

Cappellin simplified sinus lift protocol for mini-invasive lateral approach - Preliminary study results

Cappellin MR¹

Affiliations:

1. Clinica Dentale Cappellin
Pinerolo, Turin, Italy

Corresponding author:

Mario R. Cappellin
mario.cappellin@clinicacappellin.it

ABSTRACT

Purpose: The lateral approach in sinus lift allows to optimally manage severe bone resorption in posterior maxilla in order to place implant supported prosthesis; however, the conventional protocols requires bigger window and cannot determine in advance the precise position for bone incision, so in many cases the detachment of Schneider membrane is more difficult if the bone isn't cut near the sinus floor or if there is a bone septum. The aim of Cappellin simplified sinus lift protocol is to minimize the surgical difficulties with a surgical guide realized from STL 3D printed model (conversion of DICOM cone-beam CT files).

Case report: In our study (since 2013 to 2017) in 125 sinus lift cases (performed with Geistlich Bio-Oss® and a-PRF / PRGF) with 210 implants (Implant Direct® Legacy 2, 78 of which were placed at the same time as the sinus lift augmentation) we obtain a success of 100% for the sinus lift augmentation and 100% survival rate for the implants; we also drastically reduce the surgery time (average is about 25 minutes). CT scans were performed before the surgery and 4-6 months after the sinus lift; follow up for implant survival includes control and professional hygiene every 6 months.

Conclusions: In regards of these preliminary results, Cappellin simplified sinus lift protocol offers advantages in terms of safety, simplicity, quickness, reliability and allows to reduce the economic costs of the procedure.

KEYWORDS

Sinus lift percentage of success, sinus augmentation, guided surgery, STL 3D model, implant survival rate.

AIMS, MATERIALS AND METHODS

The sinus lift surgical procedure with lateral approach offers some advantages, first of all the possibility to manage a big bone augmentation if needed; there are also some disadvantages linked to the conventional procedure, like the risk of membrane perforation, the difficulty to open a window exactly as planned in the CT, the handling of filling material, a septum presence or merely the long surgery time.¹⁻⁴

The aim of our work was to find a new protocol that allows to minimize the surgical difficulties, reduce the risks and the surgery time; we included in this study (preliminary results) 125 sinus lift cases from February 2013 to September 2017, performed with Cappellin simplified sinus lift protocol which provides these materials, methods and intents:

- The patients had edentulous posterior maxilla sectors needed rehabilitation (with residual bone height from 1mm to 7 mm and prosthetic reasons which requires the use of conventional length implants); they have been selected with no signs or symptoms of sinusitis (in case of smokers, we asked from patients to abstain from smoking 2 weeks before and 4 weeks after the procedure) and they also weren't affected by systemic diseases;
- Surgical guide realized from 3D printed model, to obtain precise mini-invasive lateral window and to minimize the risk of membrane perforation, especially with a septum presence;
- A-PRF (Advanced Platelet Rich Fibrin, J. Choukroun) and PRGF (Plasma Rich in Growth Factors, E. Anitua) mixed with Geistlich Bio-Oss® to simplify handling of filling material;
- Collagen membrane Reguarde™ (Implant Direct®) to cover the lateral window, fixed with 2-3 Ti nails (De Ore®);
- Piezomed (W&H) piezoelectric surgery with inserts S1, S2, S3 to gently cut bone and start detaching Schneider membrane in order to minimize risk of perforation;

Legacy 2 implants (Implant Direct®) with rounded apex and cylinder-conic shape, in order to obtain an excellent primary stability, especially for contextual insertion; implants were placed with Implantmed (W&H) with measure of the torque during all the insertion procedure (not only final measure of maximum torque). We commonly utilized measures from 4.7mm to 5.7mm diameter and from 11.5mm to 16mm length; very rarely we utilized 4.2mm diameter and/or 10mm length.

We divided the cases in two groups: in the first one (44

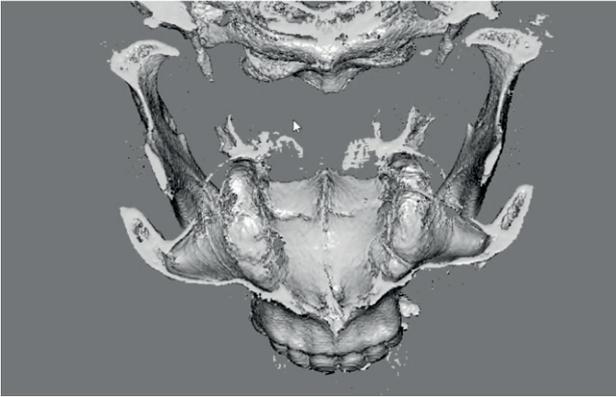
cases) we had at least 2 mm of residual bone under the sinus augmentation, so we inserted implants (in total 78) contextually to the sinus lift procedure, immediately after the filling procedure with biomaterial (we reached at least 15 Ncm of insertion torque, in average approximately 27 Ncm); in the second group (81 cases) we had less than 2 mm of residual bone, so we delayed the implant placement 4-6 months after the sinus lift (the healing time was chosen based on the estimated augmentation) and then we placed implants (in total 124) in a second surgery (we reached at least 35 Ncm of insertion torque, in average approximately 49 Ncm).

None of the implants were loaded immediately: in the first group, we waited for 4-6 months (the healing time was chosen based on the estimated augmentation) to take the first impression for provisional fixed prosthesis; in the second, we waited for 3-4 months after the second surgery (the healing time was chosen proportionally to the final insertion torque reached). All provisional prostheses had 500 microns of distance from antagonist teeth, in order to obtain progressive loading for 1-2 months, after which we took an optical impression for gingival profile and realized definitive prosthesis. All the titanium abutments (provisional and definitive) were customized, milled from Grade 5 Ti blank with a high precision industrial milling machine (G5, Dental Machine).

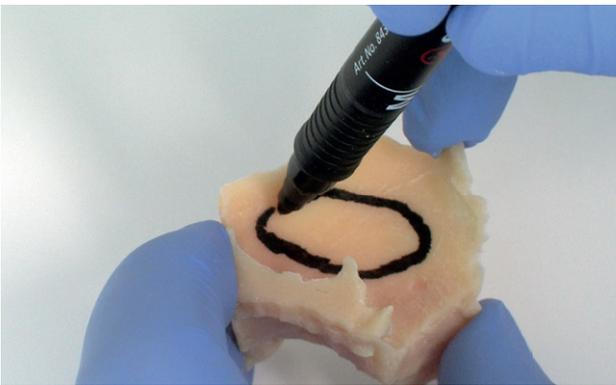
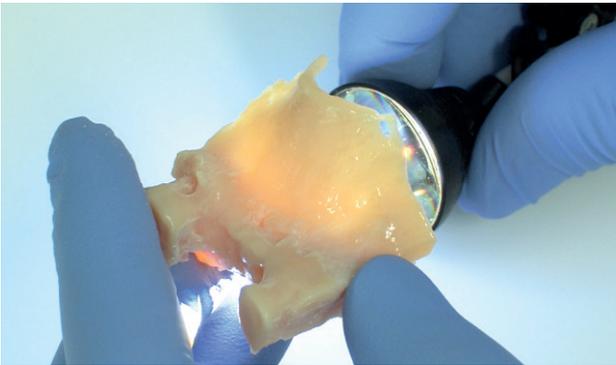
PHARMACOLOGICAL THERAPY

Before the surgery the patient was medicated with Amoxicillin 875mg + Clavulanic Acid 125 mg; immediately after the surgery we injected locally Dexamethasone 2 mg to prevent swelling and give Naproxen 550 mg; then we prescribed Amoxicillin 875mg + Clavulanic Acid 125 mg (per os, twice a day, for 3-4 days according to the volume of augmentation), Naproxen 550 mg (per os, immediately after the surgery and twice a day for 3-4 days based on estimated augmentation), Prednisone 25 mg (per os, before bedtime for 3-4 days, to prevent night swelling in the first days), Lavender + Eucalyptus essential oils (1 drop each in aerosol for 60 days before bedtime, to maintain the sinus clear and to stimulate its physiological cleaning process), Herboplanet Bacsol (2 tablets twice a day for 30 days and 1 tablet twice a day for 30 more days, with *Echinacea angustifolia*, *Salix alba*, *Harpagophytum procumbens*, *Origanum vulgare*, *Thymus vulgaris*, *Satureja montana*, *Cinnamomum zeylanicum*, to help and stimulate the immune system).

STEP BY STEP ILLUSTRATED PROTOCOL

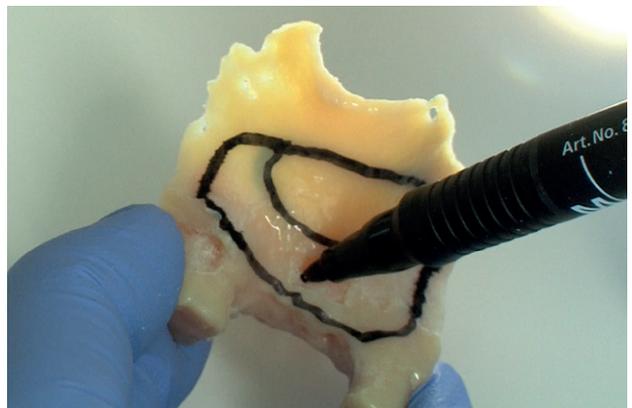
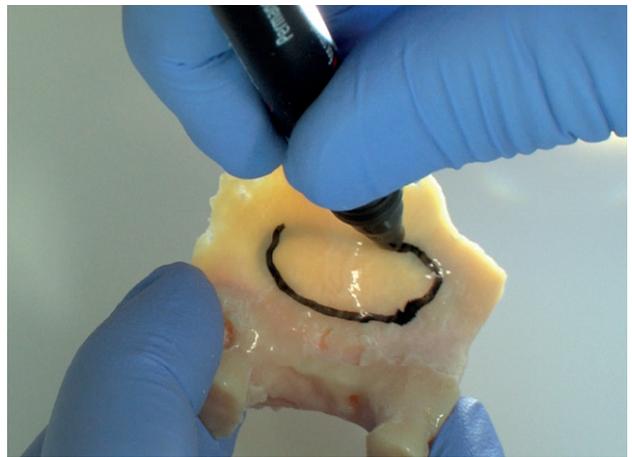


Figures 1. Convert the DICOM files of cone beam CT in STL digital model; a fundamental aspect is the CT latitude, which has a crucial influence on the quality of the 3D printed model; that the CT and the software (we used Anatomage InVivo with Medical Studio Design plug-in, actually a good alternative is 3DiEmme RealGuide) allows to set the window almost -1.500 / 2.000 Hu or better -2.000 / 3.000 Hu.

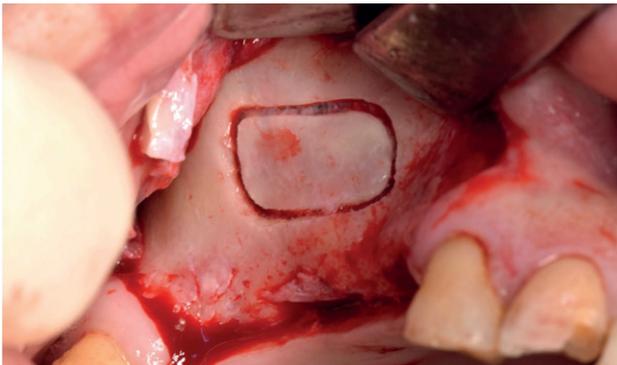
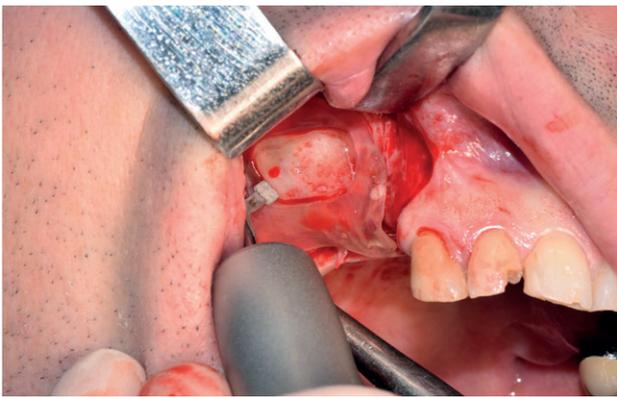
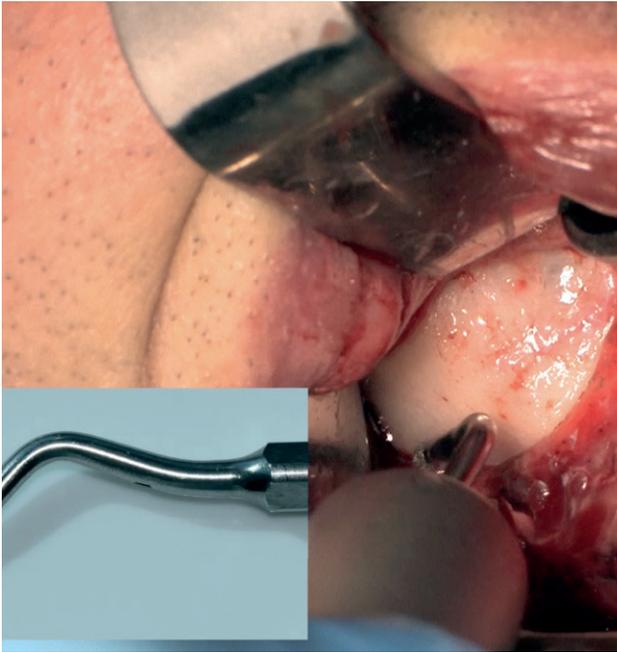


Figures 2, 3. Examine the printed model, and determine the bone thickness, so you can draw with a pencil the internal shape for the lateral window; pay attention to draw the inferior line near the floor of the sinus, a little bit coronal from the angle where the sinus floor turns vertically to become the lateral wall of the sinus. You can determine the height of the lateral window approximately as the distance between external lateral wall and the medial vertical wall of the sinus, because in Cappellin simplified sinus lift protocol we rotate the cut bone from its original vertical position to horizontal position to become the new floor of the sinus (Figures 13).

ADVANTAGES OF CAPPELLIN SIMPLIFIED



Figures 4-6. Check the drawn line in transparence, to confirm the correct position for the lateral window, according to the augmentation needed; then draw on the external part the same line; finally draw a second line which defines the shape of the surgical guide. It is very important to design a shape that involves some anatomic tridimensional portions which aren't totally flat, to simplify the seating step during the surgery.



Figures 7-9. Open the flap and seat the surgical guide over the bone; it is simple to find the correct seating if the guide is drawn as described in previous point. Use the rounded insert to trace a line over the bone, using the surgical guide; then use the flat insert to cut the bone with safety and precision. It is fundamental to avoid every spike and to round accurately all the angles.

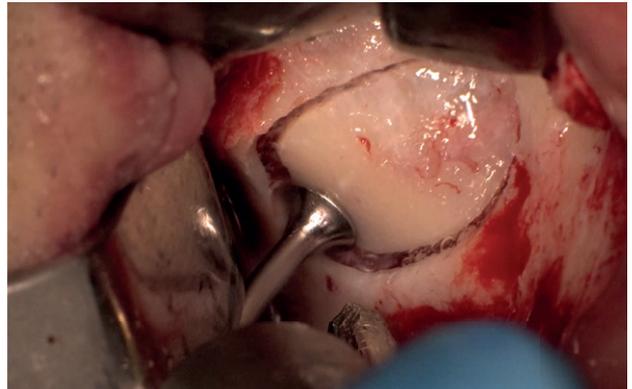
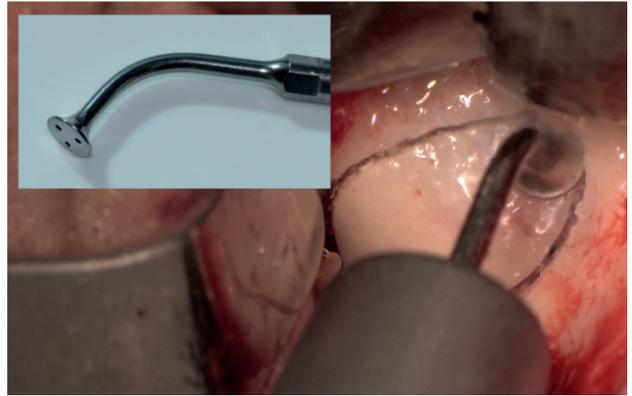


Figure 10, 11. Use the last insert to start detaching the sinus membrane; put the concave portion between the membrane and the internal part of the bone. The little holes on the insert provide saline liquid in pressure and help to soften the membrane and gently detach it.

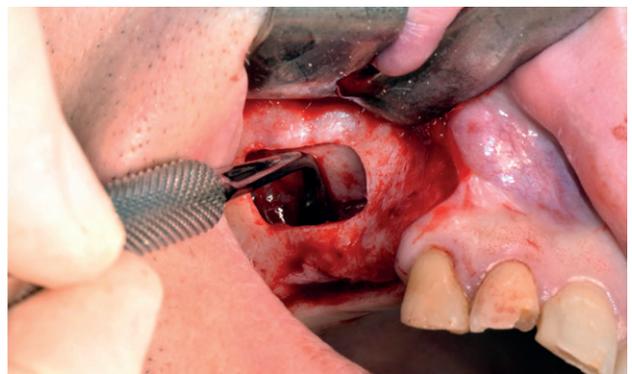
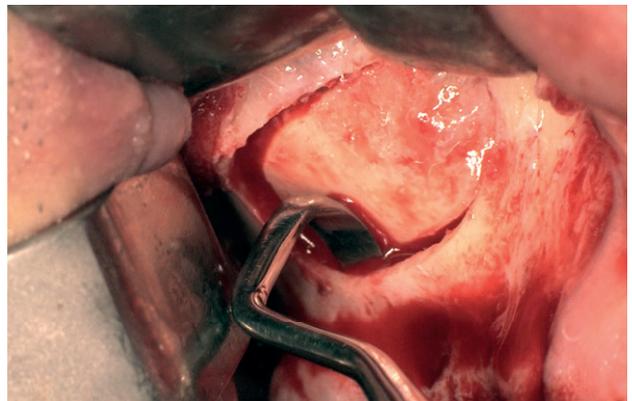


Figure 12,13. Use a surgical instrument to rotate the bone cut around the superior horizontal axis, in order to make space for augmentation and to transform the lateral bone wall in the new sinus floor; you can obtain two bone walls under (the original sinus floor) and over (the bone wall rotated) the filling material, in order to speed the bone regeneration.

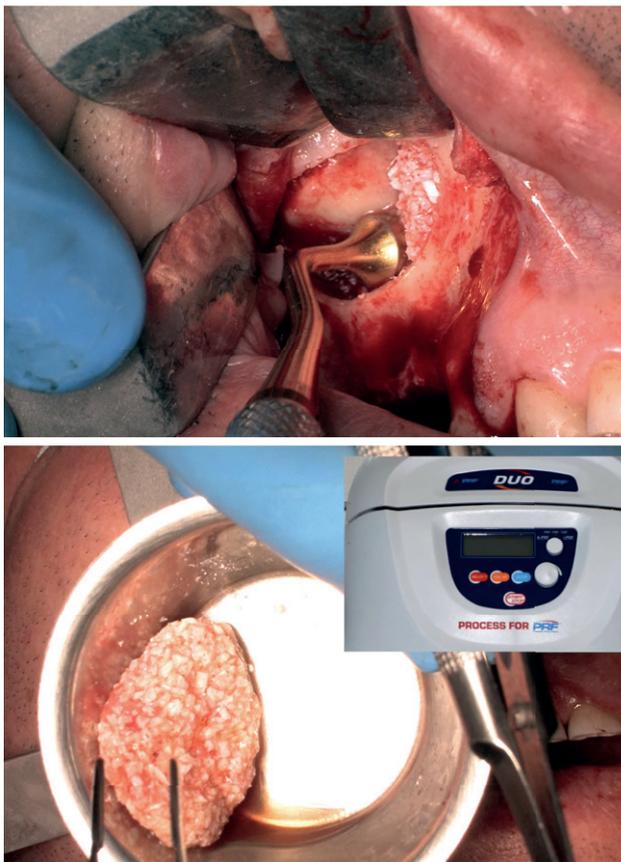


Figure 14, 15. Prepare the filling material by cutting in little pieces one or two a-PRF fibrin (according to the augmentation volume) and mixing with the biomaterial (we used Geistlich Bio-Oss®); then irrigate with PRGF liquid and in a few minutes the fibrin clot merges all the biomaterial which it is very simple to manipulate. Gently push into the sinus (you can estimate the volume in advance looking at 3D model). Prepare a little more, for safety).

SINUS LIFT PROTOCOL

Using Cappellin simplified sinus lift protocol it is very difficult and rare to perforate the sinus membrane, because the surgical guide allows to have a precise bone cutting near to the sinus floor, so detaching Schneider membrane is simpler and safer; little perforations could occur near the bone cut, but is very simple to manage: wait for one minute, then resume to detach the sinus membrane, starting by the most distant part away the perforation; wait another minute, in most cases when you have detached around the perforation, it closes itself (you can see the breathing of the membrane) or you can use a PRF membrane putting it over the hole and wait for one minute. Then you can resume to detach the last part of sinus membrane near the closed hole and start to fill with biomaterial (the PRF membrane “glues” the sinus membrane and prevents the filling material going through the perforation).^{5,6} If these steps are performed with calm and patience, it is impossible to have a big perforation: in fact, we never had in our 125 cases.

If there is a septum, it is possible to make a surgical guide with two different holes, so the surgeon can cut the bone exactly near the septum and detach the sinus membrane safely and perform two different adjacent sinus augmentations, to obtain a single bigger sinus lift with the septum in the middle.

It is possible to plan with precision the position and the amount of sinus augmentation; as a result, it is possible to reduce the volume of filling material. In addition to this, merging biomaterial with PRF membranes can reduce the needed quantity of biomaterial for the same volume: the fibrin space is better to allow the cells migrating to regenerate real bone and to have less biomaterial to resorb; at last, Cappellin simplified sinus lift protocol is cheaper and faster.

The filling material is very well amalgamated, simpler to manage and it doesn't lose granules in the sinus in case of tardive membrane perforation due to pushing too much material at the last of the filling step (you can avoid this calculating the volume of needed material looking at 3D model).

We suppose that the presence of a-PRF and PRGF speeds up the graft healing time and protects from infections;⁴ in fact, despite the very short pharmacological therapy, in 125 cases we had only 5 cases with tardive infection (2 cases after 10 days, 2 cases after 1 months, 1 case after 7 months) that we treated with a new antibiotic therapy (Metronidazol 250 mg, 2 tablets twice a day for 5 days): these episodes didn't compromise the final result of augmentation, because the volume of regenerated bone was more than sufficient to place implants above 11,5mm length.

It is possible to perform in the same surgery a bilateral sinus lift, because in Cappellin simplified sinus lift protocol the surgery time is very reduced; the patient can assume only one pharmacological therapy.

PRELIMINARY RESULTS

The present study includes 125 sinus lift cases with 210 implants (78 placed as the same time as the sinus lift augmentation): we obtain a success of 100% for the sinus lift augmentation (considering success the possibility to place implant at least 10mm length, but on average we placed implant 13mm length).

The implant survival rate was 100%, with follow up from 1 to 4 years (from 2013 to 2017).

CONCLUSIONS

Regarding these preliminary results, Cappellin simplified sinus lift protocol for guided sinus lift offers advantages in terms of safety, simplicity, quickness, reliability and allows to reduce the economic costs and timing of the procedure. Implant Direct® Legacy 2 implant shape allows to reach a very high torque of insertion and optimal primary stability, either in native or in regenerated bone; it is safe to place implants contextually if the residual bone is above 2mm.

ACKNOWLEDGEMENTS

Special thanks to Dr. Alessandro Boaglio DDS for his precious help searching and selecting the literature.

CONFLICT OF INTEREST

The authors declares that there is no conflict of interest regarding the publication of this article.

REFERENCES

1. Wallace SS, Tarnow DP, Froum SJ, Cho SC, Zadeh HH, Stoupel J, Del Fabbro M, Testori T. 2012. Maxillary sinus elevation by lateral window approach: evolution of technology and technique. *J Evid Based Dent Pract.* 12(3 Suppl):161-71.
2. Corbella S, Taschieri S, Del Fabbro M. 2015. Long-term outcomes for the treatment of atrophic posterior maxilla: a systematic review of literature. *Clin Implant Dent Relat Res.* 17(1):120-32.
3. Del Fabbro M, Wallace SS, Testori T. 2013. Long-term implant survival in the grafted maxillary sinus: a systematic review. *Int J Periodontics Restorative Dent.* 33(6):773-83.
4. Testori, Del fabbro, Wenstein, Wallace. 2004. Maxillary sinus surgery and alternatives in treatment. Quintessence publishing. 311-324
5. Aimetti M, Romagnoli R, Ricci G, Massei G. 2001. Maxillary sinus elevation: the effect of macrolacerations and microlacerations of the sinus membrane as determined by endoscopy. *Int J Periodontics Restorative Dent.* 21(6):581-9.
6. Miron RJ, Zucchelli G, Pikos MA, Salama M, Lee S, Guillemette V, Fujioka-Kobayashi M, Bishara M, Zhang Y, Wang HL, Chandad F, Nacopoulos C, Simonpietri A, Aalam AA, Felice P, Sammartino G, Ghanaati S, Hernandez MA, Choukroun J. 2017. Use of platelet-rich fibrin in regenerative dentistry: a systematic review. *Clin Oral Investig.* 21(6):1913-1927.