

## Original Article

# Dental Implants Placed in Patients with Mechanical Risk Factors: A Long-term Follow-up Retrospective Study

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### ABSTRACT

**Objectives:** Risk factors in oral implantology are defined as local or systemic conditions that increase failure rates. The purpose of this paper is to evaluate the long-term survival rate of dental implants placed in patients presenting mechanical risk factors.

**Materials and Methods:** This retrospective study was conducted only with patients presenting at least one of the following risk factors were included: Bruxism; crown-to-implant (C/I) ratio <0.8; abutment angulation. The overall implant survival was estimated using Kaplan–Meier analyses. Risk factors for implant failure were identified using the Cox proportional hazard regression models.

**Results:** Eighty-nine eligible patients were enrolled in this study: They were both male ( $n = 56$ , 62.92%) and female ( $n = 33$ , 37.08%), with an average age of 53.24 (23–76 years), with 227 dental implants inserted. The mean follow-up was 13.6 years (range: 10–16 years). The overall 10-year Kaplan–Meier survival estimate with associated 95% confidence intervals was 86.34% (82.8, 87.1). Bruxism was the only variable that showed a statistically significant association with implant failure ( $P < 0.05$ ) and a hazard ratio of 2.9, while both Crown to-implant and abutment angulations reported lower values of failure ( $P > 0.05$ ).

**Conclusions:** Within the limitations of this study, can be concluded that data suggested an evident relationship between bruxism and dental implant failure but further studies, with a larger sample and a different design are required to assess this relationship.

**KEYWORDS:** *Bruxism, dental implant, implant survival, risk factors*

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## INTRODUCTION

Risk factors in oral implantology are defined as local or systemic conditions that increase failure rates.<sup>[1-2]</sup> Smoking habit, osteoporosis, coagulation disturbs, and diabetes are considered as general risk factors.<sup>[3-5]</sup>

Failures can be divided into early failures, which are related to the surgical phase, and late failures which occurred during or after the prosthetic phase and the application of an occlusal load.<sup>[6-8]</sup> Early and late failures are associated with different causes: early failures are always biological, resulting in the lack of healing of the peri-implant tissues, without getting a proper, satisfying bone integration with an intimate bone-implant contact.<sup>[9-10]</sup>

Late failures may be categorized into biological and mechanical. The inflammatory process of peri-implant tissues may determine biological failures together with occlusal overload, resulting in a progressive loss of osseointegration with resorption and apical growth of epithelial tissue may be observed.<sup>[11,12]</sup> Mechanical failures are determined by wear and sagging of implant-prosthesis mechanical components with possible connection screw loosening or fracture, fixture fracture, abutment or prosthesis fracture.<sup>[13,14]</sup>

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Mechanical risk factors are represented by all situations which expose dental implants to lateral loads: Crown-to-implant (C/I) ratio  $<0.8$ ; angulation  $>25^\circ$ ; diameter inferior to the ideal; presence of cantilever, as well as bruxism and clenching para-functional habits.<sup>[15,16]</sup>

However, to date, most studies evaluating risk factors for implant failure are flawed in terms of their statistical analyses.<sup>[17-19]</sup>

The aim of this paper is to assess the long-term survival rate of dental implants placed in patients presenting mechanical risk factors.

The authors hypothesized that dental implants placed in patients with bruxism and clenching para-functional habits may show higher failure rates, compared to dental implants in patients presenting other mechanical risk factors.

## MATERIALS AND METHODS

The sample for this retrospective cohort study was derived from a population of patients presenting at the university's department for implant treatment, between 1998 and 2006.

The following inclusion criteria were applied: Age  $>18$  years, presence of at least one of the following mechanical risk factors (bruxism; C/I ratio  $<0.8$ ; abutment angulations), Full or partial natural dentition opposing the implants, dental implant supporting only single crown restoration, agreed to participate to the study.

Exclusion from the study was performed in case of uncontrolled systemic disorders; if patients refused to enroll in this survey or in case of missing medical records. The study was approved by the Institution Review Board.

Dental implants placed were all cylindrical, with a surface acid-etched and sanded with aluminum oxide medium grade particles (250  $\mu\text{m}$ ).

## STUDY VARIABLES

The following study variables were considered:

1. Bruxism
2. C/I ratio  $<0.8$  of single tooth implant-supported restorations. The length of the crown and of the implant was measured directly from the radiograph using constant magnification to calculate C/I ratio
3. Abutment angulations. The need to avoid an adjacent tooth or vital structure may dictate implant angulations during insertion. Data on abutment angulations were recorded from the patient's charts.

The outcome variable of interest was implant failure defined as the removal of the implant. Total survival

time was considered the duration of time, expressed in months, from implant placement to implant removal or date of the last follow-up for patients whose implants has not been removed.

## DATA ANALYSIS

The nonparametric Kaplan–Meier survival analysis was used to estimate implant survival rates, a  $\chi^2$  test was performed to evaluate statistical association between variables, with a  $P < 0.05$ . Risk factors with  $P < 0.05$ , based on univariate analyses, were analyzed to obtain a proper hazard ratio using the Cox regression model.

## RESULTS

During the study, 1354 implants were placed in 456 patients.

Eighty-nine eligible patients were enrolled in this study: They were both male ( $n = 56$ , 62.92%) and female ( $n = 33$ , 37.08%), with an average age of 53.24 (23–76 years), with 227 dental implants placed.

The mean follow-up was 13.6 years (range: 10–16 years). Data and demographic of the sample were summarized in Tables 1 and 2.

The overall 10-year Kaplan–Meier survival estimate with associated 95% confidence intervals was 86.34% (82.8, 87.1).

A total of 152 dental implants were placed in patients affected by bruxism, 45 in subjects with a C/I ratio  $>0.8$  and thirty implants had abutments angulated  $>25^\circ$  [Table 3]. Bruxism was the only variable that showed a statistically significant association with implant failure ( $P < 0.05$ ) and a hazard ratio of 2.9, while both C/I ratio and abutment angulations reported lower values of failure ( $P > 0.05$ ).

## DISCUSSION

Dental implants placed in patients affected by bruxism showed statistically significant higher failure rates, compared to other risk factors assessed.

According to our findings, bruxism had a hazard ratio of 2.9 and therefore, may represent a contraindication to implant treatment, although the evidence for this is usually based only on clinical experience and is still controversial.<sup>[20,21]</sup> Bruxism is considered as one of the possible factors, among others, for temporomandibular pain, tooth wear in the form of attrition and loss of dental implants.<sup>[22-24]</sup> In the present study, bruxism was diagnosed according to the following criteria; tooth wear affecting at least one sextant of the dentition with enamel reduction to dentine and some loss of crown height and/or masseter muscle hypertrophy.<sup>[21]</sup>

**Table 1: Sample demographic**

Demographic variable	
Mean age, years (range)	53.24 (23-76)
Male (N patients, %)	56 (62.92)
Female (N patients, %)	33 (37.08)
Study variables (N patients, %)	
Bruxism	51 (57.3)
Crown/implant ratio >0.8	51 (57.3)
Abutment angulations >25°	15 (16.85)

**Table 2: Implant treatment sites**

Maxillary locations	
Central incisor	4
Lateral incisor	6
Canine	8
First premolar	23
Second premolar	18
First molar	43
Second molar	19
Mandibular locations	
Central incisor	4
Lateral incisor	7
Canine	12
First premolar	22
Second premolar	17
First molar	27
Second molar	15

**Table 3: Study variables analysis based on number of dental implants placed**

Variable	Bruxism*	Crown/implant ratio >0.8	Abutment angulations >25°
Number of dental implants	152	45	30
Number of failures	23	5	3
P	<0.05†	>0.05	>0.05

†Chi-square test statistically significant. Cox proportional hazard regression model: \*Hazard ratio 2.9

There is no proof that suggests that bruxism can cause an overload of dental implants but Lobbezoo *et al.* recommended a careful approach when placing implants in patients with this para-functional habit.<sup>[15,16]</sup>

A recent systematic review by Chrcanovic *et al.*<sup>[22]</sup> obtained a risk ratio of 2.93 for dental implants placed in patients with bruxism, a data comparable to our findings.

They compared dental implants inserted in bruxers versus no bruxers and found out only ten studies suitable, all characterized by various biases, such as a low level of specificity and lack of control group.

Data highlighted the lack of appropriate literature on the topic, suggesting the need for further studies, with a larger sample and a different study design.

As for secondary outcome variables, in cases where the quantity of bone is not sufficient for implant insertion and regeneration techniques cannot be implemented, we can use short implants or insert them with a nonideal angulation.<sup>[25-28]</sup> According to our results, C/I ratio and abutment angulation resulted not associated with mechanical failure, therefore, not representing a risk factor for long-term survival of dental implants.

This study presents an evaluation of implant survival in patients with mechanical risk factors, especially bruxism, showing results similar to Chrcanovic *et al.*<sup>[22]</sup> However, the long-term follow-up (up to 16 years) and the large number of dental implants placed in bruxers (implant failure: 23/152, hazard ratio 2.9) characterized our study as one of the few in literature with the consistent sample and observation period.

According to the authors, further studies, with a prospective design and a control group (bruxers vs. no bruxers) are necessary to address the relevant question: How bruxism affect dental implant survival?

Literature available is made by retrospective cohort studies, included this study, with a high risk of bias and difficult interpretation of results. Another important flaw of current literature available is generated by the difficulty to establish a “definite” diagnosis of bruxism and by the status of opposing dentition, which needs to be taken into account, as well as implant characteristics (length/diameter/surface).

## CONCLUSIONS

Within the limitations of this study, can be concluded that data suggested an evident relationship between bruxism and dental implant failure but further studies, with a larger sample and a different design are required to assess this relationship.

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Nil.

## CONFLICTS OF INTEREST

There are no conflicts of interest.

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