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AlGhamdi J
Periodontist Ministry Of
Health Al-Baha Dental Center
Al-Baha, Kingdom of Saudi
Arabia

Shafik S
Professor of Periodontics
Department of Preventive
Dental Science Riyadh Colleges
of Dentistry and Pharmacy
Riyadh, Kingdom of Saudi
Arabia

Al-Mashat H
Consultant of Periodontics and
Implant Dentistry Riyadh
Dental Center King Saud
Medical City Riyadh, Kingdom
of Saudi Arabia

Prevalence of peri-implant diseases among patients received dental implants at Riyadh city, KSA

AlGhamdi J, Shafik S and Al-Mashat H

Abstract

The purposes of this study is to evaluate the prevalence of peri-implant diseases; mucositis and peri-implantitis of patients received dental implant at Riyadh city, KSA. In addition to the assessment of the relationship between peri-implant diseases and other related risk factors such as plaque accumulation, smoking, diabetes, and overall periodontal condition. A cross-sectional study was carried out for 67 patients who had 188 dental implant supported prosthesis with at least 1 year of loading time (range: 1–9 years). Modified plaque index (mPI), modified gingival index (mGI), probing depth, bleeding on probing, suppuration and mobility data were collected. Radiographs were required to evaluate supporting bone levels around implants with severe inflammatory signs. Findings revealed that on patients level (30%) of cases were with healthy implants, (43%) of cases were with peri-implant mucositis and (27%) with peri-implantitis. The overall outcome on implant level was (27%) healthy implants, (51%) with peri-implant mucositis and (22%) with peri-implantitis. Highly statistic significance association was found between healthy periodontium and healthy peri-implant tissue status. Patients with a history of periodontitis and active periodontal disease were more prone to develop peri-implant diseases. Plaque accumulation around dental implants, function time, increased number of placed implants, implant supported by full arch fixed denture and overdentures were the most involved risk factors.

Keywords: Peri-implant diseases, peri-implant mucositis, peri-implantitis

1. Introduction

Dental Implant is one of the most important scientific and surgical achievements that have been worked on and developed over the last three decades. Effective and innovative solutions were achieved for many patients who need to replace their missing teeth in a modern unconventional ways.

The success rate of osseointegrated dental implant is high, however many practitioners confront some complications that affect the long-term success of dental implant^[21].

Esposito *et al*^[6], classified Implant complications and failures according to the osseointegration concept under several main categories: biological, mechanical, iatrogenic and inadequate or insufficient patient adaptation, which includes psychological, aesthetical and phonetical problems. Biological complications such as peri-implant diseases include reactions in the peri-implant soft and hard tissues and sometimes result in implant failure^[13]. Peri-implant diseases including peri-implant mucositis and peri-implantitis are inflammatory lesions affecting tissues surrounding an osseointegrated dental implants^[29].

There are many risk factors affecting the survival rate of dental implant, including occlusal overload, preoperative or postoperative infection, inadequate bone quality or quantity. Other related factors are the patient's overall health, oral hygiene, in addition to the technique and experience of the operator^[20].

The aim of this study was to evaluate the prevalence of peri-implant diseases, and to assess the relationship between these diseases and other related risk factors in patients received dental implant at Riyadh city, KSA.

2. Materials and Methods

Ethical approval was obtained from RCsDP Ethics Committee prior to any clinical and/or radiographic evaluation, and the registered no. was FPGRP/43431002/10.

Correspondence
AlGhamdi J
Periodontist Ministry Of
Health Al-Baha Dental Center
Al-Baha, Kingdom of Saudi
Arabia

This study was conducted at Riyadh Colleges of Dentistry and Pharmacy, periodontics postgraduate clinics, Riyadh, Kingdom of Saudi Arabia. The sample represent cases in Riyadh city.

Study Model and Sample Selection

This was a retrospective cross sectional study of which 141 patients from the implant training program database were contacted, and explained to them the importance of this visit for implant follow-up. These patients have received dental implants and supporting prosthesis for more than 3 years between the years of 2007 to 2012.

These patients were contacted by phone to participate on this study. If the patient agreed upon his or her participation in the study, the patient was scheduled for the clinical examination. Of the 141 patients contacted, 50 declined their ability to participate in the study for various reasons, and 91 patients were scheduled for the evaluations. Of these remaining patients, only 68 attended their appointments, one patient was excluded from this study because the contour of superstructure prosthesis restoration did not allow for measurement of peri-implant probing depth and other diagnostic parameters. 67 patients with 181 implants were included and completed their evaluation, and therefore had their data compiled for this study.

Definition of diseases

In the current cross sectional study peri-implant mucositis was defined as the presence of inflammatory signs surrounding the dental implant, bleeding on probing, with probing depth 3-4 mm, while peri-implantitis was defined as the presence of inflammatory signs surrounding the implant tissue, bleeding and / or suppuration on probing, probing depth ≥ 4 mm with bone loss apical to the fixture/abutment junction.

Demographic data and patient history

Personal data regarding patients' gender, age, medical history, diabetes and its type were recorded at the examination date. The patients were also asked about their smoking habits and were divided into smokers, non-smokers and former smokers. Recall visits, and patient's commitment of recall visits were recorded at the beginning of the evaluation appointment. Regarding the frequency of dental visits, patients were categorized according to whether they attended a follow-up appointment at least once annually (patient with recall visits), and patients who attended less frequently (patient with no regular visits).

Regarding the implants data, date of implant placement, time between placement of implant and/or function time and examination date in years, implant system, number of placed dental implants, their location, and restoration type were also recorded.

Peri-implant Clinical Examination

The clinical examination included the following parameters at four surfaces of each implant: modified plaque index (mPI), modified gingival index (mGI) according to Mombelli *et al* [16], peri-implant pocket depth, bleeding on probing, suppuration and implant mobility. Probing depth was measured gently at four sites (mesial, buccal, distal and lingual or palatal) for each implant using a Hu-Friedys UNC 12 plastic probe. Regarding bleeding on probing; presence or absence was registered after removal of the periodontal

probe and time elapsed for 30 seconds. Visible presence or absence of suppuration was registered after probing the peri-implant sulcus.

Periodontal Clinical Examination

Periodontal clinical status included the following parameters: gingival index, plaque index, according to Silness & Loe [26], periodontal pocket depth, periodontal bleeding on probing. Selected teeth examined were the Ramfjord teeth with their substitutes if they were missing. Surfaces examined on each tooth were the buccal, lingual or palatal, mesial and distal. Presence of four or more teeth with one or more sites with pocket depth ≥ 4 mm and CAL ≥ 3 mm at the same site was diagnosed as periodontitis [11]. Clinical attachment level (CAL) was measured using the cemento-enamel junction as a reference point.

In cases of periodontitis, patients with stabilized periodontal condition were defined as history of periodontitis with BOP $< 25\%$, and patients with active periodontal disease were defined as those with BOP $\geq 25\%$ [12].

Radiographic Examination

If the clinical signs suggested the presence of peri-implantitis, radiographic examination was obtained from implants presenting an inflammatory signs, bleeding and/or suppuration on probing, and pocket depth ≥ 4 mm to assess the presence of peri-implant vertical or horizontal bone loss. Periapical radiographs using the long cone paralleling technique was used in radiographic assessment to determine if any horizontal or vertical bone loss around the implant has occurred and to confirm the diagnosis. The radiographs were analyzed digitally using an imaging software program (Sidexis XG, Sirona, Germany).

Group analysis and division

In the prevalence analysis, patients were divided into 3 groups: 1) Healthy patients; 2) Patients presenting peri-implant mucositis (at least 1 implant with mucositis); and, 3) Patients presenting peri-implantitis (at least 1 implant with peri-implantitis).

While analyzing the results when all the implants were taken into consideration, they were divided into 6 groups; 4 groups for peri-implant mucositis according to Mombelli *et al* [16], and 2 groups for peri-implantitis. 1) Healthy implants when there is no bleeding when a periodontal probe is passed along the mucosal margin adjacent to the implant; 2) Implants with mild mucositis when there are isolated bleeding spots visible; 3) Implants with moderate mucositis when blood forms a confluent red line on mucosal margin; and, 4) Implants with severe mucositis when there is heavy or profuse bleeding.

The groups of implants with peri-implantitis divided into; 1) Implants with bleeding and / or suppuration and probing depth ≥ 4 mm with bone loss < 3 mm, and 2) Implants with bleeding and/or suppuration and probing depth ≥ 4 mm with bone loss ≥ 3 mm.

Statistical analysis

Data were entered and analyzed using SPSS version 24, frequencies and percentages were used to describe sample characteristics. Cross tabulation with chi square test were used to find out the relationship between 2 categorical variables. On the other hand, simple regression was used to find out the correlation and impact of independent variables

into dependent variables. T-test were used also to find out differences between 2 groups with suitable number of sample (higher than 30 for each group) while Mann-Whitney test used to find out differences between 2 groups with number of sample (less than 30 for one and more group). Finally, Kruskal Wallis test used to find out differences between more than 2 groups with number of sample (less than 30 for one and more group).

3. Results

Sixty-seven patients were examined with the total number of 181 dental implants. At the patient level, prevalence of peri-implant mucositis and peri-implantitis were 43% and 27%, respectively (Figure 1). Statistically significance association was found between healthy periodontium and healthy peri-implant tissue status. It was found a higher frequency of peri-implant diseases (53.7%) in patients with history of periodontitis and patients with active periodontal disease. Most of the patients 67.2% were non –smokers, 20.9 % were smokers and 11.9 were former smokers. Finally, 19.4% of patients were diabetic. No association was found in the study population between peri-implant disease and smoking as well as with diabetes. The distribution of the different variables regarding patients is summarized in table 1.

Table 1

Parameter	N	%	
Gender	Male	34	50.7%
	Female	33	49.3%
Age	26 to 34 years' old	8	11.9%
	35 to 44 years' old	15	22.4%
	45 to 54 years' old	24	35.8%
	55 to 64 years' old	13	19.4%
	65 years old and more	7	10.4%
Smoking habits	Smoker	14	20.9%
	Non-smoker	45	67.2%
	Former smoker	8	11.9%
Diabetes	No	53	80.6%
	Yes	14	19.4%
Periodontal tissue status	Healthy	7	10.4%
	Gingivitis	16	23.9%
	Active periodontitis	14	20.9%
	Stable periodontal condition	27	40.3%
	Edentulous with implant supported prosthesis	3	4.5%
Recall visits	No	49	73.1%
	Yes	18	26.9%
Regular visits	No	60	89.6%
	Yes	7	10.4%

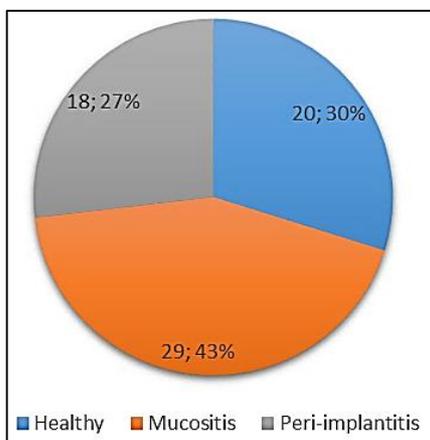


Fig 1: Prevalence of peri-implant mucositis and peri-implantitis at the patient level

52% of the 181 implants were located in mandible, while 47.5% were located in maxilla. 77.4 % of the implant were placed to substitute molars and pre-molars. BOP was found in 133 (73.5%) of the 188 implants. It was observed that 46 (25.4%) of the 188 implants presented with suppuration after probing and from those 46 implants, 37 (20.4%) presented with peri-implantitis whereas nine implants (5.0%) with suppuration and had been diagnosed with peri-implant mucositis. Peri-implantitis was diagnosed in 40 (22%) implants. Twenty-five (13.8%) of 40 implants that had been diagnosed with peri-implantitis had more than or equal 3 mm bone loss, 6 of those implants had mobility, and 15 implants (8.3%) had less than 3 mm bone loss. The distribution of the different variables regarding implants is summarized in table 2.

The mean of mPI was 1.12±0.964, while 1.68±1.471 was for mGI. Regarding mPI, mild plaque was highest percentage with 49.2%. On the other hand, for mGI the severe mucositis takes the lowest percentage 3.9%, while mild and moderate mucositis was 27.1%, and 20.4% respectively.

At the implant level, prevalence of peri-implant mucositis and peri-implantitis for implants were 51% and 22% respectively. The proportion of healthy implants was 27% (Figure 2).

When the regions of implant placement were compared separately, the anterior-maxillary and mandibular regions had statistically significant higher rates of peri-implant diseases. Implants with more than 1 to 5 years in function were statistically more prone to peri-implant mucositis, and plaque accumulation was statistically associated with the occurrence of peri-implant diseases. Edentulous patients who placed implants supported by over dentures and full arch prosthesis were statistically associated with peri-implant diseases.

Table 2

Parameters	N	%	
Probing depth	Less than 4	127	70.2%
	More than or equal 4	54	29.8%
BOP	No	48	26.5%
	Yes	133	73.5%
Suppuration	No	135	74.6%
	Yes	46	25.4%
Mobility	No	175	96.7%
	Yes	6	3.3%
Bone loss	None	141	77.9%
	Less than 3	15	8.3%
	More than or equal 3	25	13.8%
Location	Maxilla	86	47.5%
	Mandible	95	52.5%
Region	Anterior maxilla	27	14.9%
	Posterior maxilla	59	32.6%
	Anterior mandible	14	7.7%
	Posterior mandible	81	44.8%
Function time	More than 1 year to 5 years	57	31.5%
	More than 5 years to 9 years	124	68.5%
	Nobel biocare replace select	136	75.1%
Implant system	Blue sky Bio.LLC	33	18.2%
	No available information	12	6.6%
	Single crown	82	45.3%
Restoration Type	Unit bridges	80	44.2%
	Full-arch prostheses	7	3.9%
	Over dentures	8	4.4%
	No Restoration	4	2.2%

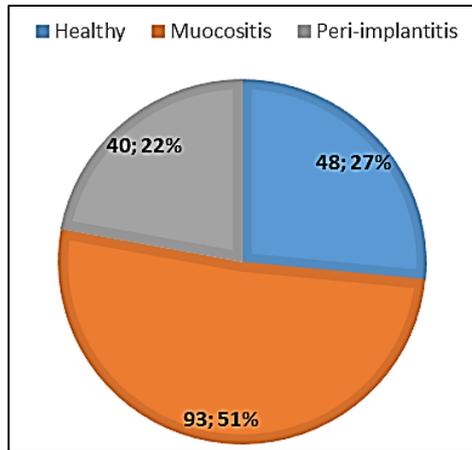


Fig 2: Prevalence of peri-implant mucositis and peri-implantitis at the implant level

4. Discussion

Prevalence of peri-implant diseases should be provided based on subject data rather than data from the individual implants, and need to describe the extension and severity of peri-implant disease for implants that are affected in each subject as well as amount of bone loss [29].

In the present study the prevalence of peri-implant mucositis and peri-implantitis on a patient-level were 43% and 27% respectively. The results were closely resembling Daubert *et al.* study [3], whereas mucositis was found in 48% of the patients, and peri-implantitis occurred in 26% of the patients.

Many studies represent a controversial issue regarding the prevalence of peri-implant diseases [28]. In most recent publications, the outcomes indicated a wide range in the prevalence of peri-implant diseases. In a study done by Aguirre-Zorzano *et al.* [1], the prevalence of pre-implant diseases at patient level was 24.7% for mucositis and 15.1% for peri-implantitis. In another study done by Marrone *et al.* [12], the prevalence's of mucositis and peri-implantitis at the patient's level were 31% and 37% respectively. Rinke *et al.* [23], found in their investigation that prevalence's of 44.9% and 11.2% for mucositis and peri-implantitis respectively. In a systematic review by Derks and Tomasi [4], the prevalence of peri-implant mucositis was reported at 43% ranged from 19% to 65%, whereas for peri-implantitis it amounted to 22% ranged from 1% to 47%. These contradictory in most prevalences of peri-implant diseases publications may be attributed to many factors such as, difference in criteria applied, difference of follow-up periods, variation in assessment methods, difference in diagnostic criteria and peri-implant disease definitions.

Several studies have reported that the rates of peri-implant disease in patients with a history of periodontitis are higher than those without a history of periodontitis. Karoussis *et al.* [8], concluded that patients with implants replacing teeth lost due to chronic periodontitis demonstrated lower survival rates and more biological complications than patients with implants replacing teeth lost due to reasons other than periodontitis during a 10-year maintenance period. Another systematic review indicated that a history of periodontitis is a possible risk factor for peri-implantitis [27]. In the current study, there was statistically significant association between healthy periodontium and healthy peri-implant tissue status. It was found a higher frequency of peri-implant diseases (53.7%) in patients with history of periodontitis and patients

with active periodontitis. This finding is in agreement with a study on the prevalence and risk factors for peri-implant disease in Belgian adults [12], which reported that subjects with active periodontitis were more prone to develop peri-implantitis. Therefore, it is important to take periodontal condition into consideration in the treatment planning of the dental implants, and patients with a history of periodontitis should be followed for supportive therapy at least every 6 months.

Heitz-Mayfield & Huynh-Ba [7], concluded that the combination of a history of periodontitis and smoking increases the risk of implant failure and peri-implant bone loss. Most of the studies regarding risk factors for peri-implant disease concluded that smoking was associated with peri-implant diseases. However, the present study did not found such an association between peri-implant diseases and smoking habit. This could be explained by the small proportion of smokers (20.9%) in our study population. The small percentage of smokers in the present study were similar to those reported in Marrone *et al.* [12] and Konstantinidis *et al.* [9].

The present study demonstrated no statistically significant relationship between diabetes and peri-implant diseases. There is limited evidence showed that diabetes is associated with peri-implant diseases. Most of clinical studies indicated statistically insignificant of dental implants failure even in moderately uncontrolled diabetic patients [5].

In the current study, 51% implants were diagnosed with peri-implant mucositis, while 22% of implants were diagnosed with peri-implantitis. Clinical and radiographic examination should routinely be obtained after prosthesis installation on dental implants in order to establish a baseline for the diagnosis of peri-implant diseases during the maintenance of patients receiving dental implants. For the accurate evaluation of bone loss associated with peri-implantitis, intraoral radiographs are used to determine if any bone loss around dental implants had been occurred and findings compared with baseline radiographs [9].

In the current study there are some limitations that apply to every cross-sectional study. Intraoral periapical baseline radiographs taken after implant placement were not available in many cases. However, radiographic examination was obtained only from implants presenting severe inflammatory signs. Ozgur *et al.* [18], concluded in their study that marginal bone loss is affected by location of the implants especially in the maxillary posterior region, excessive crown/implant (C/I) ratio and occlusal table width/implant diameter (OT/I) ratio. For this reason, the present study was designed mainly to focus on assessment and diagnosis of inflammatory diseases around dental implant that could lead to bone loss.

In general, low values of the Mombelli Index were recorded, mPI: 1.12 ± 0.964 and mGI: 1.68 ± 1.471 . Even if there was no significance association between recall visits and peri-implant tissue status, a higher prevalence of peri-implant diseases might be expected among non-compliant patients, where the proportion of patients without recall visits was 73.1%, and 89.6% of patients with no regular visits. According to Roos-Jansaker *et al.* [24], they reported that peri-implant lesions represented a common finding among patients not adhering to a regular supportive periodontal therapy program including implant maintenance. This is also supported by Salvi & Zitzmann [25], who stated that long-

term diagnostic monitoring of tissue conditions around dental implants should be performed at regular intervals.

BOP was found in (73.5%) of the implants. This is in agreement with Baelum and Ellegaard ^[2], who reported in their study that the prevalence of positive BOP at implants increased from 46–51% at 5 years to 70–91% at 10 years. Absence of BOP may represent stable peri-implant soft tissue status, similar to the way that absence of BOP indicates periodontal health. Therefore, periodic recording of BOP parameter in conjunction with light probing force ie, 0.2 to 0.25 N can be recommended to monitor peri-implant soft tissue conditions ^[10].

Regarding the location of dental implant, in the present study when the regions of implant placement were compared separately, the anterior-maxillary and mandibular regions had statistically significant higher rates of peri-implant diseases. It may be confounded by other factors such as plaque accumulation, type of supra-structure prosthesis and occlusal forces. There is a conflicting evidence that implant location influence the success or failure of the dental implant. McDermott *et al* ^[15] found no association between location of implants in maxilla or mandible and inflammatory complications. However, Moy *et al* ^[17], found significant association between implant location and implant failure.

Regarding the function time, the present study showed that implants with more than 1 to 5 years in function were statistically more prone to peri-implant mucositis. In a study done by Maximo *et al* ^[14], they concluded that presence of peri-implant diseases may be associated with the increasing time of loading and generalized periodontal bone loss. It is expected from the observation of the present study that when there is a longer duration of implant placement and loading, there will be more plaque accumulation and it was statistically associated with the occurrence of peri-implant diseases.

In the current study, edentulous patients who placed implants supported by over dentures and full arch prosthesis were statistically associated with peri-implant diseases. This is in accordance with Marrone *et al* study ^[12] who found that total edentulous patients were more prone to present peri-implant disease and implants covered with overdentures were more associated with peri-implantitis (40.7%) than those with fixed prosthesis. Quirynen & Van Assche ^[22], reported that periodontal pathogens may persist for a long time in the oral cavity of edentulous patients with a history of periodontitis. These periodontal pathogens in the oral cavity might be re-colonized around the surface of dental implants and form an oral biofilm, which induces inflammatory reactions in the surrounding tissues.

In the present study, it was found positive relation between the number of placed dental implants and peri-implant tissue status, as the number of placed dental implants increases, the peri-implant disease surrounding implant tissue increases as well. In a study done by Passoni *et al* ^[19], they concluded that more than 5 implants in total fixed rehabilitation, increase bone loss and consequently the prevalence of peri-implantitis. Therefore, it is important to instruct and motivate patients to perform correct hygiene methods using appropriate cleaning devices, monitoring and maintaining implant restorations for preventing any complications.

5. Conclusion

The increasing prevalence of peri-implant diseases and plaque accumulation lead us to highlight the need for greater awareness regarding oral hygiene care and encouragement of oral health promotion for patients receiving dental implants.

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