



Influence of Smoking on Periodontal and Implant Therapy: A Systematic Review

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Abstract: Tobacco today considered one of the main causes of death, being associated with countless diseases such as: cancer, neurological, cardiovascular, and respiratory diseases. Smoking also has a negative effect on oral health which directly impairs treatment with dental implants. This current review aimed to evaluate the influence of smoking on dental implant failure rates and marginal bone loss (MBL). **Materials and Methods:** Electronic search was undertaken in three databases, failure and MBL were associated with follow - up time. **Conclusions:** Implants placed in smokers present a higher risk of failure than implants placed in non - smokers.

Keywords: dentistry; implantology; dental implant; failure; marginal bone loss; smoking; systematic review; meta - analysis; meta - regression

1. Introduction

Tobacco smoking is an epidemic that have spread progressively all over the world killing about 8 million people per year (1). It has a direct relation to many serious health conditions such as; cancer and neurological, cardiovascular, and respiratory diseases (1, 2). Smoking tobacco have negative consequences to oral health. In the oral environment, it is linked directly to several oral and maxilla - facial conditions (black hairy tongue, leukoplakia, epithelial dysplasia, oralsquamous cell carcinoma and many others) (3, 4, 5). Smoking is the main cause of failure in dental implants. A review study was conducted by Chrcanovic, B. R et al: 2015 suggested that; placement of implants in smokers' patients had a high influence on

implant failure rates and on marginal bone loss as well when compared to non - smoke s' patients (6). The severity of periodontal diseases is higher among smokers than among non - smokers (3). Many other studies targeted the same subject in many years. It was therefore the aim of the present systematic review to perform an update on the subject, adding more information from supplementary studies.

2. Materials and Methods

This study followed the PRISMA 2020 checklist, assigned with the registration number CRD42021240682 in the PROSPERO platform (7). The **objective** of the current study was to test the null hypothesis of no difference in the implant

failure rates and marginal bone loss (MBL) after dental implants insertion in smokers' patients compared with the insertion in non - smokers' patients, against the other hypothesis of a difference, based on a systematic review of the literature. The research question was " what is the effect of smoking on the implant failure rates and marginal bone loss?" PICO format (participants, interventions, comparisons, outcomes). **Criteria for the inclusion and exclusion** of studies was carried out as: Clinical human studies on failure of implant from pure titanium or its alloys in smoking and non - smoking patients were included. Case reports, technical reports, in vitro studies excluded, studies evaluating mini - implants, zygomatic, orthodontic, zirconia, subperiosteal, or hollow implants were excluded. **The search strategy** was conducted electronically by collecting English database last updated in July2022 from PubMed/Medline, Web of Science, and Science Direct with the searched terms " dental implant" "smoking" "smoker" "tobacco" "nicotine" and manually by searching in the listed supplementary materials of journals related to dental implants. Studies appearing to meet the inclusion criteria were read and disagreements were resolved by discussion between the authors. **Quality assessment** of all the studies was executed by the three authors of the review according to the Quality Assessment Tool of the National Institutes of Health (8) and disagreements were resolved by discussion between the authors. **Data extractions** were performed by the reviewer authors after contacting the authors for missing data. The following data were retrieved from the studies: year of publication, country, study design, patients' age,

number of patients, implant healing period, failed and placed implants and MBL in each group, implant system, smoking definitions, jaws receiving implants (maxilla and/or mandible), and follow - up time.

3. Results

The process of study selection is viewed in Figure 1. The search initially resulted in 4350 papers (1424 in PubMed, 1750 in Web of Science, 1176 in ScienceDirect). All searched articles were filtered by typing 'Article type— Research articles', as well as the terms 'dental implant' and 'oral implant', of which 224 publications were eligible for inclusion, but after limitation of the selection of the published articles between 2011 and 2021. A total of 123 studies were selected. 51 were multicenter, 62 unicenter and it was not possible to get clear information for the other 10 studies. When it comes to study design, 16 studies were randomized clinical trials (RCT), 10 were prospective studies (without a pre - established controlled group), 10 were prospective controlled clinical trials, and 87 retrospective observational studies. For 100 studies, the mean follow - up $\pm$ standard deviation was 45.7 ± 34.8 months. For the other 35 studies, there was neither the mean follow - up time nor information on the precise time of follow - up. Information on follow - up in these 23 studies was usually reported as, for example, 'patients were followed up between the years 2011 to 2015', or 'patients were followed up for up to 48 months.

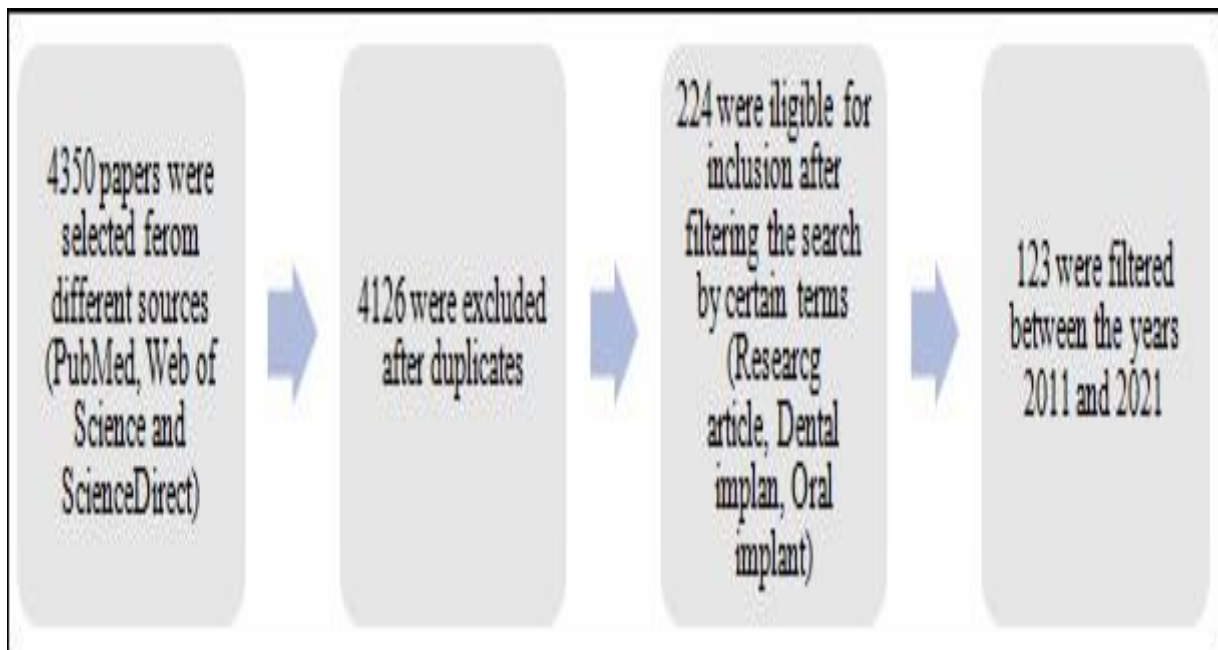


Figure 1: Study screening process

For quality assessment: All included studies were classified as 'good' according to the quality assessment tool (8). In many cases, the main issues in the publications were related to statistical methods not being well - described and to the inclusion of nonconsecutive patients in the studies.

4. Discussion

According to the results of this review paper, implants placed in smokers presented a statistically significant higher risk of failure and a higher mean MBL than implants placed in non - smokers. The null hypothesis was therefore not accepted. Failures between the groups do not change with follow - up suggesting that the effect of smoking in implant failures does not fade away with time. The explanations for the higher implant failure rate in smokers as it has a direct association with the negative effects of the smoking toxins on bone metabolism and osteogenesis, and on angiogenesis as smoking Cigarette causes an alteration in the composition of bone matrix and worsens bone mineralization, which leads to bone fragility. The smoking can result in a reduction in bone trabeculae thickness, which is associated with a decrease in mineralizing surface and in the mineral deposition rate leads to decrease bone formation rate and longer mineralization time (9). The longer the duration of smoking and the higher the dose lead to higher impact on bone mineral density (10). Several pathophysiologic mechanisms that predispose smokers to bone loss have been identified with an inhibitory effect on osteogenesis and negative impact on bone metabolism (11) that play an indirect role in activating bone pro - resorption pathways via affecting osteoclast differentiation and activity (12). The expose to smoke also affects the RANKL–RANK–OPG pathway, a series of biochemical processes that regulate the proliferation and activity of osteoclasts (13). Finally disturb the bone healing process (14). It has been suggested that smoking cigarette may inhibits several biochemical and

physiological processes that disturb angiogenesis, which in turn results in abnormal blood supply to tissues, ending up decreasing repair of damaged tissues and remodeling (15). The higher MBL observed in smokers can be associated with the negative consequences of smoking on bone metabolism, osteogenesis, and angiogenesis. In comparing the smoker with non - smoker, there is an increased risk of peri - implant it is in smokers (16). People who smoke usually present worse peri - implant biological parameters than non - smokers, including higher bleeding index, deeper peri - implant pockets, and higher degree of peri - implant mucosal inflammation (17).

The general result agrees with the results of previous reviews. The findings of these reviews resulted in significant differences of implant failure and/or MBL, with worse results for the group of smoker patients (18, 19). Many information added from observational studies may establish a more solid foundation for causal inferences and aid in clinical reasoning (20). Another review demonstrated the possible association between an enhanced risk of dental implant failure and an increased number of cigarettes smoked per day, found a positive correlation between these factors (21). Smoking may impair treatment with dental implants so, further research should focus on the possible influence of smoking preventive measures, such as whether stopping smoking for varied lengths of time before and after the time of surgery may have a positive impact on the

clinical outcomes and on the quantitative impact of smoking on dental implant outcomes.

5. Conclusion

Implants placed in smokers present a higher risk of failure than implants placed in non - smokers. There was no clear influence of the follow - up time on the failure of implants and on MBL in the selected studies. Further studies are

needed to evaluate more clinical outcomes and on quantitative impact.

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