Maxillary Sinus Floor Augmentation Using Blood Without Graft Material. Preliminary Results in 10 Patients

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Purpose: The maxillary sinus lift is recognized and stable, and there have been different innovations to optimize the technique. The aim of this study was to investigate the maxillary sinus lift technique with the use of a blood clot and without the use of a bone graft.

Materials and Methods: Ten patients were recruited for a unilateral sinus lift; patients without sinus pathology or other contraindication were selected. The maxillary sinus was accessed conventionally under local anesthesia followed by an osteotomy and a 1-cm² bony window access. The sinus membrane was detached and the window was repositioned above and stabilized with a 12- or 14-mm osteosynthesis screw introduced through the alveolar ridge. Dental implants were installed in the second surgical stage. Standardized panoramic radiographic checks were performed at every stage.

Results: Seven completely edentulous patients and 3 partially dentate patients were treated surgically. From the first to the second surgery, a bone gain of 2.37 mm was obtained, although loss of bone height was observed in 1 completely edentulous patient. In 7 patients, it was not possible to install the implants owing to insufficient bone height or inadequate bone quality.

Conclusion: The protocol used in this investigation failed in the bone increase required for implant installation.

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Different publications have reported the efficacy of different bone fills under these conditions. Recently, other investigations have indicated that new bone formation and osseointegration are possible by maintaining the sinus membrane using a blood clot or peripheral blood only. Nevertheless, in maxillary sinuses that demand a greater level of reconstruction because the remaining bone in the sinus floor is smaller and does not allow immediate implant installation, there is little information on the performance of the blood clot as a fill element.

The aim of this study was to determine bone formation in maxillary sinus lifts using only blood clots as the fill element.

**Materials and Methods**

Ten patients 43 to 58 years old (8 female and 2 male) were selected for inclusion in the study; 7 presented total edentulism, whereas 3 presented partial edentulism. Only 1 maxillary sinus per patient was treated surgically. Those patients who presented with a history of sinus pathology or tobacco use were excluded. Data collected in the study were analyzed descriptively with the help of Excel (Microsoft, Redmond, WA). This investigation was approved by the research ethics committee of the State University of Campinas (number 146/9).

**SURGICAL PROCEDURE AND FOLLOW-UP**

**First Surgery**

Under local anesthesia (2% lidocaine with 1:100,000 epinephrine), a mucoperiosteal flap was fabricated by an incision in the maxillary sinus alveolar ridge and a vertical relief incision in the sector anterior to the defect. With a number 8 spherical diamond bur in a 20,000-rpm motor, vertical and horizontal osteotomies were performed until arriving at the sinus mucosa; the osteotomies formed a window of approximately 1 cm².

The sinus mucosa was detached, keeping the bony window joined to the lifted sinus mucosa; detachment of the membrane took place in the lower, medial, anterior, and posterior quadrants without detaching the upper quadrant (Fig 1). A screw from the 2.0 system (12- or 14-mm long as appropriate; Engimplan, Rio Claro, Brazil) was installed in the alveolar ridge, passing it through until contact with the lifted bony window was achieved (Fig 2). At that point, it was expected that the created defect would begin to fill with blood from the different disrupted sectors (Fig 3). The lateral region of the maxillary sinus was protected by a decalcified bovine cortical bone membrane (Genius, Sao Paulo, Brazil; Fig 4), and the incision was sutured with 4-0 chromic catgut. Pharmacologic management was with oral amoxicillin 500 mg every 8 hours, analgesia with nonsteroidal anti-inflammatory drugs as needed by the patient, and 0.12% chlorhexidine as an oral rinse for 10 days.

**Second Surgery**

Seven to 8 months after the first intervention, surgery was performed to remove the screw and to begin the implant installation process. At this stage, the implants were installed according to the plan in each case using conventional implant installation protocols. Clinical follow-up occurred weekly for the first month and monthly for the next 6 months.

**RADIOGRAPHIC FOLLOW-UP**

Radiographic follow-up took place with the assistance of a surgical guide that was used to take the panoramic images at the presurgical stage and at days 30, 120, and 240 after the first surgery (Fig 5). The surgical guide used spherical balls 3 mm in diameter to measure the maxillary sinus floor (floor height) in each
location planned for implantation; measurements were made on all panoramic images using a digital caliper operated by an observer on 3 different days, thus obtaining an average of the measurements that was recorded for the study.

Owing to the ethical aspects of the study, when the technique performed did not attain the objective of installing implants in the designated sector, alternative treatments were undertaken, such as the installation of zygomatic implants, modification of implant installation areas, or reconstructive surgeries with the use of bone grafts.

**Results**

Ten maxillary sinuses were treated surgically with blood clots in the present patients (average age, 51.2 yr); no infections of the surgical site, sinus pathology, or other alterations were observed. Seven patients exhibited total edentulism, whereas the 3 remaining patients presented with teeth in the anterior sector and posterior to the sinus defect that was to be reconstructed.

Bone formation at the time of the second surgery was deficient in 7 of the 10 cases, making it impossible to install implants in those patients because of insufficient bone height or the existence of unstable tissue (intrasinus soft tissue). Patient 2, who presented an extensive pneumatization of the maxillary sinus, did not exhibit bone formation; on the contrary, this patient exhibited alveolar ridge resorption, most likely caused by detachment of the mucosa and periosteum (Table 1). Another example of the problems caused by this technique was evident in patient 4: although sufficient height was present on the panoramic radiograph, it was not possible to record the bone formation clinically. Only soft tissue was present, which could not sustain implants; these clinical conditions were observed at the time of screw removal and first drilling for implant installation.

In the imaging study before the first surgery (maxillary sinus lift), an average bone height of 3.17 mm was observed; before the second surgery (implant installation), an average height of 5.54 mm was observed. The patients who presented the greatest bone formation were those who still had teeth close to the area of the maxillary sinus lift (premolar or molar teeth present), with an average bone gain of 3 mm (panoramic radiographic evaluation), whereas the edentulous patients presented an average height increase of 2.14 mm.

Insufficient bone formation and the likely formation of fibrous tissue in the maxillary sinus rendered the installation of implants impossible in 7 patients with elevated maxillary sinuses. In 3 patients, it was possible to install implants according to what had previously been planned, and implants with lengths of 8.5, 13, and 8.5 mm were installed.

**Discussion**

The results of this study showed some relevant aspects of the maxillary sinus lift technique; the patients recruited for this investigation were mainly edentulous adults with enlarged maxillary sinuses. The bone regeneration contributed by the blood clot was insufficient in 7 of the 10 cases. Although it is conceivable that there was indeed bone formation, it was insufficient in amount and quality for implant installation.

It is possible to achieve bone formation from blood clots, because blood components and their derivatives, such as platelet-rich plasma, can heal the bone of critical defects. This is consistent with findings obtained from animal models of metabolic diseases, such as diabetes.

In addition, the potential of the sinus membrane to promote new bone formation has been reported; it also has been noted that maintaining the blood clot in
the maxillary sinus lift technique permits immediate bone formation under implant installation conditions without needing to fill it with any other type of material. Considering that Chaves Netto et al showed that critical defects larger than 9 mm in canine models were unable to achieve adequate bone formation solely by maintaining the blood clot, it is appropriate to ask when the blood clot is capable of allowing bone regeneration in maxillary sinus lifts.

In the present investigation, the authors observed that in defects of partially dentate patients (2 cases), there was sufficient bone formation to install implants and that there was sufficient bone formation in only 1 edentulous patient. The authors believe that this limited result of the maxillary sinus lift technique and clot filling of the same defect points to 3 conclusions. First, the size of the defect is very important in intrasinus bone formation. Major extensions or increased fills of the maxillary sinus are not viable solely with a blood clot. De Moraes et al concluded that to install an 11.5-mm-long implant in maxillary sinuses with an alveolar height of less than 3 mm, it was necessary to fill it (in different directions) with almost 2 cm³ of graft material, confirming that enlarged sinus floor lifts may establish a critical intrasinus defect, thus limiting the efficiency of the bone formation derived exclusively from the blood clot.

Second, it is likely that when teeth are adjacent to the walls of the maxillary sinus, more bony walls are compromised, determining a greater capacity for new bone formation from the adjacent tissue; research has shown that 3-wall defects can be repaired to a significant degree with different bone fills. In fact, as a result of work such as that by Choi et al, it is conceivable that regardless of the fill material used, the presentation of further compromised bony walls can help repair the defect, with the bony walls most likely being more important than the biomaterial used.

Third, bone loss or the presence of more corticalized bone decreases the blood supply, presenting few options to achieve the amount of bone regeneration needed. Microvascular defects, decreased blood flow, and the inhibition of osteoblastic activity elicit decreased bone mineralization. In addition, the amount of progenitor cells from the bone marrow, periosteum, and neighboring capillaries is decreased in patients with severe bone atrophies. This hypothesis is sustained by the finding that large defects caused by the removal of odontogenic cysts exhibit adequate bone formation after 2 years, which may indicate the presence of a suitable reparative capacity of the remaining walls and the adjacent periosteum and an adequate blood supply surrounding the defect.

The maxillary sinus lift technique has shown high success rates with delayed installation and immediate
installation implants.6 Lambert et al27 indicated that the blood clot and the autogenous bone chip graft might be inadequate as a structural support in the medium term owing to decreases in bone volume as a result of the compression of the sinus membrane. A study by Thor et al28 of immediate installation implants and blood clot fill showed an average height gain of 6.5 mm, which was significantly related to the length of the implant installed; they used the innate potential of the membrane for bone formation as the mechanism for bone regeneration.3 In that investigation, the bony window was externally repositioned, whereas in the present investigation, a resorbable collagen membrane was used. It is possible that the rapid resorption of this membrane in the present research will generate connective tissue invasion with the resulting interruption in bone formation or alterations in physiologic mechanisms.29

Although Thor et al28 found a 6.5-mm bone gain in all patients, in patients with 2 to 4 mm of residual alveolar height, only 2 to 4 mm of bone gain was achieved. Thor et al13 also presented patients with a maxillary sinus located between the anterior and posterior teeth and the implants (with surface treatment) in function. This clinical situation provided better biological conditions than those of the present patients, who exhibited an average bone height of 3.18 mm with a bone gain of 2.37 mm and with no capacity to support implant installation in most cases. In contrast, Thor et al13 used immediate implants with stability, and to install these implants, sufficient amounts of high-quality residual bone must be present. Their patients thus exhibited better initial oral conditions compared with the present patients.

Interestingly, Thor et al28 also indicated that in maxillary sinus lifts performed in conjunction with implants, contact of the blood with the implant surface can increase the amount of thrombin and platelets present at the surgical site, which could facilitate more adequate bone repair. The present investigation used a screw to support the lateral window, similar to a false ceiling, thus limiting the possibility of a better biological response, because of the screw and the absence of the lateral bony window. Moon et al9 also reported excellent results in bone repair when they installed implants in maxillary sinuses in conjunction with a maxillary sinus lift using peripheral blood fill. In that study, the lateral window also was repositioned to close the defect, further illustrating the efficacy of this surgical tool.

Considering the sample of this pilot study, the authors conclude that the poor bone gain results are mainly associated with insufficient bone quality and the large scope of the defects. This research protocol must be modified in light of these deficiencies.

References


Table 1. AVERAGE BONE HEIGHT OF ALVEOLAR RIDGE IN THE STAGES BEFORE AND AFTER MAXILLARY SINUS LIFT WITH BLOOD CLOT

<table>
<thead>
<tr>
<th>Patient</th>
<th>Edentulism</th>
<th>Presurgical Height (mm)</th>
<th>Post surgical Height (mm)</th>
<th>Height Gain (mm)</th>
<th>Implant</th>
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<td>4</td>
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<td>8.57</td>
<td>4.47</td>
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