PREVALENCE OF PERI-IMPLANT DISEASES AMONG AN ITALIAN POPULATION OF PATIENTS WITH METABOLIC SYNDROME: A CROSS-SECTIONAL STUDY.
LA PREVALENZA DELLE PATOLOGIE PERI-IMPLANTARI IN UNA POPOLAZIONE ITALIANA DI PAZIENTI CON LA SINDROME METABOLICA: UNO STUDIO TRASVERSALE

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Abstract
Introduzione: *Nel corso degli anni, solo pochi autori si sono concentrati sulla possibile correlazione tra patologie sistemiche e le malattie peri-implantari. L'obiettivo di questo studio trasversale è quello di valutare la prevalenza e la severità della peri-implantite nei pazienti con diagnosi di sindrome metabolica.* ***Materiali e Metodi:*** *Sono stati selezionati pazienti con almeno un impianto dentale, con minimo 5 anni di carico protesico, per effettuare uno screening parodontale, peri-implantare e metabolico. La diagnosi di Sindrome Metabolica è stata effettuata secondo i criteri diagnostici NCEP-ATP III, mentre la nuova classificazione delle malattie parodontali e peri-implantari del 2017 è stata utilizzata per la peri-implantite e la mucosite peri-implantare. La regressione multipla è stata eseguita per analizzare la relazione tra sindrome metabolica, presenza di malattia parodontale, sesso, tipo di protesi, sede implantare, fumo e la peri-implantite e la mucosite.* ***Risultati:*** *Sono stati arruolati 183 pazienti: nei pazienti con sindrome metabolica la prevalenza delle patologie peri-implantari riscontrata è stata del 97.6%, con un OR di 10.01 per la mucosite e 15.26 per la peri-implantite, mentre nei soggetti privi di Sindrome metabolica è stata evidenziata una frequenza dell'81.8%, con p<0.001.* ***Conclusioni:*** *I pazienti con una diagnosi di sindrome metabolica hanno mostrato una nettissima prevalenza delle patologie peri-implantari.*

Abstract
Purpose: The aim of this study is to detect frequency and severity of peri-implant diseases among an Italian population of patients affected by metabolic syndrome (MetS).
Methods: In this cross-sectional study, patients with at least one dental implant with >5 years of functional loading were screened to evaluate metabolic, periodontal and peri-implant status. MetS diagnosis was established in accordance with the NCEP ATP III criteria, while case definitions of the 2017 World Workshop were adopted for peri-implant diseases. Multinomial logistic regression analysed the relationship between gender, diagnosis of metabolic syndrome, presence of periodontitis, smoking, type of prosthesis and location of implants and peri-implant mucositis and peri-implantitis.
Results: A final sample of 183 patients was enrolled: in MetS subjects, 97.6% of implants were diagnosed with peri-implant diseases, with an OR of 10.01 for mucositis and OR 15.26 for peri-implantitis, compared to subjects without MetS, where frequency of peri-implant diseases was 81.8% , p<0.001.
Patients with periodontitis showed a higher association with peri-implant mucositis (OR=4.33) and peri-implantitis (OR=9).

Conclusions: Based on the results of this study, patients with MetS showed a greater prevalence of peri-implant diseases, with further studies that need to confirm the possibility of this new possible risk indicator.

Introduction

The European population is getting older, with an increasing concern about oral health: according to Schimmel et al.[1], implant-prosthetic rehabilitation has become routine practice in elderly patients, however coexisting systemic risk factors should carefully be taken into account by clinicians[2].

Dental implants have shown well-documented long-term survival rates (> 10 years)[3-4], however, implant success may be affected by either mechanical or biological complications[5-6].

According to the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions, plaque-related inflammatory conditions can be classified as peri-implantitis and peri-implant mucositis[7].

Prevalence of peri-implant diseases is still controversial, according to Derks & Tomasi around 42% of dental implants are affected by mucositis, while a diagnosis of peri-implantitis could be established in 23% of dental implants[8].

Schwarz et al.[9] showed that there is strong evidence for history of periodontitis as a risk factor for peri-implantitis, an assumption supported by several longitudinal and cross-sectional studies[10-12].

Peri-implantitis, as well as periodontitis, is considered sensitive to factors inducing tissue inflammation (smoking, poor plaque control, hyperglycaemia) together with systemic oxidative stress and up-regulation of inflammatory cytokines[13-14].

Over the years, correlation between metabolic and cardiovascular diseases has been described in literature[15-17], while only few authors have studied the association of these conditions with peri-implantitis[18-19].

In particular, Monje et al.[20] found out that diabetes patients no-smokers showed a 3.39 higher risk for peri-implantitis compared to normoglycaemia subjects, however several studies included in the systematic review failed to identify diabetes as a risk factor for peri-implantitis.

Renvert et al.[21] concluded that history of cardiovascular disease (CVD) had a high likelihood of comorbidity with peri-implantitis, expressing an Odds Ratio (OR) of 8.7, while Koldsland et al.[22] found no association between CVD and peri-implant diseases.

Metabolic syndrome

Metabolic syndrome (MetS) is a clustering of clinical findings made up of abdominal obesity, high glucose, high triglycerides and low high-density lipoprotein (HDL) cholesterol levels, and arterial hypertension (HT)[23]. Its overall prevalence is more than 40%, but ranged from 38% to 60%, depending on age, sex, socioeconomic status, the ethnic background of study cohorts, and the definition used[23-24]. Several definitions of MetS, indeed, have been proposed, with varied requirements, including those by the International Diabetes Federation and the National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP) III[25] that has been recognized as more accurate and sensitive for prediction of CVD[26]. According to the NCEP ATP III, a diagnosis of MetS is made by fulfilment of 3 of the following 5 criteria: (1) waist circumference (WC) $\geq$ 102 cm for males or $\geq$ 88 cm for females; (2) fasting glucose $\geq$ 110 mg/dL; (3) triglycerides $\geq$ 150 mg/dL; (4) HDL - cholesterol < 40 mg/dL for males or < 50 mg/dL for females; (5) blood pressure (BP) $\geq$ 130/85 mmHg[25].

MetS is associated to higher cardiovascular (CV) and metabolic complications with increased risk of type 2 diabetes mellitus and CVD mortality[27].
Recently, it has been highlighted by several cross-sectional[28-30] and case-control[31-32] studies that there is an interrelationship between periodontitis and MetS[33]. Therefore, it has been suggested that the evaluation of periodontal parameters should become part of routine diagnostic procedures for patients affected by MetS[34].
However, data about the association between MetS, its components and peri-implant diseases is lacking and only lately it has been highlighted the relevance of this feasible relationship in the management of patients with implants affected by MetS[35].
The aim of this cross-sectional survey is to detect frequency and severity of peri-implant diseases among an Italian population of patients affected by MetS, and to further identify possible role of MetS as a risk indicator.

Material and Methods

Study design

To address the research purpose, the authors developed and implemented a cross-sectional study, conducted at the Departments of Oral and Maxillo-Facial Sciences and Translational and Precision Medicine, at "Sapienza" University of Rome.

Study population

From April 2018 to September 2018, all subjects referred to the Tertiary Centre of Secondary Hypertension Unit, Policlinico Umberto I, "Sapienza" University of Rome, for screening, diagnosis, and treatment of primary and/or secondary hypertension were consecutively evaluated.
Patients were enrolled in the study based on the following inclusion and exclusion criteria:
age $\geq$ 18 years and presence of at least one osseointegrated implant functioning for >5 years.
Each patient received detailed descriptions of the study protocol and all subjects signed the inform consent form and gave written approval to be included in the study population, according to the latest version of the World Medical Declaration of Helsinki (2013). The study was approved by the institution review board of "Sapienza" University of Rome (Ref. 4948/2018) and reported according to the STROBE statement (www.strobe-statement.org).

Medical Examination

Anthropometric measurements and venous blood samples were obtained from all patients in the early morning after an overnight fast. Data about smoking habit, as well as current medications, past medical history, including CV events, was collected, and we performed a complete screening to exclude secondary forms of hypertension, such as primary aldosteronism, renovascular diseases, Cushing's syndrome, and pheochromocytoma. The instrumental evaluation included the 24-hours ambulatory blood pressure monitoring (ABPM) and the Doppler ultrasound for carotid arteries to estimate the intima media thickness (IMT) value and the presence of plaques, as markers of hypertensive- and metabolic-related vascular damage[36].
The 24-hours ABPM was performed by the Spacelabs 90207 (SpaceLabs®, Washington, USA). For each registration, the blood pressure (BP) values were obtained every 15 minutes during the day and every 30 minutes during the night time period. The parameters collected include: mean 24-hours systolic and diastolic BP and its standard deviation (SD), mean daily and night-time systolic and diastolic BD and their SD, the dipping values.

A Doppler scan was used to detect IMT and plaques. The common carotid artery, the carotid bulb, and the near and far wall segments of the internal carotid artery were scanned bilaterally. Images were obtained in longitudinal sections with a single lateral angle of insonation, optimizing the image for the far wall. According to the consensus statement from the American Society of Echocardiography Carotid Intima-Media Thickness Task Force, endorsed by the Society for Vascular Medicine[36], IMT was defined as the distance between the ultrasound interfaces of the lumen-intima and media-adventitia. Six manual measurements were performed, with automatic border detection, at equal distances along 1 cm on the far wall of the common carotid. Carotid plaque was defined as the presence of focal wall thickening that is at least 50% greater than that of the surrounding vessel wall or as a focal region with IMT greater than 1.5 mm that protrudes into the lumen that is distinct from the adjacent boundary.

All patients were screened for the MetS according the NCEP ATP III criteria[23]. The diagnosis was made by the evidence of ≥ 3 of the following criteria: (1) WC ≥ 102 cm (M) or ≥ 88 cm (F). The WC was measured placing the measuring tape horizontally around the patient's abdomen and aligning the bottom edge of the tape with the belly bottom. We used a measuring tape with a spring handle in order to control the pressure exerted on the patient's abdomen. (2) Fasting plasma glucose value ≥ 110 mg/dL; (3) serum triglycerides concentration ≥ 150 mg/dL; (4) serum HDL - cholesterol concentration < 40 mg/dL (M) or < 50 mg/dL (F); (5) BP ≥ 130/85 mmHg, obtained by 24-hours ABPM[23].

Dental examination

All patients with at least one dental implant with >5 years of functional loading were referred at the Oral Surgery Unit, Policlinico Umberto I, "Sapienza" University of Rome to evaluate periodontal and peri-implant status.

Patients' data collected included: sex, age, referred medical systemic condition and periodontal status (presence or absence of periodontitis).

A full mouth periodontal examination at six sites per teeth and implant [mesio-vestibular (mv), mid-vestibular (v), disto-vestibular (dv), mesio-palatine/lingual (mp/ml), mid-palatine/lingual (p/l), and disto-palatine/lingual (dp/dl)] was performed by using a periodontal probe (PCP-Unc 15, Hu-Friedy®, Chicago, Illinois, USA) with a light force (approximately 0.15 N), without anaesthesia, by the same trained previously calibrated examiner (BDM).

A patient was defined as a "periodontitis case" in accordance with the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions[37] if:

- Interdental CAL was detectable at ≥2 non-adjacent teeth, or
- Buccal or oral CAL ≥3 mm with pocketing >3 mm was detectable at ≥2 teeth and the observed CAL cannot be ascribed to non-periodontal causes such as: 1) gingival recession of traumatic origin; 2) dental caries extending in the cervical area of the tooth; 3) the presence of CAL on the distal aspect of a second molar and associated with malposition or extraction of a third molar, 4) an endodontic lesion draining through the marginal periodontium; and 5) the occurrence of a vertical root fracture

To achieve intra-examiner reliability, the examiner was calibrated to show an agreement of 90% within 1 mm by duplicate measurements of probing depths on randomly selected teeth (10) and implants (10).

For each implant, the following clinical measurements were recorded:

- Probing Pocket Depth (PPD). Measured in millimetres, is the distance from the mucosal margin to the bottom of the probable pocket
- Plaque Index (PI) recorded with dichotomic values (present/absent)

- Mucosal redness defined as the phenomenon of inflammation presents as a biological response to extrinsic or intrinsic insult and recorded with dichotomic values (present/absent)
- Suppuration defined as a pus formation followed by discharge within a natural aperture or fistula and recorded with dichotomic values (present/absent)
- Bleeding on probing recorded with dichotomic values (present/absent)

Furthermore, years of functional loading, implant location (maxilla or mandible) and type of prostheses (single crown or multiple unit) were recorded.

In addition, mesial and distal implant crestal bone levels were measured on standardized (Rinn Centratore XCP Evolution 2003, Dentsply, Rome, Italy) digital periapical x-rays for each implant obtained by using an imaging plate scanner (PSPIX²®, Acteon Group, Norwich, UK).

A calibrated software (SOPRO Imaging, Acteon Group, Norwich, UK) was used to estimate variations in the marginal peri-implant bone level. The implant length and width were used as references for calibration of measurements. Two expert investigators who were blinded to other aspects of the study conducted the radiographic assessment. Any disagreement was solved by consensus, and a third investigator was consulted when it was not initially possible to achieve complete agreement (defined as a difference between the measurements made by the two experts of >0.1 mm).

The reference point for the bone level measurement was the implant shoulder. The bone level was digitally evaluated by measuring the distance between the implant shoulder and the first visible bone contact on the implant. The bone level measurements were recorded on the mesial and distal aspect of each implant.

An error of 0.75 mm was considered when reporting marginal bone loss (MBL), a threshold exceeding the measurement error (mean 0.5 mm) by 50%, as recommended by Berglundh et al[7].

Case definitions for epidemiological or disease surveillance studies of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions were adopted to establish diagnosis of peri-implant diseases[7].

Peri-implant health was defined as absence of clinical signs of inflammation, bleeding and/or suppuration on gentle probing, without radiographic bone loss.

Peri-implant mucositis was characterized by presence of bleeding and/or suppuration on gentle probing, without radiographic bone loss.

Peri-implantitis was defined as presence of bleeding and/or suppuration on gentle probing, with radiographic bone levels ≥3 mm apical of the most coronal portion of the intra-osseous part of the implant.

Statistical analysis

A database was created using Excel (Microsoft, Redmond, WA, USA). Descriptive statistics including mean ± SD values were calculated for each variable, and box plots were used to evaluate data outliers. The Shapiro-Wilk test was used to determine whether or not the data conformed to a normal distribution.

Risk indicators for peri-implant mucositis and peri-implantitis were analysed at the patient level.

The outcomes were explored by multinomial logistic regression to evaluate the relationship between gender, diagnosis of metabolic syndrome, periodontal status, smoking, type of prosthesis and location of implants and peri-implant mucositis and peri-implantitis.

An independent-samples t-test was run to determine if there were differences in mean value of marginal peri-implant bone level and in probing depth between patients with or without diagnosis of metabolic syndrome and with or without periodontitis.

Data were evaluated using standard statistical analysis software (version 20.0, Statistical Package for the Social Sciences, IBM Corporation, Armonk, NY, USA). In each test, the cut-off for statistical significance was $p \leq 0.05$.

Results

A total of 784 patients was consecutively evaluated at the Secondary Hypertension Unit in the study period: 363 subjects declared they had dental implants placed, however 134 had implants functioning by less than 5 years and were, therefore, excluded from the study.

The remaining 229 patients were referred at the Oral Surgery Unit in order to evaluate peri-implant status: 26 refused to be included in the study, 20 did not attend the scheduled visit and refused a new dental examination.

A final sample of 183 patients was enrolled in this study: 112 females (61.2%) and 71 males (38.8%) with a mean age of 66.08 ± 10.42 years (age range 42-85).

Eighty-four patients had a diagnosis of metabolic syndrome (45.9%), while the remaining 99 (54.1%) did not meet MetS criteria (Table 1).

The subgroup with MetS, compared to patients without MetS, showed significantly higher values of waist circumference and triglycerides (103.4±9.7 vs 92.2±11.0 cm, p=0.01, 147.5±62.2 vs 87.9±30.4 mg/dl, p=0.002, respectively), and lower HDL cholesterol levels (50.3±16.1 vs 66.8±14.5 mg/dl, p=0.01).

Presence of periodontitis was detected in 115 subjects (64.8%).

Subjects enrolled had 567 dental implants placed, with a mean of 3.1 implants per patient.

Out of the 183 dental implants included, mucositis was diagnosed in 57.9% of cases, peri-implantitis in 31.1% and only 10.9% of implants were classified as healthy. Mean functional time was 7.61±4.04 years (range: 5-24 years).

Mean values of MBL were mesially 1.765±1.424 and distally 1.918±1.576 mm.

The mean PPD was 3.71±1.48 mm (Table 1).

The multinomial logistic regression revealed that two of the six predictor variables were statistically significant for a diagnosis of mucositis: presence of metabolic syndrome (p=0.005; odds ratio 10.01) and periodontitis (p=0.25; odds ratio 4.33); and two of the six predictor variables were statistically significant for a diagnosis of peri-implantitis: metabolic syndrome (p=0.001; odds ratio 15.26) and periodontitis (p=0.002; odds ratio 9) (Table 2).

No difference was found in mean values of MBL between patients with metabolic syndrome (1.96±1.41 mm) and without metabolic syndrome (1.6±1.42 mm) (p=0.081).

By contrast, mean PPD values in patients with MetS (4.26±1.74 mm) were statistically significant (p=0.013), compared to subjects without metabolic syndrome (3.71±1.55 mm).

The sub-group with periodontitis showed statistically significant greater values of PPD and MBL (4.17±1.85 vs 3.6±1.21 mm, p=0.024, 2.05±1.44 vs 1.28±1.27 mm, p<0.001), compared to patients without periodontitis.

Conclusions

Risk indicators for implant biologic complications are still debated in literature and, among others, poor plaque control, smoking, lack of keratinized tissue, years in function, number of rehabilitated dental implants, history of periodontal disease and co-existing systemic medical conditions were individuated[39].

Implant treatment in the medically compromised patient represents, nowadays, a common clinical situation for dentists[40] and MetS prevalence has been constantly rising in the last years, involving approximately 30% of the population[41].

Several studies have reported an inter-relationship between periodontal disease and MetS[42], although, to the best of the authors' knowledge this is the first article to report data regarding MetS and peri-implant diseases.

A high prevalence of peri-implant diseases has been described by various authors: Atieh et al.[43] and Gurgel et al.[44] revealed that peri-implant diseases were diagnosed in around 82% of individuals, while in the study conducted by Pimentel et al.[45], they were observed in 94.5% of implants and 100% of individuals.

On the other hand, Wada et al.[46] reported a significant lower prevalence, with peri-implant mucositis and peri-implantitis being diagnosed at subject level in 23.9% and 15.8%, respectively.

According to our results, patients with Metabolic Syndrome had a strong association with peri-implant mucositis (OR= 10.01) and even stronger with peri-implantitis (OR=15.26) (Table 2).

In MetS patients, 97.6% of implants (n=82/84) were diagnosed with either mucositis or peri-implantitis, a highly statistically significant difference ($p<0.001$) compared to subjects without MetS, where frequency of peri-implant diseases was 81.8% (n=81/99).

No differences were found among patients for smoking habits, implant location, gender and type of prosthetic rehabilitation.

Patients with presence of periodontitis were found to have a higher association with peri-implant mucositis (OR= 4.33) and peri-implantitis (OR=9): they showed also statistically significant greater values of PPD ($p=0.024$) and MBL ($p<0.001$), a result in accordance with previous studies[47-48] (Table 2).

In line with our data, Renvert et al.[21] showed an Odds ratio (OR) of 10.8 for peri-implantitis in patients with a diagnosis of periodontitis, while Derks et al.[49] reported an OR of 4.08.

Although, Ferreira et al.[10], in a recent systematic review with meta-analysis, highlighted the heterogeneity of studies present in literature, with OR ranging from 1.74 to 22.9 depending on the different study design.

They concluded that there was evidence that patients with diagnosis or history of periodontitis were associated with the occurrence of peri-implantitis.

In this study, the diagnostic criteria proposed by the latest 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions were applied.

Previous systematic reviews highlighted how differences in the occurrence of peri-implant diseases were mostly due to the different clinical and radiographic parameters adopted, with minor changes in the diagnostic criteria producing a great difference in detection and frequency[50].

Main limitations of our study are represented by the absence of several important implant-related data, such as implant brand, shape, connection, surface treatment or guided bone regeneration (GBR) procedures.

These data were not available due to the cross-sectional nature of our study: the vast majority of implants were installed in private settings all over Italy, either by general practitioners, oral surgeons or periodontists.

Furthermore, absence of a retrospective standardized baseline (at prostheses delivery) radiological examination did not allow performing accurate bone level measurements, however, as recommended by Berglundh et al.[7], an error of 0.75 mm was taken into account when performing the assessment.

There are no previous studies to which our findings can be compared and the design of this study do not allow establishing direct cause-effect relationships, however, the present study demonstrated a high prevalence of peri-implant diseases at the patient level in an Italian population of MetS subjects (97.6%).
This possible association need to be evaluated by further studies, with greater power and a longitudinal design: directionality of the relationship should be investigated and patient's therapeutic response analyzed.
Based on the results of this cross-sectional study, patients affected by metabolic syndrome showed a greater prevalence of peri-implant diseases, with further studies that need to confirm this new possible risk indicator.

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Table 1: Sample demographics

Variable (categories)	**Mean ± SD or % distribution**
Patients without metabolic syndrome (P = 99;I = 288)	
Sex, % (Male – Female)	46.5 – 53.5
Age (years)	64 ± 10
Smoking, % (yes – no)	43.4 – 56.6
Presence of periodontitis, % (yes – no)	69.7 – 30.3
Implant years in function	8.8 ± 5.2
Implant location (maxilla – mandible)	62.6 – 37.4
Type of prosthesis (multiple unit – single crown)	58.6 – 41.4
Probing pocket depth (mm)	3.7 ± 1.5
Marginal bone loss (mm)	1.6 ± 1.4
Plaque Index (%)	65.6
Mucosal Redness (%)	18.1
Suppuration (%)	12.1
Bleeding on probing (%)	71.7
Peri-implant mucositis (%)	55.6
Peri-implantitis (%)	26.3
Healthy implants (%)	18.1
Patients with metabolic syndrome (P = 84; I = 279)	
Sex, % (Male – Female)	29.8 – 70.2
Age (years)	68 ± 11
Smoking, % (yes – no)	25 – 75
Presence of periodontitis, % (yes – no)	54.8 – 45.2
Implant years in function	6.5 ± 2.3
Implant location (maxilla – mandible)	72.6 - 27.4
Type of prosthesis (multiple unit – single crown)	59.5 - 40.5
Probing depth (mm)	4.3 ± 1.7
Marginal bone loss (mm)	2 ± 1.4
Plaque Index (%)	69
Mucosal Redness (%)	16.6

Suppuration (%)	22.6
Bleeding on probing (%)	90.4
Peri-implant mucositis (%)	60.7
Peri-implantitis (%)	36.9
Healthy implants (%)	2.4

SD = standard deviation; mm = millimetre; P = number of patients; I = number of dental implants

Table 2: Effects of gender, diagnosis of metabolic syndrome, presence of periodontitis, smoking, type of prosthesis and location of implants on the diagnosis of mucositis and peri-implantitis.

	Peri-implant mucositis							
							95% Confidence Interval for Odds Ratio	
	B	S.E.	Wald	df	Sig.	Odds Ratio	Lower	Upper
Intercept	-,579	,597	,943	1	,331			
Female	.945	.582	2.633	1	.105	2.572	.822	8.052
Male	0[b]	.	.	0	.	.	.	.
Patients with metabolic syndrome	2.309	.818	7.969	1	.005	10.066	2.026	50.021
Patients without metabolic syndrome	0[b]	.	.	0	.	.	.	.
Patients with periodontitis	1.466	.652	5.057	1	.025	4.331	1.207	15.540
Patients without periodontitis	0[b]	.	.	0	.	.	.	.
Smoker	-.325	.641	.257	1	.612	.723	.206	2.540
No smoker	0[b]	.	.	0	.	.	.	.
Multiple unit	.498	.598	.694	1	.405	1.645	.510	5.306
Single crown	0[b]	.	.	0	.	.	.	.
Implant located in mandible	.679	.570	1.423	1	.233	1.973	.646	6.024
Implant located in maxilla	0[b]	.	.	0	.	.	.	.

Peri-implantitis								
							95% Confidence Interval for Odds Ratio	
	B	S.E.	Wald	df	Sig.	Odds Ratio	Lower	Upper
Intercept	-.802	.648	1.528	1	.216			
Female	.464	.622	.556	1	.456	1.590	.470	5.378
Male	0[b]	.	.	0	.	.	.	.
Patients with metabolic syndrome	2.725	.847	10.362	1	.001	15.259	2.903	80.196
Patients without metabolic syndrome	0[b]	.	.	0	.	.	.	.
Patients with periodontitis	2.198	.706	9.688	1	.002	9.004	2.256	35.932
Patients without periodontitis	0[b]	.	.	0	.	.	.	.
Smokers	.111	.671	.027	1	.869	1.117	.300	4.161
No smokers	0[b]	.	.	0	.	.	.	.
Multiple unit	-.630	.635	.985	1	.321	.532	.153	1.848
Single crown	0[b]	.	.	0	.	.	.	.
Implant located in mandible	-.468	.644	.529	1	.467	.626	.177	2.212
Implant located in maxilla	0[b]	.	.	0	.	.	.	.

The reference category is: No diagnosis of peri-implant disease

b. This parameter is set to zero because it is redundant