Osteotome sinus floor elevation with or without grafting: a preliminary clinical trial

Hong-Chang Lai
Long-Fei Zhuang
Xiao-Fei Lv
Zhi-Yong Zhang
Yun-Xin Zhang
Zhi-Yuan Zhang

Authors’ affiliations:
Hong-Chang Lai, Long-Fei Zhuang, Xiao-Fei Lv, Zhi-Yong Zhang, Yun-Xin Zhang, Department of Oral & Maxillofacial Implantology, Shanghai Ninth People’s Hospital, School of Medicine, Shanghai Jiaotong University, Shanghai, China
Zhi-Yuan Zhang, Department of Oral & Maxillofacial Surgery, Shanghai Ninth People’s Hospital, School of Medicine, Shanghai Jiaotong University, Shanghai, China

Corresponding author:
Prof. Hong-Chang Lai
Department of Oral & Maxillofacial Implantology Shanghai Ninth People’s Hospital School of Medicine Shanghai Jiaotong University Shanghai 200011
China
Tel.: + 86 21 232 71 699
Fax: + 86 21 530 73 068
E-mail: lhc9@hotmail.com

Key words: cumulative survival rate, dental implant, endo-sinus bone gain, osteotome sinus floor elevation, radiographic analysis

Abstract
Objectives: This clinical trial aimed (1) to evaluate the predictability of the osteotome sinus floor elevation (OSFE) technique, (2) to study the influence of simultaneous grafting on the clinical success of placing dental implants in the posterior maxilla using OSFE and (3) to observe the bone changes in the elevated space with OSFE without grafting.

Material and methods: Two hundred and eighty Straumann® implants were placed in the posterior maxillae of 202 patients using OSFE. One hundred and ninety-one implants were placed in 125 patients without grafting. The implants were allowed to heal for 3–4 months for non-grafted implants and for 6–8 months for grafted cases. For radiographic analyses, periapical and panoramic radiographs were taken of 30 implants at 3 and 9 months to assess the bone changes for the elevated sites without grafting.

Results: Two hundred and sixty-eight of 280 implants fulfilling the survival criteria represented a cumulative survival rate of 95.71%. The residual bone height (RBH) was 5.6 ± 2.5 mm for the non-grafted group and 4.7 ± 2.1 mm for the grafted group. The perforation rate was 4.29%. No significant differences were found between the two groups in RBH, survival rate or membrane perforation rate. The radiographic analyses demonstrated that new bone formation in the elevated sinus was visible and the endo-sinus bone gain was 2.26 ± 0.92 mm and 2.66 ± 0.87 mm at 3- and 9-month follow-up, respectively. Crestal bone loss (CBL) was 0.89 ± 0.5 and 1.2 ± 0.48 mm at 3 and 9 months. For the two test groups, RBH did not have a significant influence on the survival of the implants. At the 9-month follow-up, the endo-sinus bone gain and CBL were not significantly correlated to RBH. The implant protrusion length was significantly correlated to the endo-sinus bone gain.

Conclusions: The findings of this study indicated that uneventful osseointegration may be predictable on applying OSFE whether with or without grafting in atrophic posterior maxilla. Spontaneous new bone formation seemed to be expected with implants placed using OSFE without simultaneous grafting.

Posterior maxillae commonly pose a challenge for successful dental implants due to the poor bone quality and insufficient bone quantity. Efforts have been made to allow successful implant placement in the posterior maxilla subject to limited bone height under the sinus. Approaches available now include the application of tilting implants, short implants, the sinus floor elevation technique, etc.

The osteotome sinus floor elevation (OSFE) technique, first introduced by Tatum (1986), has been proved to be a predictable procedure [Bruschi et al. 1998;
Fugazzotto & Vlassis 1998; Komamycký & London 1998; Rosen et al. 1999). For OSFE, access to the sinus membrane is achieved through a crestal approach. Therefore, compared with the window technique, OSFE is considered to be less invasive and less traumatic while having a limitation with regard to the residual bone height (RBH) under the sinus. According to the consensus conference in 1996, the OSFE technique should be limited to RBH ranging from 7 to 9 mm [Jensen et al. 1998]. However, with the improvement of implant design and surgical technique, the high predictability of implant therapy has encouraged re-evaluation of this limitation. Favorable results have been reported with more compromised sites even with RBH of around 4 mm [Winter et al. 2002; Nedir et al. 2006]. Moreover, there is controversy regarding the necessity of a grafting material in order to maintain the space for new bone formation [Bruschi et al. 1998; Haas et al. 1998; Winter et al. 2002; Lundgren et al. 2004; Leblebicioglu et al. 2005; Nedir et al. 2006; Tan et al. 2008]. In a previous pilot study [Lai et al. 2008], 42 implants were placed in posterior maxillae with OSFE without bone grafting materials. The RBH ranged from 4 to 8 mm (average 6.36 mm). The 5-month result also demonstrated predictable results. But, to date, there are still insufficient data regarding the clinical results of the implants in posterior maxilla with the OSFE technique without grafting and the necessity of grafting with OSFE still remains to be elucidated.

In this context, therefore, the authors attempted to assess the clinical success of dental implants placed in posterior maxillae using OSFE with or without grafting and to observe the endo-sinus bone changes when no grafting materials are applied. The current clinical trial was aimed at testing the hypothesis that the application of grafting materials may not significantly improve the clinical success of the dental implants placed using OSFE with an RBH range between 2 and 8 mm and that spontaneous new bone formation may be observed with implants placed using OSFE without simultaneous grafting.

Material and methods

**Patient data and pre-operative treatment**

Two hundred and eighty Straumann® implants (Straumann AG, Waldenburg, Switzerland) were placed in 202 patients (92 men and 110 women) between January 2003 and January 2008. Patient age ranged from 20 to 68 years [mean 47 ± 3.6 years]. Table 1 shows the distribution of the implant position.

A complete pre-treatment examination was conducted for each patient. Panoramic radiographs were taken of all patients. The residual alveolar height was measured on the panoramic radiographs by one examiner, and each height was measured twice to obtain an average. Computer tomography (CT) scans were performed when it was difficult to define the sinus floor on the panoramic radiograph.

The inclusion criteria were (1) edentulous in the posterior maxillary region, (2) RBH ranging from 2 to 8 mm, (3) no rhinitis or sinusitis, and (4) bone width sufficient to maintain the primary stability. The patients were excluded if they were (1) heavy smokers (≥10 cigarettes per day); (2) systemically contra-indicated for implant placement (e.g. uncontrolled diabetes, hypertension, carotid diseases); (3) subject to uncontrolled periodontal diseases; (4) subject to bruxism.

The patients who fulfilled the inclusion criteria were allocated to either of the two test groups, i.e. (1) OSFE without grafting and (2) OSFE with simultaneous grafting. No specific randomization was applied. All the patients, whether included in this study or not, were to be given an eight-digit registration number by the hospital at the first visit when registering at the reception. The patient was allocated to the grafting group if the patient registration number that was given at registration was odd or was allocated to the non-grafting group if the number was even. One hundred and ninety-one implants were placed in 125 patients with no grafting and 89 implants were placed in 77 cases with simultaneous grafting.

Informed consents were signed after a comprehensive consultation. All patients received oral hygiene instructions before entering the study.

**Surgical procedure**

For all the cases, local infiltration anesthesia was used. Following a midcrestal incision, with mesial and distal releasing incisions extending well up into the buccal fold, a full-thickness mucoperiosteal flap was reflected. A round bur was first used to mark the implant positions. Then, a minimal pilot drilling (Ø 2.2 mm) was performed to a depth approximately 1 mm away from the sinus floor boundary according to the depth taken from the panoramic radiograph or the CT scan. The cortical part of the implant bed was further widened to either Ø 3.5 mm for Ø 4.1 mm implants or Ø 4.2 mm for Ø 4.8 mm implants. At this stage, the integrity of the sinus membrane was examined using the Valsava maneuver. Then the elevation of the maxillary sinus was achieved using a Ø 2.8 mm osteotome by light malleting to achieve the initial sinus up-fracture and was developed with osteotomes of increasing diameters gradually till the final depth. For the group of simultaneous grafting, the autogenous bone chips harvested during the drilling procedure were mixed with an alloplastic bone-replacing material, β-tricalcium phosphate Cerasorb® (Curasan AG, Kleisthaim, Germany), and the mixture was placed into the “socket” by osteotomes when elevating the sinus membrane until the final depth. No profile drill was used for any of the cases. The implants were placed in the prepared osteotome site using a hand ratchet without tapping. All implants were placed in sites using a non-submerged technique and in a one-stage procedure. A panoramic and a periapical radiograph were immediately taken of all the cases (baseline).

**Postoperative treatment**

Anti-inflammatory cefradine [Xinya Co., Shanghai, China, 500 mg, four times a day for 7 days] and metronidazole [Xinyiwanxiang, Shanghai, China, 400 mg, three times a day for 7 days] were used after the surgery. Non-steroidal anti-inflammatory agents were prescribed for postsurgical analgesia. A 0.12% chlorhexidine oral rinse was prescribed for 60 s five to six times a day for 14 days. Sutures were removed after 1 week. Patients were not
allowed to use any removable prostheses during the healing period.

**Prosthetic procedure**
The implants were allowed to heal for 3–4 months for non-grafted implants and for 6–8 months for grafted cases. A panoramic and a periapical radiograph were taken to examine whether there was continued radiolucency around the implant body. When implants were stable, solid abutments were tightened with a 35 N cm torque, the impressions were taken and porcelain-fused-to-gold prostheses were cemented to the solid abutment after 7–10 days.

**Follow-up and radiographic analyses**
Patients were recalled for a radiographic and clinical examination 1 (n = 268), 2 (n = 229), 3 (n = 147), 4 (n = 83) and 5 (n = 29) years after prostheses attachment. At each visit, a panoramic radiograph was taken to evaluate the bone level and peri-implant radiolucency. Clinical examination included the assessment of implant mobility, the prostheses and patients’ satisfaction. The patients were asked orally about the comfort, appearance, ability to chew and general satisfaction and were asked to grade these as excellent, good, fair or poor. The survival of implants was evaluated using the criteria proposed by Buser et al. (1997).

Thirty implants placed in 25 patients (11 males, 14 females) using OSFE without grafting between June 2007 and June 2008 were enrolled for radiographic analyses. The patient age ranged from 18 to 62 (mean 43 ± 2.9). Periapical and panoramic radiographs were taken on the day of surgery (baseline), at 3 and 9 months after surgery. The following parameters were measured using the software SIDEXIS (SIDEXIS 1.12, Sirona Dental System GmbH, Bensheim, Germany): [1] endo-sinus bone gain change; [2] crestal bone loss (CBL). For these parameters, both mesial and distal aspects of the implants, i.e. 60 sides, were measured.

**Statistical analyses**
SPSS Software (SPSS 16.0, SPSS Inc., Chicago, IL, USA) was applied to conduct the statistical analyses. Descriptive statistics, mean and standard deviation were used to assess the radiographic parameters of the two test groups including RBH, implant protrusion length and endo-sinus bone gain. An unpaired t-test was applied to compare the RBH of the two test groups. The survival rates and the membrane perforation rates were calculated of the two test groups and of the different test groups classified according to RBH, implant length and implant diameter. To bypass the problem of dependencies between multiple implants within one patient, the patient-based survival rates and membrane perforation rates were calculated with one implant per patient randomly chosen. A $\chi^2$ -test was applied to compare the survival rates and the membrane perforation rates of the two groups and to compare these rates of the three groups classified according to RBH, implant length and implant diameter. Partial correlation coefficient was used to assess the correlation between RBH and endo-sinus bone gain and CBL and the other two factors. For these parameters, both mesial and distal aspects of the implants, i.e. 60 sides, were measured.

**Table 2. Implant 5-year cumulative survival rate and membrane perforation rate for the two test groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of implants</th>
<th>Implant failures</th>
<th>Survival rate (%)</th>
<th>Membrane perforation rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Implant-based survival rate and membrane perforation rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grafting (G)</td>
<td>89</td>
<td>7</td>
<td>92.13</td>
<td>7.87</td>
</tr>
<tr>
<td>No grafting (NG)</td>
<td>191</td>
<td>5</td>
<td>97.38</td>
<td>2.62</td>
</tr>
<tr>
<td>$P$ value</td>
<td></td>
<td></td>
<td>0.089</td>
<td>0.089</td>
</tr>
<tr>
<td>(B) Patient-based survival rate and membrane perforation rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grafting (G)</td>
<td>77</td>
<td>5</td>
<td>93.51</td>
<td>2.6</td>
</tr>
<tr>
<td>No grafting (NG)</td>
<td>125</td>
<td>2</td>
<td>98.4</td>
<td>2.4</td>
</tr>
<tr>
<td>$P$ value</td>
<td></td>
<td></td>
<td>0.147</td>
<td>0.705</td>
</tr>
</tbody>
</table>

The results demonstrated the survival rates of implants placed in sites with different RBH. For the two test groups, RBH did not have a significant influence on the survival of the implants. A significant difference was only found between the two test groups for RBH = 6–8 mm. But it should be noted that the sample size is only 23 for the grafting sites and 91 for non-grafting. Implant diameter and length had no significant effect on the survival rates.

For the 30 implants included in the radiographic analyses, the post-treatment RBH was 4.97 ± 1.47 mm (mesial 5.2 ± 1.53 mm and distal 4.73 ± 1.38 mm). The protrusion length of the implants measured at baseline was 3.94 ± 1.14 mm (mesial 3.62 ± 1.12 mm, distal 4.26 ± 1.08 mm). The survival during the observation period was 100%. Only one implant was subject to membrane perforation.

The endo-sinus bone gain and CBL compared with baseline at 3 and 9 months are shown in Table 3. At the 3-month follow-up, _de novo_ endo-sinus bone formation...
was observed for 42 sides of the implants. The new bone demonstrated a lower density. The original sinus floor outline was still recognized. At 9 months, a new sinus floor outline was observed for 48 sides [Figs 1 and 2]. At the 9-month follow-up, the endo-sinus bone gain and CBL were not significantly correlated to the endo-sinus bone height [Table 6]. The protrusion length of the implants significantly correlated to the endo-sinus bone gain [Table 7].

## Discussion

OSFE has expanded the prosthetic option by enabling the placement of an additional implant support in maxillary segments with atrophic ridges and pneumatized sinuses. OSFE is thought to be less invasive, to have no need for re-entry and to reduce the healing time and cost. On the other hand, however, the sinus floor is elevated “blindly” with OSFE [Diserens et al. 2005], and therefore it has been questioned whether implants placed with OSFE could have a survival rate comparable with those placed with the window technique or those placed in non-elevated sites. In the present trial, the 5-year cumulative survival rate of implants placed with OSFE was 95.71%. The result was in accordance with the survival rates reported by many clinicians and researchers [Ferrigno et al. 2006; Nedir et al. 2006, 2009; Pjetursson et al. 2008, 2009a; Schmidlin et al. 2008; Gabbert et al. 2009]. Tan et al. [2008] reported, in a recent systemic review, that the 3-year survival rate of implants placed in transalveolar sinus floor augmentation sites was 92.8%, which was comparable with those in non-elevated sites, and the corresponding survival rate of implants placed through the lateral approach reported by the same group in a systemic review was 90.1% [P < 0.05] [Pjetursson et al. 2008].

because of the indirect overview of the elevated sinus floor, the OSFE procedure had once been thought to increase the risk of membrane perforation. In the present study, however, the perforation rate was only 4.29%. This result was confirmed by the perforation rates reported by many other researches [Diserens et al. 2005; Becker et al. 2008; Tan et al. 2008; Gabbert et al. 2009]. Engelke and Deckwer [1997] also revealed in an endoscopic study that the sinusoor might be elevated up to 5 mm without perforating the membrane.

When placing implants in posterior maxillae, the guideline now available is given to the RBH. Tan et al. [2008] concluded in their systemic review that the failure rate of the implants placed with transalveolar sinus floor augmentation increased and correlated with reduced RBH. Rosen et al. [1999] reported a significantly lower survival rate for implants placed with RBH, which was < 4 mm. Pjetursson et al. [2008] also reported similar results. In the present study, however, implants placed in sites with RBH < 4 mm were not related to a significantly lower survival rate. This finding may be explained by the implant stability. In the previous study [Lai et al. 2008], the stability of implants placed in posterior maxillae with an RBH of 4–8 mm by OSFE without bone grafting was studied. The ISQ values demonstrated that all the implants achieved good primary stability and reached a comparably high stability at 16 weeks postoperation with a dip between 2 and 6 weeks in the stability curve. The pre-treatment vertical bone height did not have a statistically significant influence on the mean ISQ and its changing pattern. Gabbert et al. [2009] also reported that an RBH of 3–8 mm did not result in significantly lower survival than 8 mm bone height. Still, it should be noted that studies of higher evidence level may be needed to further confirm the result.

Moreover, the question regarding the necessity of simultaneous grafting remains open. Simultaneous application of grafting materials has been reported to result in improved outcomes with a transalveolar sinus floor elevation procedure [Pjetursson et al. 2009]. In the present trial, however, the application of OSFE in combination with grafting materials did not demonstrate a significantly higher survival rate compared with the non-grafting sites. Gabbert et al. [2009] and Nedir et al. [2009] also reported high survival rates for implants placed using OSFE without grafting. So far, although only a limited number of studies have been available, the OSFE technique seemed to be predictable when no grafting materials were used.

Grafting the sites is thought to improve the primary stability by providing more

---

### Table 3. Five-year cumulative survival rates for the two test groups according to residual bone height

<table>
<thead>
<tr>
<th>RBH (mm)</th>
<th>Grafting</th>
<th>No grafting (NG)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-4</td>
<td>89.47% (n=19)</td>
<td>90% (n=20)</td>
<td>0.957</td>
</tr>
<tr>
<td>4-6</td>
<td>93.33% (n=45)</td>
<td>97.56% (n=82)</td>
<td>0.241</td>
</tr>
<tr>
<td>6-8</td>
<td>91.3% (n=23)</td>
<td>98.9% (n=91)</td>
<td>0.042</td>
</tr>
</tbody>
</table>

RBH, residual bone height.

### Table 4. Five-year cumulative survival rate according to the implant length and diameter

<table>
<thead>
<tr>
<th>Implant length (mm)</th>
<th>Implant diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 8 mm (short implant)</td>
<td>≥ 10 mm</td>
</tr>
<tr>
<td>6 mm</td>
<td>8 mm</td>
</tr>
<tr>
<td>Number</td>
<td>12</td>
</tr>
<tr>
<td>Number of failures</td>
<td>1</td>
</tr>
<tr>
<td>Survival rate (%)</td>
<td>95.49</td>
</tr>
<tr>
<td>P value</td>
<td>0.859</td>
</tr>
</tbody>
</table>

### Table 5. Radiographic results calculated at 3 and 9 months according to the baseline

<table>
<thead>
<tr>
<th>Endo-sinus bone gain (mm)</th>
<th>Crestal bone loss (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesial</td>
<td>Distal</td>
</tr>
<tr>
<td>3 months</td>
<td>2.11 ± 0.94</td>
</tr>
<tr>
<td>9 months</td>
<td>2.57 ± 0.85</td>
</tr>
</tbody>
</table>

---

© 2010 John Wiley & Sons A/S

bony anchorage of implants. But the result of the previous study (Lai et al. 2008) demonstrated that the implants placed with OSFE without grafting could also achieve good primary stability. Profile drills were not used for preparing any of the implant sites in our study, and therefore the conical “machined” neck part of the implants could be placed beneath the level of cortical bone, thus providing the cortical anchorage, which may contribute to the primary implant stability even in sites with RBH < 4 mm.

Moreover, the application of grafting material is thought to create and maintain the space for new bone formation. Many researchers have attempted to investigate the bone remodeling and bone formation under the elevated sinus with simultaneous grafting (Brägger et al. 2004; Discens et al. 2005; Artzi et al. 2008; Kirmeyer et al. 2008; Pjetursson et al. 2008; Kim et al. 2009). Pjetursson et al. (2008) described a cloudy dome structure with a hazy demarcation observed for grafting sites, which showed signs of shrinkage during the follow-up to the level of the implant apex. The other researchers reported similar observations. Their results were in favor of grafting from the point of view of bone gain measured from panoramic and intra-oral radiographs, but it should also be noted that it is difficult to judge from a panoramic or an intra-oral radiograph whether the grafting material has transformed into bone (Diserens et al. 2005).

The present study focused on the endo-sinus bone gain of implants placed without grafting. New bone formation in the elevated sinus was visible and the endo-sinus bone gain was 2.26 ± 0.92 and 2.66 ± 0.87 mm at the 3- and 9-month follow-up, respectively. These findings were in accordance with other studies (Leblebicioglu et al. 2005; Gabbert et al. 2009; Nédir et al. 2009). Gabbert et al. (2009) reported that apical bone gain could be observed in 30% implants with internal sinus lift without grafting. Nédir et al. (2009) demonstrated that all the implants gained endo-sinus bone without grafting and the mean gained bone was 2.5 ± 1.2 mm, which increased significantly to 3.1 ± 1.5 mm during the first 3 years. The findings regarding the CBL change of the current study were also in accordance with those of Nédir et al. (2009) and the reason for CBL change remains unclear. That the “machined” surface of the implant neck was not expected to integrate with bone may contribute to the CBL reduction. RBH and implant protrusion length are thought to be the influencing factor of endo-sinus bone changes. In the present study, there was no significant

Table 6. Radiographic analyses according to RBH at 9-month follow-up

<table>
<thead>
<tr>
<th>RBH (mm)</th>
<th>2–4</th>
<th>4–6</th>
<th>6–8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (mm)</td>
<td>3.1 ± 0.61</td>
<td>5 ± 0.54</td>
<td>6.6 ± 0.49</td>
</tr>
<tr>
<td>Number of implant sides</td>
<td>17</td>
<td>24</td>
<td>19</td>
</tr>
<tr>
<td>Endo-sinus bone gain (mm)</td>
<td>2.77 ± 1.13</td>
<td>2.79 ± 0.55</td>
<td>2.37 ± 0.73</td>
</tr>
<tr>
<td>CBL (mm)</td>
<td>1.17 ± 0.43</td>
<td>1.23 ± 0.53</td>
<td>1.2 ± 0.48</td>
</tr>
</tbody>
</table>

Partial correlation coefficient was −0.158 between RBH and endo-sinus bone gain (P < 0.05). Partial correlation coefficient was −0.248 between RBH and CBL (P < 0.05). CBL, crestal bone loss; RBH, residual bone height.

Table 7. Radiographic analyses according to implant protrusion length at 9 months

<table>
<thead>
<tr>
<th>Implant protrusion length (mm)</th>
<th>2–4</th>
<th>4–6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.1 ± 0.64</td>
<td>4.97 ± 0.64</td>
</tr>
<tr>
<td>Number of implant sides</td>
<td>33</td>
<td>27</td>
</tr>
<tr>
<td>Endo-sinus bone gain (mm)</td>
<td>2.34 ± 0.98</td>
<td>3.06 ± 0.64</td>
</tr>
<tr>
<td>Crestal bone loss (CBL) (mm)</td>
<td>1.19 ± 0.51</td>
<td>1.23 ± 0.45</td>
</tr>
</tbody>
</table>

Partial correlation coefficient was 0.518 between implant protrusion length and endo-sinus bone gain (P < 0.001). Partial correlation coefficient was 0.106 between implant protrusion length and CBL (P > 0.05).
correlation between RBH and endo-sinus bone gain. This finding was different from the result of Nedir et al. (2006). The difference may be explained by the different statistical methods. The implant protrusion length was significantly correlated to endo-sinus bone gain. This result may be explained by increasing the space under the elevated sinus. Still, due to the limited documentation and the low level of evidence available, randomized-controlled clinical trials of OSFE with or without bone grafting are needed to further confirm the radiographic result.

It is also one of the main purposes of grafting to allow for longer implants. Pjetursson et al. (2008) reported a survival rate of only 47.6% for 6 mm implants placed with the transalveolar osteotome technique, which was significantly lower than longer implants. In our study, no significant difference was found between long [10 mm or more in length] and short implants [6 or 8 mm in length]. The authors [Lai et al. 2008] reported that implant length did not have a statistically significant influence on the implant stability. But the results should be interpreted with caution due to the limited sample size. Only seven 6 mm implants were involved in the study of Pjetursson et al. (2009a) and the corresponding number in our study was only 12. Long-term results with more short implants involved will be needed to provide more evidence.

In conclusion, placing implants in atrophic posterior maxillae applying OSFE, whether with or without simultaneous grafting, may be predictable. No significant differences in survival or mem-

brane perforation rates between the two test groups were observed. Implant length and RBH seemed to have no significant influence on the survival rate. Spontaneous new bone formation under the elevated sinus floor seemed to be expected with implants placed using OSFE without simultaneous grafting. Because of the limitations of the current study, long-term results of studies with randomization design may be required to confirm the result.

Acknowledgement: This study has been supported by the Shanghai Municipal Education Commission (08zz257) and by Science and Technology Commission of Shanghai Municipality (09411955000).

References


学霸图书馆

www.xuebalib.com

学霸图书馆（www.xuebalib.com）是一个“整合众多图书馆数据库资源，提供一站式文献检索和下载服务”的24小时在线不限IP图书馆。

图书馆致力于便利、促进学习与科研，提供最强文献下载服务。

图书馆导航：

图书馆首页 文献云下载 图书馆入口 外文数据库大全 疑难文献辅助工具