COMPARISON OF THE OSSEOINTEGRATION OF IMPLANTS IN SMOKERS AND NON-SMOKERS

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ABSTRACT

INTRODUCTION: Wound healing is fundamental to the process of osseointegration and smoking is recognized as a risk factor. Several mechanisms have been proposed by which smoking may affect wound healing. The development of osseointegrated implants represents one of the most important breakthroughs in contemporary dental practice in the oral rehabilitation of partially or fully edentulous patients.

AIM: The aim of this retrospective study is to compare the osseointegration of implants with two kinds of surfaces in smokers and non-smokers.

MATERIALS AND METHODS: Patients - smokers and non-smokers, with implant treatment for at least 3 years, were divided into four groups with 25 patients in each group. Their implant placement was made following the same protocol, by one operator and after that they received same instructions.

RESULTS AND DISCUSSION: Both osseointegration and good healing of the mucosal structures are required for dental implant placement to be successful.

CONCLUSION: Smoking is one of the factors contributing to implant failure. It imposes multiple effects on the oral mucosa. The soft tissues around implants with two kinds of surfaces showed stable healing between smokers and non-smokers, with no great difference.

Keywords: *smokers, non-smokers, osseointegration, implants*

INTRODUCTION

Wound healing is fundamental to the process of osseointegration and smoking is recognized as a risk factor. Several mechanisms have been proposed by which smoking may effect wound healing: (a) carbon monoxide released by cigarette smoke has a higher affinity for hemoglobin, which reduces oxygenation of the healing tissues; (b) nicotine is vasoconstrictive, which increases platelet aggregation and adhesiveness and thus further reduces blood flow; (c) the cytotoxic effects on fibroblasts and polymorphonuclear cells additionally disrupt cell repair and defense; and (d) wound healing is impaired leading to a higher complication rate with all surgical procedures (1).

The development of osseointegrated implants represents one of the most important breakthroughs in contemporary dental practice in the oral rehabilitation of partially or fully edentulous patients (2).

Moy et al. (3) reported a success rate in implant treatment for non-smokers of 91% compared with 80% for smokers. Most failures occurred during the first year following implant placement. Hinode et al. (4) conducted a meta-analysis, which revealed a relationship between smoking and the risk of osseoin-

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tegrated implant failure, more particularly those implants located in the maxillary arch.

Good evidence exists to show a low overall failure rate such that smokers should not necessarily be denied implant treatment, but should be apprised of the increased complication rate. There is emerging evidence to suggest that modified surface implants reduce these risks comparable to non-smokers but more research is required (5). It has been concluded that with smoking cessation protocol there are success rates for osseointegration in smokers who follow it (6).

AIM

The aim of this retrospective study is to compare the osseointegration of implants with two kinds of surfaces in smokers and non-smokers.

MATERIALS AND METHODS:

Patients with implant treatment for at least 3 years, were divided into four groups with 25 patients in each group. Their implant placement was made following the same protocol, by one operator and after that they received same instructions. The implants were with diameter 3.7; 4.1; and 4.7 mm; and with lengths - 10 and 11.5 mm.

The patients from Group 1 were with implants with microtextured (*MTX*) surface and smokers. *MTX* is a non-coated, microtextured surface created by grit-blasting the machined titanium implant surface with hydroxylapatite (HA) particles, followed by washing in non-etching acid and distilled water baths to remove residual blasting material. The *MTX* surface has been shown to allow for increased bone apposition compared to machined surfaces. That surface achieved excellent bone-to-implant contact and osteoconductive capacity (7).

The patients from the second group were non-smokers with implants with *MTX* surface.

The patients from Group 3 were smokers and they received implant treatment with trabecular metal implants. The implants that were used in this group were with mid-section, which has been designed to be structurally similar to the cancellous bone. Due to the interconnected porosity this surface was designed to enhance secondary stability through osseoincorporation.

In Group 4 were included non-smoker patients with implants with trabecular metal.

Every patient from the four groups, before placing the final crown over the implant, received a CT scan, had the pocket depth around the crown, the papillary bleeding index (PBI), and the plaque index measured, as well as the stability - the ISQ values. The same was done at the first, second and third year of the follow-up period. On the CT scan was observed the volume of the bone around the implant.

On every patient was made intraoral sectorial x-ray picture of the implant, where was observed the bone level around the implant and if there is bone lost (Fig. 1 - first group; Fig. 2 - second group; Fig. 3 - third group; Fig. 4 - fourth group).

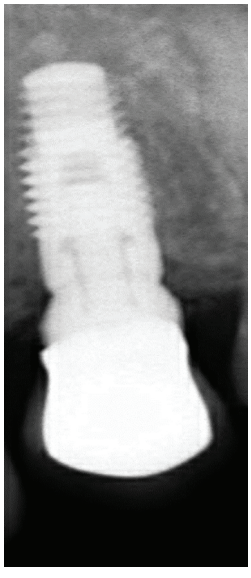

Fig. 1. First group

For all groups, the protocol at the control visits was the same:

The pocket depth was measured with periodontal probe, marked on 1, 2, 3, 5, 7, 8 and 9 mm with 4 mm and 6 mm missing. The pockets around the implants were measured in six points - medio-vestibular, vestibular, disto-vestibular, medio-palatal or lingual, lingual or palatal and disto-palatal or lingual.

The papillary bleeding index (PBI) permits both immediate evaluation of the patient's gingival condition and his motivation based upon the actual bleeding tendency of the gingival papillae. A periodontal probe was inserted into the gingival sulcus at

Fig. 2. Second group

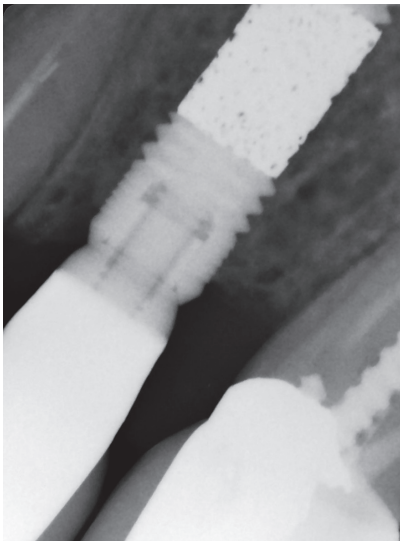

Fig. 3. Third group

the base of the papilla on the mesial aspect, and then moved coronally to the papilla tip. This was repeated on the distal aspect of the papilla. The intensity of any bleeding was recorded as:

- Score 0 – no bleeding;
- Score 1 – a single discreet bleeding point;
- Score 2 – several isolated bleeding points or a single line of blood;
- Score 3 – the interdental triangle fills with blood shortly after probing;
- Score 4 – profuse bleeding occurs after probing; blood flows immediately into the marginal sulcus.

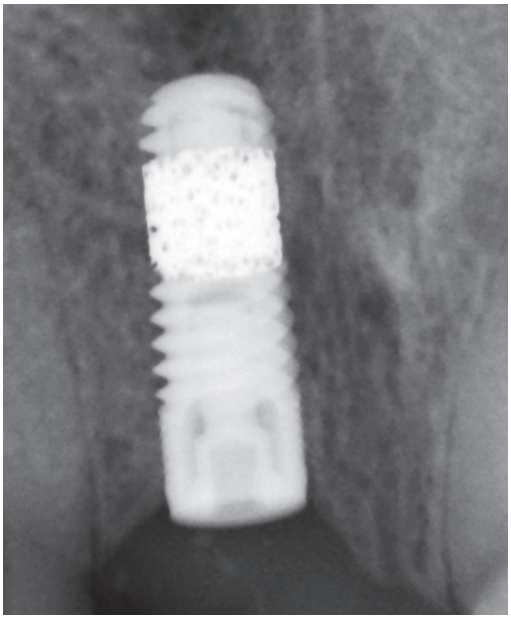

Fig. 4. Fourth group

The plaque index was measured for classifying the debris around the surface of the crown over the implants. In this study the modified plaque index by Mombelli et al. (8) was used to establish the plaque accumulation around the oral implants (Table.1).

Table 1. Modified plaque index by Mombelli et al.

0	No detection of plaque
1	Plaque only recognized by running a probe across the smooth marginal surface of the implant
2	Plaque can be seen by the naked eye
3	Abundance of soft matter

The stability of the implants was measured and the osseointegration process was monitored. Resonance frequency analysis (RFA) was used to determine the clinical status of a dental implant. The stability of implants was detected non-invasively using the ISQ scale (implant stability quotient). The result was presented as an ISQ value of 1-100: the higher the ISQ, the more stable the implant. According to the scale high stability meant >70 ISQ, between 60-69 was medium stability, and <60 ISQ was considered as low stability.

RESULTS

In this study we observed 100 patients with 25 in each group. Sixty of them were men and 40 were women, all of them at an age between 25 and 65 years.

For the three years of follow-up period the implants of the patients from all groups showed 100% survival rate. All indexes showed normal values, as seen in Table 2.

The results between the patients from the four groups were similar. The ISQ values were over 70 for both smokers and non-smokers. The bleeding of the papillae and the plaque index showed no big variations. In the four groups were observed deeper pockets around the crowns over implants in the patients from Group 1 and 3, with an average difference of 0.5 mm, compared with the patients from Group 2 and 4 (Fig. 5 – first group; Fig. 6 - second group; Fig. 7 - third group; Fig. 8 - fourth group).

Table 2. Average values of PBI, plaque index, pocket depth and ISQ

Groups	Group 1	Group 2	Group 3	Group 4
PBI	0.4	0.25	0.5	0.5
Plaque index	0.25	0.2	0.6	0.1
Pocket depth	2.5	2	2.5	1.9
ISQ	75	79	71.5	71.7

Fig. 5. First group

Fig. 6. Second group

Fig. 7. Third group

Fig. 8. Fourth group

The ratio of the indexes between smokers and non-smokers was as followed:

- PBI - smokers:non-smokers =0.45:0.375
- Plaque index – smokers:non-smokers =0.425:0.15
- Pocket depth – smokers:non-smokers =2.5:1.95

The healing process for the patients from Group 1 and 3 who were smokers was on average slower, the tissues were more insufficient, but in the bone osseointegration and regeneration we did not find significant differences.

DISCUSSION

All scientific evidence leads to the fact that wound healing in smokers is more insufficient than in non-smokers. During the first two weeks after implant treatment in most smokers the tissues heal more insufficiently. After the loading of the implants with crowns and good personal hygiene the implant treatment in smokers is stable and shows no great difference in the values of the indexes compared to non-smokers.

CONCLUSION

Osseointegration may be defined as the direct interface between an implant and bone without intervening soft tissue. Both osseointegration and good healing of the mucosal structures are required for the dental implant placement to be successful.

Smoking is one of the factors contributing to implant failure. It has multiple effects on the oral mucosa. The soft tissues around implants with two kinds of surfaces showed stable healing between smokers and non-smokers, with no great difference.

The success rate in implant treatment with the two different implant surfaces is good in smokers and non-smokers with no significant differences in the osseointegration.

REFERENCES

1. Levin L, Schwartz-Arad D. The effect of cigarette smoking on dental implants and related surgery. Implant Dent. 2005;14(4):357–63. doi: 10.1097/01.id.0000187956.59276.f8.
2. Roos-Jansaker AM, Lindahl C, Renvert H, Renvert S. Nine to fourteen-year follow-up of implant treatment. Part I: implant loss and associations to various factors. J Clin Periodontol. 2006;33(4):283–9. doi: 10.1111/j.1600-051X.2006.00907.x.
3. Moy PK, Medina D, Shetty V, Aghaloo TL. Dental implant failures and associated risk factors. Int J Oral Maxillofac Implants. 2005;20(4):569–77.
4. Hinode D, Tanabe S, Yokoyama M, Fujisawa K, Yamauchi E, Miyamoto Y. The influence of smoking on osseointegrated implant failure: a meta-analysis. Clin Oral Implants Res. 2006; 17(4):473–8. doi: 10.1111/j.1600-0501.2005.01244.x.
5. Liddelow G, Klineberg I. Patient-related risk factors for implant therapy. A critique of pertinent literature. Aust Dent J. 2011; 56(4):417–26. doi: 10.1111/j.1834-7819.2011.01367.x.
6. Bain CA. Smoking and implant failure-benefits of a smoking cessation protocol. Int J Oral Maxillofac Implants. 1996; 11(6):756–9.
7. Todisco M, Trisi P. Histomorphometric evaluation of six dental implant surfaces after early loading in augmented human sinuses. J Oral Implantol. 2006;32(4):153-66. doi: 10.1563/812.1.
8. Mombelli A, Van Oosten MAC, Schürch E, Lang NP. The microbiota associated with successful or failing osseointegrated titanium implants. Oral Microbiol Immunol. 1987; 2(4):145–51. doi: 10.1111/j.1399-302x.1987.tb00298.x.