

Ryder MI. The influence of smoking on host responses in periodontal infections. Periodontology 2000 2007;43:267-77. (62 refs.)

Purpose: To discuss the role and effect of tobacco in both the periodontal pocket and periodontal tissues.

Materials and Methods: Literature review with author's opinion.

Findings and Conclusions: In smokers, 2 levels of tobacco exposure are encountered, a chronic exposure and an acute exposure. Chronic exposure results in low levels of tobacco products in serum, saliva, GCF, and within the cells and extracellular matrix of the tissue itself. Acute exposure occurs during the act of smoking and may produce concentrations of the tobacco products hundreds to thousands of times higher in the above mentioned areas. These different types of exposures may result in different effects on cells and other host response mechanisms. Tobacco products themselves may have different effects on periodontal tissues, such as nicotine which has been demonstrated to have both positive and negative effects on elements of the host reparative response. The effects of tobacco smoke on the composition of the microflora has been an area of debate with some authors demonstrating no significant difference between smokers and non-smokers while others have found significant differences between the 2 groups.

Pocket

The first host response occurs in the periodontal pocket between the plaque biofilm and neutrophils. These neutrophils do not efficiently remove the bacteria and also release proteolytic enzymes and inflammatory mediators that cause localized destruction of the supporting periodontal tissues. Several studies have suggested that cigarette smoking may tip the balance of neutrophils away from protective functions and more towards their greater destructive activity. The effects of smoking on neutrophil function have demonstrated impaired phagocytosis, chemotaxis, and elevations in the release of superoxide and hydrogen peroxide. Smoke also appears to aid in the destruction by stimulating the migration of neutrophils into the periodontal connective tissue. Studies have also demonstrated increased levels of destructive enzymes in the GCF such beta-glucuronidase, MMPs, elastase, etc. However, it should be noted that other studies have demonstrated no difference between smokers and non-smokers in this respect.

Tissue

The principle component in the line of defense against smoke products in the tissues is the mononuclear/monocyte cell. The balance between protective and destructive action is mediated mainly by the type of cytokine pattern being secreted from these cells. The inflammatory/destructive cytokines consist of IL-1 α , IL-1 β , TNF- α , prostaglandins, IL-6, and IL-8. The protective/repairative cytokines consist of TGF- β , insulin-like growth factor, interferons, etc. Evidence suggests smoking will tip the balance of cytokine production towards the more destructive profile. As is the case above, some authors report significant differences in the amounts of cytokines produced between smokers and non-smokers while others report no differences.

Other modifying factors

Other local and systemic factors may play a major role in the development and progression of periodontal diseases. The factors include genetics, alcohol use, and psychological stress.

Effect on therapy

Adverse effects of smoking may occur through the increased levels and/or activity of proteolytic enzymes, the elevation of destructive inflammatory cytokines, and/or suppression of the regenerative/repairative functions of the periodontium. One clinical aid which may tip the balance toward regeneration/repair and away from destruction/inflammation are the tetracycline family of antibiotics. These antibiotics may neutralize substances of inflammation that are particularly elevated

in tobacco-associated periodontal diseases by depressing the activity of several MMPs, inhibiting the release of IL-1 β , and acting as a scavenger for destructive oxygen species.

Guntsch A, Erler M, Preshaw PM et al. Effect of smoking on crevicular polymorphonuclear neutrophil function in periodontally healthy subjects. J Periodont Rest 2006; 41:184-8. (46 refs.)

Purpose: to assess PMN function in crevicular washes in smokers and non-smokers who were periodontally healthy.

Materials and Methods: 60 dental students were recruited and divided into four groups, each containing 15 subjects. Smokers were categorized as light smokers (<5 cigs/day), moderate (5-15 cigs/day), and heavy (>15cigs/day). Nonsmokers constituted the control group. All subjects received professional tooth cleaning 2 wks prior to samples being obtained. Clinical parameters recorded included the plaque index, the sulcus bleeding index, and probing depths at six sites per tooth. Crevicular washes were obtained. The numbers of cells and their viability were counted. The measurement of phagocytosis of crevicular PMNs was carried out, and *Candida albicans* was used as indicator particles to determine the number of PMNs containing and adhering to the *Candida* cells. The analyses were performed with light microscope immediately after stopping the phagocytosis process.

Findings: In demographic data, there were non significant differences among groups. However, there was a tendency for the proportion of males to increase with increasing cigarette consumption. The sulcus bleeding index in both moderate (0.10) and heavy (0.07) smokers demonstrated a statistically significantly lower sulcus bleeding index compared to the non smoking control group (0.14). There were no statistically significant differences in mean probing depth among groups, but the greatest mean probing depths were measured in the heavy smokers (1.79mm) and the lowest in the control group (1.45mm). The number of PMNs increased from the non-smokers to the light and moderate smokers. In heavy smokers, there was a reduction in the number of PMNs to a value less than that of the non-smokers. In the non-smokers, 85% of PMNs were vital cells, but by contrast, in all the smoking subgroups, the percentage viability of PMNs was significantly reduced. (range 75-78%). There were no significant differences in percentage viability within the smoking subgroups. All three smoking subgroups had significantly lower percentage phagocytosis scores (41-58%) than the non-smokers (74%). the percentage phagocytosis scores decreased significantly from on smoking subgroup to the next as cigarette consumption increased. In a group of periodontally healthy subjects, there was clear evidence of a deleterious effect of smoking on PMN function, including reduced viability and reduced phagocytosis.

Heasman L, Stacey F, Preshaw PM et al. The effect of smoking on periodontal treatment response: a review of clinical evidence. J Clin Periodontol.2006;33:241-53.

BACKGROUND: Smoking has been identified as a significant risk factor for periodontal diseases and is regarded as being responsible for incomplete or delayed healing in patients following periodontal treatment.

Purpose: to review relative clinical responses of periodontal treatment in smokers, non-smokers and ex-smokers.

Materials and Methods: literature review

Findings:

1) *Clinical response of smokers and non-smokers to periodontal treatment:* majority of studies are relatively short term ≤ 1 year follow up. Substantial evidence of clinical improvement in smokers to indicate that smoking is a risk factor that compromises instead of prevents tissue healing. The majority of clinical trials show significantly greater reductions in probing depths and BOPs, and significantly greater gain of clinical attachment following non-surgical and surgical treatments in non-smokers compared with smokers. This benefit is also seen at class I and II furcation sites and in patients prescribed systemic or local antimicrobial treatments.

2) *Longitudinal evidence for benefits of smoking cessation on the periodontium:* evidence is lacking. Bolin et al.(1993)- a 10 year follow-up radiographic study of alveolar bone loss- found bone loss progression retarded in ex-smokers vs. smokers. Only longitudinal study- Preshaw et al (2005b) a 10 subjects study with 12 month data - ex-smokers demonstrated significant reduction in probing depths vs. smokers.

3) *Immune-inflammatory mechanisms underlying clinical response:* insufficient evidence available. Potential benefits of quitting smoking can be hypothesized from studies on effects of smoking and nicotine on the host periodontal tissues and the immune inflammatory response. These benefits may include a shift towards a less pathogenic subgingival flora, recovery of gingival microcirculation, restoration of neutrophil function, metabolism and viability, damping of enhanced immune response and re-establishing any imbalance of cytokine production.

Conclusion: No long term, multi-center, longitudinal clinical data to monitor periodontal treatment response of smokers, ex-smokers. Therefore, evidence from epidemiological, cross-sectional and case-control studies data suggest that smoking cessation is likely to benefit to oral and periodontal health. The periodontal status of ex-smokers following treatment suggests that quitting the habit is beneficial although there are only limited data from long-term longitudinal clinical trials to clearly demonstrate the periodontal benefit of quitting smoking.

Jansson H, Lindholm E, Lindh C, Groop L, Bratthall G. Type 2 diabetes and risk for periodontal disease: a role for dental health awareness. J Clin Periodontol 2006; 33: 408-414. (33 ref.)

Purpose: To examine in a group of subjects with type 2 diabetes 1) the association between medical characteristics and severe periodontal disease and 2) dental care habits and knowledge of oral health.

Materials and Methods: 191 type 2 diabetic subjects were selected for periodontal and radiographic examinations. At the start of the experiment, each participant submitted answers to a questionnaire so that information pertaining to the subjects' dental care habits, oral hygiene habits, education levels, and smoking habits could be obtained. Participants were placed in groups according to their smoking habits: non-smokers vs. smokers. Subsequently, one of 3 calibrated examiners conducted clinical examinations on the participants to record the number of teeth, the number of sites with probing pocket depth greater than 4 mm, bleeding upon probing, and oral hygiene status using disclosing solution. Participants were then given panoramic radiographic examination to assess the amount of marginal bone loss around each remaining tooth.

Findings: Radiographic examinations revealed that 20% of the type 2 diabetic subjects suffered from severe periodontitis. Clinical measurements confirmed this finding. Using the aforementioned clinical/radiographic findings and the information obtained from the questionnaires, the investigators noted several differences between type 2 diabetic subjects *with* periodontal disease and type 2 diabetic subjects *without* periodontal disease.

1. Type 2 subjects *with* periodontal disease had higher levels of HbA1c (7.1% vs. 6.5%), a higher prevalence of cardiovascular complications such as myocardial infarction or stroke (25%-4%), less likely to be of Scandinavian origin (50% vs. 73%), and more likely to be smokers (57% vs. 21 %) compared to type 2 subjects *without* periodontal disease.
2. Subjects *with* periodontal disease were less likely to retain teeth (26% vs. 24 %), greater probing pocket depths of 4-5 mm (30% vs. 11%), more probing pocket depths greater than 6 mm (11% vs. 1%), more bleeding upon probing (54% vs. 32%), and greater plaque scores (70% vs. 56%.)
3. 76% of subjects *with* periodontal disease were more likely to perceive their oral health status as poor while 49% of subjects *without* periodontal disease rated their oral status as poor. This was deemed to be statistically significant. Furthermore, only 66% of subjects *with* periodontal disease understood that their diabetes might affect their periodontal condition compared with 18% of subjects *without* periodontal disease.
4. In terms of being informed that diabetes and smoking are risk factors to the development of periodontal disease, only 13% of the type 2 subjects *without* periodontal disease reported being informed while only 29% of the type 2 subjects *with* periodontal disease reported being informed.

In all, these findings indicate that individuals who are type 2 diabetics and smokers have a greater tendency to develop periodontal disease, measure higher concentrations of Hb1Ac, and be more likely in experiencing cardiovascular complications.

Conclusions: Although a clear "cause and effect" relationship has not been demonstrated, it can be seen that a strong association exists between periodontal disease, smoking, and type 2 diabetes. Individually, diabetes and smoking are independent modifying factors that can increase the risk for and severity of periodontal disease. The consequences are even more alarming when these risk factors co-exist in an individual. This study, for instance, shows that the periodontal condition of type 2 diabetics is more pronounced in smokers compared with non-smokers; type 2 diabetic smokers, for example, tend to have more severe periodontitis and reduced number of teeth. Therefore, it can be said that smoking is a serious risk factor for both type 2 diabetes and periodontal disease. Moreover, the findings indicate that a significant number of type 2 diabetic patients are not aware of the significant impact diabetes and smoking has on the periodontium. Thus, it is incumbent on the dental practitioner to educate diabetic patients on the possible oral health complications.

Laine ML, Leonhardt A, Roos-Jansaker AM, et al. IL-IRN gene polymorphism is associated with peri-implantitis. Clin Oral Impl Res. 2006;17:380-5. (45 refs.)

Purpose: Genetic variation in genes shown to be relevant to periodontal disease may be one of several factors responsible for peri-implantitis. Interleukin (IL)- 1 α , IL-1 β , and their natural specific inhibitor IL-1 receptor antagonist (IL-1ra) have been shown to play key roles in the regulation of the inflammatory response in periodontal tissues. Specifically polymorphisms in the IL-1 gene cluster have been associated with severe adult periodontitis. The purpose of this study was to investigate the same IL-1 gene cluster polymorphisms in patients with peri-implantitis.

Materials and Methods: One hundred and twenty systemically healthy, Northern Caucasian individuals (58 edentulous, 62 dentate) aged 32-88 years with 1-12 implants per patient (in function for at least 2 years) participated in the study. 71 patients demonstrated peri-implantitis at one or more implants as evidenced by bleeding and /or pus on probing and bone loss amounting to >3 threads on Branemark implants. 76% of these participants were smokers. A total of 49 patients with clinically healthy mucosa and no bone loss around the implants were used as controls. 45% of these patients were smokers.

Cells were collected from all subjects using mouthwash. Cells were centrifuged, DNA isolated, and genotyping of the bi-allelic polymorphisms IL-1A at positions 889, 3954, and polymorphism IL-1B at position 511 were collected. A number of tandem repeat IL-IRN gene polymorphisms were also genotyped using polymerase chain reaction.

Findings: Differences were found in the carriage rate of allele 2 in the IL-IRN gene between peri-implantitis patients and controls (56.5% vs 33.3% respectively). Logistic regression analysis taking smoking, gender, and age into account confirmed the association between IL-IRN allele 2 carriers and peri-implantitis. Also, smoking represented a significant risk factor for peri-implantitis.

Conclusions: The results of the study indicate that IL-IRN gene polymorphism is associated with peri-implantitis and may represent a risk factor for this type of pathology. This study also confirms an association between smoking and peri-implantitis irrespective of the IL-1 cluster.

Garg N, Singh R, Dixit J, et al. Levels of Lipid peroxides and antioxidants in smokers and non smokers. J Periodont Res 2006;41:405-10. (25 refs)

Purpose: To study two things in smokers and non smoker's 1- Per-oxidation product in blood and inflamed gingival tissue, 2- Level of enzymatic antioxidants and non enzymatic antioxidant.

Materials and Methods: 35 subjects with chronic moderate periodontitis and systemically healthy were selected in this study. 25 patients were smokers and 10 were non smokers. The smokers were grouped into three. Group I: 15/20 cig/day, Group II: 21/30 cig/day, Group III: >50 cig/day. Gingival tissue was collected during the Modified Widman Flap Procedure and blood was collected and was analyzed for Lipid peroxide, Superoxide dismutase SOD, Catalase, Glutathione and total Thiol.

Findings: The level of Lipid peroxide was consistently lower in nonsmokers (2.24 +- 0.775 in tissue) than in smokers in all Groups except in tissue of Group I. The Level of SOD was significantly decreased in blood of all group and group III smoker in case of tissue. Catalase level was consistently higher in smokers than non smokers. Glutathione level in tissue and blood was significantly higher in the control than in the Group III, but was not that significant when compared with the Group I. For total thiol the level was higher in the smokers than in control.

Conclusion: Smoking increases the level of Free radicals in periodontal tissue, which in turn may be responsible for the destruction seen in periodontal disease.

Peleg M, Garg AK, and Mazor Z. Healing in smokers versus nonsmokers: Survival rates for sinus floor augmentation with simultaneous implant placement. Int J Oral Maxillofac Implants 2006; 21:551-9. 49refs.

Purpose: to compare the long-term survival rates of implants placed simultaneously with sinus grafting (lateral window) in smokers and nonsmokers, and to describe a surgical approach developed to improve the outcome of sinus floor augmentation with simultaneous implant placement.

Materials and Methods: This study was followed up over a 9-year period. A strict smoking cessation protocol was applied as follows: for 1 week prior to surgery, smokers were required to reduce cigarette consumption to 2-5 cigarettes /day. They were required to stop smoking completely 1 day before surgery. After surgery, participants were instructed no to smoke for 10 days. Augmentation materials were 1) autogenous bone alone, 2) 50% of autogenous bone and 50% Bio-Oss, 3) 50% of autogenous bone and 50% of DFDBA, and 4) Synthetic bone cement alone. The donor site of autogenous bone was varied, such as symphysis, maxillary tuberosity, lateral aspect of the mandible (body and ramus), anterior maxillary wall, the zygomaticomaxillary buttress, retromolar area and iliac crest. All implants were 15mm Zimmer implants, HA-coated cylindrical implants, or titanium screw-type implants with microtextured surfaces created by blasting with HA particles.

Surgical technique: all patients were premedicated with amoxicillin (1.5g) or clindamycin (450mg) 30 min. prior to surgery. Also amoxicillin 500mg tid or clindamycin 150mg qid was prescribed for 10 days postsurgically. Sinus membrane raptures were repaired using collagen membrane. After completion of grafting, the buccal window was covered with resorbable membrane (a resorbable DFDBA membrane, BioMend, or freeze-dried dura matter). Patients who were fully edentulous were fitted with interim implants and provisional prosthesis. Patients who wore dentures were instructed not to wear them for the first 2 weeks after surgery. For the 3 month after that, dentures were worn for esthetic purposes only, and no mastication was permitted. Second stage was carried out 6-9 month after implant placement. Patients were fitted with a fixed implant-supported prosthesis.

Findings and Conclusions: A total of 731 sinuses were included; 2132 simultaneous implants were placed in the grafted maxillary sinuses of 226 smokers and 505 nonsmokers. A total of 627 implants were placed in smokers. Mean follow-up was 69 month after second-stage surgery. Majority of patients had composite grafts, either autogenous bone + Bio-Oss or autogenous bone + DFABA. Compared with nonsmokers, smokers had a greater proportion of implants placed in 1-2 mm of residual bone (27.1% vs 17.6%).

The cumulative implant survival rate was 97.9% A total of 15 implants in 6 sinuses failed to integrate prior to uncovering. Another 18 implants were lost between second-stage surgery and the 1-year follow-up examination. A total 11 implants were lost between 4-7 years of follow-up. The failure rate was slightly higher in smokers (16 of 627 or 2.6%) compared with nonsmokers (28 of 1505 or 1.9%), although the difference was not statistically significant. The major reason of implant failure in both smokers and non smokers was infection. A greater proportion of implants failed in 1-2 mm of residual bone (4.1%) than in 3-5 mm (1.5%) or > 5mm (1.6%) of residual bone. This study has demonstrated a high survival rate for implants placed simultaneously with grafting of the maxillary sinus. No statistically significant differences were found in failure rates between smokers and nonsmokers.

Sanchez-Perez A., Moya-Villaescusa MJ, Caffesse RG. Tobacco as a risk factor for survival of dental implants. J Periodontol 2007;78:351-9. (Case series) (56 refs.)

Purpose: To evaluate the risk of smoking, with regards to implant success in a dental office in Spain.

Materials and Methods: An analysis focused especially on smoking habits was made over a 5-year follow-up period (1998 to 2002) of the clinical and radiographic findings corresponding to 66 consecutive patients (mean age 43.4 years) who received a total of 165 implants. The NS (non-smokers) had never smoked or had quit at least 10 years ago and had not used any other form of tobacco. Patients were divided into 2 groups depending on their smoking habits: group S (current smoking), 40 patients implants, 58% of the sample); and group NS, 26 patients (71 implants, 42%). S and NS patients were further divided into 4 categories: 1) NS, 26 patients; 2) light smokers (LS) (<10 cigs/day), 23 patients; 3) moderate smokers (MS) (10 to 20 cigs/day), 11 patients; and 4) heavy smokers (HS) (>20 cigs/day), six patients. These conditions were maintained over time. From the entire sample, 105 implants (63.6%) were placed in the maxilla and 60 (36.4%) in the mandible. Of the 105 maxilla implants, 40 implants (56.3%) were placed in the maxilla of NS versus 65 implants (69.1%) in the maxilla of the S group. A total of 31 implants (43.7%) were placed in the mandible of NS versus 29 implants (30.9%) in the mandible of the S group. All implants are installed before December 1997 by same surgeon. The subjects those who needed bone augmentation were excluded. Bone quality was classified into four categories according to Lekholm and Zarb's classification.

With regard to loading conditions, 119 implants (72.1%) were loaded with fixed prostheses and 46 (9%) with overdentures. Of the total, 50 implants (70.4%) were loaded with fixed prostheses in NS versus 69 (73.4%) in the S group. A total of 21 implants (29.6%) were loaded with overdentures in NS versus 25 (26.6%) in the S group.

The clinical success of the implants were defined following the Albrektsson's criteria. At the periodic check, PI, GI, papillar bleeding index, PD, mobility (by Periotest), marginal bone level were monitored.

Findings: The overall success rate was 90.3%; the failure rate was 9.7%. Fifteen of the 16 failures recorded were in the S group (84.2% success rate). It was observed that the failure rate differed among groups and these differences to be significant among groups, except between MS (12%) and HS group (30.8%). There is no statistical differences among the quality of bone and the success rate at the end of time of follow-up between S and NS. With regard to PD, when considered the S alone, the statistical significant difference was found between implants considered success, with 2.6mm (± 1.2 mm), and those classified as a failure, with 5.1mm (± 2.6 mm). For the mobility, there is no statistically significant difference between S and NS in a general sample. Regarding the kind of prosthesis or in the localization of implants (maxilla or mandible) of the general sample or of the sample classified according to S category, there were no statistical differences with respect to success of implants at the end of time of follow-up. Odds ratio was calculated as follows; for the general smokers group, this probability had a value of 13.1, being 7.0 for LD, 9.5 for MS, LS and MS in set they had a 7.8, and 31.1 for HS.

Conclusions: The use of tobacco involved an implant failure risk of 15.8% over 5 years. No differences were found between LS and MS with regard to implant loss. Heavy tobacco use (>20 cigs/day) involves an implant failure risk of -31.1%.