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Clinical Paper
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Maxillary sinus lift without grafting, and simultaneous implant placement: a prospective clinical study with a 51-month follow-up

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Abstract. A prospective clinical study of maxillary sinus lift procedures in the posterior region of the maxilla, using only blood clot as filling material, was conducted. Seventeen patients underwent a maxillary sinus lift procedure; 20 maxillary sinus regions were operated on and a total of 25 implants were placed. The sinus mucosa was lifted together with the anterior wall of the osteotomized maxilla and supported by the implants placed. Computed tomography (CT) scans were obtained immediately postoperative ($T_{initial}$) and at 3 (T_1) and 51 (T_2) months postoperative for the measurement of linear bone height and bone density (by grey tones). Only one implant was lost in the first stage (96% success). After dental prosthesis placement and during up to 51 months of follow-up, no implant was lost (100% success, second stage). The difference in mean bone height between $T_{initial}$ (5.94 mm) and T_1 (13.14 mm), and between $T_{initial}$ and T_2 (11.57 mm), was statistically significant (both $P < 0.001$); comparison between T_1 and T_2 also presented a statistical difference ($P < 0.001$). Bone density had increased at the end of the period analyzed, but this was not statistically significant ($P > 0.05$). Thus, the maxillary sinus lift technique with immediate implant placement, filling with blood clot only, may be performed with a high success rate.

Key words: maxillary sinus; blood clot; implant.

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The main obstacle to rehabilitation with osseointegrated implants, particularly in the posterior region of the maxilla, is the process of alveolar resorption that occurs after the loss of teeth, with later pneumatization of the maxillary sinus.[1–3] Therefore, in order to obtain the minimum height required for dental implant placement, techniques such as the sinus lift associated with grafts are performed routinely.[4–6]

Autogenous bone is among the well-established materials used to fill the area of the maxillary sinus that was lifted. This is considered the gold standard in alveolar bone reconstruction, because it

has osteogenic, osteoinductive, and osteoconductive characteristics.[7–9] However, in view of some of the disadvantages and systemic limitations, such as the need for a second surgical site and postoperative morbidity, diverse bone substitutes have been developed, such as materials of homogeneous, heterogeneous, and alloplastic origin.[9–11] These materials have the limitation of having osteoconductive properties only, and although limited, they may transmit diseases and contamination.[12] As a result of these limiting characteristics, more recent research has sought to find an ideal bone substitute that diminishes surgical morbidity and is capable of maintaining the properties of osteoinduction, osteoconduction, and osteoprogenitor cells.

Lundgren et al.[13] were the first to report that after removal of a cyst from the maxillary sinus, there was bone neoformation in the region without any biomaterial having been used for vertical augmentation of the alveolar ridge. With the publication of that study, a new perspective was gained, and other researchers have used this information to observe the bone neoformation potential of the blood clot in the maxillary sinus.[14–19]

Recently, there have been reports of the use of blood clots as filling material by means of the guided bone regeneration technique, promoting bone neoformation in the maxillary sinus areas.[14–19] These studies showed no difference in bone density when this procedure was performed than when allogeneic filling materials were used, as measured by computed tomography (CT).[16] One implant was lost, and a 97.7% survival rate was observed in the radiographic study.[17] Altintas et al.[16] measured the tomographic bone density at 6 months after implant placement. Since long-term assessments are very important, especially after the installation of the prosthesis, further research is warranted. Therefore, this prospective clinical study of the maxillary sinus lift procedure in the posterior region of the maxilla, using only a blood clot as filling material, was conducted. CT scans were obtained immediately postoperative ($T_{initial}$) and at 3 months (T_1) and 51 months (T_2) for the analysis of the linear bone height and bone density measurements.

Methods

Patients

This prospective study was conducted in accordance with the STROBE statement. Twenty patients requiring rehabilitation in the posterior region of the maxilla by means of a maxillary sinus lift were selected for this study. Inclusion criteria were the following: patients who were systemically controlled, non-smokers, requiring rehabilitation in the posterior region of the maxilla, with a minimum of 5 mm of remaining alveolar ridge (mean 5.56 mm) confirmed by CT, and with no maxillary sinus pathologies.

Of these 20 patients, two refused treatment and one did not attend the postoperative control appointments. Thus, 17 patients underwent the surgical procedure; 20 maxillary sinuses were operated on and a total of 25 implants were placed in these regions. The clinical protocol, patient information, and consent form were approved by the local institutional human research ethics committee.

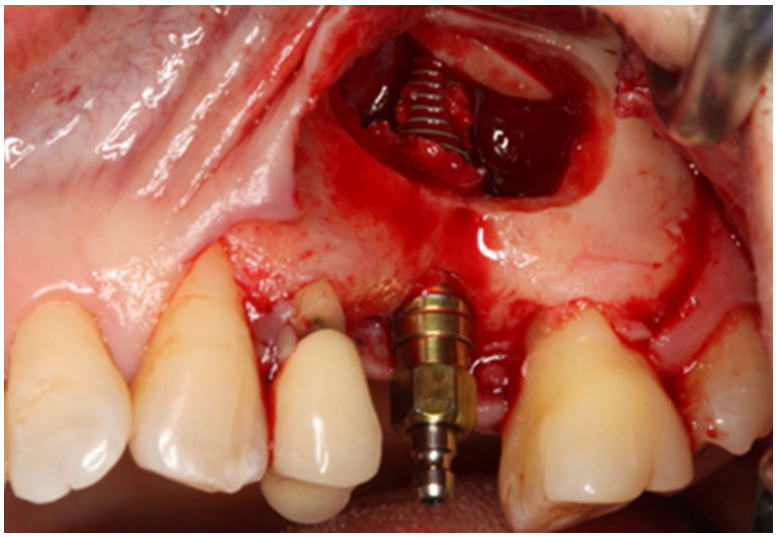

Fig. 1. Clinical aspects of the maxillary sinus lift and implant placement procedure. Note the anterior wall of the maxillary sinus in the new position as the roof of the maxillary sinus, supported by the implant.

Surgical procedure

The surgical procedures were performed under local anaesthesia, in accordance with the protocol that is well established in the literature.[20] After a low triangular incision and full mucoperiosteal displacement, an osteotomy was performed in the anterior wall of the maxilla using spherical surgical burs, preserving the vestibular bone window[21] so that this would be the maxillary sinus floor in the sinus membrane elevation, with the membrane in a more superior position. The implants were then placed, all measuring 4.3 × 13 mm (Alvim; Neodent, Paraná, Brazil). The peri-implant space was filled with a blood clot only, without a bone graft (Fig. 1), and a bovine cortical bone membrane was placed in the vestibular position (GenDerm; Baumer SA, São Paulo, Brazil). All implants presented primary stability (mean implant stability quotient (ISQ) 60.92), which was measured by resonance frequency analysis (Osstell, Gothenburg, Sweden).

After implant placement, the patients were followed-up clinically and with CT at 3 and 51 months postoperatively. The implant-supported dental prostheses were placed 9 months after the maxillary sinus lift surgery. Clinical evaluation included verification of the conditions of the soft tissues and periodontium, assessment of occlusal stability (and if necessary, adjustments to the occlusion), and checking for postoperative haemorrhage or infection.

Tomographic evaluation (bone height and density)

For tomographic evaluation, images of the posterior region of the maxilla were obtained by means of cone beam CT (CBCT; Sirona Dental Systems GmbH, Bensheim, Germany) immediately after implant placement and at time intervals of 3 and 51 months postoperatively. The images were obtained from the tomograph (Sirona Dental Systems GmbH) at 14–85 mAs and 85 kV. The radiation dose was 29 μSv at 21 mAs and 85 kV. The images obtained by the Galileos 3D program (Sirona Dental Systems GmbH) were $15 \times 15 \times 15\ cm^3$ with $0.3\ mm^3$ voxel resolution. The CT cuts were performed with the patient's head in the same position, with the occlusal plane parallel to the floor and perpendicular to the median