Smoking May Increase Risk of Implant Failure

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Original article being reviewed: Smoking and dental implants: A systematic review and meta-analysis. Chrcanovic BR, Albrektsson T, Wennerberg A. J Dent 2015;43: 487–498.

Background
This article critically appraises a systematic review that was conducted in 2015 to evaluate implant survival, postoperative infection, and marginal bone loss (MBL) in smokers compared with nonsmokers.

Clinical question
In patients undergoing implant placement, are smokers at higher risk than nonsmokers for implant failure, postoperative infection, and MBL?

Summary of methods
An electronic search was conducted in three databases in addition to hand searching without date or language restrictions. All studies, including randomized controlled trials, nonrandomized controlled trials, and retrospective studies, were included in this review. Results were expressed as risk ratios for dichotomous outcomes (implant failure and postoperative infection) and as mean differences for continuous outcomes (MBL). A fixed-effects model was used in meta-analysis for studies with low homogeneity, while a random-effects model was used for those with high heterogeneity.

Critical appraisal
The review met all requirements on the AMSTAR checklist. The overall quality of evidence is low, as the review includes both randomized and nonrandomized trials in addition to retrospective studies. Due to the many uncontrolled confounders, the results should be interpreted with caution.

Practical implications
Because of the possible association between smoking and increased rates of implant failure, postoperative infection, and MBL, caution is warranted when considering dental implants in patients who smoke.

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Evidence summary

Background

The effects of smoking on general and oral health in humans have been extensively evaluated and well documented. The prevalence of smoking worldwide is high; in 2012, it was estimated that there were 928 million men and 207 million women who smoked. Generally, Eastern and Southeastern Asia and Eastern European countries have the highest prevalence of male smokers, whereas European countries have the highest prevalence of female smokers, followed by Oceania and North and South America.[1,2]

Tobacco has many components (ie, more than 4,000 potentially toxic substances, including nicotine) that adversely affect collagen production, fibroblast function, immunoglobulin production, and the immune system. Moreover, nicotine plays a role in vasoconstriction, which leads to a decrease in blood supply and low oxygen capacity and could eventually result

in ischemia. In addition, nicotine has a direct determinant effect on bone healing and bone metabolism with subsequent effects on bone formation and remodeling.[1,3–7]

Although dental implant therapy has high success rates—100% in some studies—there are higher rates of implant failure, postoperative infection, and marginal bone loss (MBL) in smokers compared with nonsmokers.[8] However, the implant failure rate in patients who smoke is variable among studies. Many contributing factors may be involved, such as previous periodontal disease. Additionally, because most studies do not categorize the selected patients according to smoking severity (ie, light, moderate, or heavy), the relation between severity of smoking and the degree of dental implant complications is still unclear.[9–11]

Clinical question

In patients undergoing implant placement, are smokers at higher risk than nonsmokers for implant failure, postoperative infection, and MBL?

Methods

This systematic review was conducted in September 2014 using an electronic search of PubMed/MEDLINE, Web of Science, and the Cochrane Oral Health Group Trials Register, as well as hand searching, with no date or language restrictions.

The inclusion criteria were as follows: all studies—randomized controlled trials (RCTs), nonrandomized controlled clinical trials (CCTs), and both prospective and retrospective studies—without a follow-up period restriction that evaluated implant failure, postoperative infection, and MBL in smokers compared with nonsmokers. Smokers were classified as patients who smoked at least one cigarette per day.

Three authors screened titles and abstracts independently for study selection. Any disagreement was solved through discussion. Quality assessment of the studies was performed according to the Newcastle-Ottawa Scale (NOS), which is used when observational studies are included in systematic reviews.[12]

Data extraction was performed by only one reviewer, and data extracted included the year of publication, study design, country, setting, number of patients, type of smokers included in the study (ie, light smokers versus heavy smokers), age of the patients, follow-up period, days of antibiotic prophylaxis, use of a mouthrinse, implant healing period, failed and placed implants, postoperative infection, MBL, implant surface modification, jaws receiving implants (maxilla and/or mandible), type of prosthetic rehabilitation, and opposing dentition.

The results of dichotomous data (implant failure and postoperative infection) were expressed as risk ratios (RRs), while the continuous data (MBL) were expressed as mean differences (MDs). For all outcomes the statistical unit was the implant. Sensitivity analysis tests were performed to evaluate the results sensitivity toward some variables, such as bone quality. Finally, the publication bias was assessed by funnel plot.

Results

Of the 1,432 studies resulting from the search, 107 were deemed eligible for final qualitative and quantitative analysis. Four RCTs, 16 CCTs, 16 prospective studies, and 71 retrospective analyses were included in the meta-analysis. A total of 19,836 dental implants were placed in patients who smoked, resulting in 1,259 failures (6.35%); a total of 60,464 implants were placed in patients who did not smoke, resulting in 1,923 failures (3.18%).

The heterogeneity was assessed for each outcome by using the I^2 test. In the meta-analysis, a random-effects model was used for studies with high heterogeneity and a fixed-effects model was used for studies with low heterogeneity.

The meta-analysis revealed that smoking significantly affected implant failure rates with an RR of 2.23 (95% confidence interval [CI] = 1.96 to 2.53) ($P < .00001$). This implies that implant failure in smokers is 2.23 times more likely than in nonsmokers.

Whether or not a patient smoked statistically affected the incidence of postoperative infection (RR = 2.01, CI = 1.09 to 3.72; $P = .03$; heterogeneity: $P = .63$; $I^2 = 0\%$, fixed-effects model), as well as the MBL (MD = 0.32, CI = 0.21 to 0.43; $P < .00001$; heterogeneity: $P < .00001$; $I^2 = 95\%$, random-effects model).

Sensitivity analysis was performed to evaluate whether bone quality was a factor in implant failure. The results show a statistically significant difference between smokers and nonsmokers in the maxilla ($P < .00001$) but not in the mandible ($P = .07$). Finally, a funnel plot found no publication bias in this systematic review.

Conclusions

The authors concluded that whether or not a patient smokes affects rates of implant failure, postoperative infection, and MBL. However, the results should be interpreted with caution due to the presence of many confounding factors.

Critical appraisal

According to the AMSTAR tool for systematic review assessment, this systematic review met all requirements.[13] There are several points of strength in this systematic review, including the adhesion to PRISMA statement guidelines and the large number of included studies (170), which means a larger sample size. Sensitivity analysis regarding the effect of bone quality in the maxilla or mandible was performed and all important outcomes that were possibly related to smoking were reported. There was also an assessment for publication bias. Finally, the conclusion of this review was compatible with the overall result from the pooling of the included studies.

The weakest point of this systematic review is the inclusion of both randomized and nonrandomized studies, the latter of which may introduce risk of bias. Although three reviewers independently screened titles and abstracts, only one reviewer performed data extraction. There were many confounding factors in the included studies, such as the placement of a bone graft in some studies versus implant placement in fresh extraction sockets in others, the placement of implants in different locations with different healing periods, and the placement of implants in diabetic patients, as well as patients with bruxism not being excluded in some studies. The number of cigarettes smoked was also not considered during study selection or data analysis; although the authors stated that smoking one cigarette per day was sufficient for inclusion in the smoker group, this consideration may obscure the true effect of smoking because evidence has shown that smoking has a quantity-related effect on osseointegration.[14] Finally, the authors did not perform subgroup analysis within each study design to evaluate differences and draw stronger evidence.

Due to the limitations of the study, and especially considering the large number of confounders and additional variables, the results of this review should be interpreted with caution, which is also stated by the review authors.

Generally, smokers who receive dental implants have higher implant failure rates, more incidence of postoperative infection, and greater MBL. However, further studies are needed to draw more robust evidence on the true effect of smoking and the role of smoking habits (quantity of cigarettes smoked) on dental implant failure. The required studies should avoid all additional variables that may affect the result. A systematic review including only RCTs or a pragmatic RCT with a large sample size and long follow-up period is recommended.

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