

Success rate of dental implants in heavy smokers

A longitudinal study

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Objective

The failure rate of dental implants is reported to be higher in smokers than in non-smokers. The aim of the study described in this article was to compare the success rate of 721 dental implants inserted in 181 smokers with given reports in the literature. In our study, implants from one factory were used and the implants were inserted by one surgeon to exclude individual factors. In order to increase the success rate for dental implants inserted in

smokers, a specific protocol was established in our dental surgery. In the following, the results of two patients are reported in detail.

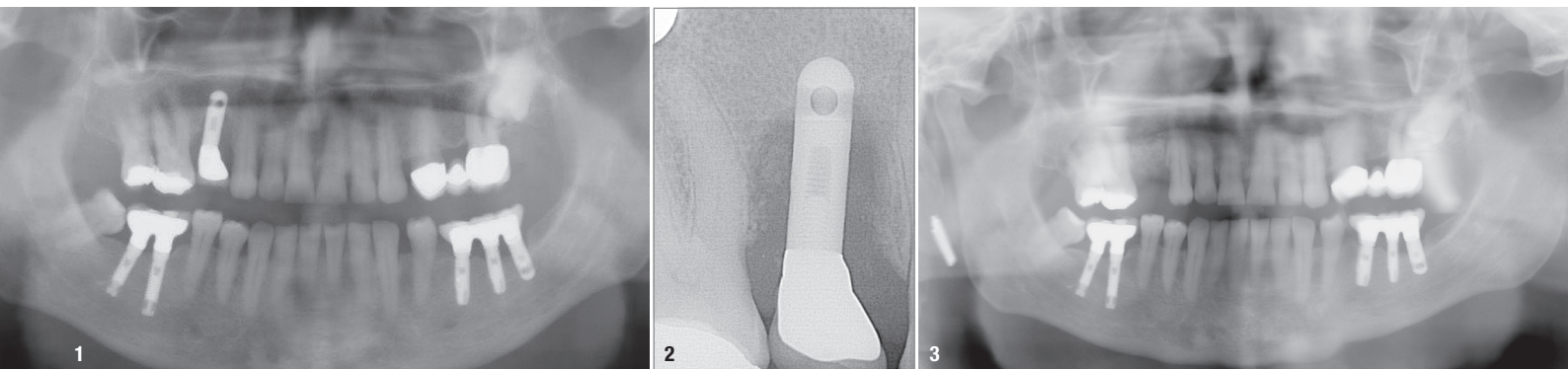
Introduction

In general, smoking is reported to increase implant failure and favour peri-implantitis. One possible mechanism that might lead to increased failure rates is a lowering of the blood flow and direct adverse effects on the osteoblasts. If smokers are treated with implants, good bone quality is required. In our study, bone augmentation procedures were necessary in 62 of the cases.

With our study, we set out to investigate whether there is a significantly enhanced risk of implant failure due to the increased number of cigarettes smoked per day. Though smoking is a risk factor for implant failure, it is not considered an absolute contra-indication. When implant treatment is planned, the patient's smoking history should first be obtained, including the duration, the intensity (past and present), the present status of smoking, the number of cigarettes smoked each day and whether there is any notable passive smoking. Here, the surgeon has to rely completely on the correctness of the information provided by the patient. To achieve a satisfactory result regarding implant survival, a number of different

Diameter (mm)	Length (mm)	No.	Successful	Failed
3.70	8.00	4	4	0
3.75	10.00	182	167	15
3.75	12.00	200	182	18
3.75	14.00	1	1	0
3.30	12.00	38	35	3
4.10	8.00	2	2	0
4.10	10.00	101	88	13
4.10	12.00	193	177	16
Total		721	656	65

Table 1a



Case 1—Fig. 1: The 54-year-old female patient had an extreme periodontal defect at tooth #44 with bone loss at the apical side. Fig. 2: Radiographic close-up. Fig. 3: Final result.

Jaw	Regions	No.
Upper	17–14	48
	13–11	149
	21–23	151
	24–27	64
Lower	47–44	150
	43–41	9
	31–33	9
	34–37	141

Table 1b

factors have to be taken into consideration, such as bone type and quality, bone density, placement and location of the inserted implants (Tables 1a & b), the patient's personal situation, health risks and unrelated diseases, such as diabetes.¹

On smoking

Smoking tobacco reduces leucocyte activity. It has an influence on blood vessels and reduces the body's healing capacity and osseointegration of dental implants. Smoking has a direct influence on osteoblastic function.² The exact mechanism by which smoking compromises wound healing is still unknown. Smoking enhances the risk for ingress of bacteria which may cause peri-implantitis. It is hypothesised that nicotine and chemicals contained in tobacco smoke induce a state of oxidative stress in the tissue (gingiva and alveolar bone) around implants.^{3,4} Abstinence from smoking should be extended to at least eight weeks after

the implantation in order to promote osseointegration.

Materials and methods

We assessed 181 patients (97 women and 121 men with an average age of 49.2 years) with 721 implants. In detail, 384 bone-level implants, 289 bone-level tapered implants and 48 tissue-level implants were inserted (Table 2). The implants were classified according to their location in the upper and lower jaws. As for the smoking history of the patients, the number of cigarettes smoked per day ranged from 20 to 60 cigarettes.

Surgical technique

Implant placement was performed under local anaesthesia (40mg of Dexamethasone, intramuscular; ratiopharm) after premedication with antibiotics. The osteotomy was extended gradually according to the intended implant diameter. After carrying out the incision, the oral cavity was cleaned and necrotic or inflammatory tissue was removed. The osteotomy sites were prepared with a sequential order of drills, as recommended by the manufacturer. Implants were inserted in the prepared osteotomy sites at an insertion torque of 45 Ncm.

Postoperative treatment

Postoperative periapical radiographs were taken, which confirmed the accuracy of the implant placement. Postoperative medication included antibiotics. Digital radiographic images were taken



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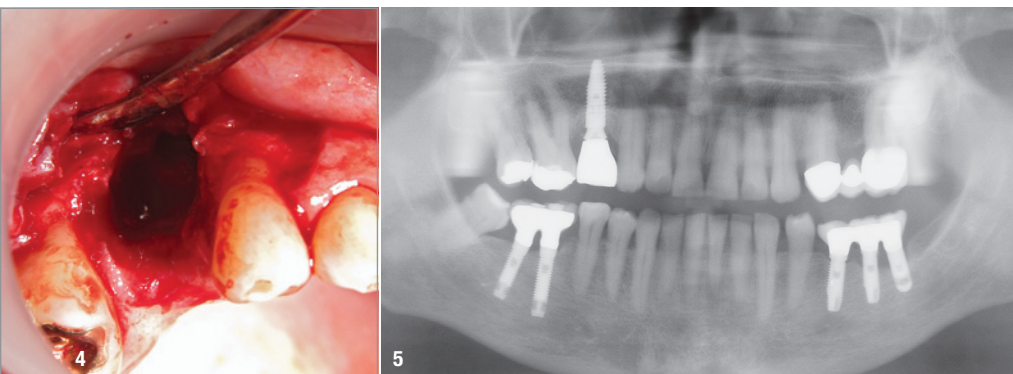
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Case 2—Fig. 4: Defect situation after explantation and guided bone regeneration in a 67-year-old male patient who smoked 42 cigarettes per day and suffered bone loss 27 years after implantation. **Fig. 5:** Implant with a new crown.



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DENTAL IMPLANTS

Type	Diameter (mm)	Length (mm)	No.
Bone-level	3.30	8	0
	3.30	10	0
	3.30	12	47
	3.75	8	9
	3.75	10	43
	3.75	12	62
	4.10	8	18
	4.10	10	94
	4.10	12	92
	4.10	14	7
	4.80	8	4
	4.80	10	4
	4.80	12	4
Bone-level tapered	3.30	8	0
	3.30	10	0
	3.30	12	29
	3.75	8	4
	3.75	10	48
	3.75	12	97
	4.10	8	19
	4.10	10	39
	4.10	12	50
	4.10	14	3
	4.80	8	0
	4.80	10	0
	4.80	12	0
Tissue-level	3.30	8	0
	3.30	10	0
	3.30	12	6
	3.75	8	0
	3.75	10	0
	3.75	12	0
	4.10	8	8
	4.10	10	9
	4.10	12	22
	4.10	14	0
	4.80	8	0
	4.80	10	0
	4.80	12	0
Tissue-level ROX-CERA	3.30	8	0
	3.30	10	0
	3.30	12	0
	4.10	8	0
	4.10	10	1
	4.10	12	0
Tissue-level WP	4.80	8	0
	4.80	10	0
	4.80	12	2

Table 2

at the time of surgery, after 24 hours and one month later in order to evaluate the success of the implant treatment. Inflammatory processes were found in 24.1% of the patients. If necessary, augmentation was done by means of NanoBone (Artoss), Geistlich Bio-Oss bone substitute and Geistlich Bio-Gide membranes (both Geistlich Biomaterials).

Indication for implants

The indications for inserting implants in our study were as follows:

- treatment of the edentulous jaw;
- single-tooth replacement;
- treatment of larger interdental gaps; and
- free-end situation.

Results

Of the 721 implants inserted, 65 implants failed. Conclusively, the success rate was at 90.98%, which is lower compared with our previous study on non-smokers, in which the success rate was 98.70%.² In the group of failed implants, most of them (75.4%) were lost two to four weeks after implant placement owing to a lack of osseointegration. Peri-implantitis occurred in 20% of the failed implants. This could be traced back to poor oral health and plaque formation. In 4.6% of the cases,



Case 2—Fig. 6: Cemented crown *in situ*. Fig. 7: Final result.

peri-implantitis occurred between one and three years after implant placement owing to mechanical issues after bone loss. There was no correlation to be found between implant length and diameter and the implant failure rate, and neither did we find a correlation between the number of cigarettes smoked and the implant failure rate.

Discussion

As established earlier, the failure rate of dental implants in smokers is higher than in non-smokers, which is due to lack of early osseointegration and the occurrence of peri-implantitis. Peri-implantitis was obvious in 62 cases included in our study. Failed osseointegration was the main reason for implant failure. However, in conclusion, it must be stated that the results we obtained were excellent.

Dental implant therapy is a treatment of choice for treating patients with missing teeth. However, certain conditions, such as smoking, hypertension and diabetes, have a negative influence on the success of dental implants. Nicotine is found to cause osteoclastic changes. Based on the cases described here and the results in other patients, it can be concluded that today good results can be obtained in heavy smokers. It is difficult to evaluate the role of a single risk factor such as smoking regarding positive treatment outcomes of dental implants, since many patients have additional co-risk factors, including diabetes, advanced age or low bone density. In addition, there is great variance in smoking behaviour regarding the actual number of cigarettes smoked per day and the years for which a patient has been smoking. Furthermore, the location of implants, placed in either the maxilla or the mandible, may have an influence on osseointegration success. Marginal bone loss around implants placed in smokers is more pronounced in the maxilla. Implant failure may vary with implant location in connection to the quality and quantity of the alveolar bone in which the implant is placed. The alveolar bone varies in terms of mineral density, microarchitecture and trabecular bone thickness.

In the relevant literature, it is reported that smoking of more than 30 cigarettes per day and for a duration of longer than ten years promotes implant failure. There is little data available, however, on passive smoking and ex-smokers in this regard.

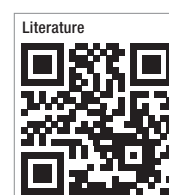
Summary and outlook

The risk of implant failure increases with increasing number of cigarettes smoked per day. We found a correlation between heavy smoking and implant loss. Smoking influences the survival rate of dental implants. Thus, patients should be educated thoroughly and be advised to discontinue the habit before implant placement can be carried out.

Conflict of interest: Dr Inge Schmitz declares that she has no conflict of interest.

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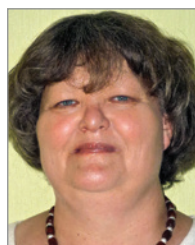
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about the authors



Dr Branislav Fatori has more than 41 years of experience in implantology and has placed more than 8,000 implants. He was trained at prominent clinics in Germany, the US, Sweden, Serbia and Switzerland. In addition, he has worked as a long-term training consultant for professional societies and implant manufacturers.



Dr Inge Schmitz has worked at the Institute of Pathology of the Ruhr-University Bochum in Germany since 1990. Her main interests are implant dentistry, stents, electron microscopy and osteology. She studied biology at the Ruhr-University Bochum and completed her PhD in anatomy at the University of Essen in Germany in 1989.

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