

ENDOSCOPIC MANAGEMENT OF THE SCHNEIDERIAN MEMBRANE PERFORATION DURING TRANSCRESTAL SINUS AUGMENTATION: A CASE REPORT

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SUMMARY

Purpose. In this article the Authors describe a procedure aimed to restore under endoscopic control, the continuity, of the Schneiderian membrane (SM) incidentally teared during a sinus lift with transcrestal approach.

Materials e methods. In a 44-year-old male, due to aforementioned complication, the SM was gently detached via transcrestal approach, with a customized small ball burnisher, in order to facilitate the placement of a collagen sponge, to close the communication with the sinus, followed by the subsequent insertion of a graft material. All the procedure was endoscopically controlled and, considering the successful grafted area elevation, was simultaneously followed by implant placement. After 6 months the second stage was performed always under endoscopic control.

Results. The endoscopic view of the grafted area showed a dome-shaped elevation sited on the top of the implant, the SM was apparently normal with no signs of inflammation, the antrum was empty and normally functioning. Periapical X-rays were performed: immediately after the surgery; at both 14 days and 6 months post-operative; at 6 months post prosthetic finalization. The volume of the grafted area progressively decreased over the time while its radiopacity, on the contrary, gradually increased, as expected after graft integration and remodelling. The implant was submitted to no functional load for 4 months by means of a temporary screwable acrylic crown inserted on a peek abutment and then finalized with a cementable metal-ceramic crown on a preformed titanium abutment.

Conclusion. The Authors recommend the use of endoscope to repair the SM incidentally teared during transcrestal sinus lift.

Key words: transcrestal sinus lift complications, Schneiderian membrane tearing, maxillary sinus, endoscopy, sinus membrane repair.

Introduction

The edentulous posterior maxillae has always been a challenging site for implant rehabilitation (1, 2). Due to both alveolar ridge atrophy and sinus pneumatization, over history numerous techniques have been developed for sinus augmenta-

tion in order to increase the bone volume, either by a lateral (so-called Caldwell-Luc approach) or a transcrestal approach to the antrum (2, 3).

The substantial difference between lateral and crestal approaches, is that the first is an open surgery procedure, thus allowing the direct visualization of the maxillary sinus membrane when its elevation occurs, therefore it facilitates the management

of potential complications, such as membrane perforations (4).

The transcresal approach has several advantages: it's an easier and faster procedure, that preserves undisturbed the vascularization of the graft, with a reduced postoperative morbidity. For these reasons this approach has been named "minimally invasive". The disadvantages related to minimally invasive sinus augmentation are: the need of at least 4-5 mm of crestal bone height for implant primary stability; the limited graft height that can be obtained; the risk iatrogenic perforation of Schneiderian membrane (SM), since the elevation is not performed under direct optical control, compromising the possibility to perform a reliable reparation in the same stage (5-10).

Despite the increasing use of the minimally invasive approach to rehabilitate the edentulous posterior maxilla, the literature lacks a technique for the management of sinus membrane perforations when such procedures are used.

The aim of this article is to describe a novel approach that, in combination with the endoscopic control, allows to repair the sinus membrane perforation via the same crestal implant tunnel and, when possible, also to concurrently insert the implant fixture.

Material and methods

A 44-year-old male was selected for this case report. He was referred to this clinic for the rehabilitation of the missing right upper first molar (1.6) and for other dental therapies. The medical history did not reveal any systemic diseases and the patient confirmed to not take any kind of medication. Before treatment, the patient was clinically and radiographically examined by panoramic radiograph and TC scan. The absence of inflammatory pathologies, of the sinus, and the reduced residual thickness of the ridge in the area of 1.6 indicated the use of transcresal sinus lift with osteotomic approach and concurrent implant placement. Although it is not a routine procedure for this intervention, we decided, for research issues, to per-

form the procedure under endoscopic control.

The patient gave his informed consent for the therapies.

Clinical procedure

The osteotomic sinus floor elevation proposed by Zaninari was adopted in this case (11). In particular straight, concave and beveled, Zaninari's modified osteotomes, provided of a double depth stop, were used (FAL - 06-08-001-FMD Ladispoli, Roma) (Figure 1g).

An antimicrobial prophylaxis was administered with amoxicillin clavulanate (Clavulin, GlaxoSmithKline, Italy), 1g every 8 h for 7 days, beginning 3 hours before the operation. After an initial rinse with chlorhexidine digluconate 0.2% (Corsodyl Mouthwash, GlaxoSmithKline, Italy) for 1 minute to disinfect the mouth, loco-regional anesthesia was performed with articaine hydrochloride 4% with epinephrine 1:100,000 (Citocartin, Molteni Dental, Italy).

Then a 4 mm wide Trocar (Karl Storz GmbH & Co. KG, Tuttlingen, Germany) was placed in the right canine fossa with flapless procedure, to make access in the maxillary sinus. Subsequently the tip was removed and the endoscope inserted. Both a portable 5 W white LED light source and a camera capable of recording Full HD videos (Samsung NV24HD, Seoul, South Korea) were mounted on a 30° endoscope, provided with a 4mm wide optics (28721BWA, Karl Storz GmbH & Co. KG, Tuttlingen, Germany).

The crestal area was exposed through reflection of a mucoperiosteal flap. Then the surgical drill sequence, to allow insertion of the osteotomes under the sinus floor, was performed. After the use of the Ø2.8 mm drill, it has been noticed the laceration of the SM. This complication was directly observed via endoscope (Figure 1a). In normal conditions without the endoscopic control, when this complication arises, is asked, to the patient, to gently inhale and exhale through the nose, keeping the dental mirror just under the implant tunnel. The mirror fog up usually confirms the membrane discon-

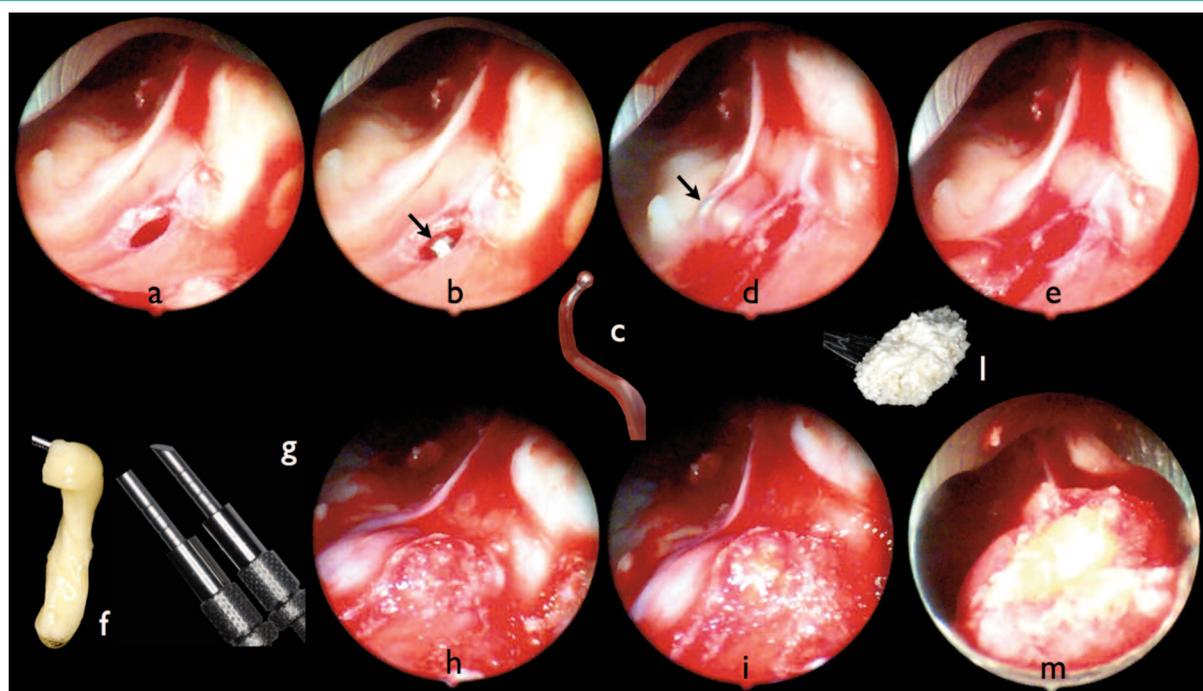


Figure 1

Endoscopic view of the case: a) the perforation of the sinus membrane; b) in the bone tunnel an apical stop, by means a wider implant drill (arrow), was created; c) a customized small ball burnisher; d) with this instrument (arrow) the membrane was carefully a circumferentially detached; e) after the membrane detachment the tension on the tear edges were reduced so that the clot created a delicate seal, such as to restore the movement of the membrane, during the patient's breathing; f) the collagen sponge (CS) wetted with an antibiotic solution; g) the straight Zaninari's osteotomes; h, i) the CS is progressively condensed in the sub-antral space; l) the graft material (GM); m) the GM is progressively injected and condensed, few granules were leaked from the laceration.

tinuity (10, 11). In general, at this occurrence, it is physically impossible to perform the transcresal detachment and elevation of SM therefore the operator can choose either: 1) to suture the flap and postpone the surgery after healing; 2) to place an implant shorter than planned as allowed by the residual bone height; 3) expanding the flap, toward the zygomatic process of the maxilla, and change the approach performing a lateral antrostomy (Caldwell-Luc approach), that increases the chances of intraoperative repair of torn SM, although resulting in a greater biological sacrifice (9-12).

Despite the appearance of this complication, thanks to the direct vision offered by the endoscope, it was decided to proceed with a different technique: the management of the perforation via transcresal approach. First, it was created an api-

cal stop by means of a Ø3,7 mm drill, made to turn at 20rpm, in order to create a conical entrance to the bony tunnel, without reach its full length (Figure 1b). This way it was conveniently modified the shape of the bone tunnel allowing a more agile access with a customized small ball burnisher (Figure 1c). This instrument had been engaged in the space between the sinus floor and the SM in order to allow a circumferential detachment of the latter (Figure 1d). At the end of this procedure the tension on the laceration edges was reduced so that the blood clot could create a delicate seal, therefore restoring the movement of the membrane during patient's breathing (Figure 1e). Then a piece of collagen adsorbable sponge (8x50 mm) (Condress Collagene, Euroresearch, Milan, Italy) was wetted with Clindamicine (Dalacin C, 4 ml; 600 mg, Pfizer Italia, Rome, Italy) (Figure 1f) and thus gently

condensed by means the straight Zaninari's concave osteotome (SZCO), through the bone tunnel, in the sub antral space. The choice to use a long piece of collagen is dictated by the fact that a small piece could more easily have engaged the laceration and consequently leak into the antrum while a relatively longer piece may project without being fully deployed into the antral space. Concerning the SZCO, it was chosen to fix the depth stop at a distance at least 1 mm shorter, in comparison to the thickness of the residual crest. In this way the SM detachment was indirect, that is performed by the hydraulic pressure, exerted by the SZCO, on the liquid present in the collagen sponge (10). The SM was progressively elevated verifying, via endoscopic view, the continuity of the torn area (Figure 1h, i). Then the graft material (Biocoral, Biocoral Inc, Saint-Gonnelly, France) (Figure 1l), always wetted with Clindamicine, was gradually injected by means a surgical siringe (FAL-4030, FMD, Rome, Italy) and subsequently condensed with SZCO. At the end of the proce-

cedure only a few granules of material were leaked from the laceration (Figure 1m), thus it was decided for the concurrent implant placement. The bony tunnel was gently enlarged by means of dedicated implant drills and then a cylindrical implant was placed (AN5.5x8mm, Elisir, FMD, Rome, Italy). In the same stage a crestal graft was performed with the identical material, described above and subsequently covered with a resorbable heterologous mesenchymal membrane (Osteobiol Evolution STD, ROEN, Pianezza, TO, Italy) then the flap was sutured without tension. Ibuprofen (Brufen 600mg, Abbot, Italy), every 8-12 hours for 5 days was administered to control postoperative pain and edema. Rinses with chlorhexidine digluconate 0.2% (Corsodyl Mouthwash, Glaxo-SmithKline, Italy) were prescribed for the disinfection of the surgical wound, 2/3 times/day for 7 days. After 14 days the sutures were removed and oral hygiene instructions were provided. The reportedly postoperative was uneventful except for a mild nasal bleeding aroused the day of the surgery.



Figure 2
Periapical X-rays of the case: a) before the surgery; b) at the end of the surgery; c) 14 days post-operative; d) 6 months post-operative; e) 6 months after the prosthetic finalization.

Periapical X-rays were performed; immediately after the surgery; at both 14 days and 6 months post-operative; at 6 months post prosthetic finalization (Figure 2a-e). The volume of the grafted area progressively decreased over the time while its radiopacity, on the contrary, gradually increased, as expected after graft integration and remodelling (Figure 2b-e).

After 6 months the second stage was performed always under endoscopic control. The trocar has been positioned in the same location used for the first operation using a needle from 21G to locate the primitive entrance that was covered by a fibrous tissue (Figure 3a). The endoscopic view of the grafted area showed a dome-shaped elevation on top of the implant, the SC was apparently normal with no signs of inflammation, the antrum was empty and normally functional (Figure 3d). Drug prescriptions before and after surgery were identical to those of the first stage surgery. The implant was previously submitted to no functional

load for 4 months, by means of a temporary screwable acrylic crown inserted on a peek abutment, and then finalized, within 2 weeks, with a cementable metal-ceramic crown on a preformed titanium abutment.

Discussion

Nowadays, the transcrestal “minimally invasive” sinus augmentation represents a safe and predictable technique to rehabilitate the edentulous posterior maxillae (6-11).

Nevertheless, there could be complications that the clinician needs to know in order to properly manage them. When performing the transcrestal approach, the main complication that may occur is the laceration of the Schneiderian membrane (6-12). There are some anatomical risk factors that can increase the percentage of occurrence of this complication: the presence of Underwood’s septa,

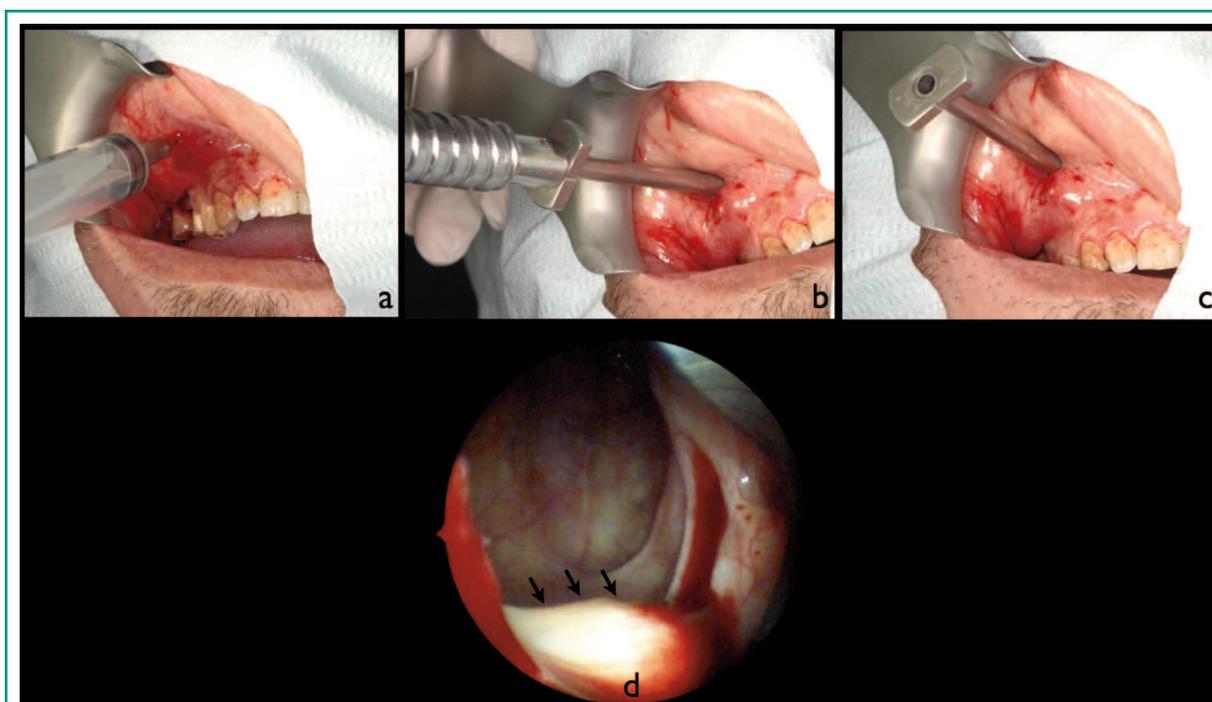


Figure 3

a) The trocar has been positioned in the same location used for the first operation using a needle from 21G to locate the primitive entrance; b) the trocar was then placed; c) the tip of the trocar was removed leaving its cannula in place; d) the endoscopic view of the area of sinus floor elevation (arrows) the aspect of mucosa was normal.

which are bony walls partitioning the sinus; the angle between the buccal and palatal walls of the antral cavity, especially when below 30°; irregularities of the sinus floor due to the protrusion of the root in the sinus or to a heavily resorbed bone; the limited height of the residual alveolar ridge (3-13).

Since discontinuities in the sinus mucosa negatively affect the functional homeostasis of the antral cavity and inevitably cause a bacterial contamination of the graft and dispersion of the particulate, several Authors have suggested different repair techniques when performing the sinus augmentation with a lateral approach (3-13).

In case of endoscopic management of SM, local anesthesia can be performed to sampling patients but it may have relevant side effect (14-17) and severe complications (18).

This topic can be also potentially investigated with immunofluorescence techniques which are well known since the nineties (19, 20).

The endoscopy of the maxillary sinus surgery can be performed with two different approaches: via transnasal (TN); via transoral (TO) through the canine fossa. According our experience the use of the second one is recommended when performing sinus lift surgery. The reason of this latter affirmation arises from several considerations: 1) TO approach can be performed by the otolaryngologist as well as the dentist; 2) TO approach is performed in the same area of interest of sinus lift so no further loco-regional anesthesia is required; 3) TN approach requires: a specific equipment (flexible endoscope); specialized surgery rooms and often general anesthesia. Thus TO approach has less limitation in comparison to TN approach (21-23). Although TO approach can be performed in dental private practice with a minimally invasive flapless procedure, this method involves the use of specific instruments and require the presence of a second operator limiting the working space around the patient's head. Its use is therefore not recommended in the daily surgical practice, but can be rightly suggested for both research purposes and in case of complications, like the one described in this paper. Furthermore it is our opinion that in case of SM tearing, during transcrestal sinus floor

augmentation procedure, is strongly recommended the use of transcrestal repair via endoscopic control as alternative to the more invasive Caldwell-Luc approach. The more conservative approach proposed limits the arising of both postoperative complication and patient's discomfort, thus validating its use in the clinical practice (21-24).

Even though the SM perforation is the most common intraoperative complication associated with transcrestal sinus lift, it doesn't represent an absolute contraindication to the continuation of surgery, since discontinuations of the SM can be adequately covered and reconstructed.

In this article a new technique is proposed to manage the SM laceration through the transcrestal implant tunnel. At 6 months after the surgery both radiographic examination and endoscopic control showed a perfectly healthy membrane and a good graft stability and integration. As previously described by other Authors, if the sinus functionality and its mucociliary clearance are efficient, the loss of few sterile granules into the antral space cannot create iatrogenic pathologies (23). Further studies are needed to confirm the validity of this technique.

References

1. Esposito M, Grusovin MG, Kwan S, Worthington HV, Coulthard P. Interventions for replacing missing teeth: bone augmentation techniques for dental implant treatment. *Cochrane Database Syst Rev.* 2008;3:CD003607.
2. Esposito M, Grusovin MG, Polyzos IP, Felice P, Worthington, HV. Interventions for replacing missing teeth: dental implants in fresh extraction sockets (immediate, immediate-delayed and delayed implants). *Cochrane Database Syst Rev.* 2010;9:CD005968.
3. Lee JE, Jin SH, Ko Y, Park JB. Evaluation of anatomical considerations in the posterior maxillae for sinus augmentation. *World J Clin Cases.* 2014;2(11):683-8.
4. Jensen OT, Shulman LB, Block MS, Iacono VJ. Report of the Sinus Consensus Conference of 1996. *Int J Oral Maxillofac Implants.* 1998;13Suppl(11-45).
5. Watzek, G, Weber, R, Bernhart, T, Ulm, C & Haas, R. Treatment of patients with extreme maxillary atrophy using sinus floor augmentation and implants: preliminary results. *Int J Oral Maxillofac Surg.* 1998;27(6):428-34.
6. Ferrigno N, Laureti M & Fanali S. Dental implants

- placement in conjunction with osteotome sinus floor elevation: a 12-year life-table analysis from a prospective study on 588 ITI implants. *Clin Oral Implants Res.* 2006;17(2):194-205.
7. Zitzmann NU, Scharer P. Sinus elevation procedures in the resorbed posterior maxilla. Comparison of the crestal and lateral approaches. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1998;85(1):8-17.
 8. Ziccardi VB, Betts NJ. Complications of maxillary sinus augmentation. (eds. Jensen, OT). *The Sinus Bone Graft.* Chicago: Quintessence Books. 1999; 201-08.
 9. Pjetursson BE, Lang NP. Sinus floor elevation utilizing the transalveolar approach. *Periodontol* 2000. 2014;66(1):59-71.
 10. Cavicchia F, Bravi F, Petrelli G. Localized augmentation of the maxillary sinus floor through a coronal approach for the placement of implants. *Int J Periodontics Restorative Dent.* 2001;21(5):475-85.
 11. Zaninari A. Rialzo del Seno Mascellare Prima parte. Tam Tam Dentale. In: (eds. Mich, CE). *Contemporary Implant Dentistry 3rd Ed.* St. Louis: Mosby Elsevier. 2008;405.
 12. Meleo D, Mangione F, Corbi S, Pacifici L. Management of the Schneiderian membrane perforation during the maxillary sinus elevation procedure: a case report. *Ann Stomatol (Roma).* 2012;3(1):24-30.
 13. Ulm CW, Solar P, Krennmair G, Matejka M, Watzek G. Incidence and suggested surgical management of septa in sinus-lift procedures. *Int J Oral Maxillofac Implants.* 1995;10(4):462-5.
 14. Feltracco P, Barbieri S, Galligioni H, Pasin L, Gaudio RM, Tommasi A, Zucchetto A, Trevisiol P, Ori C, Avato FM. A fatal case of anaphylactic shock during paragliding. *J Forensic Sci.* 2012;57(6):1656-8.
 15. Feltracco P, Gaudio RM, Avato FM, Ori C. Authors' Response (Letter). *Journal of Forensic Sciences.* 2012;57(5).
 16. Feltracco P, Gaudio RM, Barbieri S, Tiano L, Iacobone M, Viel G, Tonetti T, Galligioni H, Bortolato A, Ori, Avato FM. The perils of dental vacation: possible anaesthetic and medicolegal consequences. *Med Sci Law.* 2013;53(1):19-23.
 17. Gaudio RM, Barbieri S, Feltracco P, Tiano L, Galligioni H, Uberti M, Ori C, Avato FM. Traumatic dental injuries during anaesthesia. Part II: medico-legal evaluation and liability. *Dent Traumatol.* 2011;27(1): 40-5.
 18. Gaudio RM, Barbieri S, Feltracco P, Spaziani F, Alberti M, Delantone M, Trevisiol P, Righini F, Talarico A, Sanchioni R, Spagna A, Pietrantonio V, Zilio G, Dalla Valle R, Vettore G, Montisci M, Bortoluzzi A, Sacco A, Ramacciato G, Pasetti A, Mognato E, Ferronato C, Costola A, Ori C, Avato FM. Impact of alcohol consumption on winter sports-related injuries. *Med Sci Law.* 2010;50(3):122-5.
 19. Petruzzi M, Campus G, Paparusso F, Lucchese A, Lauritano D, De Benedittis M, Serpico R. Analysis of plasma fibronectin levels in patients affected by oral lichen planus. *European Journal of Inflammation.* 2012;10(1):45-50.
 20. Petruzzi M, Lucchese A, Nardi GM, Lauritano D, Favia G, Serpico R, Grassi FR. Evaluation of autofluorescence and toluidine blue in the differentiation of oral dysplastic and neoplastic lesions from non dysplastic and neoplastic lesions: a cross-sectional study. *J Biomed Opt.* 2014;19(7):76003.
 21. Nkenke E, Schlegel A, Schultze-Mosgau S, Neukam FW, Wiltfang, J. The endoscopically controlled osteotome sinus floor elevation: a preliminary prospective study. *Int J Oral Maxillofac Implants.* 2002;17 (4):557-66.
 22. Giannitelli SM, Basoli F, Mozetic P, Piva P, Bartuli FN, Luciani F, Arcuri C, Trombetta M, Rainer A, Licocchia S. Graded porous polyurethane foam: a potential scaffold for oro-maxillary bone regeneration. *Mater Sci Eng C Mater Biol Appl.* 2015;51:329-35.
 23. Engelke W, Capobianco M. Flapless sinus floor augmentation using endoscopy combined with CT scan-designed surgical templates: method and report of 6 consecutive cases. *Int J Oral Maxillofac Implants.* 2005;20(6):891-7.
 24. Andreasi Bassi M, Andrisani C, Lopez MA, Gaudio RM, Lombardo L, Lauritano D. Endoscopically controlled hydraulic sinus lift in combination with rotary instruments: one-year follow-up of a case series. *J Biol Regul Homeost Agents.* 2016;30 (S2):21-8.

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