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ORIGINAL ARTICLE

Sinus lift: 3 years follow up comparing autogenous bone block versus autogenous particulated grafts

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KEYWORDS
autogenous bone graft;
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Abstract *Background/purpose:* The aim of this prospective randomized controlled clinical trial was to compare vertical bone gain and bone resorption after sinus graft procedures performed either with particulate or with autogenous bone block.
Material and methods: Forty-one patients underwent sinus graft procedures with autogenous bone. They were randomly assigned to one group. The first group of 22 patients was treated with autogenous bone block with or without particulated bone, while in the second group of 19 patients sinus floor elevation was performed only with particulated autogenous bone. Linear measurements were recorded before surgery with a computed tomography scan at surgery and at 36 months after sinus lift grafting with a second computed tomography scan. To detect statistical differences Student *t* test was applied. Differences were considered significant if P values were < 0.05.
Results: There was a statistically significant difference in bone gain for the group treated with bone block grafts.
Conclusion: As a general clinical guideline the clinician should prefer, wherever feasible, en-block bone grafts for sinus floor augmentation procedures.

Introduction

Rehabilitation of the posterior maxilla with the placement of dental implants is often a challenging procedure due to the reduced bone volume. The loss of bone volume is a consequence of alveolar bone resorption which occurs immediately after extraction of teeth. The pneumatization of the maxillary sinus steadily continues throughout life and

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therefore the sinus usually becomes larger as the years pass.[1]

The prosthetic rehabilitation of the partially or completely edentulous maxilla without the placement of implants is still an alternative in cases of severely athropic maxilla when patients do not want to undergo a surgery. However, the patient's comfort and satisfaction are usually higher when it comes to implant-retained or -supported prosthesis.[2]

Alternative solutions, which avoid entering the sinus, are sometimes possible: short implants and tilted implants can be duly placed if the vertical bone height is suffiecient.[3]

Elevation of the maxillary sinus floor was presented by Boyne and James[4] in 1980. They proposed access to the maxillary sinus by drilling a bone window in the lateral sinus wall (lateral window approach), using a small, round bur, elevation of the maxillary sinus membrane, and insertion of autogenous particulated graft under the Schneiderian sinus membrane. This technique was performed when residual vertical bone height was $< 6-7$ mm.

Tatum[5] was one of the first to think of the sinus lift technique for implant-prosthetic rehabilitation, where the maxillary sinus was grafted using autogenous particulated iliac bone. Since then the original technique has undergone many modifications. Summers[6] presented a more conservative and less invasive approach than the conventional lateral approach of sinus floor elevation known as transalveolar or crestal technique. This procedure was originally applied when the residual vertical bone height was 6–7 mm, but still not enough to place a traditional implant.[7–10]

During the past few years, elevation of the maxillary sinus was performed with alternative techniques differing in the graft material (autogenous, allogenic, xenogenic, alloplastic), the donor site of autogenous bone (intraoral, extraoral), and the surgical technique.[11,12] If autogenous bone is chosen as a filler material, it can be particulated or en block. The block technique has often been challenged to bear a higher risk of infection and failure. Le Lorc'h-Bukiet et al[13] described a sinus lift procedure with a block graft harvested from the parietal bone. This technique, though very promising, is linked to a major surgical approach[14,15] and is hampered by an increase in morbidity.

The aim of the present randomized, prospective study was to evaluate long-term graft resorption in sinus graft procedures performed either with particulated or with autogenous bone block. A secondary endpoint was to assess whether block transplant would show a higher risk of failure. We performed a modified Tulasne technique for the harvesting of the bone block grafts as the donor sites differed from calvaria.

Materials and methods

Patient selection

The patients were selected for edentulous spaces in the posterior severely athropic maxilla. Inclusion criteria were a residual bone height 1–5 mm evaluated with preoperative computed tomography. In fact, residual bone height varied from a minimum of 1 mm to a maximum of 5 mm [mean, 2.73; standard deviation (sd) = 1.43].

The other inclusion criteria were Cawood and Howell[16] Class V–VI and age above 20 years (Table 1). Exclusion criteria were concomitant severe systemic disease, pregnancy, and bisphosphonate therapy.

Patients were randomly assigned to the block group (Table 2) or to the particulated group (Table 3) by coin flip after sinus preparation. Written informed consent was obtained from all the included patients. The Ethical Committee decided that no ethical vote was necessary for this study, as the two procedures are well-established clinical therapies. The trial was conducted in accordance with the Helsinki Declaration.

Surgical technique

Forty-one patients (27 men and 14 women) with a mean age of 53.20 years (sd = 9.27; range, 39–72) were treated because of a lack of vertical dimension of the alveolar

Table 1 Characteristics of the sample.

	Group 1 (bone block)	Group 2 (particulated bone)
Sample size	22	19
M/F	13/9	14/5
Mean age (y)	55.82 ± 9.85	50.16 ± 7.71
Mean residual bone height (baseline, mm)	2.73 ± 1.45	2.74 ± 1.45

F = female; M = male.

Table 2 List of patients who received the block graft (if in parentheses more than one block was harvested).

Patient	Size of the block graft
N1	1 × 1.5
N2	2 × 3
N3	1 × 2
N4	2 × 1
N5	2 × 2.5
N6	2 × 2
N7	2.5 × 2
N8	2 × 1
N9	1.5 × 3
N10	2 × 3
N11	(1 × 2), (1 × 1.5)
N12	(1.5 × 1), (1 × 1.5)
N13	(1 × 2), (1.5 × 1)
N14	(1 × 1), (0.5 × 1)
N15	2 × 1
N16	2 × 3
N17	3 × 1.5
N18	3 × 2
N19	1 × 1.5
N20	(1.5 × 1), (1.5 × 1)
N21	1.5 × 1.5
N22	1 × 2

Table 3 List of patients who received particulated bone obtained by grinding of the bone block (if in parentheses more than 1 block was harvested).

Patient	Size of the block graft for particulated bone harvesting
N1	2.5 × 1
N2	1.5 × 2.5
N3	1 × 0.8
N4	3 × 2
N5	2 × 3
N6	1 × 1.5
N7	(1.5 × 2), (1 × 1)
N8	1 × 1
N9	3 × 2
N10	1.5 × 1.5
N11	2 × 1
N12	1 × 1
N13	2 × 2
N14	(3 × 2), (1 × 1)
N15	1 × 1
N16	1 × 1.5
N17	2 × 1
N18	1 × 1
N19	1 × 1

crest in the posterior maxilla with a maxillary sinus floor augmentation and delayed implant placement. Two groups were formed according to different grafting techniques. In one group of 22 (13 men and 9 women) sinus floor elevation was performed with autogenous bone block, while in the other group of 19 (14 men and 5 women) the grafting procedure was done only with particulated autogenous bone. Briefly, following a midcrestal incision and two vertical releasing incisions, a mucoperiosteal flap was raised to expose the lateral wall of the sinus. The osteotomy was performed using conventional round burs (Hager & Meisinger GmBH, Neuss, Germany; Komet, Lemgo, Germany) or piezosurgery[17] (Satelec, Merignac, France) and copious irrigation in order to prepare a bony window (Figure 1). The upper margin of the lateral window was always prepared at 15 mm from the crestal bone ridge and represented a fix and stable landmark for subsequent measurements, being the new sinus floor. Sinus mucosa was carefully elevated using manual sinus elevators. Attention was paid to mobilize the Schneiderian membrane from the inner bone surface without perforation. Once the sinus membrane was elevated, a coin was flipped in order to allocate the patient either to Group 1 (bone block) or to Group 2 (particulated bone). Bone graft was harvested from the patient and either introduced as a block in the sinus or ground to obtain a particulate graft to fit in the sinus. No membrane was used to cover the graft area. Tension-free flap closure was accomplished with suitable flap preparations and sutures. Postoperative systemic antibiotic, amoxicillin (1 g twice a day for 6 days) or claritromicin (500 mg twice a day for 6 days), and anti-inflammatory drugs were administered. Patients were given detailed instructions about oral hygiene and were seen weekly for the 1st postoperative month and then 3 months and 4 months later until they were ready to receive implants. Mobile dentures were not permitted for use until they were adjusted and refitted no sooner than 2 weeks after surgery.

Radiographic examinations

Linear measurements were performed at baseline (before sinus graft procedures) and vertical residual ridge height was recorded at its minimum. Briefly, the area of minimal residual bone height (Table 1) was recorded and registered. All patients included in the study were examined after 3 years with a new computed tomography (KaVo, Biberach an der Riß, Germany) as defined in the postoperative maintenance program. The 3-year measurements were recorded at the same positions as at baseline. Measures were approximated to 1/10 mm. All radiographs were examined by the same examiner.

The following data were collected and examined (Figure 2): X, residual bone height (which corresponds to basal crestal bone at the time before surgery); Y, the amount of bone required to reach the 15-mm landmark; Z, bone graft resorption at the 3-year control; and Y−Z, residual bone above the basal crestal bone, which represents the bone gain after the 3-year control.

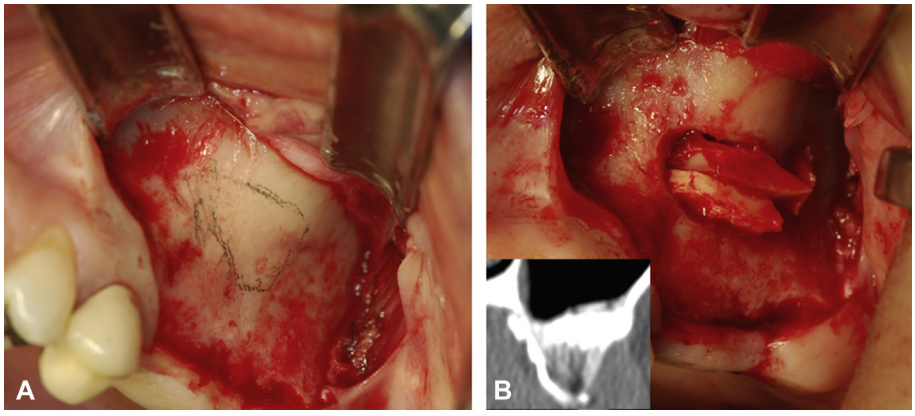

Figure 1 Outline of the lateral window. (A) Before performing sinus graft procedure. (B) After sinus graft procedure.

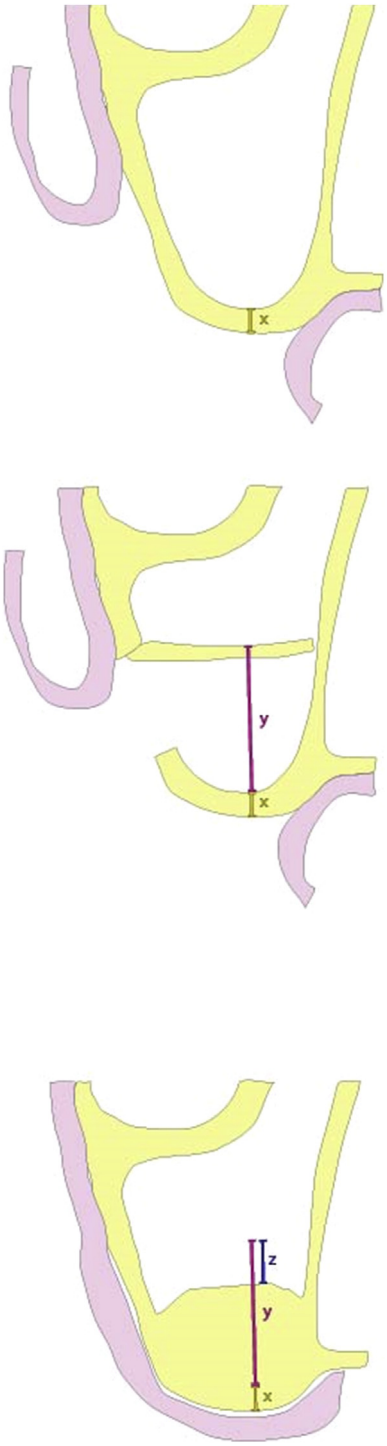

Figure 2 Drawing showing: X (residual bone height before sinus graft procedure); Y (amount of bone required to reach the 15-mm landmark); and Z (bone graft resorption at the 3-year control).

Statistical analysis

All data were analyzed with descriptive methods using box plots (Figure 3). Mean values and sds were calculated in the two groups: bone block and particulated autogenous bone.

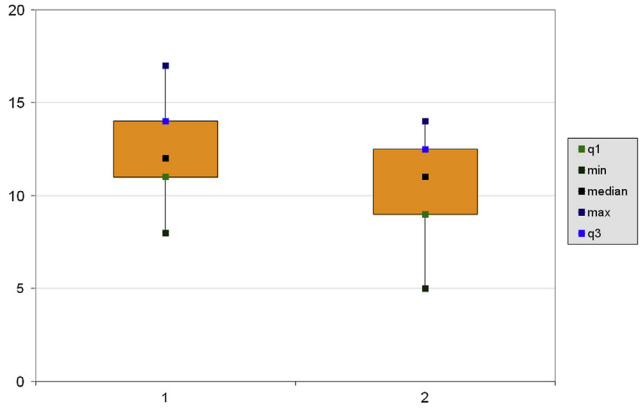

Figure 3 Box plot. Group 1: bone block; Group 2: particulated bone. Min : The minimum; Max : The maximum; Median : The median; Q1 : 25th percentile; Q3 : 75th percentile.

To analyze potential differences in bone height gain between the two groups a statistical analysis was carried out using mean values and sds. To detect statistical differences an unpaired form of Student *t* test was applied since data were normally distributed. Differences were considered significant if P values were < 0.05.

Results

Complications

In our study, all cases of intraoperative complications were managed so that the operation could be performed. Six cases (14.6%) of small membrane tears were left untreated because of the use of block graft. Three cases (7.3%) of hemorrhage[18,19] were encountered; the surgical procedure was hindered but the final outcome was not influenced. During postoperative controls, three cases (7.3%) of slight wound dehiscences were handled easily and only one case (2.4%) reported a partial graft loss so that the patient had to undergo a second surgical operation.[20] One patient (2.4%) had temporary alteration due to an inferior alveolar nerve injury during the bone harvesting procedure, but it resolved without permanent loss of nerve sensitivity. At the control visit all patients apart from one (2.4%) had received their implants (Straumann Implant System, Straumann AG, Basel, Switzerland) ,10 mm or 12mm long, and all implants apart from one (1.04%) were osseointegrated according to the radiographic evaluation. No data on implants are presented in the present work (this will be included in a future manuscript).

Bone gain

The sinus floor, independent of the employed technique (bone block vs. particulated bone), was always positioned at 15 mm from the alveolar crest. At this landmark we always reconstructed our sinus floor, thus obtaining a definite and repeatable reference.

The volume of the bone harvested per patient in the block group was approximately 2.5 cm^3 (mean, 2.51 cm^3; sd, 1.18), while it was 2.2 cm^3 in the particulated group (mean,

Table 4 List of the volumes of the grafts harvested in patients of the block group.

Patient	Volume of the block graft (cm^3)
N1	0.9
N2	3.6
N3	1.2
N4	1.2
N5	3.0
N6	2.4
N7	3.0
N8	1.2
N9	2.7
N10	3.6
N11	4.2
N12	3.75
N13	4.5
N14	1.8
N15	1.2
N16	3.6
N17	2.7
N18	3.6
N19	0.9
N20	3.6
N21	1.35
N22	1.2

2.19; sd, 1.89; Tables 4 and 5). A statistical analysis performed on the two groups using an unpaired form of Student *t* test showed that there was not a statistically relevant significance for volumes of bone harvested (P = 0.53).

In the group treated with a bone block, the bone gain in terms of height comparing the 3-year recorded value to the baseline registered value before surgery, was approximately 13 mm (mean, 12.55 mm; sd, 2.60). In the second group treated with particulated bone, the 3-year assessment showed an increase in bone height if compared with the baseline level before surgery of roughly 10 mm (mean, 10.63 mm; sd, 2.61). Statistical analysis performed on the two groups using an unpaired form of Student *t* test showed a statistically relevant significance for height (P = 0.02).

Table 5 List of the volumes of the grafts harvested in patients of the particulated group.

Patient	Volume of the block graft for particulated bone harvesting (cm^3)
N1	1.5
N2	2.25
N3	0.48
N4	3.6
N5	3.6
N6	0.9
N7	4.5
N8	0.6
N9	3.6
N10	5.4
N11	1.2
N12	0.6
N13	2.4
N14	7.2
N15	0.6
N16	0.9
N17	1.2
N18	0.6
N19	0.6

Bone resorption

As we already stated, for both groups the level just after the sinus floor elevation procedure was 15 mm, where the new sinus floor was always repositioned. In 10 out of 22 cases (45% of total) in the sample treated with bone blocks, we observed an increase above the 15-mm landmark in the vertical dimension. Therefore, the mean resorption rate for the group treated with bone block was −0.2 mm indicating a slight increase in the graft dimensions. However, the group treated with particulated bone graft showed a mean resorption rate of 1.63 mm. The bone tissue resorption in the block group versus the particulated group is definitely lower and statistically significant (P = 0.005).

Bone survival

We did not perform any histologic evaluation of our bone grafts and therefore data on the viability of the grafts can be only inferred. The survival rate of the subsequently positioned implants indicates a viable and healthy bone tissue. We did not observe a sequestrum of the bone block in any of the treated cases, indicating that a recolonization by osteoblasts takes place in the implanted graft irrespective of its composition whether particulated or block.

Discussion

The aim of the present prospective randomized study was the long-term evaluation at 3 years of bone resorption for sinus floor elevation techniques. The two techniques employed in the present work, were either sinus floor elevation performed with autogenous bone block or alternatively with particulated autogenous bone. In other words, the material was kept constant—autogenous bone—but its structure differed either as block or particulated tissue.

Sinus floor elevation has become a predictable surgical technique to overcome bone height deficiencies in the posterior maxilla.[21] The surgical technique has been performed using different materials which vary from autogenous bone to nonautogenous grafting materials.[22] The limit to harvest autogenous bone is the increased morbidity and the patient's discomfort,[15,23] but it is still regarded as the gold standard by many clinicians. The long-term results of the different methods employed do not show substantial differences in the outcomes of graft stability and implant survival rates.[24,25]

Our work concentrated solely on the use of autogenous bone as grafting material in its different available forms, either as a block or as particulated tissue. There are not many studies about changes in graft height after maxillary

sinus floor elevation performed only with autogenous bone.[26,27] The purpose of most studies is to compare autogenous bone with different grafting materials in order to search for another ideal bone graft[28] with less morbidity and patient discomfort than autogenous bone.

We focused on another issue, considering whether autogenous bone in its different forms may influence the stability of the graft. Data analysis of our study showed that bone gain was always present for the two adopted techniques. In all cases subsequent staged implant positioning was always possible, thus confirming the usefulness of the methods for the rehabilitation of the atrophic maxilla. The mean bone gain for the group treated with bone block was 12.55 mm, while the mean bone gain for the group with particulated bone graft was 10.63 mm. The statistically significant difference between the bone gain in the two different groups suggests that the clinician should always prefer, whenever feasible, to adopt the bone block technique for sinus floor elevation.

The block technique shows another major advantage. The resorption rate of the block graft is definitely lower than the resorption rate of the particulated graft. This guarantees minor resorption of the positioned graft. In fact we also analyzed the resorption in terms of vertical height values at the 3-year control for the two groups. For the block group, we had minimal resorption in nearly half of the cases (55%) and minimal bone increase in the rest of our series (45%). Substantially these data indicate that with the bone block there is virtually no resorption at the 3-year control. This proves that the bone block graft technique to be a useful and predictable method for severely athrophic maxilla, where huge bone gain is required.

Our work is in line with the data of Sbordone et al[26] who performed a similar investigation. Also, their conclusion led to the assumption that bone block are more stable and undergo less remodeling in sinus lift procedure, thus ensuring the best long-term success.

Keeping these data in mind, it also appears evident that the group who received only particulated bone grafts showed excellent bone height gain, supporting staged safe implant placements in all cases.

In nearly half of the cases treated with bone blocks we observed a bone gain over time instead of a bone resorption as already stated. These data can have different explanations. First of all, although the window upper margin was constantly placed at 15 mm, the introduction and positioning of the bone block graft inside the sinus may have mobilized the graft in a more cranial position. We feel that this hypothesis is somehow weak as the same should have happened with the particulated bone graft group. If the block undergoes a displacement during its positioning, the same should be true when the particulated bone graft is pressed inside the sinus. It is in fact well known that graft stability plays a fundamental role for the success of graft survival. The block graft is stabilized with a press fit method, while the particulated graft is stabilized by a tight compression. Therefore the hypothesis of a cranial displacement of the sinus membrane is theoretically possible for both techniques, although we only observed it in one group. It should be stressed that the physical nature of the different grafts may account for different graft stabilities over time.

A second and more reliable possible explanation is that the colonization by new osteoblasts of the block graft stimulates, in many cases, an increase or at least a stabilization in dimension, especially in larger sinuses when the block does guarantee a contact with the medial sinus wall.[29] We can exclude that this observation has something to do with implant positioning, as we always placed the implants with a staged approach 4 months after sinus grafting procedures. Unfortunately, at the moment we do not have a unique explanation for this clinically important observation.

The outcome of our study (bone gain vs. bone resorption) was measured using a bidimensional technique and not a volumetric analysis. As a matter of fact, the volumes used for the sinus graft procedures were comparable for the two groups with a nonstatistical significant difference. It should also be stressed that the residual bone height of the two groups was similar, as reported in Table 1. Therefore, the bidimensional measure of bone height recording definitely supports the conclusions which we draw.

The conclusion that can be drawn by the presented work is that autogenous block graft is the most stable graft material for sinus lift procedures if compared with autogenous particulated bone graft and should therefore be preferred in order to minimize graft resorption.

According to our work, the insertion of a non-vascularized bone block in the maxillary sinus cavity does not lead in any case to a sequestrum of the bone tissue but to its recolonization. Particulated autogenous graft is still a valid alternative to autogenous bone block graft if the former cannot be performed for patient centered reasons.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

References

1. Van den Bergh JPA, ten Bruggenkate CM, Disch FJ, Tuinzing DB. Anatomical aspects of sinus floor elevation. *Clin Oral Implants Res* 2000;11:256–65.
2. Att W, Bernhart J, Strub JR. Fixed rehabilitation of the edentulous maxilla: possibilities and clinical outcome. *J Oral Maxillofac Surg* 2009;67:60–73.
3. Pozzi A, Sannino G, Barlattani A. Minimally invasive treatment of the atrophic posterior maxilla: a proof-of-concept prospective study with a follow-up of between 36 and 54 months. *J Prosthet Dent* 2012;108:286–97.
4. Boyne PJ, James RA. Grafting of the maxillary sinus floor with autogenous marrow and bone. *J Oral Surg* 1980;38:613–6.
5. Tatum Jr H. Maxillary and sinus implant reconstructions. *Dent Clin North Am* 1986;30:207–29.
6. Summers RB. Sinus floor elevation with osteotomes. *J Esthet Dent* 1998;10:164–71.
7. Ferrigno N, Laureti M, Fanali S. Dental implants placement in conjunction with osteotome sinus floor elevation: a 12-year life-table analysis from a prospective study on 588 ITI implants. *Clin Oral Implants Res* 2006;17:194–205.
8. Fermergård R, Åstrand P. Osteotome sinus floor elevation and simultaneous placement of implants —a 1-year retrospective

study with Astra Tech implants. *Clin Implant Dent Relat Res* 2008;10:62—9.
9. Tan WC, Lang NP, Zwahlen M, Pjetursson BE. A systematic review of the success of sinus floor elevation and survival of implants inserted in combination with sinus floor elevation. Part II: transalveolar technique. *J Clin Periodontol* 2008;35:241—54.
10. Pjetursson BE, Rast C, Brägger U, Schmidlin K, Zwahlen M, Lang NP. Maxillary sinus floor elevation using the (trasalveolar) osteotome technique with or without grafting material. Part I: implant survival and patients' perception. *Clin Oral Implants Res* 2009;20:667—76.
11. Del Fabbro M, Rosano G, Taschieri S. Implant survival rates after maxillary sinus augmentation. *Eur J Oral Sci* 2008;116:497—506.
12. Chaushu G, Mardinger O, Calderon S, Moses O, Nissan J. The use of cancellous block allograft for sinus floor augmentation with simultaneous implant placement in the posterior atrophic maxilla. *J Periodontol* 2009;80:422—8.
13. Le Lorc'h-Bukiet I, Tulasne JF, Llorens A, Lesclous P. Parietal bone as graft material for maxillary sinus floor elevation: structure and remodeling of the donor and of recipient sites. *Clin Oral Implants Res* 2005;16:244—9.
14. Tessier P, Kawamoto H, Posnick J, Raulo Y, Tulasne JF, Wolfe SA. Taking calvarial grafts—tools and techniques: VI. The splitting of a parietal bone "flap". *Plast Reconstr Surg* 2005;116:74S—88S.
15. Rawashdeh M, Telfah H. Secondary alveolar bone grafting: the dilemma of donor site selection and morbidity. *Br J Oral Maxillofac Surg* 2008;46:665—70.
16. Cawood JI, Howell RAA. Classification of the edentulous jaws. *Int J Oral Maxillofac Surg* 1988;17:232—6.
17. Siervo S, Ruggli-Milic S, Radici M, Siervo P, Jäger K. Piezoelectric surgery. An alternative method of minimally invasive surgery. *Schweiz Monatsschr Zahnmed* 2004;114:365—77 [in French, German].
18. Flanagan D. Arterial supply of maxillary sinus and potential for bleeding complication during lateral approach sinus elevation. *Implant Dent* 2005;14:336—9.
19. Traxler H, Windisch A, Geyerhofer U, Surd R, Solar P, Firbas W. Arterial blood supply of the maxillary sinus. *Clin Anat* 1999;12:417—21.
20. Zijderveld SA, van den Bergh JPA, Schulten EAJM, ten Bruggenkate CM. Anatomical and surgical findings and complications in 100 consecutive maxillary sinus floor elevation procedures. *J Oral Maxillofac Surg* 2008;66:1426—38.
21. Bornstein MM, Chappuis V, von Arx T, Buser D. Performance of dental implants after staged sinus floor elevation procedures: 5-year results of a prospective study in partially edentulous patients. *Clin Oral Implants Res* 2008;19:1034—43.
22. Zijderveld SA, Schulten EAJM, Aartman IHA, ten Bruggenkate CM. Long-term changes in graft height after maxillary sinus floor elevation with different grafting materials: radiographic evaluation with a minimum follow-up of 4.5 years. *Clin Oral Implants Res* 2009;20:691—700.
23. Fasolis M, Boffano P, Ramieri G. Morbidity associated with anterior iliac crest bone graft. *Oral Surg Oral Med Oral Pathol* 2012;114:586—91.
24. Pjetursson BE, Tan WC, Zwahlen M, Lang NP. A systematic review of the success of sinus floor elevation and survival of implants inserted in combination with sinus floor elevation. *J Clin Periodontol* 2008;35:216—40.
25. Nkenke E, Stelzle F. Clinical outcomes of sinus floor augmentation for implant placement using autogenous bone or bone substitutes: a systematic review. *Clin Oral Implants Res* 2009;20:124—33.
26. Sbordone C, Toti P, Guidetti F, Califano L, Bufo P, Sbordone L. Volume changes of autogenous bone after sinus lifting and grafting procedures: a 6-year computerized tomographic follow-up. *J Craniomaxillofac Surg* 2013;41:235—41.
27. Shibuya Y, Takeuchi Y, Asai T, Takeuchi J, Suzuki H, Komori T. Maxillary sinus floor elevation combined with a vertical onlay graft. *Implant Dent* 2012;21:91—6.
28. Hatano M, Shimizu Y, Ooya K. A clinical long-term radiographic evaluation of graft height changes after maxillary sinus floor augmentation with a 2:1 autogenous bone/xenograft mixture and simultaneous placement of dental implants. *Clin Oral Implants Res* 2004;15:339—45.
29. Jang HY, Kim HC, Lee SC, Lee JY. Choice of graft material in relation to maxillary sinus width in internal sinus floor augmentation. *J Oral Maxillofac Surg* 2010;68:1859—68.