

Is implant placement a risk in patients with increased susceptibility to periodontitis?

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A critical appraisal of a systematic review: Chrcanovic BR, Albrektsson T, Wennerberg A, Periodontally compromised versus periodontally healthy patients and dental implants: a systematic review and meta-analysis, *Journal of Dentistry* (2014), <http://dx.doi.org/10.1016/j.jdent.2014.09.013>

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Summary

Systematic review conclusion: The present study suggests that an increased susceptibility for periodontitis may translate to an increased susceptibility for implant loss, loss of supporting bone, and postoperative infection. The results should be interpreted with caution due to the presence of uncontrolled confounding factors in the included studies, none of them randomized.

Critical appraisal conclusion: Periodontally compromised patients are at higher risk post-operative infection, marginal bone loss (peri-implant disease) and implant failures in comparison to periodontally healthy patients. The clinical significance and implications of the results of this review should be interpreted with caution due to lack of controlling important confounding factors such as smoking habits that is known to influence the incidence of post-operative infections, peri-implant disease and implant failures.

Implications for clinical practice: It is clinically prudent to accept that patients with a history of chronic periodontitis (susceptible or compromised) are at greater risk for implant related complications and failures. Patients with chronic periodontitis should be assessed and managed on an individual basis when contemplating implant therapy. The risks are higher in patients with aggressive periodontitis or with co-morbidity factors such as smoking or uncontrolled systemic conditions such as diabetes and immune-deficiency and therefore need extra precautionary measures. Appropriate periodontal therapy, adherence to a strict periodontal maintenance program and limiting co-morbidity risk factors are critical for ensuring a predictable and successful treatment outcome with implant therapy.

Clinical question

In periodontally compromised patients (PCP's) receiving dental implants, do post-operative infection, marginal bone loss and implant failure rates differ compared to implants inserted in periodontally healthy patients (PHP's).

Review methods

Methodology

This study followed the PRISMA Statement guidelines.¹ The methodological quality assessment of the studies was executed according to the Newcastle-Ottawa scale (NOS).²

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Search strategy and study selection

The investigators did an electronic search without time or language restrictions in March 2014 of the electronic databases: PubMed, Web of Science, and the Cochrane Oral Health Group Trials Register, to identify papers on the topic in the clinical question. They also conducted a manual search of dental implant-related journals. The reference list of the identified studies and the relevant reviews on the subject were also scanned for possible studies. Online databases (www.clinicaltrials.gov; www.centerwatch.com/clinicaltrials; www.clinicalconnection.com) were also checked for possible clinical trials in progress. Three reviewers independently screened the titles and abstracts identified through the electronic searches for articles related to the focus question. Full text articles of studies appearing to meet the inclusion criteria, or where there were insufficient data in the title and abstract to make a clear decision were obtained and read by all the reviewers. Disagreements were resolved by discussion between the authors.

Eligibility and exclusion criteria

Only randomised controlled trials (RCTs) or controlled clinical trials on humans were eligible for this study. The clinical studies had to compare implant failure rates in PCP's receiving dental implants compared to PHP's. Implant failure was defined as the complete loss of the implant. Case reports, technical reports, animal studies, in vitro studies, and reviews papers were excluded from this study.

Outcome measures and data extraction and synthesis

Implant failure, postoperative infection and marginal bone loss were the primary outcomes that were measured. The estimates of relative effect for implant failure and postoperative infection were expressed in risk ratio (RR) with a 95% confidence interval (CI). The estimate of relative effect for marginal bone loss was expressed as mean difference (MD) in millimeters with a 95% confidence interval (CI). The data for each variable was used to construct a Forest plot for analysis of the pooled data.

The authors of primary studies were contacted to obtain information on missing data. Whenever outcomes of interest were not clearly stated, the data were not used for analysis. The statistical unit for the outcomes was the implant.

Appropriate statistical analysis was conducted to determine biases, heterogeneity and differences in outcome measures between PHPs and PCPs.

A meta-analysis was only performed on studies with similar comparisons reporting the same outcome measures. Studies lacking information about the relative probability of an event

was automatically omitted from the meta-analysis. A funnel plot was used to estimate publication bias and other biases related to sample size. The choice between fixed-effect and random effects model was based on I^2 statistical test for heterogeneity.

Main results

A total of 22 publications were included in the meta-analysis. Ten studies were controlled clinical trials (CCTs) and twelve retrospective analyses. There were no randomized controlled studies. All studies except one were rated as having high methodological rigor however, all were judged to be at high risk of bias. The funnel plot showed asymmetry when the studies reporting the outcome 'implant failure' in the comparison between PCPs vs. PHPs are analyzed, indicating possible presence of publication bias. From the 22 studies comparing PHPs and PCPs, a total of 10927 dental implants were inserted in PCPs, with 587 failures (5.37%), and 5881 implants were inserted in PHPs, with 226 failures (3.84%).

A statistically significant increase in implant failure rates was observed with insertion of dental implants in PCP's compared to PHPs. Pooling of the data showed a RR of 1.78 (95% CI 1.50-2.11) ($P < 0.00001$). When only the CCTs were pooled, a RR of 1.97 resulted (95% CI 1.38 -2.80) also showing a similar statistically significant increase in implant failure rates in PCPs. ($P = 0.0002$).

Only four studies provided information about postoperative infection. The insertion of dental implants in PCPs or PHPs statistically affected the incidence of postoperative infections in favor of PHPs. A RR of 3.24 (95% CI 1.69-6.21) ($P=0.0004$) was observed.

Five studies provided information on the marginal bone loss in PCPs and PHPs receiving dental implants (A total of 212 implants were placed in PCPs and 269 implants in PHPs) There was statistically significant difference in marginal bone loss (MD 0.60, 95% CI 0.33-0.87; $P < 0.0001$) between PCPs and PHPs, favoring PHPs.

Conclusion

The present study suggests that an increased susceptibility for periodontitis may also translate to an increased susceptibility for postoperative infection, loss of supporting bone, and implant loss. However, the results should be interpreted with caution due to the presence of uncontrolled confounding factors in the included studies.

The authors did not declare whether they received financial support or whether there was any potential

conflict of interest with respect to the authorship and/or publication of this review.

Commentary

Background and importance

Dental implant therapy has become a well-established treatment modality with favorable long-term success rates for replacing missing teeth in the general population. With increasing numbers of patients receiving dental implants, it is certain that post-operative complications, incidence of peri-implant disease and implant failures will increase, posing a significant health care problem for both the patient and the clinician. It is also plausible that more patients will receive implants to replace missing teeth lost due to periodontal disease. In an attempt to limit post-operative complications, peri-implant disease and implant failures, increased attention is being placed on understanding the associated etiologic and risk factors.^{3, 4} Although there is some evidence that patients with a history of periodontitis may be at greater risk for peri-implant disease,⁵ there is no general consensus regarding its influence on the outcome of implant therapy.³ Further conflicting evidence suggests that although periodontally compromised patients are at greater risk of MBL and peri-implantitis, there is no difference in implant survival rate, between periodontally compromised and periodontally healthy patients.⁶

Are the results valid?

The authors stated that only randomized controlled trials or controlled clinical trials were eligible for this study. However, 12 of the 22 studies included were retrospective studies. These studies cannot be considered as controlled clinical trials and therefore are rated as a lower level of evidence. There were no randomized controlled trials included in this review, therefore the potential risk for bias in all the studies are great.

Overall there was a marked variability of the results between the individual studies possibly due to differences in sample sizes, population characteristics, and definition of periodontitis. The groups in general were very heterogeneous and not all treated in the same way. The severity of periodontal disease and how it was treated, the time of implant placement, pre-and post-operative periodontal maintenance, healing period and implant loading protocol, differences in prosthetic supra-structures varied amongst the primary studies. Furthermore, not all the studies provided details about the periodontal maintenance and the presence/absence of residual pockets. Another potential

limitation was the varying lengths of follow-up time (3-5 years) (median of 5 years). Such relative short follow-up could possibly have led to an underestimation of the estimate of the failure rate.

Wide inclusion criteria generally increase the risk of finding heterogeneity, thus making the analysis and interpretation of confounding factors on results difficult. However, statistical analysis surprisingly showed no significant heterogeneity between the test and control group. Based on the statistical test the investigators choose to use the fixed-effect model. However, it should be pointed out that the choice between using a fixed-effect and a random-effects meta-analysis should never be made on the basis of a statistical test for heterogeneity.⁷ The two models are not the same and conceptually measure different things. The decision what statistical model to use should be done at protocol stage based on the knowledge of variability across studies. Choosing a model as done in this study can produce misleading results.

Although a methodological quality assessment was carried using predetermined criteria, it is not reported whether this evaluation was carried out independently by more than one person and what their degree of agreement was. The reviewers did not provide a list of excluded studies and their reasons for exclusion. The lack of control of confounding factors (i.e. smoking habits, periodontal maintenance compliance, untreated periodontal disease, diabetes, use of prophylactic antibiotics and antimicrobial mouth rinses, varying lengths of follow-up, patient ages, number of implants, severity of periodontitis etc.) could modify both post-operative complications, MBL and implant success rate, therefor limiting the potential of this review to draw strong conclusions.

Overall, the high level of variability between individual studies, high risk of bias and lack of controlling confounding factors resulted in poor quality of evidence and therefor we have to question the validity of the results.

What were the key findings?

Implant failures

A RR of 1.78 (95% CI 1.50-2.11) (P <0.00001) implies that dental implant failures are 1.78 times likely when implants are inserted in PCPs compared to when implants are inserted in PHPs. When only the CCTs were pooled, a RR of 1.97 resulted (95% CI 1.38 -2.80) also showing a similar statistically significant increase in implant failure rates in PCPs. (P = 0.0002).

Although the implant failure rate was statistically significant

and consistently showed less risk of implant failure in periodontal healthy patients, the individual results were clinically insignificant. Most studies had results with very wide CI crossing the line of no clinical difference. This observation can be ascribed to the small sample sizes.

Post-operative infection

The insertion of dental implants in PCPs or PHPs statistically affected the incidence of postoperative infections in favor of PHPs. A RR of 3.24 (95% CI 1.69-6.21) (P=0.0004) implies that post-operative infection are 3.24 times likely to happen in PCPs compared to when implants are inserted in PHPs.

The data for post-operative infection showed some inconsistency. Of the four individual studies that were pooled one study showed that there was statistically significant less post-operative infection in periodontally compromised patients.⁸ The results of other individual studies included in the meta-analysis can also be considered as clinically insignificant due to small sample sizes.

Marginal bone loss

Nine individual studies were included in the subgroup analysis for marginal bone loss. There was statistically significant difference in marginal bone loss (MD 0.60, 95% CI 0.33-0.87; P < 0.0001) between PCPs and PHPs, favoring PHPs.

All, except two of the individual studies were also clinically significant. The clinical relevance or importance of these margins of bone loss has to be questioned. It is also likely the small sample sizes could have distorted the results.

In the final analysis the results of this review should be interpreted with caution due to the presence of several uncontrolled confounding factors. An important consideration that should be mentioned is the possible high influence of smoking habits on post-operative infection, incidence of peri-implant disease and implants failure rates. Smokers were included in 14 of the studies reviewed.

Irrespective of the limitations of this study, the findings are in accordance with that reported in other meta-analysis.^{9, 10}

How are the results of this review applicable in clinical practice?

Limiting complications are clinically important and relevant to the patient and the clinician. Therefore, making the correct clinical decisions about risks and benefits of treatment are important because this could mean the difference risking or losing and implant or maximizing a successful treatment outcome.

Wide inclusion criteria generally increase the risk of heterogeneity and thus invalidate generalizability of results if confounding variables are not controlled and analyzed. However, statistical tests showed no heterogeneity between the test and control groups. If no heterogeneity is found when wide inclusion criteria is used, the results will reasonable be more applicable to the clinical practice situation. However, because confounding factors have not been controlled, caution should be exercised in interpreting and applying the results.

Overall, it is logical to assume that patients with a history of chronic periodontitis are at greater risk for implant related complications and failures and therefore assessed and managed on an individual basis when contemplating implant therapy. For example, some patients on periodontal maintenance may be refractory to treatment and continue to experience complications, tooth loss and implant failures. Furthermore, patients with co-morbidity factors such as smoking or uncontrolled systemic conditions such as diabetes, osteoporosis and immunodeficiency's need extra precautionary measures with periodontal maintenance and implant treatment.

The original periodontal diagnosis is important for implant prognosis but the presence of residual pockets and non-attendance of periodontal maintenance during follow-up as well as the presence of smoking habits are important risk factors that may negatively affect predictability and outcome of treatment.¹¹ Maintenance of periodontal health is critical and includes control of periodontal parameters and stabilization of disease progression.

Clinical Resolution

The results of this review suggest that compromised periodontal health is an important risk factor for post-operative infection, peri-implant disease and implant failure. However, it should be noted that combining poor quality or overly biased data, unreliable results can occur, therefore any inferences made regarding complications associated with implant placement in patients with increased susceptibility to periodontitis should be done with caution. The presence of residual pockets, smoking and non-compliance to adequate periodontal maintenance may have a negative impact on implant treatment outcome. At this stage of time, the influences of the type and severity of PD on implant loss, peri-implant disease and marginal bone loss remain to be defined. Further research is needed to clarify whether implants can be placed successfully and predictably in patients that are periodontally compromised and whether

patients that adhere to a maintenance periodontal program will have a decreased risk of post-operative infection, peri-implant disease, and implant loss. Baseline data should also clearly indicate that periodontal health was achieved prior to implant placement and during the maintenance period. Studies should also extend their follow-up to more than 5 years. New evidence accumulated over time should continuously be reassessed to refine diagnostic and therapeutic treatment protocols and eliminate unnecessary procedures.

Disclosure

Dr Johan Hartshorne is trained in clinical epidemiology, biostatistics, research methodology and critical appraisal of research evidence. This critical appraisal is not intended to, and do not, express, imply or summarize standards of care, but rather provide a concise reference point for dentists to aid in understanding and applying research evidence from referenced early view or pre-published articles in top ranking scientific publications and to facilitate clinically sound decisions as guided by their clinical judgement and by patient needs.

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