations (6). Therefore, any potential association of inflammation, infection, and depression is not fully understood yet.

Depression is also thought to have an adverse effect on periodontal disease. That is supported by studies that depression may modify the immune response and making the individual more susceptible to the development of the periodontal disease (7). There are also certain factors common for these two diseases such as stress and anxiety which could both affect depressive state and periodontal disease risk. The study of Saletu et al. confirmed that depression is a pathogenetic factor for periodontitis (8). However, periodontal disease and depression may affect each other in such a way that periodontal disease has a direct effect on depression.

Another possible mechanism for the association between depression and periodontal disease is body image and

Received: 12.05.2020 Accepted: 10.07.2020 Available online: 23.06.2021

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self-esteem. Body image and self-esteem might decrease in people with periodontal diseases and low body image and self-esteem levels might increase the risk of depression. Body image is one's aesthetic perception of him or herself and affected by visual appearance (9). Periodontal diseases have visual clinical symptoms such as the presence of calculus and plaque, erythema, and edema of the gingival tissue, bleeding, changes in contour and consistency (10). Also, gingival appearance affects the smile. In this regard, visual clinical symptoms of oral and periodontal problems should be considered in improving self-esteem and body image in depressive patients.

Considering possible association between these two diseases, the hypothesis of the present study is 'Improving oral health with periodontal treatment might help improving depressive state by decreasing inflammatory status and increasing body image and self-esteem. Therefore, the aim of this study is to evaluate the effect of periodontal treatment on depressive state, self-esteem, body image and anxiety.

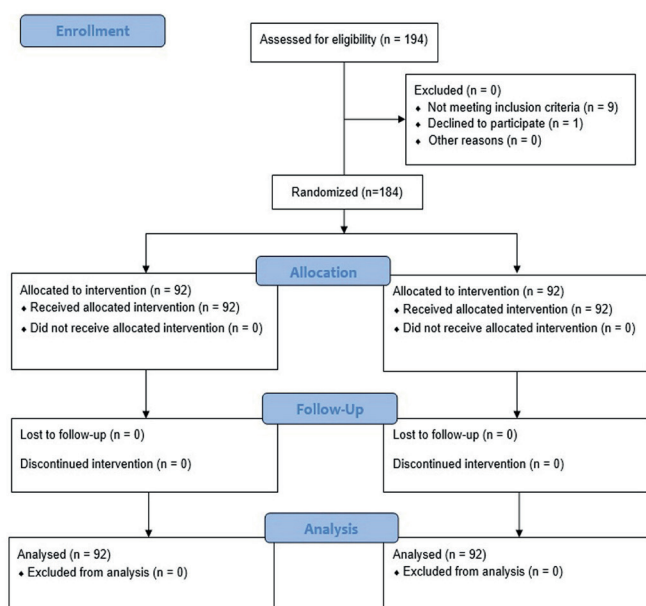
## MATERIALS and METHODS

### Ethical Approval

Tokat Gaziosmanpasa University Local Ethics Committee was reviewed and approved the study.

### Study Design

This study was a randomized controlled parallel clinical trial. 194 patients were referred to Tokat Gaziosmanpasa University, Periodontology Department at Faculty of Dentistry from May 2015 to March 2016. A patient refused to participate and 9 patients did not meet the inclusion criteria. Consequently, 184 patients were included in the study. Flowchart of the study is presented in Figure 1.



**Figure 1.** The flow chart of the study

For inclusion criteria of the study, 1) the presence of periodontal diseases, 2) the presence of diagnosed minor depression, 3) the presence of at least 15 natural teeth,

and 4) those generally systemically healthy, were considered. All of the patients were under maintenance program in Tokat State Hospital Department of Psychiatric and Neurological Diseases, neither of the patients was taking medication for any disease.

Exclusion criteria included the following: 1) the use of antidepressants, anti-inflammatory, and antimicrobial medicaments, and hormonal supplements within the preceding 6 months, 2) having a systemic disease (like inflammatory systemic diseases and diabetes mellitus, known to influence periodontal disease), 3) smoking cigarettes, 4) breastfeeding, pregnancy, and menstrual cycle, 5) received any periodontal treatment within six months.

### Sample Size

The sample size enrolled in the study was determined using a Power Analysis. With an n of 76 in each group, an  $\alpha = 0.05$ , and an effect size of 0.20 was found and power was 0.80 (11) Assuming of a dropout rate, 92 patients included per group.

### Randomization

Block randomization was used to have same number of patients in a group. Names of treatment groups (test or control) were placed into colored opaque envelopes which were then closed, mixed, and numbered. All patients met the inclusion criteria chose an envelope depend on the study group.

### Experimental Procedure

Patients were randomly assigned to the groups: Control group (delayed periodontal treatment, without treatment during the study period, n = 92) or Test group (received periodontal treatment immediately, n = 92). Patients of the control group started to receive the same periodontal treatment after six weeks of study period.

The number of patients with periodontitis and gingivitis was 28 and 64 respectively in the test group and 25 and 67 respectively in the control group respectively. Periodontitis and gingivitis were diagnosed by calibrated examiner (HBY) based on the clinical and radiographic criteria. A diagnosis of gingivitis was rated if there was a gingival inflammation without the loss of connective tissue attachment. Periodontitis was diagnosed in individuals with higher than 10% bleeding on probing and with probing pocket depth of 4 mm or more in more than 2 teeth. Individuals with an interdental attachment loss of 1-2 mm, a <15% radiographic bone loss, and no dental loss due to periodontitis were classified as Stage 1 periodontitis. Individuals with interdental attachment loss of 3-4 mm, 15-30% radiographic bone loss and no dental loss due to periodontitis were classified as Stage 2 periodontitis.

Initial periodontal treatment was performed within a week for gingivitis patients and within two weeks for periodontitis patients. All treatment was performed by the same operator (OG). Periodontal treatment included instruction and monitoring of oral hygiene and scaling.

Unlike gingivitis patients, periodontitis patients received root planning procedure. Periodontal treatment was performed via manual instruments (Hu-Friedy Co., Chicago, IL) (scaler and Gracey curettes) and ultrasonic instruments (Master Piezon, EMS S.A, Nyon, Switzerland) under local anesthesia. Patients were recalled after six weeks following the periodontal treatment.

#### **Intra Examiner Reproducibility**

One calibrated clinician (HBY) who was unaware of the treatment allocation performed all the measurements. At the beginning of the study, clinician underwent calibration training. The clinician examined ten individuals who were not participated to this study, at two separate examination. Between measurements the intra-class correlation coefficient (ICC) were  $0.94 \pm 0.03$  and  $0.96 \pm 0.04$  for probing pocket depth (PPD) and clinical attachment level (CAL) results, respectively.

#### **Periodontal Clinical Measurements**

The periodontal clinical measurements were recorded baseline and after 6 weeks. Full mouth PPD, CAL, gingival index (GI), plaque index (PI) and bleeding on probing (BOP) measurement performed. CAL and PPD level were measured to the nearest millimeter and for probing measurements, a periodontal probe (Hu-Friedy Co., Chicago, IL) was used. PPD was measured in millimeters from the gingival margin to the base of the periodontal pocket, CAL was calculated as the distance in millimeters from the cemento-enamel junction to the bottom of the periodontal pocket. BOP was recorded based on the presence or absence of bleeding up to 60 s after probing at the experimental sites. The measurements were performed at six sites per tooth (mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distolingual), excluding third molars.

#### **Psychological Measurements**

In order to assess depression, body image self-esteem, and anxiety, patients answered four questionnaire tests. All patients were called 1 hour early to their appointments and rested till treatment. While this waiting period, the receptionist gave questionnaires to the patients and collected them after the patients filled the questionnaires. All questionnaires were taken care of by the receptionist who was unaware of the study. The questionnaires were kept in a place that was not accessible to anyone. 6 weeks after treatment, in the control session, questionnaires were repeated and kept altogether with previous questionnaires. When the study was completed, all questionnaires were handed to the physician (SI) by receptionist. The physician assessed questionnaires unaware of the patients and study groups.

Beck Depression Inventory (BDI) (12) consists of 21 items. Each of the 21 statements is scored from 0 to 3. The total score allows the classification of depression severity. This self-report scale was adapted and validated for the Turkish population (13). Scores less than 10 indicates lack of the depression. The scores between 10–16 indicate

minimum depression, the scores between 17–29 indicate moderate depression, scores greater than 30 indicate severe depression.

Body Cathexis Scale (BCS) (14), which was adapted and validated for the Turkish population (15), is a self-report scale and consists of 40 items to assess the degree of satisfaction with the functions and appearance of one's body. Each of the 40 statements is scored from 1 (strongly dislike) to 5 (strongly like). The minimum score is 40 and the maximum score is 200. The higher total score means higher body satisfaction.

Rosenberg Self-Esteem Scale (RSES) (16) consists of 10 items. Items are scored on a scale spanning strongly agreement to strongly disagreement. The scores 0–1 indicate higher self-esteem, the scores from 2 to 4 indicate moderate self-esteem. Higher scores indicate lower self-esteem. This self-report scale was also adapted and validated for the Turkish population (17).

Beck Anxiety Inventory (BAI) (18) consists of 21 items. The descriptive expressions of anxiety symptoms were rated by the patient on a four-point scale. The total score allows the classification of anxiety severity. This self-report scale was also adapted and validated for the Turkish population (19). The scores between 0–10 indicate minimum degree of anxiety, the scores between 20–30 indicate moderate anxiety, scores greater than 30 indicate severe anxiety.

#### **Data Analysis**

The primary outcome was Beck Depression Inventory scores which were chosen to evaluate the change in depression after periodontal treatment. Body image, self-esteem scores, and periodontal conditions after periodontal treatment were considered as secondary outcome variables.

Data were expressed as mean  $\pm$  standard deviation. Chi-square test was used for the data recorded as scores. One way analysis of variances was used to compare the continuous normal data among groups. For post-hoc comparisons between the pair-wise groups, the Tukey HSD test was used. For the time, group factor and interaction effect with time and group, two-way repeated measures ANOVA was used. A p-value  $< 0.05$  was considered significant. Analyses were performed using statistical software (SPSS, v.19.0, IBM, Armonk, NY).

## **RESULTS**

The demographic characteristics of the test and control groups were summarized in Table 1. There were no significant differences between test and control groups with respect to age, gender, education level and marital status ( $p > 0.05$ ).

Psychosocial measurements of patients with gingivitis were presented in Table 2. The differences of BCS scores of patients with gingivitis were statistically different between the groups ( $F = 16.056, p^a < 0.001$ ).

**Table 1. Descriptive demographic characteristics of test and control groups**

Variable	Test (n = 92)	Control (n = 92)	p
Age (years) (mean±sd)	35.35 ± 12.1	33.79 ± 9.25	0.711
Gender n (%)			
Men	76 (82.6)	72 (78.3)	0.452
Women	16 (17.4)	20 (21.7)	
Education Level n (%)			
Primary school	16 (17.4)	22 (23.9)	0.090
Middle School	14 (15.2)	8 (8.7)	
High school	24 (26.1)	35 (38.1)	
University	38 (41.3)	27 (29.3)	
Marital Status n (%)			
Married	57 (62)	60 (65.2)	0.642
Single	35 (38)	32 (34.8)	

Psychosocial measurements of patients with periodontitis were presented in Table 3. There was a significant difference in the difference of BCS scores of patients with periodontitis between the test and control groups ( $F = 10.284$ ,  $p^a = 0.002$ ).

Table 4 presents clinical periodontal parameters and their differences within and between groups. Baseline periodontal conditions (T0) were similar in the test and control group ( $p^a > 0.05$ ). After periodontal treatment (T1), there is a significant difference in all periodontal clinical parameters between control and test groups ( $p^b < 0.05$ ). There was a statistical difference in all periodontal clinical parameters between T0 and T1 for the test group ( $p^c < 0.001$ ), but the difference for the control group was not significant except GI ( $p^d > 0.05$ ).

**Table 2. Psychosocial measurements of patients with gingivitis in the test and control groups at baseline and after 6 weeks (the end of the therapy)**

Clinical Psychosocial measurements	Grouping	Baseline measurement	6 <sup>th</sup> week measurement	Difference	p <sup>b</sup> value
Beck Anxiety Inventory	Test	23.2±10.93	9.43±8.13	13.77±11.73	<0.001
	Control	17.49±8.22	6.83±5.95	10.66±8.66	<0.001
	F	10.293	4.331	2.292	
	p <sup>a</sup>	0.002	0.039	0.133 <sup>†</sup>	
Beck Depression Inventory	Test	22.55±7.09	9.05±5.27	13.32±6.52	<0.001
	Control	26.43±8.21	14.88±6.54	11.55±5.88	<0.001
	F	8.415	31.019	3.069	
	p <sup>a</sup>	0.004	<0.001	0.082 <sup>†</sup>	
Body Cathexis Scale	Test	127.38±26.91	155.38±28.45	-27.42±18.34	<0.001
	Control	136.69±26.81	153±23.28	-16.31±17.49	<0.001
	F	4.609	0.245	16.056	
	p <sup>a</sup>	0.034	0.622	<0.001 <sup>†</sup>	
Rosenberg Self-Esteem Scale	Test	2.15±0.74	0.85±0.58	1.28±0.74	<0.001
	Control	2.47±0.8	1.21±0.71	1.26±0.92	<0.001
	F	5.661	9.145	0.012	
	p <sup>a</sup>	0.019	0.003	0.913 <sup>†</sup>	

p<sup>a</sup> : statistical difference between test and control groups at T0 and T1, †: Time x group (interaction) effect

p<sup>b</sup> : statistical difference between T0 and T1 for the control and test group. Two-way repeated measures ANOVA test was used

**Table 3. Psychosocial measurements of patients with periodontitis in the test and control groups at baseline and after 6 weeks (the end of the therapy)**

Clinical Psychosocial measurements	Grouping	Baseline measurement	6 <sup>th</sup> week measurement	Difference	p <sup>b</sup> value
Beck Anxiety Inventory	Test	17.93±11.03	7.89±7.03	10.04±8.85	<0.001
	Control	14.04±8.04	6.63±5.83	7.41±8.14	<0.001
	F	2.031	0.441	1.130	
	p <sup>a</sup>	0.160	0.510	0.293 <sup>†</sup>	
Beck Depression Inventory	Test	22.93±7.45	11.59±8.18	11.78±5.33	<0.001
	Control	22.7±4.39	12.44±3.99	10.26±5.27	<0.001
	F	0.015	0.259	0.581	
	p <sup>a</sup>	0.903	0.613	0.449 <sup>†</sup>	
Body Cathexis Scale	Test	130.81±26.33	157.3±31.3	-27.89±23.17	<0.001
	Control	137.7±25.8	146.44±19.51	-8.74±17.52	<0.001
	F	1.304	2.157	10.284	
	p <sup>a</sup>	0.259	0.148	0.002 <sup>†</sup>	
Rosenberg Self-Esteem Scale	Test	2.33±0.93	1.14±0.66	1.2±0.95	<0.001
	Control	2.19±0.81	0.84±0.46	1.34±0.86	<0.001
	F	0.403	3.627	0.342	
	p <sup>a</sup>	0.528	0.063	0.561 <sup>†</sup>	

p<sup>a</sup> : statistical difference between test and control groups at T0 and T1, †: Time x group (interaction) effect

p<sup>b</sup> : statistical difference between T0 and T1 for the control and test group. Two-way repeated measures ANOVA test was used

Table 4. Periodontal characteristics of patients within the groups at baseline (T0), at the end of treatment (T1) and between T0-6

Variable	T0			T1			T0/T1-t	T0/T1-c
	Test Mean ± SD	Control Mean ± SD	p <sup>a</sup>	Test Mean ± SD	Control Mean ± SD	p <sup>b</sup>	p <sup>c</sup>	p <sup>d</sup>
CAL(mm)	2.36±1.39	2.22±1.8	0.552	1.75±1.15	2.38±1.91	0.007	<0.001	0.196
PPD(mm)	2.98±1.19	2.9±1.36	0.686	2.28±0.93	3.07±1.37	<0.001	<0.001	0.056
GI	2.27±0.59	2.15±0.63	0.187	0.87±0.73	2.33±0.56	<0.001	<0.001	0.031
BOP (%)	63.42±20.56	65.1±20.15	0.577	18.24±10	66.13±19.45	<0.001	<0.001	0.555
PI	1.8±0.96	1.75±0.85	0.685	0.57±0.5	1.82±0.89	<0.001	<0.001	0.593

SD: Standard Deviation of the Mean, p<sup>a</sup>: statistical difference between test and control groups at T0, p<sup>b</sup>: statistical difference between test and control groups at T1, p<sup>c</sup>: statistical difference between T0 and T1 for the test group, p<sup>d</sup>: statistical difference between T0 and T1 for the control group

## DISCUSSION

This is the first study evaluating that the treatment of periodontal disease may be an effect on the psychological state. In the present study, patients who received periodontal treatment showed significant positive changes in body image and depression. Self-esteem and anxiety scores did not change with periodontal treatment.

Beck Depression Scale was used to diagnose the depression (11,20-22). It was shown that depression may be a pathogenetic factor for periodontitis where positive relationship between periodontitis and depression has been investigated (7,23). Johannsen et al. showed that depressive women had higher gingival inflammation levels, larger levels of plaque accumulation, of interleukin (IL)-6, and of cortisol when compared to non-depressed women (7). Ng and Keung Leung showed that patients with severe clinical attachment loss had higher depression scores compared to periodontal healthy subjects (23). However, other studies failed to establish the relationship between periodontitis and psychological factors (11,20). A recently published systematic review showed statistically no significant association between depression and periodontitis. However, they called for more studies with different designs in different populations to investigate this relationship. In a recent systematic review, it has also been shown that antidepressant treatment that contributes to immune regulation, both in cellular and humoral immunity, in patients with a major depressive disorder may benefit periodontal disease-related inflammation (24).

Periodontal diseases can initiate and maintain various cytokines at high systemic levels associated with the inflammatory response (5). Other than periodontitis, depression could also alter cytokine levels. Maes et al. suggested that constituents of the immune response such as IL-1 beta may play a role in depressing hypothalamic-pituitary-adrenal axis hyperactivity (25). Similarly, Johannsen et al. reported the increased level of IL-6 in the stress-related depressive group (7).

On the other hand, Thunell et al. demonstrated that pro-inflammatory cytokines and chemokines are effectively reduced by periodontal therapy (26). All these cytokines and mediators are important markers for periodontal diseases thus; periodontal treatment might reduce the

level of depression by causing a general decrease in systemic inflammation. In the present study, it was found that depression scores significantly decreased with periodontal therapy suggesting that a decrease in pro-inflammatory cytokine levels following the periodontal treatment may have an effect on the pathophysiology of depression. O'Neil et al. demonstrated a clear association between poor dental health and depression and the results of present study supported this association (27). The biological mechanisms of psychological situations might be responsible for the positive effect of periodontal treatment on depression.

The behavioral mechanism of psychological situations includes changes in lifestyle such as smoking, unhealthy diet and neglect of oral hygiene and these conditions in depressed patients may play a role in gingival inflammation (5). Deinzer et al. showed that psychosocial stress, which could be a factor contributing to depression, leads to increased accumulation of plaque and neglect oral hygiene (28). As a result of the gingival inflammation gingival bleeding, erythema and gingival enlargement occur. The symptoms of gingival inflammation have a strong impact on general negative emotions, self-confidence and other psychosocial variables. In addition, the gingival appearance is one of the most important components of the smile (29). The results of present study revealed that body image scores significantly increased with periodontal therapy. This could be interpreted that the visual symptoms of periodontal health after periodontal therapy may have a positive effect on the body image.

Dumitrescu et al. reported that poor periodontal health can cause an undesirable appearance, more negative body image and low self-esteem (30). In contrast, the present study found that self-esteem was not affected by periodontal treatment in patients. Body image is the concern of anyone regarding the thoughts of other people about themselves and usually is an integral part of the aesthetic (30). On the other hand, self-esteem is only the perception of one's self. To consider or not to consider others' thoughts is the main difference between body image and self-esteem. Therefore, body image is more dependent to aesthetic appearance than self-esteem (9). Improvement in aesthetic appearance could contribute to body image more than self-esteem. The fact that

periodontal treatment improved body image but not self-esteem in present study might be a proof for this situation.

Moore et al. indicated that dental anxiety is associated with social and psychological problems (31). In association to disruption of social interactions and psychological problems, anxiety contributes to depression and may also lead to avoidance of dental care, which causes a decline in oral health. Hagglin et al. showed a relationship between anxiety, poor oral hygiene and periodontal disease (32). It is possible that patients with higher anxiety may visit the dentist less frequently, and thus have poorer dental hygiene. Patients may be in need of periodontal health care more than healthy individuals and neglect of oral hygiene might worsen periodontal diseases more evidently. Furthermore, higher anxiety could increase the severity of depression. In present study, anxiety was considered as a complementary scale for depression and the results showed no changes in anxiety scores after periodontal treatment. That means patients' involved in present study had the anxiety other than dental anxiety.

Present study showed that periodontal treatment provided improvement in depressive state and body image after periodontal treatment. However, there are some limitations of present study. 6 weeks could be considered to be a short time period for evaluating the effect of non-surgical periodontal treatment. Longer follow-up duration would be beneficial in future studies. Also, the reduction in pro-inflammatory cytokine levels after periodontal treatment may be a positive effect on the immune mechanisms of depression. This needs to be investigated with more extensive studies with longer time periods and biochemical assessments of cytokines.

## CONCLUSION

This study is the first study to examine the effect of periodontal treatment on depression, body image, and self-esteem. Initial periodontal treatment was performed to the test group and effective oral hygiene education was instructed to patients. Periodontal treatments of the control group were delayed after the study period. As a result, significant positive changes in body image and depression were seen in test group patients. Oral health is a major component in an individual's social life and impairment in oral health can easily alter social relationships. With periodontal treatment, both infections is eliminated and oral hygiene is increased to a high level. Considering that stress and depression reduce immune system function and cause chronic inflammation, periodontal therapy can be thought to provide bilateral gain in psychological diseases.

*Competing interests: The authors declare that they have no competing interest.*

*Financial Disclosure: There are no financial supports.*

*Ethical approval: Tokat Gaziosmanpasa University Local Ethics Committee was reviewed and approved the study (14-KAEK-218)*

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