Introduction
In the posterior maxillary sextants, insertion of implants of desired length and diameter is often limited by the dimensional alterations of the residual ridge as well as the pneumatization of the maxillary sinus occurring after tooth loss. Transcrestal sinus floor elevation (TSFE) represents a surgical option to vertically enhance the available bone in the posterior maxillary sextants through an access created through the edentulous bone crest. Surgical techniques for TSFE are mainly based on the fracture of the Schneiderian membrane obtained by means of osteotomes or burs. The apical displacement of the Schneiderian membrane obtained by TSFE may be enhanced and better maintained by condensing a deproteinized bone mineral (DBBM). Previous studies showed that the dimensional alterations of the residual ridge as well as the pneumatization of the maxillary sinus occurring after tooth loss significantly reduce the available bone height. Thus, techniques to fracture the sinus floor by means of osteotomes or burs are proposed to increase the sinus floor height in order to vertically enhance the available bone. The apical displacement of the Schneiderian membrane obtained by TSFE may be enhanced and better maintained by condensing DBBM. Recently, we proposed a minimally invasive procedure for TSFE, the Smart Lift technique, which is characterized by a transcrestal access to the sinus cavity by means of specially designed drills and osteotomes. The procedure represents a modification of the technique proposed by Fugazotto. However, the major novelty is that all the instruments are used with adjustable stop devices, thus restricting the working action of burs and osteotomes to the vertical amount of residual bone. This is aimed to prevent any accidental penetration of instruments into the sinus cavity. Previous studies showed that the Smart Lift technique results in a predictable apical displacement of the sinus floor and a limited post-operative morbidity, when used in association with graft biomaterials. With the Smart Lift technique, the vertical augmentation of the implant site is provided by the condensed trephined bone core that is displaced into the sinus.

Fig. 1a-m - Surgical steps of the Smart Lift technique for transcrestal sinus floor elevation

Fig. 1a - All manual and rotating instruments of the Smart Lift technique are used with adjustable stop devices (length ranging from 4 to 11 mm).

Fig. 1b - The Locator Drill perforates the cortical bone to a depth of 3.5 mm at the site where the implant is to be placed.

Fig. 1c - The Probe Drill (Ø 1.2 mm) is used to define the position and orientation of the implant. This bur is used with an adjustable stop device which is set at least 1 mm shorter than the radiographic working length.

Fig. 1d - The “Probe Osteotome” (Ø 1.2 mm) is gently forced in an apical direction through the cancellous bone until the cortical bone resistance of the sinus floor is met. Therefore, the Probe Osteotome will provide the “surgical working length”.

Fig. 1e - A Radiographic Pin (Ø 1.2 mm) can be used to check radiographicaly the orientation and depth of the prepared site.

Fig. 1f - A Guide Drill of either Ø 3.2 mm or Ø 4.0 mm according to implant diameter is used to create a crestal countersink, 2 mm deep, where the trephine bur will be inserted.

Fig. 1g - The trephine bur (Smart Lift Drill, Ø 3.2 mm or Ø 4.0 mm), produces a bone core up to the sinus floor.

Fig. 1h - The bone core is condensed to fracture the sinus floor by means of a calibrated osteotome (Smart Lift Elevator, Ø 3.2 mm or Ø 4.0 mm) that corresponds to the diameter of the trephine preparation.

Fig. 1i, l - The Smart Lift Elevator is used under gently malleting forces to implode the trephined bone core over the sinus floor.

Fig. 1j, m - The implant is inserted.
Recently our research group competitively sustain bone regeneration in association with tSFE may effectively be controlled by levamisole. Scientific evidence clearly indicates that the use of a graft biomaterial for proper implant placement, bone formation may be implemented by the additional use of a graft.

Scientific evidence clearly indicates that the use of a graft biomaterial in association with tSFE may effectively sustain bone regeneration. Recently our research group compared the clinical effectiveness of a synthetic hydroxyapatite in a collagen matrix (S-HA) and DBBM when used in association with the Smart Lift technique and we demonstrated that both biomaterials may provide a predictable elevation of the maxillary sinus floor along with limited post-surgical complications and post-operative pain/discomfort.

At present, whether and to what extent the Smart Lift technique may benefit by the additional use of different graft biomaterials, and which biomaterial is the most suitable to provide conditions for new bone formation still needs to be elucidated. In this context, we report a clinical case in which the Smart Lift technique was associated with high basic calcium phosphate composed of hydroxyapatite (60%) and beta form of tricalcium phosphate (40%).

**Material And Methods**

**Rationale and indications**
The Smart Lift technique was developed by the Research Center for the Study of Periodontal and Peri-implant Diseases, University of Ferrara, and the Department of Odontostomatologia, Ospedale “Casa Sollievo della Sofferenza”. Giovanni Rotondo. The technique is characterized by a transcrestal access to the sinus cavity by means of specially-designed drills and osteotomes. The pristine bone at sites of implant placement is drilled up to the sinus floor with a trephine bur, and then used to fracture the sinus floor by hydraulic pressure through osteotomes. In this respect, the procedure represents a modification of the technique proposed by Gazzotto. The major novelty with previously described procedures resides in the fact that all manual and rotating instruments are used with adjustable stop devices which are selected in relation to the vertical amount of residual bone at sites where implants have to be placed (Fig. 1a). These stop devices have a variable length, from 4 to 11 mm, and may be adapted to all manual and rotating instruments. The use of the stop device restricts the working action of burs and osteotomes to the vertical amount of residual bone, thus preventing the accidental penetration of instruments into the sinus cavity. The identification of the working length (i.e. the distance from the bone crest to the sinus floor) where the osteotome and burs should limit their working action is first diagnosed on periapical x-ray or CT scan, and then intra-surgery assessed by means of a specially-designed osteotome.

The Smart Lift technique shares its clinical indications with any other proposed surgical procedures for sinus floor elevation with a transcrestal approach.

- Indications for implant-supported prosthetic rehabilitation, based on accurate diagnosis and treatment planning;
- Systemic and local conditions which are compatible with implant placement and sinus floor elevation procedures;
- Residual bone height (i.e. the distance from the bone crest to the sinus floor) of at least 4 mm.

The Smart Lift technique must not be performed when systemic and local conditions which contraindicate sinus floor elevation are present.

**Surgical Technique**

According to the prosthetic treatment planning, the location for implant placement is established, and the residual bone height at such locations is first diagnosed by proper x-ray examination. The distance from the bone crest to the sinus floor as assessed radiographically will provide the “radiographic working length”.

Surgical stents may be recommended for implant positioning, particularly when multiple implants have to be inserted. All instruments in the surgical set will be used to check the angular and depth of the prepared site by means of a perisurgical x-ray (Fig. 1e). The Radiographic Pin handle has a diameter of 4.0 mm, thus permitting to evaluate the spatial relationship between the prepared site and the bucco-lingual as well as mesio-distal dimensions of the alveolar ridge. This will help the clinicians to determine the diameter of the implant to be placed. Then, a “Guide Drill” (Ø 2 mm (implants Ø 3.5 - 4.0 mm) or Ø 4.0 mm (implants Ø 4.8 - 5.0 mm) can be inserted. This drill follows the Ø 1.2 mm site preparation and creates a crestal counterburr; 2 mm deep, where the trephine bur (Smart Lift Drill) will be inserted (Fig. 1f). Such counterburr enables the trephine bur to centre the working action of the bur according to the desired direction. The Smart Lift Drill (Ø 3.2 or 4.0) set at the surgical working length, produces a bone core up to the sinus floor (Fig. 1g). Following the removal of the trephine bur, the bone core (Fig. 1h) is then condensed and malletted to fracture the sinus floor by means of a calibrated osteotome (Smart Lift Elevator, Ø 3.2 or Ø 4.0) that corresponds to the diameter of the trephine preparation (Fig. 1i). If the alveolar bone core is found to be inside the trephine, the bone core is gently removed from the trephine and replaced in the alveolar bone preparation. The osteotome is used under gently malletting forces to implode the trephined bone core over the sinus floor.

**Fig. 2.a - n** A paradigmatic case of transcrestal sinus floor elevation performed with the Smart Lift technique.
In relation to the extent of vertical bone augmentation to be achieved, a cortical bone particulate or a bone substitute can further graft and condensed into the sinus by the osteotome. Again, the Smart Lift Elevator is used with the adjustable stop device and surgical working length, thus preventing any unwanted penetration of the instruments into the sinus cavity. Provided that the residual bone may enter an adequate primary stability, an implant can be inserted during the same surgical session (Fig. 1.m). Otherwise, a staged approach is recommended.

Clinical case report

A 35-year-old male, former smoker patient, was referred to the Office of Maxillofacial Surgery for implant placement in the left maxillary left quadrant (Fig. 2.a). Neither systemic or local conditions contraindicating implant surgery or sinus lift procedures were identified at the screening visit. The prosthetic rehabilitation included the placement of a prosthesis supported by one implant, placed in the region of the left second premolar. The pre-operative peroratory radiograph showed a radiographic working length of 6.5 mm at location of the edentulous alveolus (Fig. 2.b).

Therefore, a transcrestal sinus floor elevation was planned to allow for the placement of an implant of adequate length. A full-thickness flap was elevated to access the alveolar crest and the implant site in the position 2.5 mm was prepared using the Smart Lift technique. First, the Locator Drill was used to perforate the cortical bone at implant sites. Then, the Probe Drill was used with the 6-mm adjustable stop device. The surgical working length was assessed at 6.5 mm. The entry point of the drill was marked by tactile perception of the sinus floor using the Probe Osteotome (Fig. 2.c). A counter sunk was prepared by the Guided Drill technique. Two of the cortical bone core was created by the Smart Lift Drill Ø 3.2, with the stop device set at 7 mm (Fig. 2.d). The bone core created by the Smart Lift Drill (Fig. 2.e) was gently malletted upwards using the Ø 3.2 Smart Lift Elevator until the sinus floor was fractured. Additional biomaterial (bioactive calcium phosphate) was inserted into the implant site, to be grafted into the sinus cavity. A 53-year-old male, former smoker patient, was referred to the Office of Maxillofacial Surgery for implant placement in the right maxillary right quadrant (Fig. 2.f, g). Visual inspection and Valplast monitoring revealed that the sinus floor was present around and above the apical portion of the distal implant (Fig. 2.n).

Discussion and Conclusions

The present case report illustrates an innovative technique resulting in sinus floor elevation using the (transalveolar) osteotome technique with or without grafting material. The combined use of a trephine drill penetrating up to 1 mm from the sinus floor. Then, an osteotome was used to impale (by the use of a mallet) the trephined bone core to a depth of 1 mm less than the initial trephine cut. The hydraulic pressure exerted by the autogenous bone core determined the fracture of the sinus floor with vertical augmentation of the implant site. Previous reports with such technique showed a cumulative success rate of 98.0% following 19–48 months of follow-up. Although proven effective, the technique proposed by Furacchio et al. seems highly technique-sensitive, particularly with respect to the control of the working action of both trephine bur and osteotome. It may be conceivable that, during the drilling action of the trephine bur and the mallet pressure onto the osteotomes, a direct damage of the sinus membrane due to instrument penetration over the sinus floor can occur. Recently, a systematic review reported an incidence of membrane perforation ranging from 0% to 21.4%, and postoperative infection from 0% to 2.5% following transcrestal sinus floor elevation procedures. In an experimental evaluation of maxillary sinus membrane response following osteotome technique with or without grafting material, the risk of membrane perforation was observed in 6 out of 25 implants (24%), the risk being increased with an increasing extent of sinus floor elevation to be obtained. An endoscopic study revealed that the sinus floor may be elevated up to 10 mm without perforating the sinus membrane. However, other endoscopic studies have demonstrated the risk of membrane perforation while performing transcrestal sinus floor elevation: An endoscopic evaluation of the bone-added osteotome sinus floor elevation procedure revealed that the surgical approach may lead to large detachment of the membrane over a broad area extending both apically and laterally to the implant tip contour. However, in 2 out of 8 analyzed patients mem- 

References

Once the surgical working length is established, the use of adjustable stop devices would dictate the extent of the working action of manual and rotating instruments, thus minimizing the risk for membrane perforation and post-surgery infections. Other techniques have been reported where the use of burs of variable length and provided with a shoulder stop have been used to perforate the sinus floor. Unfortunately, in each procedure the selection of the working length of the rotating instruments is only based on the radiographic examination, leading to potential under- or over-estimation of the amount of residual bone height. Extensive malleting trauma during sinus floor elevation with osteotomes may cause BPPV, a benign syndrome characterized by short, recurrent episodes of vertigo, initiated by movements of head lateralization and extension toward the affected site. In this respect, the combined utilization of a trephine bur in close proximity to the sinus floor limits the need for repeated malleting. Therefore, the Smart Lift technique may result less traumatic and disconcerting to the patient with respect to the conventional osteotomy procedures.

Vertical augmentation of the implant site is provided by the condensed trephined bone core which is displaced into the sinus. This intrasinus osteotomy procedure elevates the sinus membrane, thus creating a space for blood clot formation. It is conceivable that the contribution of the bone core to intra-sinus bone formation may relate to the amount of residual bone at the implant site, i.e. the more native bone pushed into the sinus, the more newly formed bone. When a limited amount of residual bone is present with respect to the amount of bone needed for proper implant placement, bone formation may be implemented by the additional use of a graft. Grafting material is added incrementally and condensed into the sinus by the osteotome. During the grafting procedure, it is the graft biomaterial only that exerts the hydraulic pressure to “tent” the sinus membrane, while any direct penetration of the osteotome into the sinus cavity is prevented by the adjustable stop device. Previous studies seem to suggest an enhanced osteointegrative potential with the additional use of bone substitutes. Pjetursson and colleagues compared the transcortical sinus floor elevation by means of osteotomes with and without the additional use of deproteinized bovine bone matrix. A gain in radiographic bone height of 4.1 mm and 1.7 mm where observed in grafted and non-grafted sites, respectively. Recently our research group demonstrated that independently from the biomaterial used in association with the Smart Lift technique, the procedure may provide a predictable elevation of the maxillary sinus floor along with limited post-surgical complications and post-operative pain/discomfort. In conclusion, the Smart Lift technique represents a minimally-invasive surgical option for sinus floor elevation procedures.

**Note**
SMART LIFT, Meta GM SpA, Reggio Emilia, Italy. BoneGraft, Straumann® Straumann AG, Freiburg, Basel, Switzerland. Thauman Medical AG, Waidwil, Switzerland.

---

**DVD per la sala d’aspetto:**

Questo film per la sala d’aspetto informa i pazienti odontoiatrici sui vantaggi della terapia implantare. L’argomento è trattato in modo ironico e accattivante da attori e supportato da animazioni e disegni 2D.

Obiettivo è rendere maggiormente consapevoli e preparati all’intervento coloro che stanno valutando, o hanno già optato, per questa soluzione dissipando ombre, diffusi timori e certi luoghi comuni.

**DURATA: 20 MIN. ORARIO**

**CAPITOLI**

1. **L’IMPIANTOLOGIA E...**
2. **Che rischis ci sono?**
3. **Chi puo’ fare l’IMPIANTO?**
4. **C’è chi l’IMPIANTO C’è esistente?**
5. **In caso di controindicazioni?**
6. **Quanto tempo ci vuol un IMPIANTO?**
7. **È un intervento delicato?**
8. **È carico immediato?**
9. **Costi e modalità di intervento?**
10. **Tecnica implantare computerizzata?**

**M. RONCATI, P. MARZOLA**

**75,00 euro + iva**