

Impact of Bruxism on Dental Implant: A Systematic Review & Meta-Analysis

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ABSTRACT

Background: *Bruxism was generally deliberated as a contraindication for oral implanting. The fundamental relationship amid bruxism and dental implant failure has remained debatable in current literatures.*

Purpose: *This meta-examination was performed to explore the connection between them.*

Materials and Methods: *This review directed an electronic systematic literature search in MEDLINE (PubMed) and EmBase. Methodological quality was evaluated by using the Newcastle-Ottawa Scale tool. Odds ratio (OR) with 95% confidence interval (CI) was pooled to estimate the relative outcome of bruxism on dental implant failures. Statistical analyses done by using Review Manager 5.1.*

Results: *The extracted data were categorized into two groups. Units were created on the number of prostheses (group A) and the number of patients (group B). In group A, the total pooled OR of bruxers versus nonbruxers for all subgroups was 4.72 (95% CI: 2.66-8.36, p = .07). In group B, the total pooled OR of bruxers versus nonbruxers for all subgroups was 3.83 (95% CI: 2.12-6.94, p = .22).*

Conclusions: *We found that Prostheses in bruxers had a higher failure rate. Our analysis advocates that bruxism is a contributing factor for the occurrence of dental implant technical/biological complications and may lead to dental implant failure.*

KEY WORDS: *Bruxism, Complication, Dental Implant, Implant Failure, Teeth Grinding.*

INTRODUCTION

Endosseous dental implant has become a promising treatment method to supplant the missing teeth in completely and partially edentulous patients as recognized by systematic reviews recently.^{1,2} The scope of dental implantation indications is extended by constant efforts and improvements, which significantly enhanced the quality of life of patients. Notwithstanding of the extraordinary success rates, dental implant complications and even total failure are still the problems that each implantologist has to face in clinical practice. Only 66.4% of patients are totally free from any type of stated complications ensuing the restoration of the implant-supported fixed prostheses.³ According to clinical studies, dental implant complications comprise biological and/or technical complications.⁴⁻⁸ The incidence of complications is connected to various risk factors. Bruxism as one of the possible risk factors is deliberated in systematic reviews. The connecting relationship between bruxism and dental implant failure has persisted controversial.^{9,10} Bruxism is a movement disorder of the masticatory system as repetitive jaw muscle activity, nonfunctional contact of mandibular and maxillary teeth. The most significant features of bruxism are clenching or grinding of the teeth, and bracing or thrusting of the mandible.^{9,11,12} The definition of bruxism is varying in clinical studies, but atypical grinding and/or clenching of teeth are simply acknowledged by clinicians.¹³ Still bruxism cannot be a risk to human life, it is always hypothetical to be an etiological factor of producing injury to the supporting structures.^{9,10,14-16} Bruxism is usually deliberated as the contraindication of dental implantation, which is just based on the clinicians' experience.¹⁷⁻¹⁹ Consequently, the purpose of this meta-analysis is to deliver a precise evaluation of the relationship between bruxism and dental implant failure.

MATERIALS AND METHODS

Eligibility Criteria: Patients with implants, Bruxism, Dental implant failure included technical and biological complications, and the primary outcome was technical failure (fracture: porcelain/screw/ implant; loosening: screw/implant; losing of retention/implant) for at least 1 year in function, Studies had to be designed as cohort studies.

Exclusion Criteria: Duplicated, poor designed study, Search Strategy and Study Selection, MEDLINE (PubMed) and EmBase were searched. The words searched were "bruxism" "dental implant", "implant failure". Studies were selected by following steps: Initial scanning of the retrieved studies was conducted on the basis of the title and abstract.

Data Extraction: Extracted data comprised first author, year of publication, age of patients, patient numbers, classification of cohort studies, exposure factors, proportion (%) of bruxers and nonbruxers in total population, failure rate in bruxism group and nonbruxism group, correspondingly, duration of follow-up time, and statistical parameters for outcomes.

Assessment of Methodological Quality: Quality of retrieved studies was evaluated by using the Newcastle-Ottawa Scale (NOS) tool.²⁰ NOS scores of 1 to 3, 4 to 6, and 7 to 9 were judged for low, moderate, and high quality of studies, respectively.

Statistical Analysis: Review Manager 5.1 (The Nordic Cochrane Centre, Copenhagen, Denmark) was used to carry out statistical analyses. Odds ratio (OR) with 95% confidence interval(CI) was pooled to estimate the relative effect of bruxism on dental implant failures. Heterogeneity across studies was tested by Cochran's Q statistic and p value. p Value lower than 0.10 is an indicator of significant heterogeneity.^{21,22} If the heterogeneity was high and the p value was lower than 0.10, the DerSimonian and Laird random effects was chosen for meta-analysis.²³ Publication bias should be investigated by use of Begg's

funnel plots, which through constructing a funnel plot and examining its signs of asymmetry investigate whether the publication bias affected the validity of the estimates.²⁴⁻²⁶ Sensitivity analysis was also performed by sequentially excluding each study.

RESULTS

A total of 218 citations were recognized. 103 citations were excluded as duplicated. 100 were excluded as obviously irrelevant. For the 17 studies of potential interests, seven cohort studies were included in this meta-analysis. (Figure 1) Maximum of the seven studies were published in recent. Among these seven cohort studies, the data units in two studies were based on patients,^{6,36} 3 studies were based on the number of prostheses,^{32,34,35} and 2 studies were based on both number of patients and number of prostheses.^{7,33} A total of 447 participants were included, and 82 patients had a history of bruxism habits in group B.^{6,7,33,36} Characteristics among these studies were several, for patient number was extended from 14 to 194, and most of the mean age was older than 50 years old. The mean duration of follow-up time for each study extended from 1 to 10 years. In disparity to biological complications, mechanical complications were common in clinic.

Meta-Analysis: Collected data were classified into two groups based on number of prostheses (group A) or patients (group B). Data in the two groups had both shown the relationship between bruxism and dental implant failure, and subgroup analysis for each group was performed directly. Egger's regression asymmetry test could not be made in this review due to lack of sufficient number of studies. Subgroup analysis in group A (units: prostheses; **Figure 2**): Subgroup1.1.1 included two studies in which the two primary studies recorded the similar outcome: ceramic (or porcelain) chipping (or fracture). The pooled OR of bruxers versus nonbruxers was 11.08 (95% CI: 0.78–156.77, $p = .10$); Subgroup1.1.2 that included one study recorded implant loss. The pooled OR of bruxers versus nonbruxers for this subgroup was 4.90 (95% CI: 1.75–13.71), while the heterogeneity was not applicable; Subgroup 1.1.3 that included two studies recorded various mechanical failure. The pooled OR of bruxers versus nonbruxers was 4.28 (95% CI: 1.12– 16.41, $p = .02$). Total pooled OR of bruxers versus nonbruxers for all subgroups was 4.72 (95% CI: 2.66– 8.36, $p = .07$); test for subgroup differences was $I^2 = 0\%$ and p value = .82. Statistic analysis in this group showed bruxism and dental implant failure had statistical significance and prostheses in bruxers had a higher failure rate than nonbruxers. Among all the complications, ceramic (or porcelain) chipping (or fracture) had a higher failure rate than the others. Subgroup analysis in group B (units: patients; **Figure 3**): Subgroup2.1.1 included two studies in which the two primary studies recorded the similar outcome: ceramic (or porcelain) chipping (or fracture). The pooled OR of bruxers versus nonbruxers for this subgroup was 3.17 (95% CI: 1.53–6.56, $p = .04$); Subgroup1.1.2 that included one study recorded implant loss. The pooled OR of bruxers versus nonbruxers was 3.65 (95% CI: 0.32–41.89), while the heterogeneity was not applicable; Subgroup 1.1.3 that included two studies recorded various mechanical failure. The pooled OR of bruxers versus nonbruxers was 6.48 (95% CI: 2.13– 19.72, $p = .79$). Total pooled OR of bruxers versus nonbruxers for all subgroups was 3.83 (95% CI: 2.12– 6.94, $p = .22$); test for subgroup differences was $I^2 = 0\%$ and p value = .57. Statistic analysis in group B showed bruxism and dental implant failure had statistical significance and prostheses in bruxers had a higher failure rate than nonbruxers.

Sensitivity Analysis: Sensitivity analysis was performed by sequentially excluding each study in both groups A and B. Outcome of each sensitivity analysis was illustrated in Table 3. The total pooled OR of bruxers versus nonbruxers for all subgroups was 4.72 (95% CI: 2.66–8.36,

$p = .07$) in group A and 3.83 (95% CI: 2.12–6.94, $p = .22$) in group B. The result, especially for porcelain chipping or fracture, was more stable when one study was excluded.⁷ The total pooled OR of bruxers versus nonbruxers for all subgroups was 3.73 (95% CI: 2.62–5.32, $p = .26$) in group A and 3.24 (95% CI: 1.74–6.04, $p = .56$) in group B after excluding the study Papaspyridakos and Lal 2013. The small sample size of this study may be the potential risk factor that had an influence on the quality of the study.

Figure 1: Flowchart of retrieved studies.

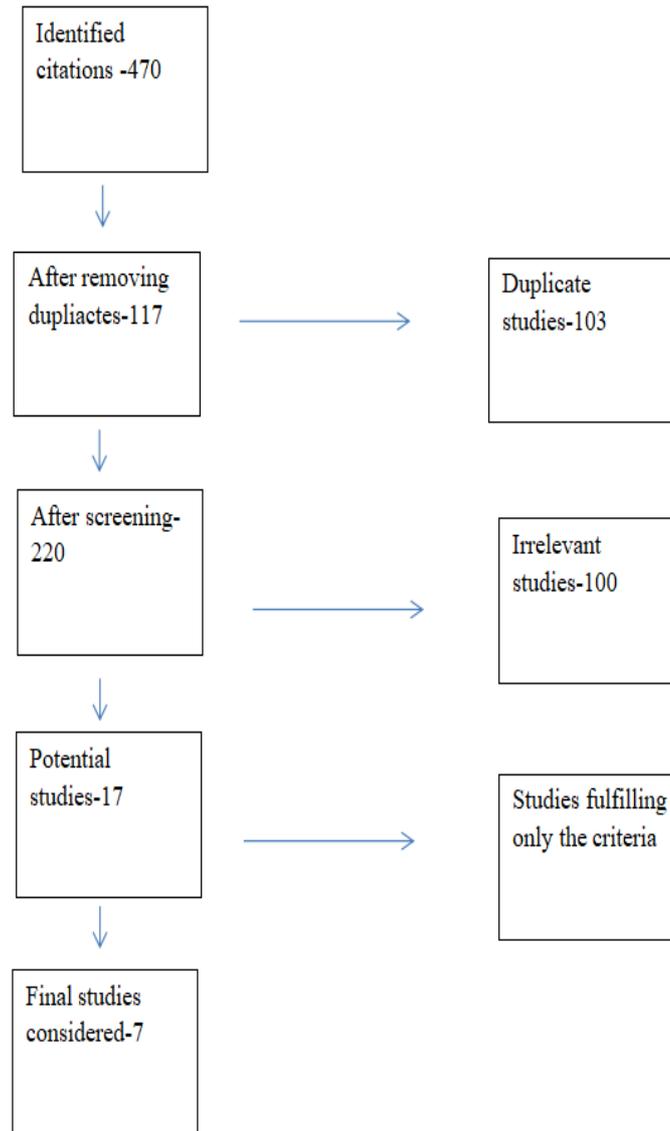


Figure 2: Forest plot of comparison: 1. the relationship between bruxism and dental implant failure; outcome: 1.1 dental implant failure in group A (analysis based on the number of prosthesis).

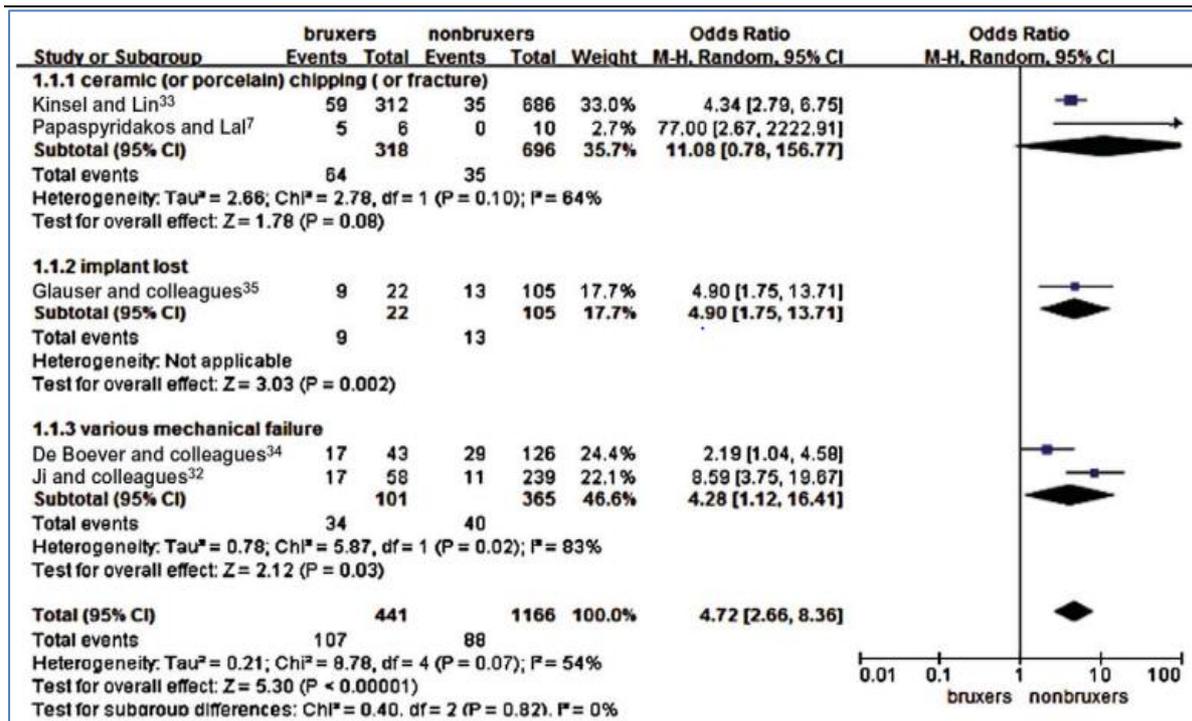
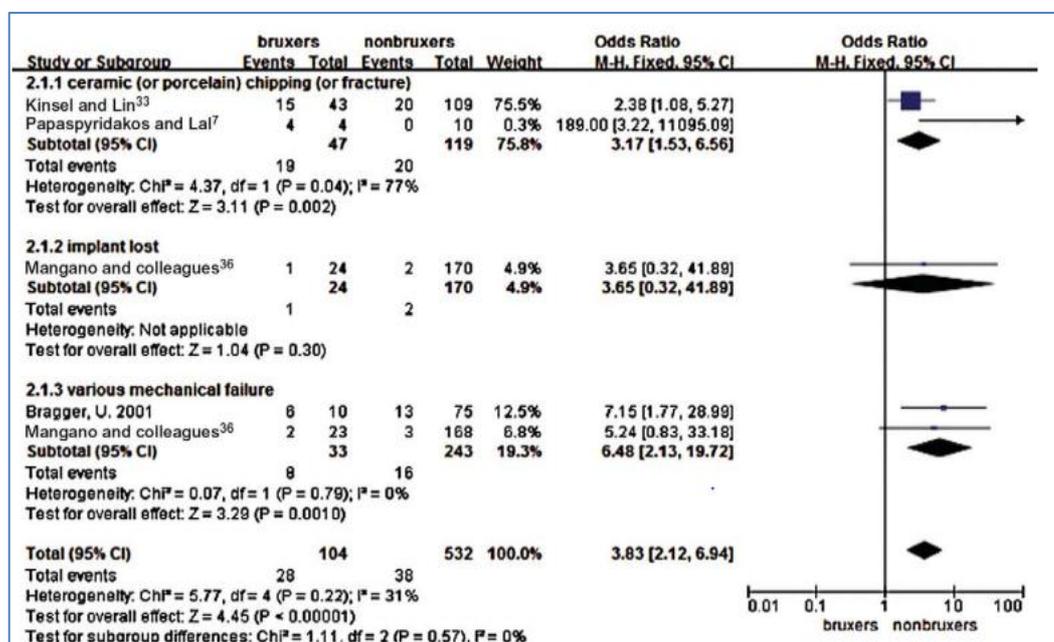


Figure 3: Forest plot of comparison: 2. the relationship between bruxism and dental implant failure; outcome: 2.1 dental implant failure in group B (analysis based on the number of patients)



DISCUSSION

Bruxism and dental implant failure have statistical significance in present meta-analysis. In contrast to nonbruxers, prostheses in bruxers have a higher failure rate. Porcelain chipping or fracture on implants reinforced crowns are common complications in bruxers. According to literature, the density and strength of bite force in bruxers was greater than in nonbruxers. It was described that the maximal bite force (MBF) value was 105.1 ± 34.2 N in bruxism group, while it was 81.3 ± 31.0 N in control group ($p < .05$) in incisor area.³⁷ In the meantime, in the first molar region, higher MBF and lengthier period of bruxism events were witnessed.^{38,39} Therefore, overload may occur easily in bruxers. Instead, the proprioception around dental implants and the proprioceptive feedback mechanisms to the jaw closing muscles were partial due to lack of periodontal ligament around implants.^{16,40} Thus, overload to implants and their superstructures during mastication may be more likely to occur in bruxers. This phenomenon could cause technical difficulties, such as porcelain chipping, screw/implant loosening, screw/implant fracture, and losing of retention/implant.^{6,7,32-36} Furthermore is that overload may also cause of the imbalance of bone remodeling and absorption, which lastly leads to biological complications (marginal bone loss peri-implantitis).^{41,42} Evidence from the current reviews advocated that the cause-and-effect relationship among bruxism and dental implant failure remained contentious.^{16,43,44} Furthermore to those reviews, some clinical studies suggested that bruxism was not the main or unique reason but a causative factor for causing dental implant failure. In 2011, a study to conclude what risk factors may increase the likelihood for implant failure in speedy function by using a tilted distal four-implant approach in the maxilla. After valuation, the result showed that bruxism as well as poor bone density, contrasting natural dentition, and male patient was the risk factor in implant failure situations. Horizontal bruxers were easier to create more wear patterns on both nature dentition and implant-supported prostheses.⁵ In a 5-year respective study, 995 implants were placed in 221 patients, identifying bruxism as a risk factor for the occurrence of mechanical complication (OR: 60.95, 95% CI, 21.40-173.54; $p < .0001$).⁴⁵ In another tooth implant-supported zirconium ceramic restorations study, core fractures and veer chippings were higher in patients with bruxism signs.⁴⁶ In contrast to those individual studies, some studies recommended that bruxism had no significant effect on implant failure. In a research with short implants, 262 implants were placed in 109 patients with a mean of 53 months follow-up time, concluding that bruxism and cantilever length had no significant effect on peri-implant bone loss. What is more is that the mean bone loss was 0.74 ± 0.65 mm. The difference in the complication rate (15% overall) between bruxers and nonbruxers group was not statistically significant ($p = .51$).²⁹ As stated before, bruxism may lead to dental implant failure by generating overload, while some other studies considered overload in dental implants and their superstructures may not be produced by bruxism. Improper design of occlusal surface or other loading increase factors may play significant role in dental implant failure.^{42,43} The same finding was seen that occlusal wear failed to have any statistical impact on vertical annual bone loss.⁴⁷ The etiology of bruxism is indistinct, but it seems to be multifactorial. Certain researchers regard peripheral local morphological disorders and the central disturbances in the area of the basal ganglia as the two main theories of affecting bruxism.¹² Other researchers conclude morphological, pathophysiological, and psychosocial factors may play important roles in the etiology of bruxism. About 70% of the selected papers take the pathophysiology as the possible etiological factor.^{9,48,49} Additional promoting factors of causing bruxism may include lower age, female gender, tobacco, alcohol usage, genetics, medications, and drugs usage.⁴³ Inevitable limitations in the design and execution of some included studies propose the likelihood of bias. Firstly, cohort studies are more rational in this

review, but they are easily affected by various biases than experimental researches. In distinction to retrospective cohorts, prospective cohorts with higher quality are more objective and suggested in future study design. Secondly, various confounding factors existed in the included studies. Patient's general health conditions (diabetes, nerve mental illness) as well as local stimulation factors (e.g., occlusion, periodontitis, the temporomandibular joint disease, smoking, poor oral hygiene, postoperative infections) are different. In addition, implant types, length, diameter, embedding site, and doctors' clinical experience are also variable.^{27,50-52} These confounding factors should be prearranged in future study design by using strict inclusion and exclusion criteria. Third, bruxism, as one of the exposure factors without a continuous definition and diagnostic criteria, which may also lead to the occurrence of bias. There is no method as gold standard to identify bruxism. However, the most widely used methods for diagnosing bruxism are patients' (his or her partner's) reporting and/or the examination of teeth wear. Researchers should use some evaluation methods to justify bruxism instead of unfinished diagnosis. Some practical clinical recommendations may be helpful in future research and clinical procedures. These commendations are just based on experts' experience. Firstly, clinicians should have a correct diagnosis of bruxism and determine the type of bruxism (wakeful bruxism or nocturnal bruxism). At the same time, the severity of bruxism should be evaluated. Secondly, clinicians should make a complete preoperative planning. Researchers recommended to place more implants in the proper position in order to reduce the overload.^{16,56} Longer implant with larger diameter would increase the implant-bone surface area, which could also reduce the stress around the bone and implant.^{16,57,58} Thirdly, prostheses supported by dental implants should be designed carefully during the treatment procedures. Functional cusps have occlusal contacts, and inclined plane should not touch; lateral excursion should be discouraged.⁵⁹ Cantilever length and prosthetic crown size should be reduced, using metal occlusal surface if possible.^{58,60} Lastly, proper maintenance is also necessary. If the patient grieved with wakeful bruxism, the clinician should tell him or her to self-monitor and control this kind of problem.⁵⁹ If the patient suffered with nocturnal bruxism, a night guard occlusal stabilization appliance maybe useful for reducing the occurrence of dental implant complications for nocturnal bruxers.⁵⁷⁻⁵⁹ In a word, clinicians should pay more attention in bruxers when considering implant therapy. Finally, several issues should pay much attention in future study design. The collected data had been classified into two groups based on the number of prostheses (group A) or patients (group B). The study group had a good representativeness of the exposure factor when units were based on the number of patients. However, the disadvantage was that the sample size of the study may be reduced. On the other hand, units based on prostheses could enlarge the sample size of the study while risk of selection bias was increased. Patients with cluster implant failures would enlarge or reduce the result of study. When considering the influence of implant sites, most of the included studies had analyzed complications in premolar/molar regions, while complications in anterior regions were mentioned rarely.³⁴⁻³⁶ Some of the included studies reported a higher failure rate in maxilla than in mandible.³⁵ Prostheses types were ranged from single crowns to complete dentures.³²⁻³⁴ Failure rate was higher in implant-supported fixed partial dentures.^{6,33} Without strong evidence, these controversial issues still needed further research.

CONCLUSION

This meta-analysis was done to evaluate the relationship among bruxism and dental implant failure. In distinction to nonbruxers, prostheses in bruxers had a greater failure rate. It proposes that bruxism is a contributing factor of causing the incidence of dental implant

complications and plays an important role in dental implant failure. Investigators should use several evaluation methods to justify bruxism instead of imperfect diagnosis. The statistical parameters for outcomes such as porcelain chipping, implant loss, bleeding on probing, periimplantitis, and marginal bone loss should always be measured. Finally, the units of measurements for imminent studies should be unified. Sample size may be the main shortage when units were based on the number of patients. Scientific and reliable studies are needed in future research.

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