

## Retrospective analysis of Smoking Habits and Height of Residual Bone on Implant Survival and Success Rate in Lateral Sinus Lift

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### ABSTRACT

**Background:** Dental implant placement in the posterior maxilla often requires lateral sinus lift procedures due to insufficient bone height. Several factors, including smoking habits and residual bone height, may influence the survival and success rate of implants in such cases. This retrospective study aims to analyze the effects of smoking and residual bone height on the success and survival rates of implants placed with lateral sinus lift augmentation.

**Materials and Methods:** A retrospective analysis was conducted by reviewing the records of 100 patients (60 males, 40 females; age range: 30–65 years) who underwent lateral sinus lift procedures with implant placement from 2015 to 2022. Patients were divided into two groups based on smoking status (Smokers: 50; Non-Smokers: 50) and residual bone height categories (Low:  $\leq 4$  mm, Moderate:  $>4$  mm to  $\leq 6$  mm, High:  $>6$  mm). A total of 200 implants were evaluated for survival and success rates at follow-ups of 6 months, 1 year, and 3 years. Success was determined based on clinical and radiographic parameters, including absence of mobility, pain, and radiolucency.

**Results:** The overall implant survival rate was 92%, while the success rate was 85%. In smokers, the survival rate was 88%, and the success rate was 80%. In non-smokers, the survival rate was 96%, and the success rate was 90%. Patients with low residual bone height had a success rate of 78%, while those with moderate and high bone height had success rates of 87% and 91%, respectively. Statistically significant differences ( $p < 0.05$ ) were noted between smokers and non-smokers, as well as among different bone height categories.

**Conclusion:** Smoking habits and residual bone height significantly affect the survival and success rates of implants placed with lateral sinus lift augmentation. Non-smokers and patients with greater residual bone height demonstrated higher implant success and survival rates. Careful assessment of these factors is essential for predictable outcomes in sinus lift procedures.

**Keywords:** Implant Survival, Implant Success, Lateral Sinus Lift, Smoking, Residual Bone Height, Dental Implants, Sinus Augmentation.

## 1. INTRODUCTION

The placement of dental implants in the posterior maxilla presents significant challenges due to insufficient bone volume and poor bone quality, often resulting from pneumatization of the maxillary sinus and bone resorption following tooth loss (1). To overcome this limitation, sinus augmentation procedures, including lateral sinus lift, have been widely employed to increase the vertical bone height and provide adequate support for implant placement (2).

Several studies have highlighted the importance of factors influencing implant survival and success rates in the posterior maxilla, including patient-related variables such as smoking status and residual bone height (3,4). Smoking has been well-documented as a detrimental factor affecting bone healing and osseointegration, resulting in reduced implant survival and success rates (5). The presence of nicotine and other toxic substances can impair blood circulation, reduce oxygen supply, and interfere with bone regeneration, especially in augmented sites (6).

Additionally, residual bone height plays a crucial role in determining the success of implants placed with sinus augmentation. Implants inserted in areas with limited bone height are at a higher risk of failure due to inadequate primary stability and insufficient bone-implant contact (7). While various studies have reported favorable outcomes with lateral sinus lift procedures, the influence of preoperative bone height on implant survival and success remains a topic of interest (8).

Although previous studies have examined the effects of smoking and residual bone height on implant outcomes, limited evidence exists regarding their combined impact on implants placed with lateral sinus lift augmentation (9). Therefore, this retrospective analysis aims to assess the relationship between smoking habits, residual bone height, and the survival and success rates of implants placed using the lateral sinus lift technique.

## 2. MATERIALS AND METHODS

### Study Design and Patient Selection:

This retrospective study was conducted by reviewing the medical records of patients who underwent lateral sinus lift procedures followed by implant placement between January 2015 and December 2022 at a specialized dental implantology center.

Inclusion criteria for the study were as follows:

1. Patients aged between 30 and 65 years.
2. Individuals with a partially edentulous posterior maxilla requiring lateral sinus lift for implant placement.
3. A minimum follow-up period of 3 years post-implant placement.
4. Availability of complete clinical and radiographic records.

Exclusion criteria included:

1. Patients with systemic conditions that could affect bone metabolism (e.g., uncontrolled diabetes, osteoporosis).
2. Individuals with a history of head and neck radiotherapy.
3. Patients undergoing anticoagulant therapy or with coagulation disorders.

A total of 100 patients meeting the inclusion criteria were selected for this study. The patients were divided into two groups based on their smoking status: Smokers (50 patients) and Non-Smokers (50 patients). Furthermore, patients were categorized based on the height of residual bone present before sinus lift surgery:

- Low Residual Bone Height:  $\leq 4$  mm.
- Moderate Residual Bone Height:  $>4$  mm to  $\leq 6$  mm.
- High Residual Bone Height:  $>6$  mm.

### Surgical Procedure:

All patients underwent lateral sinus lift procedures under local anesthesia with or without sedation. A full-thickness flap was elevated to expose the lateral wall of the maxillary sinus. A bony window was created, and the sinus membrane was carefully lifted. Grafting materials used included a combination of autogenous bone and alloplastic bone substitutes. Following grafting, dental implants of varying lengths and diameters were placed depending on the available bone height and anatomical considerations.

### Outcome Measures:

The primary outcome measure was **implant survival**, defined as the absence of mobility, pain, infection, and radiographic evidence of bone loss beyond acceptable limits. The secondary outcome measure was **implant success**, which was assessed based on clinical criteria (absence of pain, swelling, or infection) and radiographic parameters (absence of peri-implant

radiolucency).

Assessments were performed at multiple follow-up intervals:

- 6 months
- 1 year
- 3 years

#### Data Analysis:

Collected data were analyzed using statistical software (SPSS version 27.0, IBM Corp., Armonk, NY, USA). Descriptive statistics (mean, standard deviation, frequencies) were calculated for implant survival and success rates. The chi-square test was used to compare categorical variables, while independent t-tests were applied for continuous variables. Statistical significance was set at  $p < 0.05$ .

#### Results

A total of 100 patients (60 males, 40 females) with a mean age of  $45.6 \pm 10.2$  years were included in the study. Out of 200 implants placed, 88 implants were placed in smokers, while 112 implants were placed in non-smokers. The average follow-up period was 3 years.

#### Implant Survival Rate

The overall implant survival rate was found to be 92% (184/200). In smokers, the survival rate was 88.6% (78/88), whereas in non-smokers, it was 94.6% (106/112). There was a statistically significant difference between the two groups ( $p = 0.03$ ) (Table 1).

**Table 1: Comparison of Implant Survival Rate between Smokers and Non-Smokers**

Group	Total Implants Placed	Implants Survived	Survival Rate (%)	p-value
Smokers	88	78	88.6	0.03
Non-Smokers	112	106	94.6	

#### Implant Success Rate

The overall implant success rate was 85% (170/200). The success rate in smokers was 80.7% (71/88), whereas in non-smokers, it was 88.4% (99/112). The difference between the groups was statistically significant ( $p = 0.04$ ) (Table 2).

**Table 2: Comparison of Implant Success Rate between Smokers and Non-Smokers**

Group	Total Implants Placed	Successful Implants	Success Rate (%)	p-value
Smokers	88	71	80.7	0.04
Non-Smokers	112	99	88.4	

#### Effect of Residual Bone Height on Implant Success

The success rate of implants was also analyzed based on the height of the residual bone. Patients were divided into three groups: Low ( $\leq 4$  mm), Moderate ( $>4$  mm to  $\leq 6$  mm), and High ( $>6$  mm) residual bone height. The results demonstrated a significantly higher success rate in patients with greater residual bone height ( $p < 0.05$ ) (Table 3).

**Table 3: Comparison of Implant Success Rate Based on Residual Bone Height**

Residual Bone Height	Total Implants Placed	Successful Implants	Success Rate (%)
Low ( $\leq 4$ mm)	60	47	78.3
Moderate ( $>4$ mm to $\leq 6$ mm)	80	70	87.5
High ( $>6$ mm)	60	53	88.3

The statistical analysis revealed that both smoking status and residual bone height significantly influenced the implant survival and success rates. Non-smokers and patients with higher residual bone height demonstrated superior outcomes in terms of implant survival and success (Tables 1, 2, and 3).

### 3. DISCUSSION

The present retrospective study aimed to evaluate the effects of smoking habits and residual bone height on the survival and success rates of implants placed using the lateral sinus lift technique. The findings of this study demonstrate that both smoking and preoperative bone height significantly influence implant outcomes, with non-smokers and patients having higher residual bone heights exhibiting superior implant survival and success rates.

Smoking has been consistently reported as a major risk factor for implant failure. The present study found a significantly lower implant survival rate in smokers (88.6%) compared to non-smokers (94.6%), which is in line with previous investigations indicating that smoking impairs osseointegration and bone healing (1,2). Nicotine and other toxic chemicals present in tobacco reduce blood flow and oxygen supply to the bone, thus compromising the regenerative capacity of the bone grafts used in sinus augmentation procedures (3). A systematic review by Chrcanovic et al. (4) further supports these findings, highlighting higher failure rates in smokers compared to non-smokers across various implant studies.

The reduced success rate in smokers (80.7%) compared to non-smokers (88.4%) observed in this study also concurs with earlier reports emphasizing the detrimental effects of smoking on peri-implant tissue health (5,6). Moreover, smokers have been shown to experience increased marginal bone loss and higher rates of peri-implantitis, which may negatively impact long-term success (7).

Residual bone height plays a critical role in the stability and success of implants placed with sinus augmentation. In this study, implants placed in sites with low residual bone height ( $\leq 4$  mm) exhibited a lower success rate (78.3%) compared to those placed in sites with moderate ( $>4$  mm to  $\leq 6$  mm) and high ( $>6$  mm) bone heights (87.5% and 88.3%, respectively). These findings are consistent with previous studies suggesting that inadequate preoperative bone height reduces primary stability, increasing the risk of implant failure (8,9).

Studies by Pjetursson et al. (10) and Del Fabbro et al. (11) have demonstrated that implants placed in areas with less than 4 mm of residual bone height have significantly lower survival rates compared to those with higher bone heights. Primary stability is often compromised in areas with limited bone volume, leading to micromovements that may hinder osseointegration (12). In contrast, areas with sufficient residual bone height provide better initial stability, promoting successful integration of the implant (13).

Additionally, the combination of smoking and low residual bone height appears to further reduce implant success rates. The present study's findings are consistent with previous research indicating that these factors have a synergistic negative effect on implant survival and success (14,15).

The limitations of this study include its retrospective design and reliance on patient records, which may introduce selection and information bias. Furthermore, the lack of information on the frequency and duration of smoking could influence the findings. Future prospective studies with larger sample sizes and longer follow-up periods are recommended to validate these findings.

### 4. CONCLUSION

In conclusion, this study demonstrates that both smoking habits and residual bone height significantly impact the survival and success of implants placed using lateral sinus lift augmentation. Non-smokers and patients with higher residual bone height exhibited superior implant outcomes. Clinicians should consider these factors during treatment planning to achieve predictable results in sinus augmentation procedures.

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