

Determination of Periodontal Treatment Requirements for Patients with Parkinson's Disease

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ABSTRACT

Objective: Parkinson's disease (PD) is represented by rigidity, akinesia, and tremor, which disrupt automatic, fine motor skills and may impact oral care. Our study aimed to evaluate the periodontal status and treatment needs of patients with PD.

Methods: A cross-sectional study was conducted to evaluate periodontal health in 120 individuals with PD and age- and sex-matched controls. In the case group, with the Community Periodontal Index of Treatment Needs (CPITN) data, the Schwab-England scale (SES) for daily life activities and Hoehn & Yahr scale results were recorded to identify the stage of PD. The Mini-Mental State Examination (MMSE) and the clock drawing task were utilized to assess the cognitive condition of patients.

Results: CPITN scores were markedly elevated in the case group compared to the control group. Additionally, positive correlations were identified between the CPITN and the Hoehn & Yahr stage, SES scores, MMSE scores, and the clock drawing exam.

Conclusions: The findings demonstrate that the periodontal condition of individuals with Parkinson's disease was worse than that of the age-matched control group within the study population.

Keywords: Parkinson's disease, periodontal disease, periodontal treatment needs

INTRODUCTION

Parkinson's disease is a progressive neurodegenerative disease characterized by the loss of dopaminergic neurons in the substantia nigra [1]. The disease presents a range of motor and non-motor symptoms, including tremors, rigidity, and bradykinesia [2]. These symptoms adversely impact the quality of life of the patients, frequently leading to a breakdown in

daily living tasks, like oral hygiene procedures [3]. In addition, common symptoms such as depression, dementia, dysphagia, hypersalivation, and xerostomia in these patients may also contribute to inadequate oral hygiene practices [4]. PD was first described by physician James Parkinson [5] in England in 1817. Patients with PD complain of numerous motor and non-motor symptoms. Oral cavity issues in patients with PD should not be

disregarded [6]. The issues encompass a heightened incidence of gingivitis and periodontitis, diurnal and nocturnal sialorrhea and salivary secretion, xerostomia, orofacial discomfort, burning mouth syndrome, and bruxism [3,7,8].

The principal pathophysiology of this disease involves the degeneration of dopaminergic neurons in the substantia nigra and basal ganglia [2]. Age is considered the primary risk factor for Parkinson's disease. Age correlates with Lewy body disease, a critical component of Parkinson's pathology, and moderate extrapyramidal symptoms become progressively more common in the population at large as age increases [9]. Furthermore, genetic and environmental factors have been suggested in multiple studies to contribute to the disease's development [2,10–12]. Moreover, existing evidence indicates that systemic inflammation and chronic neuroinflammation are regularly linked to the etiology of PD [2,10,11,13].

Periodontitis is a persistent inflammatory condition that impacts the supportive tissues of the teeth due to a dysbiotic microbial biofilm [14]. Some authors suggest a possible link between PD and the systemic inflammation induced by periodontal diseases [4,15–19] *e. s.* Evidence indicates that the source of peripheral inflammation, like gingivitis, facilitates the advancement of PD. Furthermore, it is known that peripheral inflammation exacerbates the damage to the brain in neurodegenerative diseases such as Alzheimer's disease, multiple sclerosis, prion diseases, and PD [20–23]. Moreover, very recent research indicates that *Porphyromonas gingivalis*, which is strongly associated with pathophysiology, may substantially affect the initiation and advancement of neurological disorders [24]. Research examining the correlation between the two diseases highlights the existence of shared risk factors in their etiologies [25].

Main Points

- It has been found that the patients with PD have a great risk of periodontal diseases.
- A study investigating the periodontal status and treatment needs in patients with PD was not previously conducted in Turkey. Considering the cultural differences, it can be suggested that the oral hygiene procedures and awareness should be regarded as essential and improved in patients with PD in Turkish society.

Periodontal disease, while infectious, may be influenced by environmental, physical, social, and host variables. Certain systemic diseases are acknowledged to affect the onset and advancement of gingivitis and periodontitis. [26]. The relationship between PD and periodontal health is a contemporary issue that several scholars have examined. The vast majority of studies have shown similar results: the periodontal health status of individuals with PD was significantly worse than that of control subjects [17, 27–31]. Moreover, initial research indicated that oral health problems associated with PD extended beyond periodontal conditions. Patients with PD frequently report a range of oral health concerns, including dysphagia, xerostomia, sialorrhea, orofacial pain, burning mouth syndrome, and bruxism [32–34].

The periodontal status and treatment needs of PD patients within the Turkish community have not been addressed in existing research. The objective of our study was to determine the periodontal status and treatment needs of patients with PD.

MATERIALS AND METHODS

Case and Control Groups

A sample size of 60 was established to achieve a statistical power of 80%. Notwithstanding the potential for missing data, the trial was structured to encompass 70 participants. The case group consisted of 70 individuals diagnosed with PD at least one year ago at Cumhuriyet University Faculty of Medicine, Department of Neurology. The approval was taken by the Ethics Committee of Clinical Investigations of Cumhuriyet University (Desicion number: 2014-01/11, Date: 2014-01-01). All study participants received prior written information concerning the study's aims and the procedures utilized during the test. Informed consent was acquired from each patient before they participated in the experiment.

They included a comparable age cohort applying to the dental faculty. No individuals in the control group revealed a history of or current symptoms indicative of neurological disorders or other conditions impacting dental health, motor function, or cognitive state. Patients exhibiting Parkinsonism symptoms unrelated to PD and those diagnosed with PD without teeth were excluded from the study. The diagnosis of PD was contingent upon the judgment of the attending physician. All patients assessed at our facility fulfilled the necessary clinical criteria. All participants underwent evaluation by a specialist (H.B.) at the Neurology

Department of Cumhuriyet University, Faculty of Medicine, Türkiye, and had thorough medical and dental evaluations.

Clinical Evaluations

Demographic data were gathered from all participants, including education level, smoking habits, existence of detachable prosthesis, daily oral hygiene practices, and frequency of dental visits. The CPITN of each patient was documented utilizing a WHO (World Health Organization) probe to assess periodontal health and treatment requirements [35,36]. The CPITN index categorizes the mouth into six sextants, evaluating the index teeth numbered 17/16, 11, 26/27, 47/46, 31, and 36/37 within each sextant. A toothless sextant was excluded from the score. If a single tooth is present in a sextant, that tooth was included in the adjacent sextant. If the tooth or teeth corresponding to the sextant exhibited a positive finding for a pocket over 6 mm at any place, the sextant was designated with CPITN code 4. If a pocket measuring 4 or 5 mm was documented, the sextant was designated CPITN code 3. If deep pockets were absent but calculus was detected on any surface of the tooth, CPITN code 2 was designated. If neither pockets nor calculus were visible, but bleeding on probing was present, CPITN code 1 was issued. If no pockets, calculus, or gingival bleeding were identified at any place on the tooth in question, CPITN code 0 was assigned to the sextant. Scores for each tooth were determined based on the CPITN criteria, with the maximum value documented for each sextant.

All measurements were conducted by a single trained and calibrated periodontist (Z.M.) using a WHO probe as an element of the calibration procedure. Twenty locations were assessed on two occasions, seven days apart, before the commencement of the investigation. Calibration was deemed acceptable if the readings at baseline and after 7 days were within 1 mm at the 95% confidence level, as indicated by correlation coefficients between duplicate measurements ($r=0.95$).

The disease's severity was assessed using the Modified Hoehn and Yahr scale, with the patient's progression spanning stages 1 to 5. [37].

The Schwab-England scale [38] (SES) was utilized to evaluate daily activities. Scores were assigned on a percentage basis. While 100% signified complete independence, patients' reliance on others escalated as the percentage diminished, with 20% citing an individual unable to perform any tasks independently

and 0% denoting a bedridden person. To assess the cognitive situations of patients with PD, the Mini Mental State Examination (MMSE) [40] and the clock drawing test [41] were used. MMSE consists of five categories: orientation, registration, attention/calculation, recall, and language. The results were divided into three categories due to the total score: 25-30: normal range; 20-24 points: mild cognitive impairment; and <20 points: severe cognitive impairment. The clock drawing test evaluates long-term memory, mental concentration, abstract thinking, visual-spatial abilities, and planning skills. It is assessed using a six-point scale. A score of four points or less indicates compromised cognitive function.

Statistical Analysis

The data from our study are presented as descriptive statistics and frequency distributions (%) and were uploaded to SPSS (Version 23.0) (IBM Corporation, United States). The Kolmogorov-Smirnov test assessed the normality of the data, revealing an irregular distribution. Consequently, the Mann-Whitney U test, the Kruskal-Wallis test, and correlation analysis were employed for nonparametric assessments. Chi-square tests were employed for the examination of categorical data, with $p < 0.05$ being significant. Spearman rank correlation analysis was employed to examine the relationships between the Hoehn & Yahr illness stage and CPITN outcomes, the SES score and CPITN outcomes, and the MMSE score, clock drawing test score, and CPITN outcomes.

RESULTS

The control group included 70 participants of a similar age to the PD patients. None in the control group had a history of or current symptoms of a neurological disease or other diseases affecting oral health, motor, or cognitive status. Symptoms unrelated to PD were not included in the study. Individuals who had no teeth were not included in the study; 27 patients (12 women and 15 men) were in group PD, and 18 individuals (8 women, 11 men). The mean age of the patients was 62.3 years (range 27-86) and the control group's was 64.9 years (57-93). The mean age of the case group was 62.3 years (27-86), and the control group was 64.9 years (57-93). The study's demographic statistics are presented in Table 1.

Educational status was significantly different between the PD and control groups ($p<0.05$). In the PD group, the education level of female patients was seen to be below the mean level. On the contrary, the education level of both men and women

in the control group was higher than the mean. Not only in the PD groups but also in control groups, smoking was statistically significantly less frequent than non-smoking ($p<0.05$), and the difference in non-smokers between the groups was statistically significant ($p<0.05$). Dental brushing habits exhibited a significant difference between the control and test groups ($p<0.05$). Individuals in the control group were observed to have more consistent and frequent tooth brushing than patients with PD. Regarding frequency of dental visits, there was a significant difference between groups ($p<0.05$). While most of Parkinson's patients (59%) visited the dentist only when they had a dental problem, most of the control group (34%) reported that they visited the dentist every 1-2 years. Individuals in the test group were assessed for the severity of PD according to the modified Hoehn & Yahr scale, the SES score, and their cognitive state as determined by the MMSE and clock drawing test (Table 2).

While according to gender, education level, dental visit frequency, prosthesis, smoking, or tooth brushing, there was no significant difference between Hoehn & Yahr scores ($p>0.05$), a significant difference was noted concerning age. Patients over 65 years of age exhibited significantly higher Hoehn & Yahr scores ($p<0.05$). There was a positive albeit statistically insignificant relationship seen between the CPITN and the Hoehn & Yahr scores ($p>0.05$). No significant correlation was identified between SES score and age, gender, prosthesis usage, tooth-brushing frequency, cigarette consumption, or dental visit frequency when SES data were compared with other findings ($p>0.05$). A significant relationship existed between SES score and education level ($p<0.05$). A positive albeit statistically insignificant relationship was identified between the CPITN and the SES score ($p>0.05$).

Table 1. Demographic data of patients with PD and control group

Variable		PD (n:70)	Control (n:70)	p value*
Mean age $\pm$ SD		62.37 $\pm$ 10.36	64.97 $\pm$ 6.61	0.079
Sex n(%)	Female	44.3	54.3	0.237
	Male	55.7	45.7	
Educational level [†]	0	20 (28.6%)	9 (12.9%)	0.001
	1	36 (51.4%)	26 (37.1%)	
	2	14 (20.0%)	35 (50.0%)	
Smoking	+	8 (11.4%)	18 (25.7%)	0.030
	-	62 (88.6%)	52 (74.3%)	
Prostheses	+	27 (38.6%)	21 (30.0%)	0.285
	-	43 (61.4%)	49 (70.0%)	
Tooth brushing habits [‡]	0	25 (35.7%)	3 (4.3%)	0.001
	1	15 (21.4%)	32 (45.7%)	
	2	9 (12.9%)	22 (31.4%)	
	3	21 (30.0%)	13 (18.6%)	
Dental visit frequency [§]	1	2 (2.9%)	17 (24.3%)	0.001
	2	9 (12.9%)	34 (48.6%)	
	3	59 (84.3)	19 (27.1%)	

* Chi-square test, independent-samples t test; $p<0.05$ was considered to indicate significance

PD: Patients with Parkinson's Disease, n: number, SD: standard deviation, +: presence, -: absence

[†] 0: Illiterate, 1: primary school graduate, 2: high school graduate and beyond

[‡] 0: Less than once a day, 1: once a day, 2: more than once a day, 3: irregular

[§] 1: every 6 months-1 year, 2: every 1-2 years, 3: when having a problem

Table 2. Severity of PD and the cognitive status of patients with PD

Hoehn & Yahr Scale		SES		MMSE		Clock drawing test	
Scores	n (%)	Scores	n (%)	Scores	n (%)	Scores	n (%)
1.Unilateral disease.	13 (18.6%)	100%	18 (25.7%)	Normal cognitive status	33 (47.1%)	>4	31 (44.3)
1.5. Unilateral plus axial involvement.	15 (21.4%)	90%	28 (40.0%)	Mild cognitive impairment	22 (31.4%)	<4	17 (24.3)
2. Bilateral disease, without impairment of balance.	13 (18.6%)	80%	7 (10.0%)	Moderate cognitive impairment	15 (21.4%)	Illiterate	18 (25.7)
2.5. Mild bilateral disease with recovery on pull test.	11 (15.7%)	70%	5 (7.1%)			Unable to draw due to tremor	4 (5.7%)
3. Mild to moderate bilateral disease; some postural instability; physically independent.	11 (15.7%)	60%	4 (5.7%)				
4. Severe disability; still able to walk or stand unassisted.	6 (8.6%)	50%	3 (4.3%)				
5. Wheelchair-bound or bedridden unless aided.	1 (1.4%)	40%	5 (7.1%)				

SES: Schwab-England Scale, MMSE: Mini Mental State Examination, n: number

When the relationship between the CPITN and age, sex, and presence of prostheses was examined, no statistically significant relationships were established ($p>0.05$). Nevertheless, there were significant relationships of the CPITN with education level, smoking habits, tooth brushing, and dental visit frequency ($p<0.05$) (Table 3).

The CPITN results were subsequently compared between the experimental and control groups. The CPITN scores were markedly elevated in patients with PD relative to the control group ($p<0.05$). There were no participants who exhibited a CPITN score of 0 or 1; In the experimental group, the predominant CPITN score was 3 (55.7%), followed by 4 (25.7%) and 2 (18.6%). In the control group, the majority of CPITN scores were 2 (62.9%), followed by 1 (21.4%), 0 or 3 (both 5.7%), and 4 (4.3%) (Figure 1).

Furthermore, the relationship between the degree of severity of PD and the CPITN was analyzed. A positive albeit statistically insignificant correlation existed between the Modified Hoehn & Yahr scale and CPITN findings ($p>0.05$). Similarly, the correlation between the SES and CPITN findings showed a positive albeit statistically insignificant ($p>0.05$). In addition,

the outcomes of the MMSE and the clock drawing test, employed to evaluate patients' cognitive status, demonstrated a positive albeit statistically insignificant correlation with the CPITN findings ($p>0.05$) (Table 4).

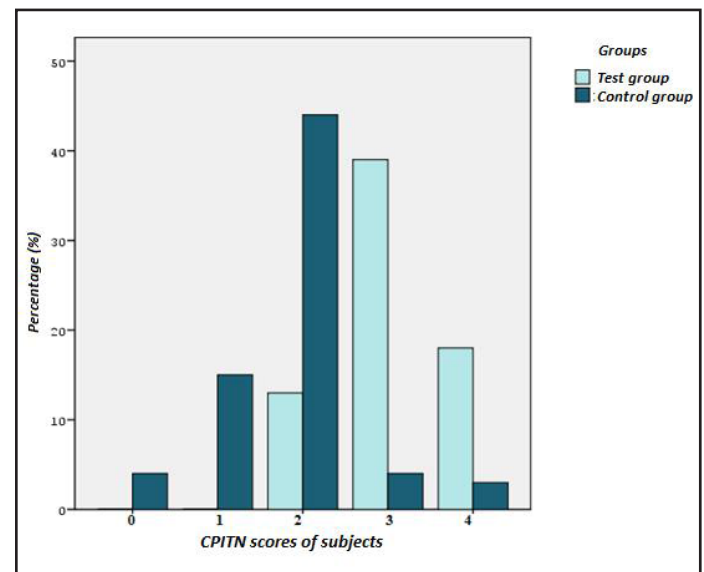


Figure 1. CPITN scores of patients with PD and the control group

Table 3. The relation between CPITN and demographic characteristics of participants

Variable		Mean CPITN $\pm$ SD		p value*
		PD (n:70)	Control (n:70)	
Age	<65	3.0 $\pm$ 0.66	1.86 $\pm$ 0.81	0.001
	>65	3.17 $\pm$ 0.66	1.72 $\pm$ 0.79	0.001
Sex	Female	3.03 $\pm$ 0.60	1.81 $\pm$ 0.69	0.001
	Male	3.10 $\pm$ 0.71	1.81 $\pm$ 0.69	0.001
Educational level [†]	0	3,30 $\pm$ 0,57	2.00 $\pm$ 0.86	0.001
	1	3,00 $\pm$ 0,63	2.11 $\pm$ 0.76	0.001
	2	2,92 $\pm$ 0,82	1.54 $\pm$ 0.74	0.001
Smoking	+	2.50 $\pm$ 0.75	1.83 $\pm$ 0.51	0.014
	-	3.14 $\pm$ 0.62	1.80 $\pm$ 0.88	0.001
Prostheses	+	3.00 $\pm$ 0.62	1.85 $\pm$ 0.79	0.001
	-	3.11 $\pm$ 0.69	1.79 $\pm$ 0.81	0.001
Tooth brushing habits [‡]	0	3.28 $\pm$ 0.61	2.00 $\pm$ 0.00	0.007
	1	2.93 $\pm$ 0.70	1.90 $\pm$ 0.68	0.001
	2	2.77 $\pm$ 0.66	1.36 $\pm$ 0.78	0.001
	3	3.04 $\pm$ 0.66	2.30 $\pm$ 0.85	0.008
Dental visit frequency [§]	1	2.50 $\pm$ 0.70	1.23 $\pm$ 0.75	-
	2	2.81 $\pm$ 0.60	1.85 $\pm$ 0.55	0.001
	3	3.11 $\pm$ 0.67	2.26 $\pm$ 0.93	0.001

* Chi-square test, independent-samples t test; p<0.05 was considered to indicate significance

PD: Patients with Parkinson's disease, n: number, + presence, - absence

[†] 0: Illiterate, 1: primary school graduate, 2: high school graduate or beyond

[‡] 0: Less than once a day, 1: once a day, 2: more than once a day, 3: irregular

[§] 1: every 6 months-1 year, 2: every 1-2 years, 3: when having a problem

Table 4. The correlations of CPITN with Hoehn & Yahr stage and SES, MMSE and clock drawing test findings

Variable		Hoehn & Yahr Scale	SES	MMSE	Clock drawing test
CPITN	r	0.216	0,226	0,324	0,279
	p	0,072	0,059	0,006	0,019
	n	70	70	70	70

*Spearman correlation analysis, r: spearman correlation coefficient; p<0.05 was considered to indicate significance; n: number, CPITN: Community Periodontal Index for Treatment Need, SES: Schwab-England Scale, MMSE: Mini Mental State Examination

DISCUSSION

To the best of our knowledge, this is the first study to investigate PD patients' periodontal status and treatment needs compared with a control population in Turkey. Patients with PD had statistically significant elevations in CPITN scores compared to control people of the same age and gender, and periodontal disease was more prevalent and severe among patients with PD. Moreover, we observed a relationship between the CPITN and Hoehn & Yahr stage, which indicates the severity of PD, but there was a poor correlation between the two indices.

Prior research on the correlation between Parkinson's Disease (PD) and oral health indicated a rise in dental complications attributed to insufficient oral hygiene, changes in saliva production and flow, and dysphagia [39–43]. Pradeep et al. [33] noted that the periodontal status in patients with PD deteriorated with advancing Hoehn & Yahr stage. A positive link was also identified between the severity of PD and the CPITN scores. Nevertheless, this link lacked statistical significance, potentially attributable to the insufficient number of patients with severe PD. This link substantiates the notion that periodontal diseases are escalating concerning motor dysfunction in patients with PD, shown by the significant dental issues documented across all participants in a Greek study conducted by Anastassiadou et al. [46]. Clifford and Finnerty [44], obtained analogous results in their investigation of dental awareness and requirements within a population affected by PD. Postal questionnaires were dispatched to members of PD societies in Belfast and London, revealing that 51% of individuals with PD experienced dental issues. Nakayama et al. [32] reported that patients with PD, particularly females, frequently expressed dissatisfaction with denture comfort. It has been reported that this problem may be related to decreased saliva and muscle weakness. Another recent cross-sectional study reported similar results to our findings. Alongside our research, oral hygiene index (OHI), modified gingival index, clinical attachment level (CAL), probing pocket depth (PPD), interproximal PPD, interproximal CAL, and tooth mobility measurements were evaluated, and the severity of PD was measured with the Hoehn-Yahr scale. As a result of the study, it was reported that gingival inflammation and tooth hygiene were worse, especially in male individuals, and periodontal tissue destruction increased with the advancement of PD [17,39,45]. In addition, two recent systematic reviews comparing patients with PD with healthy individuals in terms of oral and periodontal health reported similar results to our study. The results of the studies reported that periodontal clinical

symptoms and indices were significantly higher in patients [4,17].

Contradictory results have been reported by Persson et al. [46], Fukayo et al. [47], and Lee et al. [40]. Persson et al. had investigated the impact of PD on oral health, revealing that individuals with PD possessed a greater number of teeth and fewer occurrences of caries compared to an age-matched control group [46]. In a study of 31 outpatients with PD and 104 control individuals, similar to Persson et al, Fukayo et al. also observed that patients with PD had more teeth than controls [47]. In a case-control research by Lee et al. with a substantial patient population, it was determined that chronic periodontitis did not provide a risk for the onset of PD [40].

We observed that very few PD patients brushed their teeth once a day or more. They probably experienced challenges resulting from their Parkinson's disease symptoms, like tremors, bradykinesia, or depression. Additionally, most patients with PD reported that while they did not routinely visit the dentist, they went when they had a problem. Most of the patients with PD in the study by Nakayama et al. indicated that attending dental appointments was challenging without the assistance of a family member [32]. This may have contributed to the periodontal conditions of PD patients, which were worse than those of the control group.

Impaired manual dexterity, apathy, cognitive problems, depression, and changed motor behavior and fluctuations are linked to an inability to have regular oral self-care [17]. Absent-mindedness linked to dementia may also negatively impact oral hygiene practices in several individuals with PD [48].

Although our study had relatively few patients in advanced stages of PD, the findings indicated that the periodontal status of advanced PD patients was worse than that of the control group. Our study has some limitations, like the cross-sectional design and the sample size. Moreover, the limited sample size of patients in advanced stages of Parkinson's disease and the differences between groups regarding educational status, smoking habits, oral hygiene habits, and frequency of dental visits were the limitations of our study. There are also some limitations of the CPITN, like the inability to determine the clinical attachment level, the amount of gingival recession, or the degree of inflammation and alveolar bone loss. This index is currently favored as it expedites the registration process by

minimizing the number of checked teeth, is straightforward to use, and can signify the necessity for treatment. We employed this index due to its simplicity, brevity of measurement, and efficacy in assessing therapy requirements.

The incidence of neurodegenerative disorders is rising alongside the extension of human longevity. Enhanced attention and meticulous care are essential to ameliorate the dental health condition of these patients [17,39,49]. Numerous contemporary studies examining the correlation between neurodegenerative diseases and periodontitis have concentrated on *P. gingivalis*, with findings suggesting that this gram-negative bacterium, responsible for periodontitis, incites neuroinflammation [17,24,50,51]. Additional research is required to enhance comprehension of the correlation between PD and periodontal disease.

CONCLUSION

While it may be early to express that PD is not significant in periodontal disease, the requirement of these patients for more frequent dental examinations, heightened awareness of periodontal health, and an intensified emphasis on oral hygiene practices to mitigate the common periodontal issues they experience should not be overlooked.

In addition, a connected and cooperative relationship between the patient, dentist, and neurologist may increase the quality of life for PD patients by managing disease progression and associated complications. Multidisciplinary care involving neurologists and dentists is critical. Further studies with larger patient groups and studies aimed at understanding the mechanism are required to better understand the potential relationship between PD and periodontitis.

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Informed Consent: . Informed consent was acquired from each patient before to their participation in the experiment.

Conflict of Interest: Conflict of Interest: The authors declare that they have no conflict of interest; financial or personal affiliations that might have seemingly influenced the work presented in this study.

Ethical Approval: The approval was taken by the Ethics Committee of Clinical Investigations of Cumhuriyet University

(Desicion number: 2014-01/11, Date: 2014-01-07).

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Balaban, H. *Retired*

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