Subantroscopic Laterobasal Sinus Floor Augmentation (SALSA): An Up-to-5-Year Clinical Study

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Purpose: *The aim of the article was to introduce a new subantroscopic laterobasal sinus augmentation (SALSA) technique as a minimally invasive approach to maxillary peri-implant surgery.* ***Materials and Methods:*** *The SALSA technique consists of the following steps: (1) microsurgical opening of the subantral space (SAS) with detachment of the sinus membrane (SM) under supported videoendoscopy; (2) enlargement of the SAS by laterobasal tunnelling; (3) subantroscopic examination of the SAS with (4) optional reinforcement or repair of the SM; (5) implant site preparation with subantroscopic identification of the cavities; and (6) precise stepwise placement of graft material under endoscopic control.* ***Results:*** *Since 1996, 118 sinus augmentations have been performed on 83 patients using particulate alloplastic augmentation material (tricalcium phosphate) with various amounts of autogenous bone and blood. Mean augmentation height was 8.6 mm (range, 1 to 15 mm). Twenty-eight perforations of sinus mucosa were observed without further complication (1 case of sinusitis was treated and re-augmented endoscopically). Of 211 titanium screw-type implants placed, 11 failures were observed.* ***Discussion:*** *SALSA is a predictable surgical technique. With this minimally invasive method, adequate bone height can be achieved.* ***Conclusion:*** *SALSA may offer advantages related to lower morbidity, conservation of bone volume and blood supply, optimized view of the surgical field, and high acceptance by patients.* (Int J Oral Maxillofac Implants 2002;17:135–143)

Key words: *bone grafting, dental implants, maxillary sinus, preprosthetic oral surgical procedures, sinus augmentation*

Sinus floor augmentation has been proven to be a valuable procedure that allows the placement of endosteal implants in atrophic maxillary implant sites. Since the early descriptions by Tatum[1] and Boyne and James,[2] a classical window technique has been used by the majority of authors, with an osteoclastic approach via the anterior maxillary wall.[3] This procedure has been particularly useful when multiple implants were to be placed and bone grafts from the iliac crest used in atrophic sites with minimal bone height.[4] In cases of lesser atrophy, less invasive techniques with a transalveolar approach (osteotome technique) have been reported.[5] Autogenous bone and either allograft, alloplast, or xenograft have been used to augment the subantral space (SAS) and are effective as sinus grafting materials.[6]

Engelke and Deckwer[7] described a new endoscopically controlled technique for sinus floor augmentation. This technique involved transalveolar mobilization of the sinus membrane controlled by sinuscopy, transalveolar augmentation, and simultaneous implant placement and has been indicated for moderately reduced alveolar sites. Engelke and coworkers[8] reported on a modified endoscopic

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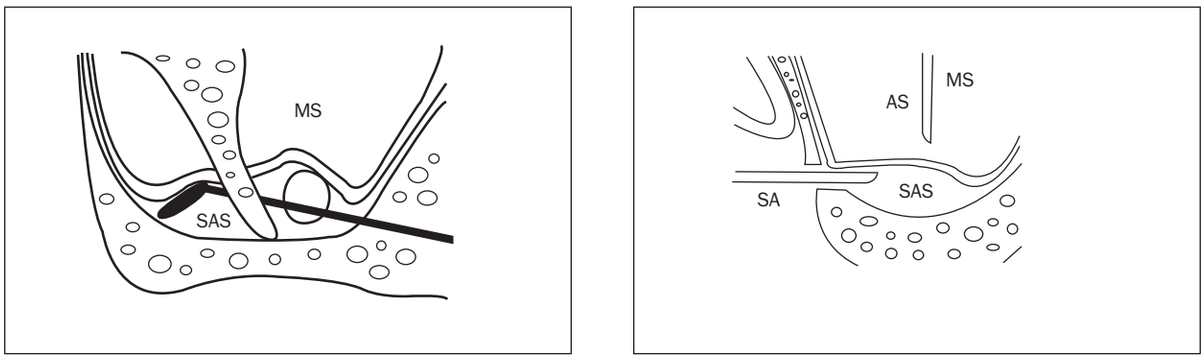

Figs 1a and 1b Schematic representation of the SALSA technique. *(Left)* Preparation of the subantral space through the keyhole approach (panoramic view). *(Right)* Endoscopic control during SALSA (cross-sectional view). MS = maxillary sinus; SAS = subantral space; AS = antroscopy; SA = subantroscopy.

technique, the laterobasal tunnel technique, which allowed augmentation of multiple maxillary sites via 1 small laterobasal trepanation (unpublished data). Through this approach, a "tenting" of the complete sinus membrane from the premolar to the second molar site could be performed, thus allowing for large augmentations in case of primary and secondary implantation. Both procedures were controlled with the endoscope placed in the lumen of the maxillary sinus via a puncture of the canine fossa.[8] The most critical aspect of the endoscopic technique is the transmucosal puncture of the maxillary sinus for antroscopy, as performed in ENT surgery, because of its traumatic appearance to the patient and the extensive clinical training necessary for oral surgeons without experience in the field of otolaryngology. Therefore, the endoscopic procedure was simplified by performing sinus floor augmentation through a strictly subantral endoscopic approach without puncture of the maxillary sinus (Figs 1a and 1b). The aim of this article was to present the current state of refined endoscopic sinus floor augmentation.

MATERIALS AND METHODS

Patients

The study group consisted of 83 consecutive patients of the Göttingen University Department of Oral Surgery who needed replacement of posterior maxillary dentition. Both partially dentate and edentulous patients were included. Indication for sinus floor augmentation was provided by insufficient height of premolar and molar implant sites with less than 10 mm of vertical bone height, as assessed from orthopantomograms of each projected implant site.

Patients with systemic diseases exhibiting risk factors that did not permit surgical intervention, as well as patients with untreated periodontitis or sinusitis, were excluded. Furthermore, all contraindications known for implant treatment in general were respected. Of the 83 patients, there were 45 men (mean age 58.8 years, range 34 to 86 years) and 38 women (mean age 51.8 years, range 27 to 76 years).

Material

For sinus floor augmentation, patient blood, resorbable beta-tricalcium phosphate (β-TCP), and various amounts of autogenous bone harvested from intraoral donor sites were used in various combinations (0% to 50%). If bone grafting was not accepted by the patient, only autogenous blood and resorbable TCP ceramic (Curasan, Kleinostheim, Germany; and Oraltronics, Bremen, Germany) were used.

A total of 211 titanium screw-type implants were placed:

- 61 Frialit-2 implants, 13 to 15 mm in length and 3.8 to 4.5 mm in diameter (Friadent, Mannheim, Germany)
- 11 IMZ implants, 4.0×15 mm (Friadent)
- 85 Semados implants, 13 to 15 mm in length and 3.75 mm in diameter (BEGO, Bremen, Germany)
- 38 Pitt-easy implants, 12 to 14 mm in length and 3.75 mm in diameter (Oraltronics)
- 16 ITI implants 4.1×14 mm (Straumann, Freiburg, Germany)

For reinforcement of the sinus membrane and/or closure of perforations, a resorbable vicryl mesh (Ethicon, Norderstedt, Germany) was used.

Figs 2a to 2d Instrumentation for SALSA: Support and protection shaft (SPS) for the oral endoscope. SPS supports the endoscope directly on the bone surface for constant object-focus distance during observation of the operating field and prevents pollution of the endoscope window during supported oral videoendoscopy.

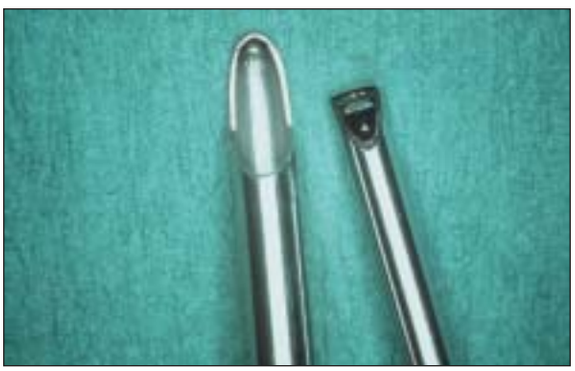

Fig 2a The 2.7-mm endoscope tip and SPS working end.

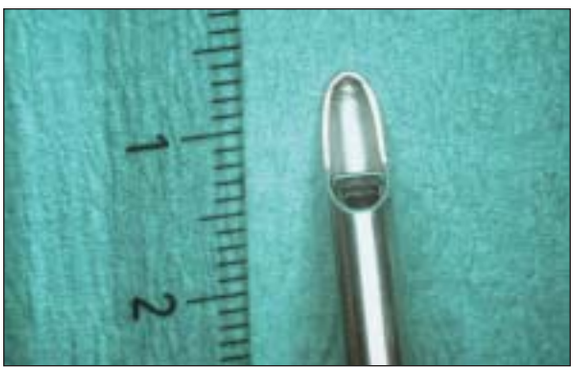

Fig 2b Endoscope with SPS mounted.

Fig 2c Microsurgical sinus elevators: type O "dish-knives" for opening.

Fig 2d Microsurgical elevators: type T for tunnel preparation.

Support video endoscopy was performed with Storz-Hopkins 30-degree and 70-degree, 2.7-mm optic equipment linked up with a Storz Endoscopy 487 B examination unit (Storz, Tuttlingen, Germany) and a VHS video recorder (Sony, Köln, Germany). A 300-W xenon light fountain (Storz) with a 6,000 K capacity served as the light source.

Surgical Procedure

Surgery was performed under local anesthesia at the infraorbital and palatal foramina with additional local infiltration at the incision line. The flap design depended on the number and location of implants planned. Typically, a crestal incision was made with a vestibular relief incision in the first premolar region. A full-thickness mucoperiosteal flap was then elevated, exposing the anterobasal aspect of the sinus wall, including the inferior third of the zygomatic buttress and the alveolar crest with the planned implant sites.

Microsurgical Access. A 5-mm-diameter laterobasal osteotomy (Fig 1a) was made directly anterior to the zygomatic buttress at the inferior aspect of the anterior sinus wall. The osteotomy was performed with a 4-mm diamond round bur under magnification with the support video endoscope technique (Figs 2a and 2b). The osseous margin of the trepanation was then identified. The sinus membrane was displaced with the help of microsurgical elevators of 2 to 4 mm in diameter (Figs 2c and 2d) around the trepanation (Fig 3). The bony access was opened just enough to allow introduction of 4-mm-diameter angulated mucosal elevators into the subantral space (Fig 2d). The circular dissection of the sinus membrane was performed under continuous microendoscopic observation on a monitor. After circular detachment, the access hole was rounded and extended to a diameter of 5 mm. Its position was always located at the most inferior aspect of the alveolar recess to facilitate the laterobasal tunnelling.

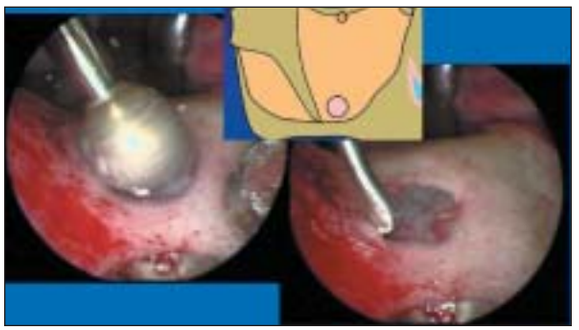

Fig 3 Microsurgical access to the subantral space.

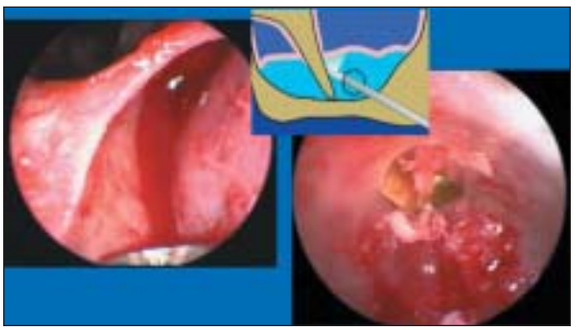

Fig 4 Subantroscopic examination of the subantral space. *(Left)* Normal appearance of the sinus membrane representing the roof of the artificial subantral space. *(Right)* Twist drill (Oraltronics, Bremen, Germany) entering the subantral space.

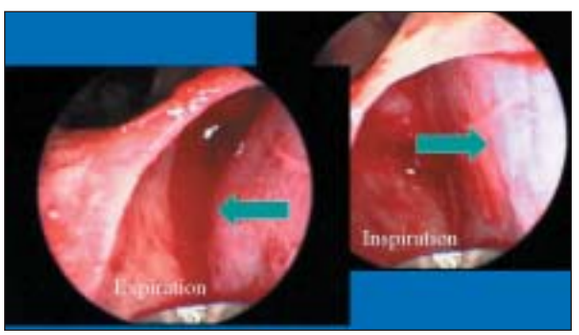

Fig 5 Sinus membrane examination. During respiration, alternating movement of the sinus membrane is observed, giving evidence of the absence of perforations.

Fig 6 Stepwise augmentation. Augmentation material is placed first at the distal and proximal ends of the subantral space and is controlled endoscopically before the periapical spaces around the implants are filled.

Creation of the SAS. The SAS was created by tunnelling the sinus membrane (Fig 1a) with elevators of 0-, 45-, and 90-degree angulation (Fig 2d) under tactile control with the osseous basal floor (Fig 1a). Primarily the membrane at the laterobasal angle of the sinus floor was detached in an anteroposterior direction. The detachment ended 5 mm dorsal to the projected most distal implant site. If necessary, the complete sinus floor was tunnelled this way. The tunnel then was extended at its medial and superior aspects. The instruments had to be guided continuously in close contact with the bone to avoid tension or perforation of the sinus membrane, particularly if irregularities of the sinus floor or difficult anatomy were present. In case of septa or irregular shape of the sinus floor, endoscopic exploration helped to lead the elevators along the basal limits of the bony maxillary wall. The tunnel size depended on the height and volume planned for the augmentation and implants. Enough space had to be provided to place the graft material without tension on the sinus membrane.

Endoscopic Control of the SAS. After detachment of the sinus membrane, the subantral space was examined via the access-trepanation using the 70-degree and 30-degree endoscopes (Figs 1b and 4). The examination included circular identification of the boundaries of the SAS and inspection of the entire sinus membrane forming the roof of the SAS for perforations or tears (Fig 5). If a perforation of the sinus membrane was detected, immediate repair was performed using polyglactine mesh (Vicryl, Ethicon). Finally, the length, height, and width of the subantral space were measured.

Preparation of Implant Cavities. Primary implant cavity preparation was carried out if primary stability of the implants could be achieved. Within the subantral space, the sinus membrane was protected with elevators, while the basal bone was perforated with the implant burs. The implant cavity had to be surrounded by at least 5 mm of SAS to allow the membrane to tent up adequately during augmentation.

Endoscopically Controlled Stepwise Augmentation. The first portion of the augmentation was placed at the most distal part of the SAS. The desired "tenting up" of the membrane was checked endoscopically before covering the mesial aspect of the most distal implant with augmentation material.

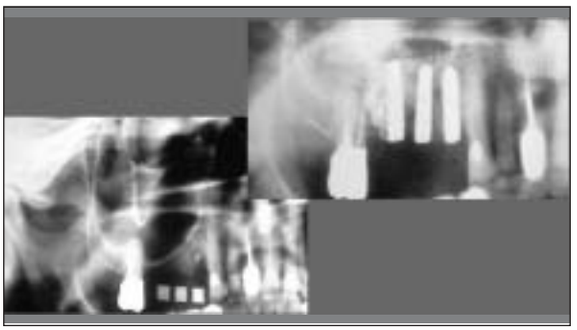

Fig 7 Radiographic result of primary implant placement with SALSA (titanium screw implants; Oraltronics; augmentation material [β-tricalcium phosphate]; Oraltronics). Note that the implant at the first molar site was stabilized with subperiosteal temporary fixation aids (satellite implants) (Mondeal, Tuttlingen, Germany).

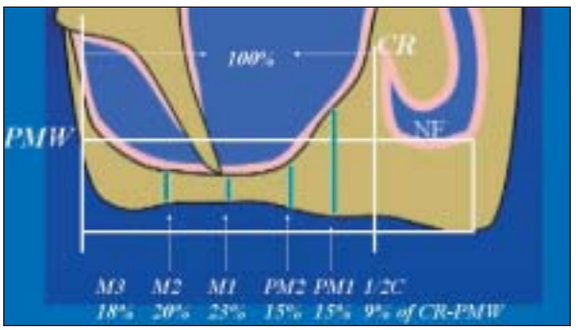

Fig 8 Radiographic assessment of posterior maxillary augmented sites. PMW = posterior maxillary wall; M3, M2, M1 = third, second, first molars; PM2, PM1 = second and first premolars; 1/2 C = canine (50% of the anterior-posterior diameter of the canine crown); CR = canine root tip; NF = nasal floor.

Proceeding from the distal extreme toward the entrance access hole, the interimplant spaces and periapical spaces around the implants were subsequently covered, with intermittent endoscopic control. Before the implant was placed adjacent to the access trepanation, the most mesial (anterior) aspect of the SAS was filled with augmentation material (Fig 6). The entrance keyhole then was covered with a mucoperiosteal flap.

Primary or Secondary Implant Placement. Implants were placed primarily, if primary stability could be achieved. In the absence of primary stability or if the bone structure was obviously insufficient, secondary placement was carried out after at least 6 months of healing time.

Postoperative Care

For antibiotic perioperative short-term prophylaxis, Amoxycillin (4 × 750 mg over a period of 3 days) and analgesic medication (Paracetamol 4 × 500 mg) were administered. The patients were allowed to wear their prosthesis, provided that no interference with the newly placed implants could occur. Sutures were removed at day 10. Surgical exposure for the secondary implantation was performed within 6 to 12 months, depending on the augmentation site and the degree of atrophy.

Clinical Evaluation

All patients underwent preoperative evaluation of their case history, a clinical dental examination, and a preoperative routine orthopantomogram. In case of difficult anatomy, additional computed tomographic scanning was performed. When necessary, surgical, operative, periodontal, and prosthetic treatments were performed preoperatively.

One postoperative radiograph was taken, and dental clinical examinations were performed at 3 and 6 months postoperatively (Fig 7). Before secondary implantation and/or at the time of exposure of implants, a radiographic re-evaluation was carried out.

After prosthetic treatment, a routine annual recall was offered to the patients, along with clinical and radiographic examination. Additional maintenance appointments were made individually if they were deemed necessary.

Site-dependent vertical measurements of preoperative bone height and postoperative bone height at planned implant sites were carried out with a reading accuracy of 0.5 mm from orthopantomograms. Site definition was based on anatomic approximation (Fig 8). Two reference structures were used: *(1)* the mid-canine region as most superior point of the alveolar crest between the lateral piriform aperture and the anterior border of the maxillary sinus, and *(2)* the most posterior aspect of the posterior maxillary wall. The vertical projection of these sites on a line parallel to the nasal floor was taken as the anterior and posterior limits of lateral maxillary implant sites. Based on mean values of Berkovitz and coworkers,[9] the lateral implant sites were: canine (posterior half), 9%; first premolar, 15%; second premolar, 15%; first molar, 23%; second molar, 20%; and third molar, 18% of the distance between *(1)* and *(2)*. Every orthopantomogram was analyzed individually to define implant sites; vertical measurement of bone heights was made from the midline of any augmented site vertically to the nasal floor.

For the purpose of the current study, the following parameters were assessed.

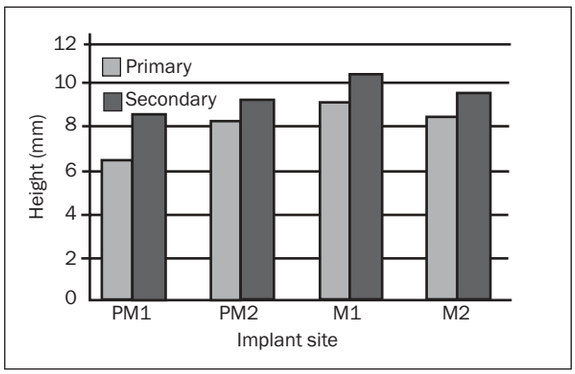

Fig 9 Site-specific mean amounts of augmentation height achieved at primary and secondary implant sites. PM = premolar; M = molar.

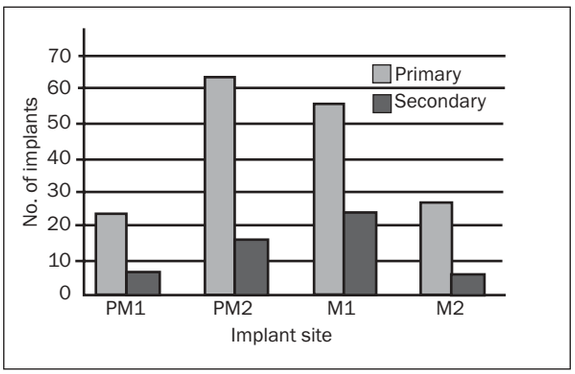

Fig 10 Distribution of implants. PM = premolar; M = molar.

1. Preoperative bone height
2. Postoperative height of augmented sites
3. Intraoperative complications
4. Postoperative complications
5. Mode of implant placement (primary/secondary)
6. Location of implants
7. Life table analysis of implant survival

RESULTS

The total number of augmentations performed was 118; 61 right and 57 left sinuses were operated. Seventeen sinuses with 32 implant sites were operated in a secondary procedure.

Preoperative Bone Height

The mean bone height for primary subantroscopic laterobasal sinus floor augmentation (SALSA) was 5.8 mm (range, 2 to 9 mm), and for secondary SALSA it was 3.1 mm (range, 0.5 to 7 mm). Implant sites with primary implantation exhibited a mean bone height of 5.3 to 7.8 mm; sites that needed secondary implantation showed mean heights between 2.4 and 3.0 mm.

Augmentation Height

Augmentation height was assessed depending upon whether primary or secondary implant placement was performed (Fig 9). Mean augmentation height was 8.6 mm (range, 1 to 15 mm). The mean augmentation height for primary implanted sites was 8.4 mm; it ranged (site-dependent) from 6.7 mm (at first premolar) to 9.4 mm (at first molar). Secondary implanted sites showed a mean augmentation height of 9.7 mm and ranged from 8.8 mm (first premolar) to 10.7 mm (first molar).

Complications

In 28 sinus augmentations, a single perforation of the sinus membrane occurred. All but 1 perforation were closed using resorbable vicryl mesh, and augmentation was completed as planned. One patient with a large perforation needed secondary intervention. In 23 operated sites, reinforcement of the membrane was performed to avoid perforations of delicate membranes during the augmentation.

One case of sinusitis was observed, with an oroantral fistula and partial loss of the augmentation material following wound dehiscence. After irrigation and antibiotic treatment, the patient's sinus was re-augmented successfully with the SALSA technique. No infraorbital nerve injury and no permanent neuralgia were observed.

Results of Implants Placed

A total of 211 implants were placed. The number of implants per patient ranged from 1 to 6 (mean 2.9). One hundred seventy-five implants were placed in a primary intervention, and 36 were placed in a secondary intervention.

The location and distribution of implants are displayed in Fig 10. The majority of implants (n = 79) were placed in the first molar region. Prosthetic treatment of the implants placed consisted of fixed prostheses for 113 implants and removable prostheses for 89. The life table analysis of all implants placed is shown in Fig 11. Implant failures occurred in 11 patients; 4 implant failures were observed with primary and 7 with secondary SALSA. The majority of implants were lost within 12 months after placement (mean 6.2 months), before prosthetic loading. Two implants with fixed restorations were lost after prosthetic loading. The implant site showing the most failures (n = 6) was the first molar region.

DISCUSSION

Since Summers[5] proposed the transalveolar osteotome technique in 1994, reduction of the invasive nature of sinus lift procedures has been addressed by several authors.[10–12] Endoscopy has been used to assess the late results after sinus floor augmentation via antroscopy or to control a transalveolar augmentation.[7,11,13] The advantages of the transalveolar approach are protection of intraosseous vessels in the maxilla and less postoperative morbidity.[13] Disadvantages are difficult working direction and limitation of the augmentation to the area surrounding the implant bed. Antroscopy via a puncture of the canine fossa requires that a surgeon perform video examination during the procedure.

To eliminate the shortcomings of the original procedure, a simplified surgical approach has been developed. While the original method required a 5-mm approach to the maxillary sinus so as to perform an antroscopy in the center of the canine fossa, the SALSA approach is located more caudally and serves as entrance to the SAS; there is no need to open the maxillary sinus lumen endoscopically. The access can be easily identified and is located directly anterior to the zygomatic buttress at the basal aspect of the anterior sinus wall. In omitting the transfacial antroscopy as surgical routine, the risk of infraorbital nerve injury (based on limited experience of oral surgeons) is eliminated.

The SALSA technique allows tunnelling of the sinus membrane in an anteroposterior direction, which is easily handled with straight instruments under continuous or intermittent endoscopic control and can be compared with the Cottle technique of subperiosteal tunnelling of the nasal septum.[14] Similar to Cottle's technique, in the laterobasal edge of the maxillary sinus, a tunnel is formed and expanded according to the requirements of the augmentation.

Subantroscopy (ie, endoscopy of the artificially created subantral space) is essential to detect possible mucosal perforation, which is a common complication according to Vlassis and Fugazzotto.[15] In the performance of sinus elevations, wide variations in the thickness of the sinus membrane have been observed.

According to van den Bergh and associates,[16] the surgical procedure for preparing the "trap door" and luxating it, together with preparation of the sinus mucosa, may cause a mucosal tear. Usually, when these perforations are not too large, they will fold together when turning the "trap door" inward and upward. Therefore, during endoscopic preparation, identification of tears is extremely important, because the sinus membrane represents the only barrier between the maxillary sinus and the augmented subantral space. Compared with the results of Raghoebar and colleagues[17] (47 perforations, out of 182 augmentations), the rate of mucosa perforation in the present study (28 of 118) appears to be within the same range. As in the study of Raghoebar and colleagues, the present technique did not appear to leave patients prone to the development of sinusitis.

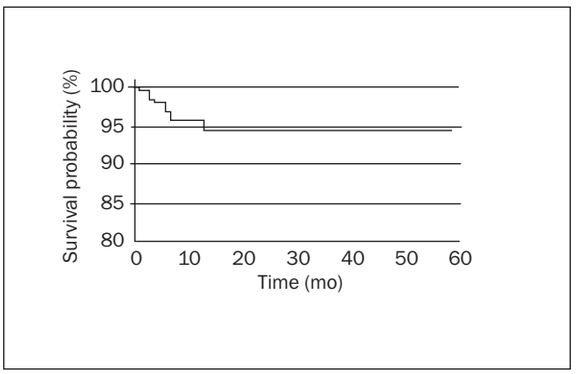

Fig 11 Life table analysis of implant survival.

Adequate respiratory movement of the maxillary sinus membrane is usually a confirmation that excessive defects or tears are not present, but only detailed endoscopic evaluation allows location of the type, shape, and size of a possible perforation so as to close it subsequently with resorbable membranes. If the endoscopic examination gives evidence of a delicate structure of the sinus membrane, a membrane may be placed to avoid rupture during augmentation. Thus, a displacement of graft material during the augmentation procedure can be avoided.

Sinusitis as a major complication of sinus lift procedures has been reported by Tidwell and coworkers[18] (10% of 48 patients) and by Small and coworkers[19] (8% of 27 patients). Recently, van den Bergh and coworkers[16] reported 2 cases of infection in 62 sinus floor elevations. Raghoebar and colleagues[17] reported 2 purulent and 3 transient maxillary sinusitis cases, out of 182 sinuses augmented with autogenous bone grafts. According to the data reported, the SALSA technique appears to exhibit lower postoperative morbidity compared with standard surgical bone grafting procedures.

An important question concerning minimally invasive sinus augmentations is the amount of bone height that can be obtained compared with conventional techniques. Bone height has not been included as a parameter in many studies.[6,20] Baumann and Ewers[13] reported on 2 cases augmented

endoscopically from 3 to 5 mm to 13 to 16 mm. Cordioli and coworkers[21] reported a mean increase of 7.1 mm in mineralized tissue in 27 patients augmented. The goal of the present SALSA study was to augment the existing bone to a level sufficient for placement of standard dental implants, at least 12 mm long, at each site. Therefore, 4 to 11 mm of augmentation was necessary, assuming that there was 1 to 8 mm of bone available at the implant sites.

The site-dependent description of bone height in sinus floor augmentation developed for the purpose of the present study refers to anatomic landmarks in routine orthopantomograms: the apical canine region, the posterior maxillary wall, and the nasal floor. With the help of the horizontal reference plane parallel to the nasal floor, it was possible to use normal anatomic crown dimensions to determine the relative position of lateral maxillary implant sites.[9] The well-known mesiodistal distortion of orthopantomograms can be neglected, if implant site location is calculated individually referring to the distance of the landmarks.[22] However, vertical distortion must be taken into account and recalculated.

Considering the results of augmentation height, SALSA permits the creation of sufficiently high implant sites independent of the preoperative bone height. There is no intrinsic limitation of the minimally invasive SALSA technique if the initial bone height is severely reduced and secondary implant placement is required. Thus, the case reports of Baumann and Ewers[13] can be supported by the present study. Because of the small approach, stepwise augmentation is the key to anatomically adequate homogeneous reconstruction of the lateral maxillary implant site. By careful placement of the particulate material, it was possible to augment individually any site with the volume necessary for reconstruction along the sinus floor.

The life table analysis of all implants placed with SALSA in this patient population shows a survival probability within the range of other studies reporting conventional sinus augmentation techniques.[6,17,20,23] Comparing the failure frequency of implants placed primary and secondarily, the higher failure rate of implants placed in secondarily augmented sites correlates with the lower preoperative bone height and may not be explained by the difference in surgical procedures. However, because of the small number of observations, the factors of implant loss and residual bone height should be evaluated with a larger patient sample, as proposed by Jensen and associates.[6]

CONCLUSIONS

The SALSA technique can provide the following advantages:

- Microsurgical minimally invasive access without puncture of the canine fossa
- No limitation of augmentation sites
- Low complication rate
- Conservation of vital bone and blood supply
- Adequate bone height independent of preoperative bone height
- Optimized visualization of the surgical site
- Endoscopic management of mucosal tears
- Precise, endoscopically controlled placement of graft material

REFERENCES

1. Tatum H. Maxillary and sinus implant reconstructions. Dent Clin North Am 1986;30:207–229.
2. Boyne PJ, James RA. Grafting of the maxillary sinus with autogenous marrow and bone. J Oral Surg 1980;38:613–616.
3. Wiltfang J, Merten HA, Ludwig A, Engelke W, Arzt T. Röntgenologische, endoskopische und sonographische Beurteilung der Kieferhöhle nach Sinuslift und simultaner Implantatinsertion. Mund Kiefer Gesichtschir 1999;3(1): 61–64.
4. Keller EE, Tolman DE, Eckert SE. Maxillary antral-nasal inlay autogenous bone graft reconstruction of compromised maxillae: A 12-year retrospective study. Int J Oral Maxillofac Implants 1999;14:707–721.
5. Summers RB. A new concept in maxillary implant surgery: The osteotome technique. Compend Contin Educ Dent 1994;15:152–160.
6. Jensen OT, Shulman LB, Block MS, Iacono VJ. Report of the Sinus Consensus Conference of 1996. Int J Oral Maxillofac Implants 1998;13(suppl):11–32.
7. Engelke W, Deckwer I. Endoscopically controlled sinus floor augmentation. A preliminary report. Clin Oral Implants Res 1997;8:527–531.
8. Fisher EW, Croft CB. Antroscopy: Current practice—A survey of UK otolaryngologists. J Laryngol Otol 1989;103: 747–749.
9. Berkovitz BKB, Holland GR, Moxham BJ. Color Atlas and Textbook of Oral Anatomy. Histology and Embryology. St Louis: Mosby-Year Book 1992:40.
10. Bruschi GB, Scipioni A, Calesini G, Bruschi E. Localized management of sinus floor with simultaneous implant placement: A clinical report. Int J Oral Maxillofac Implants 1998;13:219–226.
11. Wiltfang J, Schultze-Mosgau S, Merten HA, Kessler P, Ludwig A, Engelke W. Endoscopic and ultrasonographic evaluation of the maxillary sinus after combined sinus floor augmentation and implant insertion. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;89:288–291.
12. Mazor Z, Peleg M, Gross M. Sinus augmentation for single-tooth replacement in the posterior maxilla: A 3-year follow-up clinical report. Int J Oral Maxillofac Implants 1999;14: 55–60.

13. Baumann A, Ewers R. Minimally invasive sinus lift. Limits and possibilities in the atrophic maxilla. Mund Kiefer Gesichtschir 1999;3(1):70–73.
14. Rudert H. From Killian's submucous septum resection and Cottle's septoplasty to plastic septum correction and functional septo-rhinoplasty [in German]. HNO 1984;32(6): 230–233.
15. Vlassis JM, Fugazzotto PA. A classification system for sinus membrane perforations during augmentation procedures with options to repair. J Periodontol 1999;70:692–699.
16. van den Bergh JP, ten Bruggenkate CM, Disch FJ, Tuinzing DB. Anatomical aspects of sinus floor elevations. Clin Oral Implants Res 2000;11(3):256–265.
17. Raghoebar GM, Timmenga NM, Reintsema H, Stegenga B, Vissink A. Maxillary bone grafting for insertion of endosseous implants: Results after 12-124 months. Clin Oral Implants Res 2001;12(3):279–286.
18. Tidwell JK, Blijdorp PA, Stoelinga PJW, Brouns JB, Hinderks F. Composite grafting of the maxillary sinus for placement of endosteal implants. Int J Oral Maxillofac Surg 1992;21:204–209.
19. Small SA, Zinner ID, Panno FV, Shapiro HJ, Stein JL. Augmenting the maxillary sinus for implants: report of 27 patients. Int J Oral Maxillofac Implants 1993;8:523–528.
20. Tong DC, Rioux K, Drangsholt M, Beirne OR. A review of survival rates for implants placed in grafted maxillary sinuses using meta-analysis. Int J Oral Maxillofac Implants 1998;13: 175–182.
21. Cordioli G, Mazzocco C, Schepers E, Brugnolo E, Majzoub Z. Maxillary sinus floor augmentation using bioactive glass granules and autogenous bone with simultaneous implant placement. Clinical and histological findings. Clin Oral Implants Res 2001;12(3):270–278.
22. Pasler FA. Radiologie. In: Rateitschack KH (ed). Farbatlanten der Zahnmedizin. Vol 5: Rõntgenanatomie in Orthopantomographien. Stuttgart: Thieme, 1991:25–41.
23. Khoury F. Augmentation of the sinus floor with mandibular bone block and simultaneous implantation: A 6-year clinical investigation. Int J Oral Maxillofac Implants 1999;14(4): 557–564.