Influence of smoking and oral hygiene on success of implants placed after direct sinus lift

Abstract

Objective

The objective of this study was to evaluate the influence of smoking and oral hygiene on the success and periimplant marginal bone loss of implants placed in one-stage and two-stage direct sinus lift procedures.

Materials and methods

A retrospective clinical study of patients who underwent direct sinus lift and implant placement was conducted. Forty-six patients with 58 direct sinus lifts were included and a total of 102 implants were placed. Cigarette consumption was quantified and the level of oral hygiene determined at the time of surgery using a simplified calculus and plaque index. Bone loss and implant success (according to Buser’s criteria) were monitored after 12 months of prosthetic loading.

Results

The success rate for implants placed after direct sinus lift was 93.1% at 12 months. There was a higher success rate in nonsmokers (94.2%) than in smokers (90.9%), with a mean bone loss of 0.52 mm (range: 0.21–0.84 mm) in nonsmokers and 0.60 mm (0.24–0.92 mm) in smokers at the 12-month follow-up. The success rate in patients with poor oral hygiene was lower (81.8%) than in patients with good (95.5%) or regular hygiene (92.3%). Furthermore, there was a mean bone loss of 0.51 mm (0.21–0.82 mm) in patients with good oral hygiene, 0.57 mm (0.24–0.82) with regular hygiene and 0.66 mm with poor hygiene (0.32–0.92 mm). There was no statistically significant relationship (\( p > 0.05 \)) between bone loss or implant success and smoking or oral hygiene.

Conclusion

Within its limitations, the present investigation suggests that smoking and poor oral hygiene may negatively influence the outcome of implants placed both in one-stage and two-stage direct sinus lift procedures. However, differences were in no case statistically significant and studies with larger sample sizes should be conducted to corroborate or refute these findings.

Keywords

Sinus lift, oral hygiene, smoking, bone loss.
Materials & methods

The study was approved by the University of Valencia ethics committee (#H141026222693). All patients gave written informed consent before surgery, in accordance with the principles of the Declaration of Helsinki.

Study sample

A retrospective clinical study was performed between September 2009 and June 2012 of patients treated with dental implants placed in one-stage (simultaneous) and two-stage (delayed) direct sinus lift procedures. A minimum follow-up period of 12 months after implant loading was requested. Patients who failed to attend scheduled follow-up visits were excluded.

Surgical procedures

All of the procedures were performed by two expert surgeons, professors at the Oral Surgery Unit, Department of Stomatology, University of Valencia, under local anesthesia with 4% articaine and 1:100,000 epinephrine (Laboratorios Inibsa, Lliçà de Vall, Spain). Full-thickness flaps were raised. A window in the sinus lateral wall was made with round tungsten carbide burs and finalized with ultrasonic tips. The sinus membrane was detached with curettes and elevated using a bone graft material. A xenograft (Geistlich Bio-Oss, Geistlich Pharma, Wolhusen, Switzerland) was used as the only bone graft material (1.5–2 g). The sinus window was covered with a resorbable membrane (Geistlich Bio-Gide, Geistlich Pharma, Wolhusen, Switzerland). The implants used in this study were TSA implants with an Avantblast surface (Phibo Dental Solutions, Sentmenat, Spain). Implants were placed in the same surgery if the residual bone height was 4–6 mm, or delayed by six months if the height was < 4 mm.

All of the patients were prescribed the same postoperative medication: amoxicillin and clavulanic acid (Augmentin, GlaxoSmithKline, Madrid, Spain) 500 mg/8 h for seven days, ibuprofen (Bexistar, Laboratorio Barcino, Barcelona, Spain) 600 mg/8 h for three days, and a 0.12% chlorhexidine mouthrinse (GUM, Sunstar Americas, Chicago, Ill., U.S.) t.i.d. for seven days.

Data collection

Patient oral hygiene was evaluated using the Simplified Oral Hygiene Index (OHI-S).24 This was obtained by measuring the presence of debris and calculus on the buccal surfaces of the maxillary right central incisor, mandibular left central incisor and maxillary first molars, as well as on the lingual surfaces of the mandibular first molars. The criteria for classifying debris were as follows: no debris, no stains (0); soft debris covering less than one-third of the tooth surface (1); soft debris covering more than one-third, but less than two-thirds of the exposed tooth surface (2); and soft debris covering more than two-thirds of the exposed tooth surface (3). The criteria for classifying calculus were as follows: no calculus (0); supragingival calculus covering less than one-third of the exposed tooth surface (1); supragingival calculus covering more than one-third, but less than two-thirds of the exposed tooth surface (2); and supragingival calculus covering more than two-thirds of the exposed tooth surface (3). The OHI-S was obtained from the combination of the two subindices. The grading scale was 0–1.2 (good oral hygiene), 1.3–3 (regular oral hygiene), or 3.1–6 (poor oral hygiene). Each patient was classified as having good oral hygiene, regular oral hygiene or poor oral hygiene.

The implant success rate was recorded according to the clinical and radiographic criteria of Buser et al.25 Implants were classified as successful if they fulfilled all of the criteria (absence of clinically detectable implant mobility, absence of pain or any subjective sensation, absence of recurrent periimplant infection, and absence of continuous radiolucency around the implant after 12 months of loading) and as failed if any criterion was not met.

Radiographic examination was performed with an X-Mind intra-oral system (ACTEON MÉDICO-DENTAL IBERICA, Sentmenat, Spain) and an RVG intra-oral digital receptor (RVG 5100, Carestream Dental, Atlanta, Ga., U.S.). In order to reproduce the patient alignments, the Rinn XCP system (DENTSPLY, Des Plaines, Ill., U.S.) was used with a bite registration material in the area in which the parallelometer was fixed. Marginal implant bone loss was measured in millimeters using the RVG software. For measurement purposes, two visible and easily locatable reference points were selected at the junction point between the implant and prosthetic restoration. A straight line was traced between these two reference points.
and was considered to represent zero height. In order to determine bone loss, a perpendicular line was traced mesial and distal to the implant from zero height to contact with the bone (Fig. 1). The difference between the value recorded at the time of implant loading and after one year of loading was used to calculate bone loss mesial and distal to the implant. The largest value, either mesial or distal, was used as the bone loss value for that implant (Fig. 2).26

Smoking and oral hygiene were recorded at the time of surgery. A patient who smoked > 1 cigarette/day was considered a smoker following the definition by Wallace.27 Bone loss and success were recorded at 12 months of prosthetic loading.

Statistical analysis

A descriptive analysis was performed of the study variables, with their corresponding frequency distributions and measures of central tendency and dispersion. Statistical comparisons between the groups were conducted using the chi-squared test and Student’s t-test. The SPSS for Windows statistical software package (Version 15.0; SPSS, Chicago, Ill., U.S.) was used throughout. Statistical significance was considered for \( p < 0.05 \).

Results

Fifty patients treated with direct sinus lift and implants were monitored during the study period. Four patients failed to attend scheduled follow-up visits and were thus excluded. The final sample consisted of 46 patients (16 men and 30 women) with a mean age of 49 (range: 29–69 years). These patients underwent 58 direct maxillary sinus lift procedures and received a total of 102 implants in the grafted sites: 50 were placed simultaneously with the sinus lift procedure and 52 were placed six months thereafter. Implant lengths and diameters are detailed in Table 2.

Seven implants failed, all prior to loading, yielding an overall implant success rate of 93.1% at 12 months of loading. Five of these implants had been placed simultaneously and two implants six months after the grafting procedure. The survival was 90.0% for implants placed simultaneously and 96.2% for delayed implants. Overall, the mean periimplant marginal bone loss was 0.58 mm (range: 0.24–0.95 mm). Implants placed simultaneously had a mean bone loss of 0.62 mm (range: 0.21–0.97 mm) and implants placed in a second procedure of 0.54 mm (range: 0.27–0.93 mm; Table 3).

With respect to smoking, 69 implants were placed in nonsmokers and 33 in smokers. Nonsmokers presented a higher implant success rate at 12 months (94.2%) and lower mean bone loss (0.52 mm; range: 0.21–0.84 mm) than smokers (90.9% and 0.60 mm; range: 0.24–0.92 mm; Table 4). However, these differences were not statistically significant.

In relation to oral hygiene, 47 of the 102 implants were placed in patients with good oral hygiene, 42 with regular and 13 with poor hygiene. In patients with poor oral hygiene, the success rate at 12 months was lower (81.8%), compared with patients with regular (92.3%) or good hygiene (95.5%). Mean bone loss at 12 months was 0.51 mm (range: 0.21–0.82 mm) in patients with good oral hygiene, 0.57 mm (range: 0.24–0.82 mm) in patients with regular hygiene, and 0.66 mm in those with poor hygiene (range: 0.32–0.92 mm; Table 5). The observed differences were in no case statistically significant. The survival rate of implants placed in patients with poor oral hygiene was lower than in patients with regular or good hygiene. These differences were close to statistical significance (\( p = 0.058 \)).
Success of implants placed after direct sinus lift

Table 1

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of patients</th>
<th>No. of implants</th>
<th>Relationship between smoking and implant success (p-value)</th>
<th>Relationship between oral hygiene and implant success (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blomqvist et al.⁸</td>
<td>49</td>
<td>314</td>
<td>0.977</td>
<td>NS</td>
</tr>
<tr>
<td>Jensen et al.⁹</td>
<td>1007</td>
<td>2997</td>
<td>≤ 0.05*</td>
<td>NS</td>
</tr>
<tr>
<td>Kan et al.¹⁰</td>
<td>80</td>
<td>228</td>
<td>0.027*</td>
<td>NS</td>
</tr>
<tr>
<td>Kan et al.¹¹</td>
<td>80</td>
<td>228</td>
<td>0.027*</td>
<td>&lt; 0.05*</td>
</tr>
<tr>
<td>Levin et al.¹²</td>
<td>56</td>
<td>— (143 DSL)</td>
<td>0.08</td>
<td>NS</td>
</tr>
<tr>
<td>Beaumont et al.¹²</td>
<td>45</td>
<td>— (99 DSL)</td>
<td>&gt; 0.05</td>
<td>NS</td>
</tr>
<tr>
<td>Peleg et al.¹³</td>
<td>731</td>
<td>2132</td>
<td>0.394</td>
<td>NS</td>
</tr>
<tr>
<td>Barone et al.¹⁴</td>
<td>70</td>
<td>287</td>
<td>≤ 0.05*</td>
<td>NS</td>
</tr>
<tr>
<td>Huynh-Ba et al.¹⁵</td>
<td>57</td>
<td>116</td>
<td>0.025*</td>
<td>NS</td>
</tr>
<tr>
<td>Lin et al.¹⁶</td>
<td>75</td>
<td>155</td>
<td>≤ 0.05*</td>
<td>NS</td>
</tr>
<tr>
<td>Testori et al.¹⁷</td>
<td>106</td>
<td>328</td>
<td>≤ 0.05*</td>
<td>NS</td>
</tr>
<tr>
<td>Zinser et al.¹⁸</td>
<td>224</td>
<td>1045</td>
<td>0.009*</td>
<td>NS</td>
</tr>
<tr>
<td>Cha et al.¹⁹</td>
<td>161</td>
<td>462</td>
<td>0.0003*</td>
<td>NS</td>
</tr>
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</table>

*Significant differences; **significant differences only for >15 cigarettes/day.

Table 2

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>Diameter (mm)</th>
</tr>
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<tr>
<td>3.6</td>
<td>4.2</td>
</tr>
<tr>
<td>10.0</td>
<td>1</td>
</tr>
<tr>
<td>11.5</td>
<td>10</td>
</tr>
<tr>
<td>13.0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Implant placement</th>
<th>No. of implants</th>
<th>No. failed</th>
<th>12 months after loading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Success rate (%)</td>
</tr>
<tr>
<td>Immediate</td>
<td>50</td>
<td>5</td>
<td>90.0</td>
</tr>
<tr>
<td>Delayed</td>
<td>52</td>
<td>2</td>
<td>96.2</td>
</tr>
<tr>
<td>Total</td>
<td>102</td>
<td>7</td>
<td>93.1</td>
</tr>
</tbody>
</table>

p > 0.05
p > 0.05

Table 4

<table>
<thead>
<tr>
<th>Smoking status</th>
<th>No. of implants</th>
<th>12 months after loading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Success rate (%)</td>
</tr>
<tr>
<td>Nonsmokers</td>
<td>69</td>
<td>94.2</td>
</tr>
<tr>
<td>Smokers</td>
<td>33</td>
<td>90.9</td>
</tr>
</tbody>
</table>

p > 0.05
p > 0.05

Table 5

<table>
<thead>
<tr>
<th>Oral hygiene</th>
<th>No. of implants</th>
<th>12 months after loading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Success rate (%)</td>
</tr>
<tr>
<td>Good</td>
<td>47</td>
<td>95.5</td>
</tr>
<tr>
<td>Regular</td>
<td>42</td>
<td>92.3</td>
</tr>
<tr>
<td>Poor</td>
<td>13</td>
<td>81.8</td>
</tr>
</tbody>
</table>

p > 0.05
p > 0.05

Discussion

Direct maxillary sinus lift is a predictable procedure. Pjetursson et al. performed a systematic review to assess the survival of implants after sinus lift.²⁸ Meta-analysis indicated an estimated annual failure rate of 3.48% (95% confidence interval: 2.48–4.88%), which translated into a three-year implant survival of 90.1% (95% confidence interval: 86.4–92.8%).²⁸ These results are similar to
Success of implants placed after direct sinus lift

those obtained in the present study: a success rate of 93.1% for 102 implants placed after 58
direct sinus lifts.

The mean bone loss at 12 months was
0.62 mm for simultaneously placed implants
and 0.54 mm for those placed in a second
stage. No statistically significant differences
were observed. These results were similar to
those of Felice et al.: one year after loading,
one-stage-treated implants lost an average of
1.01 mm of periimplant bone and two-stage
sites about 0.93 mm.29 Similarly, after one year
of follow-up, Jodia et al.30 reported a marginal
bone loss of between 0.68 and 1.22 mm for si-
multaneously placed implants, and Kahnberg
and Vannas-Löfqvist13 of 0.8 mm for implants
placed in a delayed mode.

In the literature, smoking has often been
associated with a higher failure rate for con-
ventionally placed dental implants,32–35, 7 worse
osseointegration, as well as more frequent
perimplantititis, bone loss and bleeding.36, 37
However, in studies published on sinus lift,
there is no unanimity regarding the effect of
smoking on treatment outcomes. In five of the
reviewed studies (Table 1), statistically signifi-
cant differences were found, observing a
higher success rate in nonsmokers than in
smokers.9, 10, 11, 15, 1 In one study, only smoking
> 15 cigarettes/day and a residual ridge height
of < 4 mm were significantly associated with
reduced implant survival.17 In other studies,8,
12–14 no statistically significant relationship
was found between smoking and implant suc-
cess, although failure rates were higher among
smokers. Moreover, Levin et al. observed rele-
vant complications in one-third of the smokers,
compared with only 7.7% of the nonsmokers.12

A recent systematic review evaluated the
effects of tobacco smoking on the survival rate
dental implants placed in areas of maxillary
sinus lift. Eight studies, three prospective
and five retrospective, were included. Smoking
was associated with increased implant failure rates
in most individual studies and in the overall
meta-analysis. However, when only prospec-
tive studies were considered, no significant dif-
fences in implant failure were observed be-
tween smokers and nonsmokers.18 Similar re-
sults were obtained in this study: the implant
failure rate and bone loss were slightly higher
in smokers, but with the available sample
size these differences were not statistically
significant.

The literature clearly demonstrates the negative
response of the periimplant mucosa to plaque
accumulation;39–41 however, there is disagree-
ment regarding the influence of oral hygiene on
the success of conventionally placed implants.
Mombelli et al.,21 Smith and Zarb,22 and Baelum
and Elleqgaard argue that hygiene did not influ-
ence implant outcomes (success and bone loss)
in the short term.23 However, Lindquist et al. ob-
served a higher bone loss in patients with poor
oral hygiene.5 The influence of hygiene on the
success of implants placed after direct sinus lift
has been more rarely studied. Kan et al.11 evalu-
ated oral hygiene according to the modified
plaque index as described by Mombelli et al.21
and reported a failure rate of 1.4% in patients
with good oral hygiene, 13.9% with fair hygiene
and 60% with poor oral hygiene; the differences
between the groups were statistically signifi-
cant.11 In our study, a lower implant success rate
was found in patients with poor hygiene (81.8%),
compared with patients with regular and good
hygiene (92.3% and 95.5%, respectively). The
differences did not reach statistical significance,
but the comparison between poor hygiene and
the other two categories tended to significance
(p = 0.058). In fact, a difference of over 10% with
such a predictable treatment technique may be
considered of clinical relevance, and the lack of
statistical significance is probably related to the
small number of patients with poor oral hygiene.

Conclusion

Within its limitations, the present investigation
suggests that smoking and poor oral hygiene
may negatively influence the outcome of im-
plants placed both in one-stage and two-stage
direct sinus lift procedures. However, the differ-
ences were in no case statistically significant,
and prospective studies with larger sample sizes
and longer follow-up are necessary to corrobo-
rate or refute these findings.

Competing interests

The authors declare that they have no conflict of
interests related to this study.
References


