10.5005/jp-journals-10024-1277

ORIGINAL RESEARCH

Inpatient Evaluation of Periodontal, Esthetic and Inflammatory Parameters around Dental Implants and Natural Teeth

Güliz N Güncü, Gülüzar Büyüktepe, Sezen B Aşkin, Kamer Kılınç, Celal Tümer, Tolga F Tözüm

ABSTRACT

Aim: The use of endosseous dental implants (DI) has become a successful treatment alternative. However, providing peri-implant tissue health and achieving a natural esthetic look are important topics in this treatment. The aim of the present study was to evaluate periodontal and esthetic parameters around DI and natural teeth (NT) and also to analyze myeloperoxidase (MPO) levels in gingival crevicular fluid (GCF) and peri-implant sulcus fluid (PISF).

Materials and methods: Twenty DI supported fixed prosthesis and contralateral 20 NT were enrolled to the present study. Clinical periodontal parameters (probing depth, clinical attachment level, gingival bleeding time index and gingival index) were recorded and GCF/PISF samples were obtained from mesial (mesiobuccal and mesiolingual) and distal (distobuccal and distolingual) sites of DI and NT. MPO levels were spectrophotometrically determined. Additionally clinical photographs were obtained and esthetical evaluations were performed by using Jemt papilla index. The parameters belong to DI and NT were compared and correlations were evaluated using statistical analysis.

Results: A total of 40 samples were evaluated. No statistically significant differences were detected between groups in all periodontal parameters and MPO levels from mesial and distal sites. Jemt papilla index scores were slightly higher in NT however, this difference was not statistically significant ($p > 0.05$). Total PES score were similiar in DI and NT groups. Significant correlations were detected between MPO and gingival index values as expected.

Conclusion: These results suggest that DI and NT have similar inflammatory conditions and esthetics, representing DI as a predictable treatment option.

Clinical significance: Dental implants are satisfactory treatments, they provide patient esthetic natural looking, phonetic and masticatory functions.

Keywords: Dental implants, Natural teeth, Esthetic, Myeloperoxidase.

How to cite this article: Güncü GN, Büyüktepe G, Aşkin SB, Kılınç K, Tümer C, Tözüm TF. Inpatient Evaluation of Periodontal, Esthetic and Inflammatory Parameters around Dental Implants and Natural Teeth. J Contemp Dent Pract 2013;14(1):90-95.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

The treatment of total and partially edentulous patients with endosseous dental implants was shown to be a successful and reliable technique for the replacement of missing dentition.[1-3] Various numbers of clinical studies demonstrated the predictable long-term success in dental implant therapy.[1,3,4] For achieving this long-term success, periodical evaluation of dental implant sites is of primary importance. The traditional criteria for evaluating the disease status around dental implants are frequently based on radiographic and clinical changes, such as probing depth and mobility assessment.[5,6] These measures can provide information about the extent of the peri-implant tissue destruction, however they cannot actually reflect current tissue status nor can they predict the risk of peri-implant disease progression.[6,7] Thus, development of simple and reliable diagnostic tool(s) for early detection of initial peri-implant inflammatory process and for prevention of any irreversible host reactions, such as destructive peri-implant disease, is an important goal.[7-10]

When such attempts are concerned, it can be seen that considerable interest is devoted to peri-implant sulcus fluid (PISF) and the ingredients of this biologic fluid[8, 9, 11] PISF, is an osmotically mediated transudate/exudate, which consists of a large array of ingredients.[7] Composition and volumetric features of PISF clearly depend on the condition of surrounding tissues.[8,9,12,13] Although currently PISF-related measures are not applied in a routine manner, focus on the diagnostic potential and validity of this biologic fluid

is starting to be important. Recent studies analyze both the volumetric features and content of this fluid.[8,9,11,12,14,15] A close relationship between the status and degree of clinical peri-implant tissue inflammation and various PISF components, such as proinflammatory cytokines,[16] matrix metalloproteinases (MMP),[17] aspartate aminotransferase,[18] products of nitric oxide metabolism[15] and myeloperoxidase (MPO)[8,12,13] were demonstrated.

MPO, an enzyme located at the azurophilic granules of polymorphonuclear leukocytes (PMNs)[19] contributes to protease activity and connective tissue breakdown through inhibiting antiproteaseses and activating proteases and thus, changing the protease/antiprotease balance.[19,20] Increased activity of the MPO at periodontitis sites and decreased activity following treatment is suggested to support the role for MPO in destructive periodontal diseases.[19,21]Due to the higher PISF MPO levels at inflamed sites, MPO is also considered as a promising marker of inflammation around dental implants.[8,12]

The use of dental implants has become a successful treatment alternative in the present day. However, providing peri-implant tissue health and achieving a natural esthetic look are important topics in this treatment.[22] Masticatory and phonetic functions are not satisfactory and adequate for a successful implant treatment.[22,23] Implant-supported restorations should reproduce the profile of natural teeth.[22-24] The size of the interproximal gingival papilla and properties of peri-implant soft tissue (the level and curvature of the facial mucosa, and the root convexity and tissue color) have precise impacts on achieving natural appearance.

Eventually, one should suggest that successful implant restoration should include natural esthetic appearance, satisfactory masticatory and phonetic functions and healthy peri-implant tissues. Therefore, the aim of the present study is to evaluate periodontal and esthetic parameters around dental implants (DI) and natural teeth (NT) and also to analyze myeloperoxidase (MPO) levels in gingival crevicular fluid (GCF) and peri-implant sulcus fluid (PISF).

MATERIALS AND METHODS

Experimental Design and Study Groups

Between November 2009 and April 2010, 10 patients, six men and four women (age 30-58 years, mean 45.63 ± 8.98), who received dental implants in the Department of Periodontology, Hacettepe University, were consecutively enrolled in the study. Prior to the study, a detailed explanation was given to the subjects about the study and verbal consents were taken.

Plaque index (PI),[25] gingival index (GI),[25] probing depth (PD), clinical attachment level and gingival bleeding time index (GBTI)[26] parameters were recorded for evaluating clinical status of the dental implants and natural teeth. All measurements were performed at four sites around each dental implant and natural tooth, and were carried out the nearest mm using a Michigan 'O' probe.

Esthetical evaluations were performed according the Jemt et al[27] and Furhauser et al.[28] Dental papilla was evaluated clinically using a papillary index.[27] The papillary index designates five different levels of papilla height. Measurements were made from the reference line connecting the highest gingival curvatures of the implant crown restoration and the adjacent tooth or crown on the buccal side. The mesial and distal papillae were evaluated for completeness, incompleteness, or absence. The pink esthetic score (PES)[28] was also used for esthetical assessments. The PES is based on seven variables: Mesial papilla, distal papilla, soft tissue level, soft tissue contour, alveolar process deficiency, soft tissue color and texture. Each variable was assessed with a 2-1-0 score, with 2 being the best and 0 being the poorest score. The highest possible score reflecting a perfect match of the peri-implant soft tissue with that of the reference tooth was 14.

PISF/GCF Sampling

PISF/GCF samples were obtained according to the method described by Rüdin et al[29] using standardized paper strips (Periopaper, no.593525; Ora Flow Inc. Amityville, NY, USA). Briefly, following the isolation of the sampling area with sterile cotton roles, supragingival plaque was removed and the site was gently air-dried to reduce any contamination with plaque and saliva. Extreme care was taken to minimize the level of mechanical irritation during PISF/GCF sampling as this is known to affect the actual fluid volume in a given site.[10] Therefore, paper strips were placed at the entrance of peri-implant sulcus and natural tooth crevice, and were inserted to a standardized depth of 1 mm at each site regardless of the PD. Sampling time was also standardized as 30 seconds. Papers with visible blood contaminations were discarded. To eliminate the risk of evaporation, paper strips with PISF/GCF were immediately transported to previously calibrated Periotron 8000 (Oraflow Inc. Plainview, NY, USA) for volume determination. Following sampling, the PISF/GCF collected was measured in Periotron units, which were converted to microliters by MLCONVRT.EXE software (Oraflow).[30] To eliminate the risk of evaporation, strips with PISF/GCF were placed in a sterile, firmly wrapped Eppendorf tubes immediately and stored at –20°C until the day of laboratory analysis. PISF and GCF samplings were performed by the same periodontist.

Determination of MPO Levels of PISF/GCF

MPO activity of PISF/GCF was measured using the spectrophometric MPO assay that is a modification of the method reported by Suzuki et al.[31] Briefly, the assay mixture consisted of 50 mM phosphate buffer (pH 5.4), 1.6 mM synthetic substrate tetramethyl benzidine (TMB), 0.5% hexadecyltrimethyl ammonum bromide, 1 mM H_2O_2, and 50 ml GCF extract. The reaction was initiated by the addition of H_2O_2, and the rate of TMB oxidation was followed at 655 nm using a recording spectrophotometer. Considering the initial and linear phase of the reaction, the absorbance change per minute was determined. One unit of MPO activity was expressed as the amount of enzyme producing one absorbance change under assay conditions. MPO activity in PISF/GCF samples was calculated and expressed both as enzyme concentration and the total enzyme activity.

Statistical Analysis

Computer software (GraphPad Instat 3.00 for Windows, GraphPad Software, San Diego, CA, USA) was used for all statistical analysis. The Mann-Whitney U-test was performed to determine the significant differences between the DI and NT groups. The correlation between MPO levels and clinical inflammatory status were analyzed with Spearman's correlation coefficient. The p-value less than 0.05 was considered statistically significant.

RESULTS

Twenty DI supported fixed prosthesis that were completed a certain time ago (6 months to 1 year) and their 20 contra-lateral NT were evaluated in the present study.

Analysis of Clinical Parameters of Natural Teeth and Dental Implants

Descriptive data regarding statistical analysis and actual p-values are provided in Table 1. When NT sites and DI sites were concerned, clinical parameters were similar ($p > 0.05$), except GI levels. GI (mesial and distal) were higher in DI sites than NT sites, however, this difference was also not significant ($p > 0.05$).

Analysis of Esthetical Parameters of Natural Teeth and Dental Implants

Table 2 shows the JPI and PES scores of DI and NT. No statistically significant difference was observed between DI and NT groups in esthetical parameters. When JPI scores (mesial and distal) were evaluated higher values were detected in NT group (Table 3). However, this difference was also not significant ($p > 0.05$). In both groups class 3 is the most detected scores for papillae (47.5% DI and 61.54% NT). Class 0 was also detected in both group with the percentage of 25 and 3.85% in DI and NT respectively.

Additionally, the mean total PES score was 11.50 ± 2.59 in DI and 11.08 ± 1.75 in NT groups ($p = 0.609$). In level of soft tissue margin major discrepancy was not detected in both groups. Minor discrepancy was detected in five of cases in both DI and NT groups. No obvious difference (score 0) was detected in terms of soft tissue contour, color, texture and alveolar process in both groups.

Analysis of MPO Levels of Natural Teeth and Dental Implants

Total MPO levels were higher at DI sites when compared to NT sites; however, this difference was not significant

Table 1: Descriptive data regarding clinical periodontal parameters of dental implants (DI) and natural teeth (NT)

Periodontal parameters	*NT (mean ± SD)*	*DI (mean ± SD)*	*p-value*
PD	1.75 ± 0.59	1.86 ± 0.60	0.624
PD-mesial	1.92 ± 0.70	1.90 ± 0.72	0.986
PD-distal	1.65 ± 0.72	1.70 ± 0.77	0.957
GI-mesial	0.19 ± 0.21	0.25 ± 0.48	0.649
GI-distal	0.16 ± 0.22	0.46 ± 0.57	0.158
GBTI-mesial	0.69 ± 0.26	0.55 ± 0.82	0.757
GBTI-distal	0.38 ± 0.77	0.65 ± 1.18	0.703
PI mesial	0.08 ± 0.12	0.08 ± 0.12	0.964
PI distal	0.76 ± 0.14	0.08 ± 0.12	0.876

Table 2: Descriptive data regarding esthetical parameters of dental implants (DI) and natural teeth (NT)

Esthetical evaluation	*NT (mean ± SD)*	*DI (mean ± SD)*	*p-value*
JPI mesial	2.39 ± 0.87	1.85 ± 1.35	0.215
JPI distal	2.69 ± 0.48	1.90 ± 1.21	0.094
Mesial papilla	1.62 ± 0.51	1.60 ± 0.68	0.842
Distal papilla	1.46 ± 0.66	1.55 ± 0.60	0.758
Level of soft tissue margin	1.62 ± 0.51	1.75 ± 0.44	0.525
Soft tissue contour	1.46 ± 0.52	1.45 ± 0.69	0.871
Alveolar process	1.69 ± 0.48	1.95 ± 0.22	0.221
Soft tissue color	1.46 ± 0.52	1.50 ± 0.51	0.871
Soft tissue texture	1.77 ± 0.44	1.70 ± 0.47	0.758
Total PES	11.08 ± 1.75	11.50 ± 2.59	0.609

JPI: Jemt papillary index; PES: Pink esthetic score

Table 3: Statistical analysis of MPO levels of dental implants (DI) and natural teeth (NT)

Total MPO level	*NT (mean ± SD)*	*DI (mean ± SD)*	*p-value*
MPO (U)	0.86 ± 0.47	0.99 ± 1.05	0.617
MPO mesial (U)	0.84 ± 0.30	0.88 ± 0.93	0.372
MPO distal (U)	0.89 ± 0.59	1.09 ± 1.19	0.985

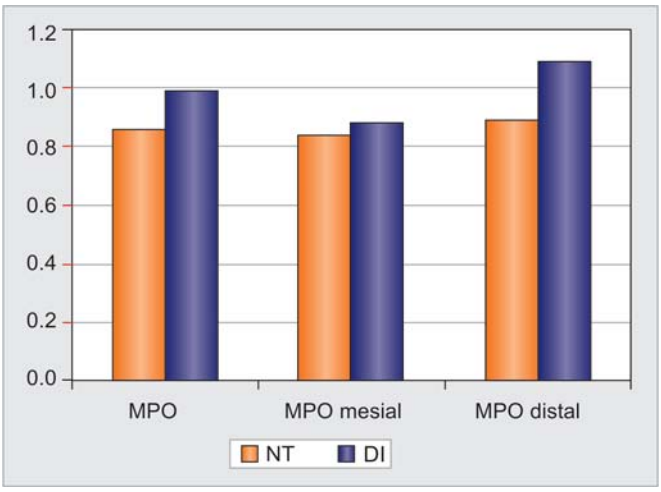

Fig. 1: PISF and GCF MPO levels of NT and DI

($p > 0.05$) (Fig. 1). MPO levels were 0.99 ± 1.05 and 0.86 ± 0.47 in DI and NT sites, respectively. Significant correlations were detected between MPO and gingival index values as expected (p: 0.002, r: 0.362).

DISCUSSION

Peri-implant tissues esthetic properties (height, volume, color and contour) should be in harmony with the healthy surrounding dentition.[24,32] 'Natural appearance' is one of the main targets in an successful esthetic implant restoration. The importance of the natural appearance contributing the success of an implant-supported rehabilitation has induced some researchers to try to make objective judgments using indices. Jemt[27] was the first author who propose such an index, to assess the aesthetic result of implant-supported single crowns. However, by analyzing only the size of the interproximal gingival papilla, this index has a risk of producing an unsatisfactory aesthetic judgment. For 'natural appearance' one should also evaluate the level of the marginal buccal tissues, the surface color and appearance, the convexity of the alveolar process, and the matching of the implant-supported element with the adjoining teeth. For these purposes, the PES index is more sensitive than a single variable rating.[28] It evaluates soft tissue esthetics, including the height of the mesial and distal papillae, the level and curvature of the facial mucosa, and the root convexity and tissue color.[32] In the present study, to evaluate esthetic parameters the authors preferred to use both JPI and PES indices together and no statistically significant difference was detected between the groups in terms of esthetic variables. JPI scores were slightly higher in NT group, as expected. No class 4 detected in study groups.

When PES scores were evaluated there were papillae deficiencies in most of DI and NT cases. Juodzbalys et al.[33] evaluated soft and hard tissue of immediate implants. Similarly with the present results they detected mesial and distal papillae deficiency. They also reported 11.1 ± 1.35 mean PES values which is nearly similar the present values of DI and NT.

It is well-demonstrated that PMNs accumulate at inflamed periodontal sites as a result of host-bacteria interaction,[34] and more PISF/GCF MPO may reflect the increase in inflammation as a result of additional migrating leukocytes[19,20] and the hyperactive state of these cells.[20] Most of the studies demonstrated elevated levels of MPO at periodontitis and gingivitis sites,[13,35] a decrease in GCF MPO levels following periodontal treatment, and the close relationship between GCF MPO activity with the clinical and microbial signs of periodontal disease.[13,21,35]

Similarly, there are studies demonstrating higher PISF MPO levels at inflamed peri-implant sites[8,11,12] Based on this similarity of PISF and GCF MPO activity in response to inflammation, it may be suggested that a similar role for MPO in the pathogenesis of both periodontal diseases and peri-implant disorders is likely to be possible. In the present study, DI sites have slightly higher MPO values than NT sites. This difference may be due to the slightly higher GI values in DI sites. Therefore, findings of the present study support the previous studies suggesting a role for MPO in the pathogenesis of periodontal–peri-implant diseases.[11-13,21]

Many histological and clinical studies also revealed that the gingiva and the peri-implant mucosa have several features in common. However, there are some differences in the alignment of the collagen fiber bundles, the composition of the connective tissue, and the distribution of vascular structures in the apical area of the barrier epithelium.[36,37] In the present study, DI and NT were compared in terms of periodontal, esthetic and inflammatory markers. DI and NT have similar inflammatory conditions and esthetics, representing DI as a predictable treatment option. In addition according to the present results, one may suggest that PISF is an unique method to detect subclinical inflammation at early stages with evaluation of PISF ingridients by biochemical assays.

ACKNOWLEDGMENT

This study was presented in 2010 Turkish Dental Association (TDA)/DENTSPLY Student Research Program in Bursa Turkey and was awarded 3rd place.

REFERENCES

1. Fiorellini JP, Martuscelli G, Weber HP. Longitudinal studies of implant systems. Periodontol 2000 1998;17:125-31.
2. Esposito M, Grusovin MG, Coulthard P, Worthington HV. Interventions for replacing missing teeth: Treatment of perimplantitis. Cochrane Database Syst Rev 2006;3:CD004970.

3. Van der Weijden GA, van Bemmel KM, Renvert S. Implant therapy in partially edentulous, periodontally compromised patients: A review. J Clin Periodontol 2005;32(5):506-11.
4. Buser D, Mericske-Stern R, Bernard JP, Behenke A, Behenke N, Hirt HP, Belser UC, Lang NP. Long-term evaluation of non-submerged ITI implants. Part 1: 8-year life table analysis of a prospective multi-center study with 2359 implants. Clin Oral Implants Res 1997;8(3):161-72.
5. Albrektsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: A review and proposed criteria of success. Int J Oral Maxillofac Implants 1986;1(1):11-25.
6. Mombelli A, Lang NP. Clinical parameters for the evaluation of dental implants. Periodontol 2000 1994;4:81-86.
7. Kaklamanos EG, Tsalikis L. A review on peri-implant crevicular fluid assays potential in monitoring and predicting peri-implant tissue responses. J Int Acad Periodontol 2002;4(2):49-59.
8. Guncu GN, Tozum TF, Guncu MB, Yamalýk N, Tumer C, Karabulut E, Kilinc K. Myeloperoxidase as a measure of polymorphonuclear leukocyte response in inflammatory status around immediately and delayed loaded dental implants: A randomized controlled clinical trial. Clin Implant Dent Relat Res 2008;10(1):30-39.
9. Tozum TF, Turkyilmaz I, Yamalik N, Tumer C, Kilinc A, Kilinc K, et al. Analysis of thte possible impact of inflammation severity and early and delayed loading on nitric oxide metabolism around dental implants. Int J Oral Maxillofac Implants 2005;20(4): 547-56.
10. Atici K, Yamalik N, Eratalay K, Etikan I. Analysis of gingival crevicular fluid intracytoplasmic enzyme activity in patients with adult periodontitis and rapidly progressive periodontitis. A longitudinal study model with periodontal treatment. J Periodontol 1998;69(10):1155-63.
11. Boutros SM, Michalowicz BS, Smith QT, Aeppli DM. Crevicular fluid enzymes from endosseous dental implants and natural teeth. Int J Oral Maxillofac Implants 1996;11(3): 322-30.
12. Liskmann S, Zilmer M, Vihalemm T, Salum O, Fischer K. Correlation of peri-implant health and myeloperoxidase levels: A cross-sectional clinical study. Clin Oral Implants Res 2004;15(5):546-52.
13. Kaner D, Bernimoulin JP, Kleber BM, Heizmann WR, Friedmann A. Gingival crevicular fluid levels of calprotectin and myeloperoxidase during therapy for generalized aggressive periodontitis. J Periodontal Res 2006;41(2):132-39.
14. Murata M, Tatsumi J, Kato Y, Suda S, Nunokawa Y, Kobayashi Y, et al. Osteocalcin, deoxypyridinoline and interleukin-1beta in peri-implant crevicular fluid of patients with peri-implantitis. Clin Oral Implants Res 2002;13(6):637-43.
15. Guncu GN, Tozum TF, Guncu MB, Yamalik N, Tumer C. A 12-month evaluation of nitrite oxide metabolism around immediate and conventionally loaded dental implants. Implant Dent 2009;18(1):27-37.
16. Petkovic AB, Matic SM, Stamatovic NV, Vojvodic DV, Todorovic TM, Lazic ZR, et al. Proinflammatory cytokines (IL-1beta and TNF-alpha) and chemokines (IL-8 and MIP-1alpha) as markers of peri-implant tissue condition. Int J Oral Maxillofac Surg 2010;39(5):478-85.
17. Sorsa T, Tjaderhane L, Konttinen YT, Lauhio A, Salo T, Lee HM, et al. Matrix metalloproteinases: contribution to pathogenesis, diagnosis and treatment of periodontal inflammation. Ann Med 2006;38(5): 306-21.
18. Fiorellini JP, Nevins ML, Sekler J, Chung A, Oringer RJ. Correlation of peri-implant health and aspartate aminotransferase levels: A cross-sectional clinical study. Int J Oral Maxillofac Implants 2000;15(4):500-04.
19. Cao CF, Smith QT. Crevicular fluid myeloperoxidase at healthy, gingivitis and periodontitis sites. J Clin Periodontol 1989;16(1): 17-20.
20. Over C, Yamalik N, Yavuzyilmaz E, Ersoy F, Eratalay K. Myeloperoxidase activity in peripheral blood, neutrophil crevicular fluid and whole saliva of patients with periodontal disease. J Nihon Univ Sch Dent 1993;35(4):235-40.
21. Yamalik N, Caglayan F, Kilinc K, Kilinc A, Tumer C. The importance of data presentation regarding gingival crevicular fluid myeloperoxidase and elastase-like activity in periodontal disease and health status. J Periodontol 2000;71(3):460-67.
22. Juodzbalys G, Wang HL. Esthetic index for anterior maxillary implant-supported restorations. J Periodontol 2010;81(1):34-42.
23. Kazor CE, Al-Shammari K, Sarment DP, Misch CE, Wang HL. Implant plastic surgery: A review and rationale. J Oral Implantol 2004;30(4):240-54.
24. Belser U, Buser D, Higginbottom F. Consensus statements and recommended clinical procedures regarding esthetics in implant dentistry. Int J Oral Maxillofac Implants 2004;19(Suppl):73-74.
25. Loe H, Silness J. Periodontal disease in pregnancy. I. prevalence and severity. Acta Odontol Scand 1963;21:533-51.
26. Nowicki D, Vogel RI, Melcer S, Deasy MJ. The gingival bleeding time index. J Periodontol 1981;52(5):260-62.
27. Jemt T. Regeneration of gingival papillae after single-implant treatment. Int J Periodontics Restorative Dent 1997;17(4): 326-33.
28. Furhauser R, Florescu D, Benesch T, et al. Evaluation of soft tissue around single-tooth implant crowns: The pink esthetic score. Clin Oral Implants Res 2005;16(6):639-44.
29. Rudin HJ, Overdiek HF, Rateitschak KH. Correlation between sulcus fluid rate and clinical and histological inflammation of the marginal gingiva. Helv Odontol Acta 1970;14(1):21-26.
30. Deinzer R, Mossanen BS, Herforth A. Methodological considerations in the assessment of gingival crevicular fluid volume. J Clin Periodontol 2000;27(7):481-88.
31. Suzuki K, Ota H, Sasagawa S, Sakatani T, Fujikura T. Assay method for myeloperoxidase in human polymorphonuclear leukocytes. Anal Biochem 1983;132(2):345-52.
32. Lai HC, Zhang ZY, Wang F, Zhuang LF, Liu X, Pu YP. Evaluation of soft-tissue alteration around implant-supported single-tooth restoration in the anterior maxilla: The pink esthetic score. Clin Oral Implants Res 2008;19(6):560-64.
33. Juodzbalys G, Wang HL. Soft and hard tissue assessment of immediate implant placement: A case series. Clin Oral Implants Res 2007;18(2):237-43.
34. Attstrom R. Presence of leukocytes in crevices of healthy and chronically inflamed gingivae. J Periodontal Res 1970;5(1):42-47.
35. Wei PF, Ho KY, Ho YP, Wu YM, Yang YH, Tsai CC. The investigation of glutathione peroxidase, lactoferrin, myeloperoxidase and interleukin-1beta in gingival crevicular fluid: Implications for oxidative stress in human periodontal diseases. J Periodontal Res 2004;39(5):287-93.
36. Berglundh T, Lindhe J, Jonsson K, Ericsson I. The topography of the vascular systems in the periodontal and peri-implant tissues in the dog. J Clin Periodontol 1994;21(3):189-93.
37. Berglundh T, Lindhe J, Ericsson I, Marinello CP, Liljenberg B, Thomsen P. The soft tissue barrier at implants and teeth. Clin Oral Implants Res 1991;2(2):81-90.

ABOUT THE AUTHORS

Güliz N Güncü

Associate Professor, Department of Periodontology, Faculty of Dentistry, Hacettepe University, Ankara, Turkey

Gülüzar Büyüktepe

Private Practice, Mersin 10, Turkey

Sezen B Aşkin

Department of Periodontology, Faculty of Dentistry, Hacettepe University, Ankara, Turkey

Kamer Kılınç

Department of Biochemistry, Faculty of Medicine, Hacettepe University, Ankara, Turkey

Celal Tümer

Professor, Private Practice, Ankara, Turkey

Tolga F Tözüm (Corresponding Author)

Professor, Department of Periodontology, Faculty of Dentistry Hacettepe University, 3rd Floor, Sihhiye, 06100, Ankara, Turkey Fax: +90-312-310-4440, e-mail: ttozum@hacettepe.edu.tr