

ORIGINAL ARTICLE

The effect of smoking and nonsmoking on bone healing (Osseo integrated phase) around locking-taper dental implants

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ABSTRACT

Background: It has been shown that smoking habits characterize an increased risk for impaired Osseo integration or bone healing and finally implant failure.

Purpose: The aim of this retrospective clinical study was to investigate the impact of cigarette smoking and nonsmoking on the bone healing around locking-taper dental implants.

Materials and Methods: A retrospective analysis was made over a 4 years and 9 months period of the clinical and radiographic findings corresponding to 54 consecutive patients (34 women and 20 men) who had received a total of 162 implants. Patients were divided into two groups: Smokers, 20 patients (received 72 implants); and nonsmokers (NS), 34 patients (received 90 implants). Smokers were identified as people smoking > 15 cigarettes per day. The success and failure cases were evaluated and studied. The data were analyzed using descriptive statistics.

Results: Four implants out of 162 implants (2.46%) failed and had to be removed.

Conclusions: Within the limitations of this study, the results indicated a high success rate 97.5% (158/162). No real difference in proportion of failure of implant placement both smokers and NS ($P = 0.8577$).

KEY WORDS: Implant, nonsmoking, Osseo integration, smoking

INTRODUCTION

Different types of Osseo integrated dental implants have proven to be an effective treatment modality since the second half of the past century (20th century).^[1]

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Survival rates for the implants are relatively high in normal healthy individuals and nonpathological bone. Longitudinal studies have reported endurance and success rates around 90–95% for endosseous dental implants.^[2] However, the occurrence of failure may be encountered. Because of the growing demand for endosseous implants, their failure is becoming one of the most challenging implant complications of our times.

Implant failure is generally defined as the mobility of the implant either in the Osseo integrated period (early failure) or in the postloading period (late failure).^[3]

Peri-implant radiolucency, pain, discomfort, and/or persistent infection at the implant site are the most common features of implant failure.^[4]

Osseo integrated period represents a dynamic process both during its establishment and its maintenance, even implants which initially integrate well, may occasionally show unexpected mobility and finally fail to complete Osseo integration - implant failure.^[5]

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Failure of Osseo integration of dental implant is often correlated with poor bone quality, surgeon experience, compromised patients, implant quality, and smoking.^[6]

Failure postloading may occur due to peri-implantitis and implant over load.^[7]

It is well-documented that cigarette smoking is associated with impaired wound healing surgery in the oral cavity, resulting in accelerated bone resorption, increased bone loss rate and reduced bone height of the alveolar ridge.^[7,8]

A great incidence of dental implant failures in the Osseo integrated period (implant-bone healing stage) in the upper jaw of smokers is more than in nonsmokers (NS) (9–1%, respectively) and higher rates of postloading period failures (11.28–4.76% for smokers and NS, respectively) have been reported.^[8]

Gorman *et al.*^[9] recognized the relationship between cigarette smoking and the failure rates of endosseous dental implants at postloading period. They recommended that smoking is unfavorable to dental implant success.^[6–9] When thoroughly reviewing the available literature for the clinical studies of the relationship between smoking habit and success of locking-taper dental implant in the Osseo integrated period (implant - bone healing phase), no studies have been reported in the Middle East and North Africa (MENA) region. The aim of this retrospective clinical longitudinal study was to evaluate the survival and failure rates at 3 months (Osseo integration phase) of locking-taper dental implants placed in different sites of the mandible and the maxilla in cigarette smoking and nonsmoking patients.

Not only is the purpose of this paper to test failure and success rates in smokers and NS in relationship to locking-taper dental implants, but also to test the hypothesis: The difference in failure rates between smokers (S) and NS groups in locking-taper dental implants are insignificant when all other factors are held constant.

MATERIALS AND METHODS

This retrospective clinical longitudinal study was conducted at the private consultant clinic of Oral and Maxillofacial surgery in Beirut, Lebanon. The patients were selected according to specific inclusion and exclusion criteria. The inclusion criteria were: Missing or failing teeth in the maxilla and mandible (from central incisive to second molar) and sufficient amount of bone to allow for replacement of an implant with the

minimum dimensions of 3.5 mm × 11.0 mm. However, bone augmentation to fill the gap between the implant and the extraction socket and/or to coat bared implant threads was included as a part of the study. The exclusion criteria were patients: With systemic disorders, mentally disabled individuals, patients who had had renal, liver and bone marrow transplants, drug dependency, psychological problems, a history of head and neck radiation and chemotherapy treatment; and insufficient bone quantity that requested block bone augmentation before implant placement.

Fifty-four consecutive patients (34 women; mean age 46.3 years and 20 men; mean age 49.5 years all Lebanese) with a mean age of 47.9 years (range of 28–70 years) underwent immediate and late implant placement in different sites of the jaws. 162 titanium hydroxyapatite-coated locking-taper Bicon Dental Implants with different dimensions; 3.5 mm × 11.0 mm, 4.0 mm × 8.0 mm, 4.0 mm × 11.0 mm, 4.5 mm × 6.0 mm, 4.5 mm × 8.0 mm, 4.5 mm × 11.0 mm, 5.0 mm × 8.0 mm, 5.0 mm × 11.0 mm, and 6.0 mm × 5.7 mm were used. 41 implants were placed in the maxillary bone, and 121 implants positioned in the mandibular bone. The size and the number of the placed implants are shown in Table 1.

Patients were divided into two groups: Smokers (group S); 20 patients (11 women, and 9 men) received 72 implants (44.4% of the sample), and NS (group NS) 34 patients (23 women and 11 men) received 90 implants (55.5% of the sample). Smokers were identified as people smoking >15 cigarettes per day. All patients received diagnostic procedures (medical history, clinical observations were recorded and panoramic radiographs and Dento-scan in special cases were examined) and treatment planning information and consented to the treatment.

Surgery was performed under local infiltration and regional nerve blocks anesthesia with

Table 1: Size and number of implants placed in 54 patients

Size of locking-taper implants diameter×length (mm)	Number of implants placed
6×5.7	1
3.5×8	0
3.5×11	2
4×8	1
4.5×8	72 (two implants failed)
4.5×11	18 (one implant failed)
4×11	25 (one implant failed)
5×11	4
5×8	39
Total	162 (four implants failed)

Xylocaine (Lidocaine 2% with 1:100,000 Epinephrine). Following the preparation of the operative site with chlorhexidine digluconate 0.2% (Perio-Kin; Laboratories Kin S.A, Spain) a full-thickness mucoperiosteal flap was raised to place the intended dental implants. Appropriate antibiotic (Dalacin 300 mg, taken orally 2 times daily for 1-week) and anti-inflammatory and analgesic (proxen 500 mg tablets or equivalent taken orally every 4–6 h as needed for pain, in cases Proxen is contraindicated, paracetamol group was the drug of choice) regimens were prescribed. The patients were instructed not to brush the surgical site, but rinse with 0.2% chlorhexidine digluconate, and consume a liquid diet for 2 weeks. A soft diet was recommended for the remaining duration of the implant healing phase (Osseo integrated period). The patients were advised against functioning in the surgical site for at least 2 weeks. Implants received by the same patient were considered as different observations since different places in the same mouth might have different characteristics as to bone quality.

Patients were monitored clinically and radiographically for implant success and failure throughout the Osseo integrated period. All examinations and data collections were performed by one examiner at the previously mentioned center. Clinical evaluations were made at 0, 1-week, 1-month, 2 months, and radiographically at 3 months (unless otherwise noted) after implant placement.

A successful implant is an implant which did not cause serious allergic, toxic or gross infections, either locally or systematically, lack of mobility offered anchorage for a functional prosthesis, and showed no signs of radiolucency at 3 months on an intra or extraoral radiographs. In the absence of these features, this means implant failure. Two types of implant failure are mentioned: Early and late (postloading) failure. Early failure is a failure of Osseo integration period. Data were analyzed with descriptive statistics (proportion, test for difference in population proportions between population of smokers and that of NS).

RESULTS

The implant survival and failure rates of smokers (20 patients with $N_1 = 72$ implants; group S) and NS (34 patients with $N_2 = 90$ implants; group NS) patients are presented in a life table [Table 2 and Figure 1]. Four implants out of 162 implants (2.46%) had lost Osseo integration. This corresponds to an overall implant success rate of 97.54%. The four failed implants (one implant in the maxilla and three implants in the mandible) were belonging to two men and two women. The sizes (diameter × length; mm) of the failed implants were: One implant of 4.0 mm × 11 mm, two implants of 4.5 mm × 8.0 mm and one implant 4.5 mm × 11 mm.

In smoker patients (group S), 3 implants out of 72 implants (4.16%) had been lost; it was removed because of acute infection. Radiographic as well as clinical examination confirmed Osseo integration of the 69 implants, with a survival rate of 95.83%.

In NS patients (group NS), one implant out of 90 implants (1.11%) did not Osseo integrate. 89 implants (98.88%) had passed Osseo integration phase.

The multivariate tests of significance revealed that there is no significant difference between the proportion of failure in smokers and NS when the significance level is measured at $\alpha = 0.10, 0.05$, and 0.01 , respectively. Hence, we have a reason to believe that the difference in failure rates between smokers (S) and NS is not significant when all other factors are held constant.

DISCUSSION

In this retrospective study, 162 taper-locking dental implants with unlike sizes placed in different sites of the mandible and maxilla of 54 patients (34 women, 20 men). The purpose of this study was to evaluate the impact of smoking and nonsmoking on bone healing around nonscrew Bicon Dental Implants at the Osseo integrated period. The survival and failure rate of different implant systems in the Osseo integration and postloading period have been documented in many studies, both in mandibles and maxillae.^[1,2,4,7] Owing to the remarkable success of dental implants, there has been growing interest in identifying the factors associated with implant failure.^[1,5] Failure of Osseo integration is often correlated with: Poor bone quality, surgeon skills and experience, quality of implants, and patient's general health.

Table 2: Life table of success and failure rate for implants ($n=n_1+n_2=162$)

Subjects	Time (Osseo integrated phase)	Number of implants (%)	Failed (%)	Succeed (%)
Smokers: 20	0–3 months	$n_1=72$	3 (4.16)	69 (95.83)
Nonsmokers: 34	0–3 months	$n_2=90$	1 (1.11)	89 (98.88)
Total: 54	0–3 months	$n=162$ (100)	4 (2.46)	158 (97.53)

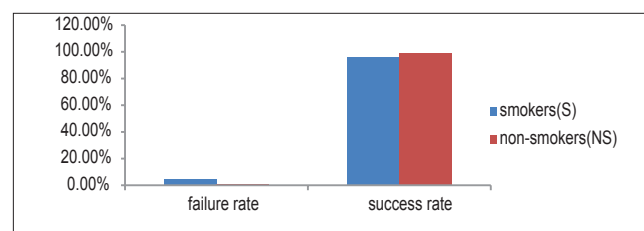


Figure 1: The implant success and failure rates of smokers and nonsmokers

Given the well-documented deleterious effect of smoking on wound healing after tooth extraction and its association with poor quality bone and periodontal^[3,7] diseases, a negative effect of tobacco use on implant success is to be expected. The impact of tobacco smoking and nonsmoking on healing bone around press-fit Bicon Dental Implants in MENA region patient has not evaluated yet.

Several studies have suggested smoking as a crucial factor in early implant failure.^[4,6,8] Smoking is a significant although not the only important factor in the failure of implants prior to functional loading.^[10] Greater incidences of implant failures before loading in the upper jaw of smokers than in NS (9% and 1%, respectively) have been reported.^[8]

César-Neto *et al.*^[8] reported that smoking habits represent an increased risk for impaired bone healing and implant failure.

Baig and Rajan^[6] evaluated the relationship of tobacco smoking and the failure rates of dental implants. They suggested that smokers have higher failure rates and complications following dental implantation and implant-related surgical procedures and that the failure rate of implants placed in grafted maxillary sinuses of smokers is more than twice that seen in NS. Bain and Moy^[11] suggested that smoking has been shown to compromise a patient's healing potential. The majority of the implant literature published in English between 1990 and 2006 implicates smoking as one of the prominent risk factors affecting the success rate of dental implants with only a handful of studies failing to establish a connection.^[6,12] The results of the present study contrast with these previous data since it was found that in NS patients (group NS), one implant out of 90 implants (1.11%) did not Osseo integrate while in smoker patients three out of 72 implants (4.16%) failed to Osseo integrate, which means a small difference. When this difference in failure proportion between smoker's population and that of NS is measured, the difference is shown to be negligible. To finalize, the different factors that influence the implant failure were taken into consideration. When it comes to bone quality, all implants, regardless of smoking a habit of patient, have been tested for required quality before performing any surgical operation. Taking the surgeon's skills and experience into consideration, all operations were implemented by the same surgeon who neutralizes the influence of this factor. Quality of implants was of locking-taper type which is consistent among all patients. The last factor patient's health was checked before any surgical action which means that only patients with good health were included in this study. Hence, this study was

done under controlled conditions which were equal at all levels and factors except for the smoking habit factor. This validates the results as correlated with a smoking habit as the discriminating factor.

CONCLUSIONS

Within the limitations of this study, it was concluded that 2.4% (4/162) risk of implant failure during the Osseo integration stage among smokers and NS slightly affected the overall success rate of the replaced implants (162 implants). No real difference in proportion of failure of implant placement both smokers and NS ($P = 0.8577$). Despite the results of this retrospective study, patients should be informed of the adverse effects of smoking.

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