

Kyu Seok Bae

5th Year, Group 16

**Relationship between periodontitis and
successful rate of implantation**

Systemic review of literature

Prof. Renata Šadzevičienė

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Clinic of Oral and Dental Diseases

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This thesis was done

by student

(signature)

Supervisor.....

(signature)

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(name surname, year, group)

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Summary

Background: A number of studies have suggested that implant failure and associated bone loss is greater in subjects with a history of periodontitis.

Objective: The objective of the present systematic review was to assess whether individuals with previous tooth loss due to periodontitis have an increased risk of loss of loss of implants, peri-implantitis, and peri-implant marginal bone loss as compared with individuals with previous tooth loss due to reasons other than periodontitis.

Materials and Methods: Longitudinal studies reporting on implant survival, success, incidence of peri-implantitis, bone loss and periodontal status, and patients with a history of treated periodontitis were included. Five electronic databases were researched in 894 publications. After selection of the studies, only 12 studies were included in systematic review.

Results: It showed that a higher and significant risk for implant loss was present in patients affected by periodontitis. There was a higher tendency for implant loss and biological complications in patients previously presenting with severe forms of periodontitis. Patients periodontally compromised showed an increased risk of peri-implantitis, when compared with patients without periodontitis.

Conclusion: There is evidence that periodontitis is a risk factor for implant loss and that periodontitis is a risk factor for peri-implantitis. Also patients with periodontitis have higher risk of implant-bone loss.

Keywords: dental implants, peri-implantitis, periodontitis, bone loss, systemic review

Introduction

Periodontitis is defined as “an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with increased probing depth formation, recession, or both”. [1] Yet, it is curable, but it could still affect the dental implantation. Over the last decades, the use of implant-supported dental rehabilitations has known a significant increase. Despite a high overall success rate, various risk factors can negatively affect the predictability of dental implants, leading to peri-implant tissue inflammation as peri-implantitis. Which causes bone resorption and, ultimately, to implant loss. Among them, history of periodontal disease often been identified as conditions favouring the onset of peri-implant pathologies. [2]

Host susceptibility to periodontitis is probably the most important consideration with regard to biological complications for implants. It has been suggested that aggressive or advanced forms of periodontitis are at higher risk for dental implant failure compared with the milder forms. [3]

The aim of this systematic review was to assess current scientific evidence regarding history of periodontitis as risk factors for implant loss and incidence of peri-implantitis, applying stringent selection criteria for study inclusion and quality assessment.

Selection Criteria of the Studies. Search Method and Strategy

Focused Question

The focused question addressed in this study is: “Does history of periodontitis has a relationship between successful rates of the dental implants?”

Inclusion Criteria

Inclusion criteria were: 1) Published in English; 2) Studies reporting implant loss, peri-implantitis, bone-loss; 3) Studies reporting a clear definition of peri-implantitis; 4) Studies reporting a clear effect of history of periodontitis; 5) Minimum follow-up period of three years; 6) Articles that has

full-text screened.

Search strategy

A wide literature search was conducted until March 2017. The following electronic databases were screened: 1) PubMed central; 2) Wiley online library; 3) Journal of periodontology online; 4) BioMed central; 5) International Journal of Dentistry. Searches were done with topic words of “Periodontitis”, “Implant” and “peri-implantitis”

Study Selection

Articles were initially screened based on the titles and abstracts. The accepted articles were read for study design, and some were eliminated based on inclusion criteria listed above. Ex) No full access to article.

Data collection process

The following items were extracted by using pre-defined forms: 1) year of publication; 2) study design; 3) sample size; 4) gender distribution; 5) mean age or age range; 6) definition of periodontal disease; and 7) other confounding factors. Types of outcome measures were 1) Implant survival:

All definitions of implant survival (i.e. cumulative survival rate, post-loading survival rate, incidence of implant loss) were considered; 2) Implant success: All definitions and set of criteria for implant success (Albrektsson et al. 1986; Zarb & Schmitt 1990; Mombelli & Lang 1994; Spiekermann et al. 1995; Buser et al. 1997; Karoussis et al. 2004) were considered including the use of clinical and radiographic criteria to define implant success (with an emphasis on the signs and symptoms of peri-implantitis), as suggested by Ong et al. (2008); 3) Bone loss: The radiographical marginal bone loss around the implant after prosthetic loading was registered; 4) Peri-implantitis:

Peri-implantitis was defined as an incidence of probing pocket depth (i.e. PPD) ≥ 5 mm with bleeding on probing (i.e. BOP) and/or suppuration and radiographic signs of bone loss of ≥ 2.5 mm or bone loss extending \geq the first three threads (Ong et al. 2008). However, all other definitions of peri-implantitis were also considered (Albrektsson & Isidor 1994; Karoussis et al. 2003; Roos-Jansaker et al. 2006b).

Search Results

Though primary data research, total of 894 potential relevant records were identified. After database

searching, there was also an addition of one more relevant record, which was available in hard copy [1]. During screening, 868 records were removed due to inclusion criteria, and 27 were screened. Out of 27 full-text articles that were assessed for eligibility, 15 were excluded; Not prospective or cross-sectional, no control group. As a result, twelve studies were included in qualitative synthesis (Fig 1).

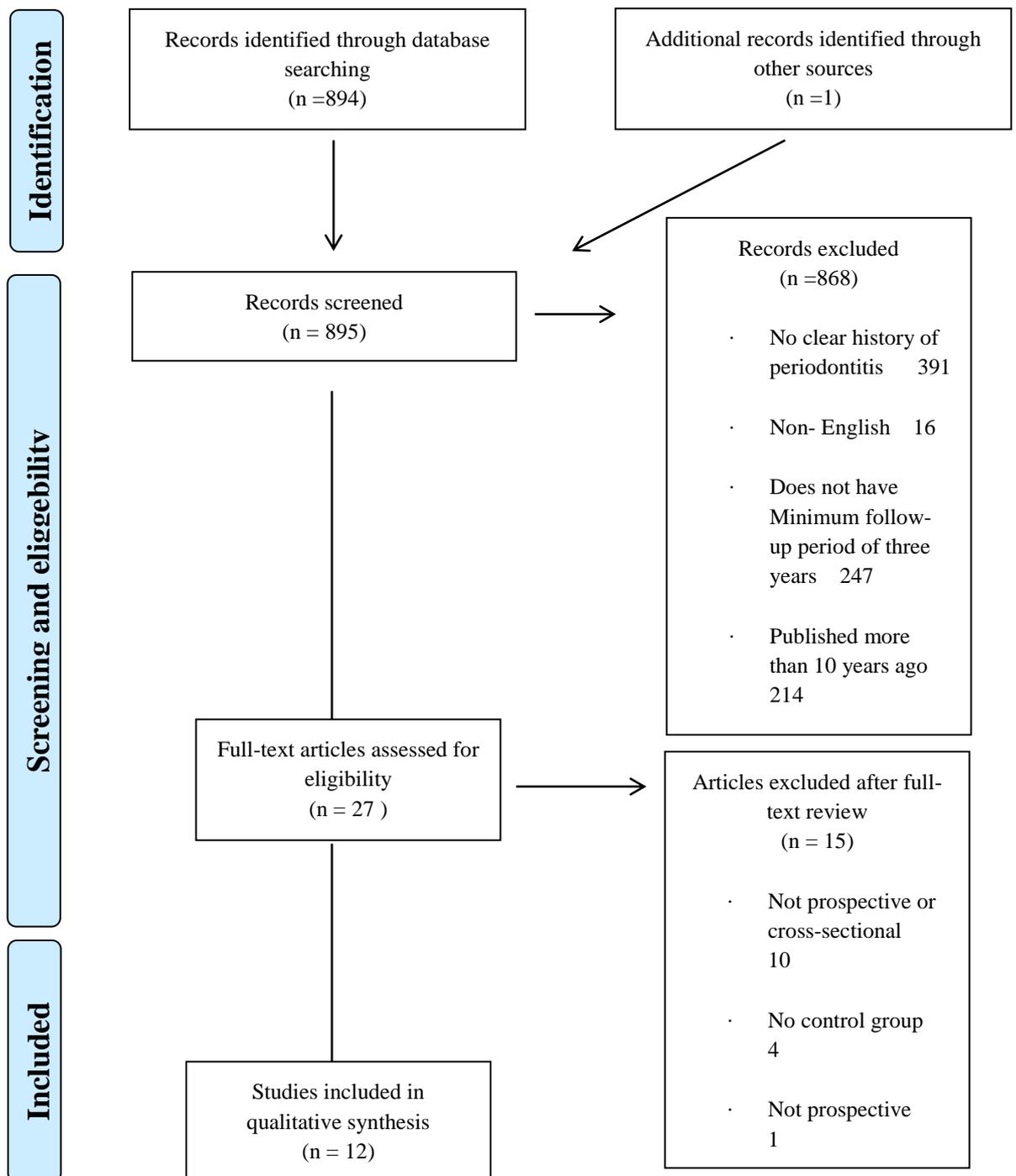


Figure 1. Literature Search Reviews

Table 1. List of excluded studies and reasons for exclusion

Study	Reasons for exclusion	Type of study
<i>Anner et al. (2010)</i>	Not prospective or cross-sectional	Retrospective study
<i>Faggion & Giannakopoulos (2013)</i>	Not prospective or cross-sectional	Systematic review
<i>Renvert & Persson (2009)</i>	Not prospective or cross-sectional	Review
<i>Safii et al. (2010)</i>	Not prospective or cross-sectional	Meta-analysis
<i>Fardal & Linden (2008)</i>	No control group	Prospective study
<i>Cho-Yan Lee et al. (2012)</i>	Not prospective or cross-sectional	Retrospective study
<i>Kim & Sung (2012)</i>	Not prospective or cross-sectional	Systematic review
<i>Renvert et al. (2013)</i>	Not prospective or cross-sectional	Retrospective study
<i>Mengel et al. (2001)</i>	No control group	Prospective study
<i>Schou et al. (2006)</i>	Not prospective or cross-sectional	Systematic review
<i>Pjetursson et al. (2012)</i>	No control group	Prospective study
<i>Ong et al. (2008)</i>	Not prospective or cross-sectional	Systematic review
<i>Marrone et al. (2013)</i>	Not prospective	cross-sectional
<i>Rocchietta & Nisand (2012)</i>	Not prospective or cross-sectional	Review
<i>Horwitz & Machtei (2012)</i>	No control group	Prospective study

As mentioned in introduction, Periodontitis is defined as “an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with increased probing depth formation, recession, or both”. [1] Yet, it is curable, but it could still affect the dental implantation. Over the last decades, the use of implant-supported dental rehabilitations has known a significant increase. Despite a high overall success rate, various risk factors can negatively affect the predictability of dental implants, leading to peri-implant tissue inflammation as peri-implantitis. Which causes bone resorption and, ultimately, to implant loss. Among them, history of periodontal disease often been identified as conditions favouring the onset of peri-implant pathologies. [2]

To find the relationship between periodontitis and successful rate of implantation, total of 12 related articles were reviewed.

Roccuzzo et al. (2013) [20] studied 32 healthy patients, 46 patients with moderate chronic periodontitis, and 45 patients with severe chronic periodontitis. Mean age of those patients were around 50 years old. Although they did not state diagnosis of the peri-implantitis, they clearly mentioned that there is relationship between the history of having periodontitis and implant failure rate.

Marrone et al. (2013) [21] studied 41 healthy patients, and 62 patients with history of chronic periodontitis. Their diagnosis of peri-implantitis were probing depth more than 5mm and bleeding on probing and bone loss of 2mm. The result of this study was impressive. Although 7.2% of patients who had history of chronic periodontitis had implant failure, only 1.2% of healthy patients had implant failure. Shows that there is relationship between the history of having periodontitis and implant failure rate.

Jiang et al. (2013) [22] studied 30 healthy patients with 127 implants, and 30 patients who has history of chronic periodontitis with 149 implants. Mean age for healthy patients were 42 years old, and mean age for patients with chronic periodontitis were 37. Although they did not mentioned the diagnosis of peri-implantitis, they said that implant failure rate of patient with chronic periodontitis were 8%, and it was 3.3% in healthy patients.

Casado et al. (2013) [23] compared 127 healthy patients and 88 patients with history of

periodontitis. Mean age was 55 years old, with 67 males and 148 numbers of females. Diagnosis of peri-implantitis was bone loss that is more than 1mm, and more than 0.2mm per year, the result was implant failure rate of 9.2% in patients with chronic periodontitis, and 3.6% in healthy patients.

Swierkot et al. (2012) [24] reviewed 18 healthy patients with 30 implants total, 35 patients who had generalized aggressive periodontitis with 149 implants total. Mean age of patients were 51 years old (73 males, 106 females). Diagnosis of peri-implantitis were probing depth of 5mm or more, bleeding on probing, and bone loss of 0.2mm or more in a year. Although they did not mentioned the specific failure rate of implantation, but they said that there was relationship between history of periodontitis and failure rate of implantation.

Levin et al. (2011) [25] studied 283 healthy patients, 149 patients with moderate chronic periodontitis, and 285 patients with severe chronic periodontitis. They did not mentioned the ages of the patients, but 273 males and 444 females were reviewed. Implant failure rate for patients with severe chronic periodontitis were 4.2%, for patients with moderate chronic periodontitis were 2.7%, and for healthy patients were only 1.2%. Shows that also the severity of periodontitis also affects the failure rate of implantation.

Koldslund et al. (2009) [26] Only mentioned that they studied with 78 healthy patients, and 28 patients with history of periodontitis, and with patients who has history of periodontitis has higher risk of implant failure.

Gatti et al. (2008) [27] reviewed 29 healthy patients with total number of 72 implants, 7 patients with moderate chronic periodontitis that has total number of 26 implants, and 26 patients with severe chronic periodontitis that has total number of 129 implants. The Mean age for each group was 40 for healthy patients, 56 for patients with moderate chronic periodontitis, and also 56 for patients with severe chronic periodontitis. Diagnosis of peri-implantitis were probing depth of 5mm or more with suppuration or other signs of infection, and bone loss of 2mm or more. They said that only patients with severe chronic periodontitis had implant failure rate of 1.6% and other groups did not had implantation failure.

Mengel et al. (2007) [28] studied 5 healthy patients with 7 implants, and 5 patients who had generalized aggressive periodontitis with total number of 46 implants. Ages for healthy patients were between 20 to 51 years old, and 31 to 44 for patients with generalized aggressive periodontitis. Although they did not mentioned the diagnosis of peri-implantitis, they said that patients with

generalized aggressive periodontitis had implant failure rate of 17%, but in healthy patients there was no failure.

Roccuzzo et al. (2010) [29] reviewed 32 healthy patients (61 implants total), 42 patients with moderate chronic periodontitis (95 implants total), and 38 patients with severe chronic periodontitis (90 implants total). Mean age for healthy group was 45 years old, 49 years old for moderate group, and 44 years old for severe group. Diagnosis for peri-implantitis was bone loss of 3mm or more. The failure rate of implantation was 2.7% on severe chronic periodontitis group, 1.2% on moderate chronic periodontitis group, and 0% on healthy group. Which said that there is relationship between periodontitis and failure rate of implantation. Not only that, it also shows that severity of chronic periodontitis has effects on implantation failure rate.

De Boever et al. (2009) [30] compared 110 healthy patients who has total number of 261 implants, 68 patients with history of chronic periodontitis who has total number of 193 implants, and 16 patients with history of generalized aggressive periodontitis who has total number of 59 implants. The mean age of total patients was 54 years old with 92 males and 102 females. Although they did not mentioned the diagnosis of peri-implantitis and implant failure rate, they stated that there was relationship between history of periodontitis and implant failure rate.

Karoussis et al. (2008) [31] researched 45 healthy patients with total number of 91 implants, and 8 patients who had history of chronic periodontitis with total number of 21 implants. They did not mentioned about the ages of patients, but diagnosis of peri-implantitis was probing depth of 5mm or more, bleeding on probing, and radiographic signs of bone loss. Implant failure rate of patients with history of chronic periodontitis was 9.5% and healthy patients was 3.5%

(Table2)

After reviewing these 12 articles, it was clear that there was relationship between periodontitis and successful rate of implantation. Also some of articles claimed that there was not only relationship, but severity of periodontitis matters too.

Table 2. Characteristics of included studies

Study	Number of patients/implants	Age (y) (M/F)	PI diagnosis	Implant failure rate
<i>Roccuzzo et al. (2013) [20]</i>	H 32/54, MP 46/96, SP 45/102	H 43.3 _ 12.4, MP 53.3 _ 10.7, SP 52.7 _ 8.4 (-)	-	-
<i>Marrone et al. (2013) [21]</i>	H 41/-, CP 62/-	-	PD \geq 5 mm + BOP + BL >2 mm	CP: 7.2% Healthy: 1.2%
<i>Jiang et al. (2013) [22]</i>	H 30/127, CP 30/149	H 42, CP 37 (41/39)	-	CP: 8% Healthy: 3.3%
<i>Casado et al. (2013) [23]</i>	H 127/-, CP 88/-	T 55 _ 12.5 (67/148)	BL > 1 mm and >0.2 mm/year	CP: 9.2% Healthy: 3.6%
<i>Swierkot et al. (2012) [24]</i>	H 18/30, GP 35/149	T 51.13 (73/106)	PD > 5 mm _ BOP + BL >0.2 mm/y	-
<i>Levin et al. (2011) [25]</i>	H 283/747, MP 149/447, SP 285/1065	_(273/444)	-	SP: 4.2% MP: 2.7% Healthy: 1.2%
<i>Koldslund et al. (2009) [26]</i>	H 78/-, CP 28/-	-	-	-
<i>Gatti et al. (2008) [27]</i>	H 29/72, MP 7/26, SP 26/129	H 40 (18–61), MP 56 (42–70), SP 56 (35–85) (23/39)	PD \geq 5 mm + suppuration or other sign of infection + BL >2	SP: 1.6% MP: 0% Healthy: 0%

			mm	
<i>Mengel et al.</i> (2007) [28]	H 5/7, GP 5/36	H 20–51, GP 31– 44 (2/8)	-	GP: 17% Healthy: 0%
<i>Roccuzzo et al.</i> (2010) [29]	H 32/61, MP 42/95, SP 38/90	H 45 _ 13, MP 49 _ 15.3, SP 44 _ 8.6	BL > 3 mm	SP: 2.7% MP: 1.2% Healthy: 0%
<i>De Boever et al.</i> (2009) [30]	H 110/261, CP 68/193, GP 16/59	T 53.8 _ 15.08 (92/102)	-	-
<i>Karoussis et al.</i> (2008) [31]	H: 45/91 CP: 8/21	-	PD ≥ 5 mm + BOP + radiographic signs of BL	CP: 9.5% Healthy: 3.5%
H, healthy periodontium; CP, chronic periodontitis; MP, moderate CP; SP, severe CP; GP, generalized aggressive periodontitis; T, total patients; PD, probing depth; BOP, bleeding on probing; M, male; F, female;				

The sample size in the single studies ranged from a minimum of 10 to a maximum of 717 patients. The total number of treated patients was 1808. Three studies did not report the sex distribution. Age range varied from 18 to 85 years old. Overall mean age was 48.9 years. Four studies did not report the mean age of the patients. On the total of 1808 patients, 830 subjects were periodontally healthy (45.9%), while patients with a history of periodontitis were 978 (54.1%). These 978 patients had different histories of periodontal disease: 216 patients were affected by chronic periodontitis (22.1%), 244 patients by moderate periodontitis (24.9%), 394 patients by severe periodontitis (40.3%) and 124 subjects by generalised aggressive periodontitis (12.7%).

Eight studies showed a higher and statistically significant implant loss rate in patients with a history of periodontitis both on an implant and patient level; and four studies did not clarify the success

rate of the implantation.

Eight studies found a higher and statistically significant peri-implantitis incidence in the periodontally compromised patients groups, both on an implant and patient level, while the four studies reached the same conclusions without specific data from the experiment.

Risk of bias

The risk of bias is shown in below (Table 3).

Reference	Selection Bias	Performance bias	Blinding of Outcome Assessment (Detection bias)	Incomplete Outcome Data	Reporting Bias
Roccuzzo et al. (2013) [20]	+	+	-	-	+
Marrone et al. (2013) [21]	+	-	+	+	+
Jiang et al. (2013) [22]	+	?	+	+	+
Casado et al. (2013) [23]	+	+	+	+	+
Swierkot et al. (2012) [24]	+	+	-	-	+
Levin et al. (2011) [25]	+	-	+	+	+
Koldsland et al. (2009) [26]	+	-	-	-	+
Gatti et al. (2008) [27]	+	+	+	+	-
Mengel et al.	+	+	+	+	+

(2007) [28]					
Roccuzzo et al. (2010) [29]	+	+	+	+	+
De Boever et al. (2009) [30]	+	+	?	-	+
Karoussis et al. (2008) [31]	+	-	+	+	+
(+) low risk (-) high risk (?) unclear risk of bias					

Discussion

The literature was systematically searched and included electronic databases and hand searching of relevant journals. Twelve studies were accepted for the present systematic review. However, eight were eligible for meta-analysis of bone loss around implants, but it still showed that scientific evidence to verify the hypotheses that PD could increase the risks of implant loss and peri-implantitis. The results seemed to confirm the hypotheses, with a strong level of evidence for implant loss and moderate level for peri-implantitis and implant bone loss.[6]

Implant Failure in studies with a duration of follow-up of at least 3 years that were accepted in this review suggested more implant loss in subjects with history of periodontitis 1.6–17% than in periodontally healthy subjects 0–3.6%. [20-31]

This systematic review demonstrated higher survival and success rates in patients who do not have a previous history of periodontitis as compared to those treated for periodontitis. In addition, the increased bone loss and incidence of peri-implantitis was observed in the latter group. These findings are in agreement with a cross-sectional study (Marrone et al. 2013) [21] that suggested a prevalence of peri-implantitis at a patient level of 39.3% in patients with history of periodontitis.[32]

Although no evidence of heterogeneity was detected for the three pooled outcomes, several important differences were present in the included studies, in terms of the implant length, diameter, surface, and placement position, time of loading, presence of grafting, time of follow-up, systemic disease, and other possible confounding factors. Smoking is an important confounding factor that should be considered when analyzing the risk of implant loss in patients with PD. As a well-known

risk factor for implant loss, smoking has been shown to reduce implant survival and the success of the augmentation procedure (Strietzel et al. 2007). [35] Smoking can negatively influence the effect of periodontal therapy (Sgolastra et al. 2015) [6].

Conclusion

Within the limits of this systematic review, it may be concluded that biological complications of dental implants and implant failure increase in patients with history of periodontitis. At the same time, further research is needed to determine the effect of residual pockets on implant outcomes. There is a trend for patients with aggressive periodontitis to exhibit decreased implant success and survival rates when compared with the chronic periodontitis group. In addition, if compared with a non-periodontitis group, patients with history of treated aggressive periodontitis presented with a higher incidence of peri-implantitis and bone loss. Based on the included evidence, the type and severity of the history of periodontitis may play a detrimental role in all the studied outcomes.

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