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Periodontal status of tooth adjacent to implant with peri-implantitis

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ABSTRACT

Objectives: To evaluate the relationship between peri-implantitis and the periodontal health of the adjacent tooth, the periodontal status of the teeth adjacent and contralateral to the implants with and without peri-implantitis.

Methods: Fifty-three subjects with existing dental implants and chronic periodontitis were examined in this cross-sectional study. Seventy implants were categorized into peri-implantitis (n = 42) and healthy/mucositis (n = 28) groups. The periodontal and peri-implant status, including probing depth (PD), clinical attachment level (CAL), and gingival recession (GR) were measured at 6 sites around the implants and the teeth adjacent and contralateral to those implants. In total 560 sites of the 70 teeth/implant sets, the association between the periodontal status at the near and away sites of the teeth (according to implant) and the implant status (without/with peri-implantitis) was examined.

Results: A significantly different mean PD (5.01 ± 1.69, 4.42 ± 1.8, 3.55 ± 0.88, and 3.71 ± 1.07 mm, $p < 0.001$) and CAL (6.02 ± 2.36, 4.89 ± 2.04, 4.35 ± 1.11, and 4.35 ± 1.5 mm, $p < 0.001$) were noted at the near sites of the teeth adjacent to the implants with peri-implantitis when compared with the away sites of adjacent and contralateral teeth and the near sites of contralateral teeth. With generalized estimating equation (GEE), the presence of peri-implantitis (β = 1.041 mm, confidence interval = 0.646–1.435, and $p < 0.001$; β = 0.857 mm, confidence interval = 0.279–1.434, and $p < 0.004$) and tooth location (β = 0.65 mm, confidence interval = 0.4–0.9, and $p < 0.001$; β = 0.682 mm, confidence interval = 0.34–1.024, and $p < 0.001$) were significantly associated with the values of the PD and CAL of the teeth. Moreover, the factor of examining sites (i.e. near and away sites of the tooth) was significantly associated with CAL (β = 0.304 mm, confidence interval = 0.019–0.588, and $p = 0.036$) and GR (β = 0.136 mm, confidence interval = 0.02–0.252, and $p = 0.022$).

Conclusion: The existence of peri-implantitis, the tooth location, and the examining site are significantly associated with the periodontal measurements of the remaining teeth.

Clinical significance: Peri-implant health is related to the periodontal health of the natural teeth close to the dental implant.

1. Introduction

Implant therapy was introduced to dentistry 50 years ago and has become one of the routine procedures for replacing the missing tooth. In spite of a relatively high long-term survival rate of dental implants, the peri-implant disease may still lead to some potential problems such as discomfort of the patients, additional surgical or nonsurgical treatments, and the associated costs [1,2]. Peri-implant disease is a collective term describing the inflammatory reactions in the tissue surrounding an implant [3]. Peri-implant mucositis affects the soft tissue around dental implants without signs of loss of supporting bone, whereas the peri-implantitis causes loss of supporting bone. Peri-implant disease is a multifactorial disease with an origin of infection. Both periodontal and peri-implant diseases share many risk factors, including poor oral hygiene, smoking, and diabetes [4].

Periodontitis is an important risk factor for the development of peri-implant disease [4]. Many studies have shown that the individuals with a history of periodontitis had a higher risk of developing peri-

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implantitis [4–7]. Periodontally compromised patients may experience more implant loss, more bone loss,and more peri-implantitis [5]. A recent cross-sectional study showed that the peri-implant conditions were significantly related to the general periodontal conditions of the remaining natural teeth [8]. However, the correlation of periodontal condition of the tooth/site next to or away from the implant to the peri-implant condition has never been assessed. There is also no information available on the above mentioned correlation in patients with existing periodontitis. Therefore, this study aimed to 1) evaluate whether the periodontal status of the tooth/site adjacent or contralateral to an implant could be correlated to the peri-implant condition of the implant in the patient with periodontitis, and 2) further elucidate the confounding factors of the periodontal status of the teeth adjacent or contralateral to the implants.

2. Material & methods

2.1. Collection of patients

All the subjects were new patients presented to the Periodontal Division, Dental Department of Tri-Service General Hospital, Taipei, Taiwan for the needs of periodontal treatments from July 2009 to September 2013. The project and protocol were approved by the institutional review board of Tri-Service General Hospital, National Defense Medical Center (1-104-05-118). A total of 53 patients, 25 females and 28 males, with chronic periodontitis (having > 30% of teeth with BoP, ≥4 mm probing pockets, and the presence of bone loss as evidenced by radiographic images) were included [9].

The age of the subjects ranged from 42 to 74 years old with the mean age being 58.6 years old (Table 1). Inclusion criteria were: 1) had received implant surgery at least 1 year ago, 2) had at least one implant in the posterior edentulous ridge, 3) there were at least one adjacent natural tooth and one contralateral tooth around the dental implant, and 4) had full mouth periodontal charting data (including probing depth, gingival recession, and clinical attachment loss). The exclusion criteria were: 1) the opposing arch was full edentulous, 2) had history of periodontal surgical treatment, and 3) had third molar teeth.

2.2. Selection of implant and teeth

In this study, the teeth gathered were according to the selected implants that were grouped by the conditions of *peri*-implantitis and healthy/mucositis. Peri-implantitis was defined when an implant was presented with radiographic bone loss of > 3 mm following implant integration, with the probing pocket depth (PD) ≥4 mm, bleeding on probing (BoP) and/or suppuration [10]. When there were two teeth adjacent to the implant, both teeth mesial and distal to the implant were evaluated and the tooth with more periodontal bone loss and attachment loss was then selected as the adjacent tooth (Adj-tooth). The contralateral tooth (CL-tooth) was further chosen from the opposite side of the jaw by using the Adj-tooth as the index (Fig. 1). Therefore, the implant, the Adj-tooth,and the CL-tooth were gathered as one set for each sample. In this study, there were 70 sets obtained, in which 36 sets were from 36 patients and another 34 sets were from 17 patients (2 sets from each patient). All examined natural teeth were categorized as having normal-mild (PD ≤ 4 mm), moderate (4 mm < PD < 7 mm), or advanced (PD ≥ 7 mm) periodontitis according to the measurement of the initial PD using a method modified from a previous study [11].

Table 1
Demographic of the study subjects and distribution of study implants.

	Patients examined	Implants obtained
Age	58.66 ± 8[a]	
Gender: Male/Female	28/25(53/47%)	35/35(50/50%)
No. of implant per person: 1/2 implant(s)	36/17(68/32%)	–
Year(s) after functional loading	–	5.71 ± 1.87 [a] (3–10 [b])
Side of implant inserted: Right/left	–	31/39(44/56%)
Jaw of implant located: Maxilla/Mandible	–	22/48(31/69%)
Peri-implantitis: with/without	35/18(66/34%)	42/28(60/40%)
Status of Periodontitis: n(%)of patients with > 30% pockets > 4 mm	12(23%)	–
Total (n)	53	70

[a] mean ± SD.
[b] range of years for loading.

2.3. Periodontal and peri-implant status of tooth/implant

Periodontal and peri-implant examinations were performed around the teeth and the implants. PD was measured using a Michigan'O' probe with Williams markings and the probing tip was inserted into the gingival sulcus parallel to the long axis of the tooth until slight resistance was met. Gingival recession (GR) was measured for the distance from the gingival margin to the cement-enamel junction (CEJ) at each examination site. Clinical attachment loss (CAL) was recorded as PD plus GR. The assessment of the above parameters was measured at six aspects (i.e. mesio-buccal, buccal, disto-buccal, disto-lingual, lingual, and mesio-lingual sites) of the tooth and implant,and presented as the mean for each tooth and implant. The tooth mobility and furcation involvement of natural teeth were also recorded at the same time. In order to further evaluate the influence of the periodontal status of a specific site of the tooth on the peri-implant conditions, the mesio-buccal, disto-buccal, disto-lingual, and mesio-lingual sites of each Adj/CL tooth were divided into near site and away site according to the location related to the implant (Fig. 1). In each near or away site, an average of the periodontal parameters on the buccal and lingual surfaces of the tooth was used. All measurements were made to the nearest millimeter.

2.4. Statistical analysis

In order to compare each measurement of the periodontal/peri-implant status (i.e. PD, CAL and recession) among the selected implants, Adj-teeth and CL-teeth, one-way analysis of variance with Tukey's post-hoc tests and Fisher's exact tests for categorical variables were used. The independent-samplet tests were used to evaluate the risk of peri-implant condition (with and without peri-implantitis) based on the each measurement of periodontal status for Adj-teeth and CL-teeth. The one-way analysis of variance with Tukey's post-hoc tests were also used to compare each measurement at different sites. To examine the impacts of the confounding factors and adjust the within factors (the subjects and the teeth), generalized estimating equation (GEE) method was selected and used to analyze the periodontal status obtained from 560 sites of the 70 teeth/implant sets according to the peri-implant status. In this study, the peri-implant condition, the examining sites (near/away site of the Adj/CL teeth), the buccal/lingual examining surfaces, gender, age, implant(s)/person, and the periodontal measurements of the teeth associated with the implants were selected as the confounding factors. All statistical analysis was performed by SPSS for Windows (PASW Statistics, version 18.0, SPSS) and the level of statistical significance was set at $p < 0.05$.

3. Results

3.1. Periodontal status of the implants and the teeth adjacent and contralateral to the implants

The distribution of significant difference in PDs was recorded among the implants, Adj-teeth and CL-teeth (Table 2). The mean PD for