

MAXILLARY SINUS AUGMENTATION USING DEPROTEINIZED BOVINE BONE (BIO-OSS®) AND IMPLADENT® DENTAL IMPLANT SYSTEM

PART I. COMPARISON BETWEEN ONE-STAGE AND TWO-STAGE PROCEDURE

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Summary: This study was undertaken to compare implant survival after one- or two-stage sinus augmentation. Ninety-two maxillary sinuses in 77 patients were augmented with deproteinized bovine bone (Bio-Oss®). These sinuses were subdivided into two groups: Group 1 (n = 49) was operated on with a one-stage procedure, and Group 2 (n = 43) with a two-stage operation. A hundred and eighty-five implants were inserted in these augmented sinuses. Clinical and radiographical evaluations were performed and recorded according to certain criteria. The follow-up period was ranging from 16 to 44 months. Out of the implants inserted using the one-stage procedure, all survived. Two implants failed in the two-stage procedure group (98.91 % implant survival). This study showed that no statistically significance was observed between the two surgical techniques ($P < 0.05$). Therefore, the authors concluded the type of surgical procedure (one- or two-stage) has no effect on implant survival.

Key words: Endosteal implant; Sinus lift; One-stage procedure; Two-stage procedure

Introduction

For many people the loss of teeth can mean the loss of jaw function, and can lead to poor oral aesthetics and severe emotional and psychological handicaps. Osseointegrated dental implants have made it possible to rehabilitate nearly all of these patients. Unfortunately, certain patients have been unable to take advantages of dental implants because of inadequate bone availability. The edentulous patient with a severely resorbed maxilla often requires bone grafting to enable implant insertion. The reason for this limited quantity of bone volume is related to the excessive resorption of the alveolar bone and/or the increased pneumatization of the maxillary sinuses that occur following teeth loss (10). The use of short implants in poor bone quality does not seem to be advisable. Jemt and Lekholm (4) reported failure rate of 24 % with implants 7 mm in length in the maxilla.

Maxillary sinus elevation (sinus lift procedure) has become a well-accepted technique for increasing height of the bone in the posterior maxilla when inadequate bone exists for the placement of dental implants. In-fracture of the lateral wall of the maxillary sinus provides access for sinus mucosa elevation and graft placement (9,17). Implants can be placed into the grafted sinus in one-stage (simultaneous-

ly) or two-stage (delayed) surgical procedure. The determining factor has been appeared to be ensuring primary stability of the implants. In one-stage procedure, implant can be placed simultaneously with a sinus graft if adequate alveolar bone is available to stabilize the implant. In this case, the cortical bones of the crest and of the original sinus floor may be used to stabilize the implant, permit its rigid fixation, and prevent migration or even loss of implants during the early healing phase (11). On other side, in a delayed implant placement procedure, a graft is placed first and requires certain time to mature, after this time, the implant bodies are placed. This requires two waiting periods: the first for graft maturation and the second for implant osseointegration (15,16,22). The question of whether to place the endosseous implants simultaneously within the sinus graft, or whether a delayed approach should be utilized following augmentation, has been evaluated in a number of experimental and clinical studies. Simultaneous implant placement has been advocated by several authors (6,9,12,14,22); however, there are several advantages that tend toward the decision to delay implant placement (1,5,8,11,13,14,15). The aim of this retrospective study was to investigate whether any significant difference in implant survival could be detected between those implants placed in one- or two-stage procedure.

Materials and Methods

From January-1998 to March-2000, seventy-seven consecutive patients (36 men and 41 women) who required sinus grafting of one, or both, of their maxillary sinuses for placement of endosseous implants in the posterior maxilla were evaluated clinically and radiographically in our center. The implants (Impladent®, Lasak, Czech Republic) placed into sinus grafts were separated into 2 groups based on the surgical technique used. Group 1 included implants placed with augmentation material using a one-stage procedure, while those assigned a two-stage procedure classified as Group 2 (Tab. 1). Clinical evaluations were recorded and radiographs were taken prior to sinus augmentation and at second stage procedure.

Tab. 1: Number of patients, number of sinus floor elevations.

	Number of patients	Number of sinus grafts	Number of implants
One-stage procedure	43	49	89
Two-stage procedure	34	43	96
Total	77	92	185

Surgical procedure

Horizontal incision was carried along the posterior alveolar crest; then small releasing incisions were made into the buccal vestibule of the tuberosity region. A releasing inci-

sion was also made into the vestibule in the canine region extending anteriorly. Once the flap was sufficiently elevated, a large round bur was used at 2000 rpm, with copious irrigation, to outline a bony window in the lateral sinus wall. The lower border of this window was estimated to be 2 mm above the sinus floor. The bony wall was then assessed for mobility, if the osteotomy was complete and the window was mobile, blunt sinus curettes (HU-FRIEDY, USA) were used to gently elevate the sinus mucosa to the anterior and medial walls of the sinus as far, posteriorly, as necessary for implant placement. A mixture of Bio-Oss® (deproteinized bovine bone), venous patient's blood, and sometimes, autogenous bone harvested from the maxillary tuberosity was packed into the void created in the sinus. The decision to use one- or two-stage procedure was taken after enough evaluation of different factors such as the available bone height, width, and quality and the implant type and diameter. In simultaneous implant placement, implant receptor sites were prepared after completion of the sinus floor elevation. The augmentation material was compacted against the sinus walls and around the implant bodies until the surgical void was filled (Fig. 1 a,b,c). The healing time prior to implant uncovering was 9 months (Fig. 2 a). In delayed implant placement, implants were inserted after a healing period of 6 months, and were allowed to osseointegrate for 9 months more (Fig. 2 b). All patients were given appropriate antibiotic treatment for 1 week beginning 1 hour before the surgery.

The criteria for implant success were taken from the O'Roark and Wayne study published in the International

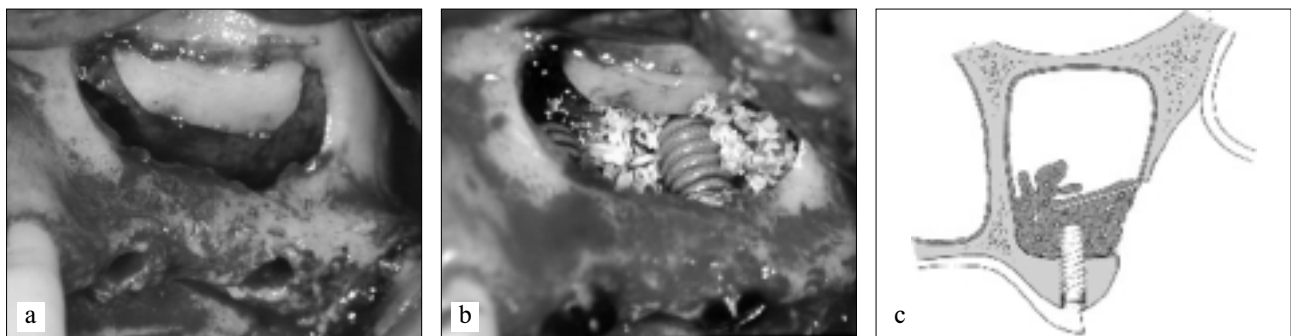


Fig. 1: (a) After trap-door elevation, implant sites have been prepared. (b) After implants insertion, Bio-OssR particles have been compacted within the sinus and around the implant. (c) Illustration demonstrates the implant-augmentation material relation.

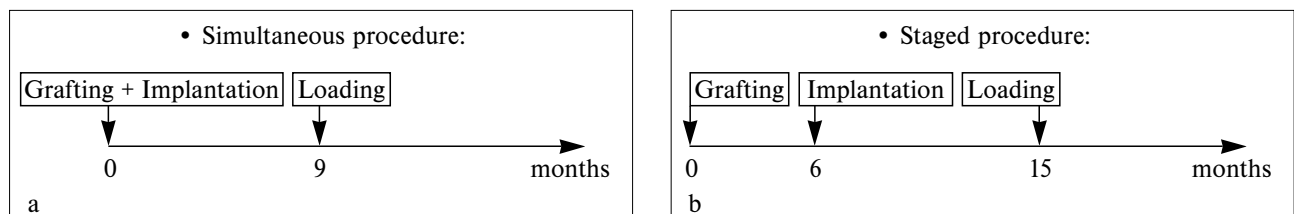


Fig. 2: (a) In one-stage procedure, implants were loaded of 9.0 months. (b) In two-stage procedure, implants were activated after a mean healing period of 6.0 months and a mean implant osseointegration period of 9.0 months.

Journal of Oral Implantology in 1991, in which success was defined as, "Survival: Any implant removed or one that would be removed by any reasonable and experienced implantologist is a failure. The remainders are reported as percent survival" (21). The following were investigated and subjected to statistical analysis:

1. Was a one-stage or two-stage procedure employed?
2. What was the failure rate of the implants?

Implant mobility was determined with the aid of a Periotest® (Siemens, Bensheim, Germany). Fisher's exact test was used statistically to compare our results.

Results

Two implants failed during the second stage (survival rate of 98.91 %) (Tab. 2). Both of them were in the same sinus, and were from Group 2. Out of the implants inserted using the one-stage procedure, all survived. No statistically significance was observed between the two surgical techniques ($P = 0.498$). At abutment connecting stage all of the surviving implants appeared well integrated and they tolerated the torque force (35 N cm) required to stretch the abutment's screws without any pain. Clinical evaluation of their stability using a Periotest® instrument (Siemens, Bensheim, Germany) showed positive results. All implants were loaded prosthetically at the time of the investigation (no one was excluded for one reason or another).

Tab. 2: Implant survival based on surgical technique.

	Number of failed implant	Implant survival (%)
One-stage procedure	0	100 %
Two-stage procedure	2	97,31 %

Discussion and Conclusions

In our study the difference between the results of simultaneous and delayed placement procedures was not statistically significant. This result agrees with others have been reported by prior studies (3,13,18,23). However, some reports indicate a higher failure rate for implants inserted simultaneously than for those inserted using a delayed approach (5,11). Jensen (5) reported a success rate of 81 % with simultaneous placement and 93 % with the two-stage procedure. Misch and Dietsh (11) reported a failure rate of 1 % in delayed implantation cases and 10 % in simultaneous implantation cases. Valentini et al (19) reported 96.8 % implant survival in two-stage procedure and 92.8 % in one-stage procedure. Tidwell et al (18) published failure of 8.7 % occurred in one-stage procedure and of 2.6 % of two-stage procedure. In other direction, the bone graft-implant interface has to be further examined in clinical studies to allow conclusions to be drawn about which surgical technique is preferable. Quinones et al (13) demonstrated significantly greater direct bone graft-to-implant contact in the delayed

implant placement than the simultaneous installation of implants in the augmented area. Zitzmann et al (23) noticed differences between the two techniques even in the potential gained bone. In their study the gain in bone height for the one-step procedure has a median of 10 mm, compared to a median of 12,7 mm for the two-stage surgery. Some investigations have preferred delayed implant placement, because it guarantees better implant position and angulation for the prosthetic reconstruction (1,4). Blomqvist et al (1) noticed that the implants inserted during one-stage procedure were angled more palatally compared with those placed with two-stage operation. This is explained by the fact that a surgeon choosing a one-stage procedure often needs to use a thicker and more rigid bone palatal at the top of the alveolar crest to acquire initial stability.

For most of the aforementioned authors the available preoperative bone was thought to be a prognosticator for whether a delayed or simultaneous technique should be used. The question how much alveolar bone is enough to stabilize the implants during the healing phase is still unsolved. It has been published that at least 3–4 mm of alveolus should be present (14,16). In each borderline case (bone height = 4 mm), the decision as to whether to perform a one-step or a two-step procedure is also influenced by the buccolingual width and the bone quality of the alveolar ridge (22). Jensen and Greer (6) demonstrated that minimal preoperative bone had been reported to be an important factor in the failure to establish or maintain osseointegration. There also seems to be a correlation between the amount of supporting residual bone and the loss of implants, irrespective of the kind of particulate graft used. In their study, the implant survival rate was only 29 % when the residual bone was less than 3 mm, while all implants were stable when the residual bone was 7 mm or more. Langer et al (7) recommended that simultaneous implant and graft placement in sinus with less than 5 mm of residual bone height appear to yield a greater number of implant losses than those with more bone. At the Sinus Graft Consensus Conference (2) they concluded that there appears to be a statistical difference in implant loss when available bone was 4 mm or less as opposed to 5 mm or greater. From 349 implants 20 were lost. Of the implants lost, 13 were initially placed in residual bone of 4 mm or less, 7 were placed in bone of 4 to 8 mm, and none of the implants placed in bone with a height greater than 8 mm were reported lost. However, presently, there are only a few reports that suggested the lack of preoperative bone as a factor in implant loss (5,6,12). Peleg et al (12) reported about one-stage procedure in cases where the residual alveolar bone height in the posterior maxilla was 1 to 2 mm, but with a special modification in the surgical technique. In our practice, we consider that there are different factors, other than the available bone height, which interface in the decision whether implant simultaneous placement can be done or not. This is variable depending on the patient's residual bone width, osseous structure of sufficient quality and

quantity, implant type, implant diameter, the type of the augmentation material that will be used, and the bone-forming capability of the patient.

The graft healing time necessary before delayed implantation surgery is also debatable. There is no conclusive evidence as to how long the optimal healing period should be, but adequate time must be provided to regenerate sufficient new bone volume. For the most augmentation materials the nine-month interval between the first and second surgery allows adequate time for the bone to mature and implants to integrate (15,22). Wheeler (20) revealed only slight percentage variances in bone volume during the 6- to 9-month healing periods. Therefore, 6 months was considered adequate time for graft maturation before implant placement or the uncovering of implants placed at the same time as grafting.

The author concluded, for short term follow-up, the type of surgical procedure (simultaneous or delayed) had no effect on implant survival. The advantages and the disadvantages of a one-stage procedure can be summarized as the following. The advantages of a one-stage procedure are:

1. Patients do not have to undergo a second surgical visit.
2. Shorter healing time so the loading can be initiated earlier and more cost effective.
3. The surgeon may assess the vertical height of augmentation before delayed placement.
4. Decreasing the risk of implant inadvertently extending into the sinus.

One-stage procedure has many disadvantages. They could be summarized as follows:

1. The implants in the middle of the sinus graft may make vascular supply more troublesome
2. If the sinus graft becomes infected a bacterial smear layer may develop on the implant and make future bone contact with the implant less predictable
3. The implants present in the graft also make treatment of the infection more difficult
4. There is an increased risk of losing the graft and implant if a postoperative infection occurs with a simultaneous implant insertion.

When reversed, the advantages/disadvantages of the one-stage procedure could be seen as the disadvantages/advantages of a two-stage surgery.

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