Balloon-Lift-Control (BLC): a minimal-invasive system for the elevation of the sinus floor mucosa

Part 2

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Results: Case report

In Figures 10 to 15 the course of a clinical sinus floor membrane elevation using the BLC System is presented with intraoral photographs and panoramic x-ray scans.

One week before the surgical operation the patient (Z. E., 43 year-old male) was verbally informed about the operation technique and risks, and also by a letter. On the operation day the patient was in good healthy condition, anamnesis and gross clinical examination did not show any signs of cardiovascular or metabolic diseases; also allergic reactions against iodine or thyroid gland dysfunctions were not known.

Figure 10a gives the local preoperative situation in the upper jaw of the patient (mirror view). The teeth in region 25 to 28 are missing. The clinical aspect indicates that a significant resorption has taken place in the edentate area of the alveolar ridge. Figure 10b shows the splint in situ performed with a reference ball that is placed in the area of the surgical operation provided. The respective panoramic x-ray scan in Figure 10c shows that the height of bony sinus floor has been reduced by the resorption processes to a minimum of 0.4 mm.

Figure 11 demonstrates the removal of the attached gingiva (a). The mucosa is drilled up to the compacta of the sinus floor using a trephine drill (b). The mucosa punch is kept in a sterile compress soaked with physiological saline for the ex-vivo-preservation of its vitality (c). In Figure 11d the distance tube with the guide is positioned to the denudated bone; the appropriate drilling weakens the bony sinus floor to a residual thickness of 1 mm.

Figure 12 shows that the borings coming to hand—bone chips and marrow—are harvested in a sterile chamber (a) to be subsequently mixed with ß-tricalciumphosphate (b) and autogenous venous blood (c).

Figure 13 shows the positioning of the osteotome guidance instrument into the osteotomy and its underpin by the apical security screw (a). Upon the handle of the inserted mandrin, two soft beats are directed with a hammer to impress the residual bony floor (after milling) 1.5 mm into Highmore's antrum (b).

Following a positive mobility test of the impressed bone (and attached mucosa), the osteotome guidance instrument is reinserted and the mandrin replaced by the ventilated balloon catheter (Fig. 14a). Then the balloon is blocked-up repeatedly (at least 5 times) with increasing fluid volume.

After removal of the osteotome guidance instrument, the balloon catheter is directly reinserted into the elevated subantral/submucosal space (Fig. 14b) and blocked-up with the radio-opaque fluid. The result of the balloon-assisted mucosa lift is demonstrated in the panoramic x-ray-scan (Fig. 14c). The balloon contains 1.5 cc of Ultravist; the space

Fig. 10_Case report, patient Z. E., 43-year old male: (a) Mirror view of local preoperative situation. (b) With splint using a reference ball. (c) Panoramic x-ray scan with reference ball (diameter 5 mm) in the area of designed augmentation and implantation.

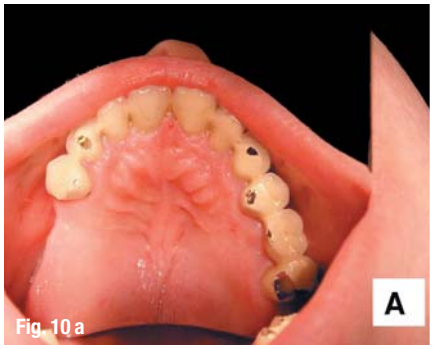


Fig. 10 a

Fig. 10 b

Fig. 10 c

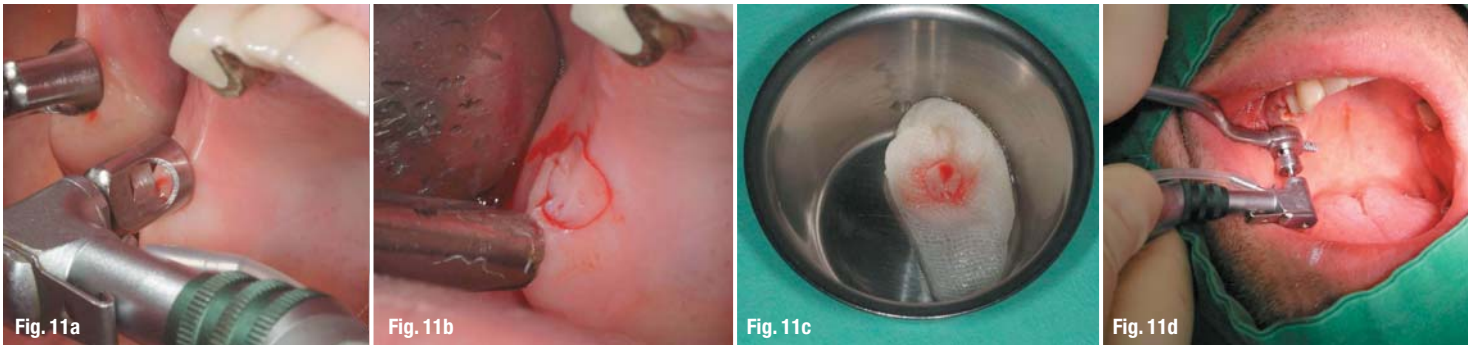


Fig. 11_Case report, patient Z. E., 43-year old male: (a) and (b) Instrumental gingiva punching. (c) Gingiva punch stored in a sterile container with a saline saturated swab. (d) Milling the alveolar process using the distance guide with the proper distance tube (the bony sinus floor is thus reduced to a thickness of approx. 1 mm).

gained, however, amounts to 1.8–2 cc and the height of the elevation of the Schneiderian membrane comes to 12 mm.

After removal of the balloon catheter, the augmentation mixture (Fig. 12) is inserted through the osteotomy in layers (Fig. 15a). The prefinal aspect (before insertion of the gingival punch and its fixation by a suture) is shown in Fig. 15b. The postoperative panoramic x-ray scan (Fig. 15c) demonstrates that the submucosal space is totally filled by the augmentation material.

_Discussion

The BLC System for the sinus floor mucosa elevation in all pre-clinical and clinical studies published up until now2–6 proved to be a simple, easy to learn and comfortable to handle technique. Whether the gingiva propria covering the alveolar ridge is taken off by punch or mucoperiosteal flap remains the decision of the implantologist.

The first step to be taken in careful consideration is the weakening of the bony floor of the sinus by precise milling. This should, by no means, penetrate the sinus floor compacta completely. All subsequent steps are secured by the precise interplay of the BLC instruments: The remaining bone is cautiously pushed with the mandrin towards the subantral space, and the sinus membrane is detached by the application of a balloon that can gradually be blocked up.

Special surface reliefs of the sinus floor like the Underwood septa mentioned are—in the height of less than 5 mm—no obstacle for the BLC system and no cause for possible ruptures of the membrane. These traumas, however, are very often associated with the use of both the direct and the indirect sinus lift techniques.

According to the author, the Summers OSFE method[9] is limited to a maximum elevation height of 3–4 mm. The BLC System renders it possible to lift the Schneiderian membrane up to a height of 10 mm and more, still remaining on the safe side.[2,3] Numerous pre-clinical experiments with human preparations[3,6] have shown that the benchmark area of the sinus membrane is located in the deepest layer of the lamina propria, the reticular stratum (exact histological definitions are defined in paper #3).

This layer obviously seems to be the so-called locus minoris resistentiae of the sinus mucosa as far as its detachment from the lying bone underneath is concerned. Therefore, the nutritional layer of the sinus mucosa, the vascular stratum of the lamina propria, is always kept intact when employing the balloon assisted mucosa separation.

On the one side, this means that the Schneiderian membrane lifted with the balloon is always capable of being sufficiently supplied by blood from the edges of its elevation. There is no risk of the development of a mucosa necrosis due to a lack in blood circulation. On the other side, the periosteal part of the reticular layer of the mucosa remains in contact with the bone walls—from here vascularisation and osteoneogenesis in the augmentation material can proceed immediately after its implantation.

The use of a distance tube and guidance system for the precise milling of the bony sinus floor has at

Fig. 12_Case report, patient Z. E., 43-year old male: Preparation of the augmentation material to be used. (a) Bone chips harvested during milling of the alveolar process are kept in a sterile chamber. (b) Bonit Matrix® (1.0 cc) is mixed with the autogenous bone chips harvested. (c) Venous blood is added to the augmentation material.

Fig. 13_Case report, patient Z. E., 43-year old male: (A) Insertion of the osteotome instrument into the bore hole and positioning of the security screw to gingiva level. (b) Impression of the residual bone into the sinus (approx. 1 mm) by a few slight beats upon the grip of the mandrin.

least two positive effects. First, the Schneiderian membrane is protected against drilling trauma. Second, this system possesses a major positive psychological aspect. The hand with the milling-supporting instruments is separated from the hand with the drill. Thus, the milling procedure can be conducted with a higher accuracy.

Besides its radiological visibility, the use of Ultravist 240 as a blocking-up fluid has the following advantage: The force that is applied with manual pressure on the piston of the syringe operates more slowly and more controlled due to the higher viscosity of the contrast medium compared to saline.

With the BLC System the entry to the sinus floor can be chosen individually:

(1) For example, a crestal access is decided when the simultaneous insertion of an implant is possible.

(2) The ventro-lateral entry to the maxillary sinus can be selected when an upper jaw bridge is still in function and the alveolar bone beneath exhibits a vertical height of less than 3 mm.

Clinically the BLC System has been used so far in more than 800 clinical cases.[2,4,5,7,8] One of these cases is demonstrated in the submitted publication. Here a two-phase procedure of augmentation and implantation due to osseous conditions (Fig. 10c) was inevitable.

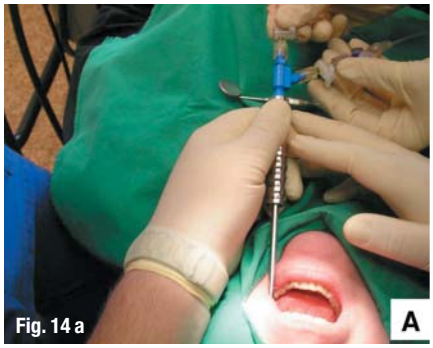
After milling and opening of the entry to the sinus floor, it could be established with a probe that the infractured residual bone with its surrounding sinus membrane was freely movable. It must be repeated that safe access to the sinus is not guaranteed with the cylinder drill when the vertical bone height has not been exactly established. The special guidance system for the use of twist drill with a drilling stop supports secure access to the sinus. The movable mandrin-impressed residual bone permits safe introduction of the balloon and its untroubled blocking up to the desired height.

After experience with extensive pre-clinical examinations and clinical observations, the BLC System is easy to teach, to learn and to handle. The time period between milling the entry to the sinus and its closure after bone grafting is relatively short. An experienced implantologist will manage this operation in less than 10 minutes. Another advantage of this balloon lift in comparison with the open lift is obvious: postoperative soft tissue swelling and pain are reduced to a minimum.

Published clinical studies with the BLC System show that with the balloon, an absolutely sufficient vertical height of the mucosa can be obtained; radiological observations indicate that starting with a balloon volume of 0.2 cc (corresponding to a height of 0.2 mm) each additional 0.1 cc elevates the membrane 0.1 mm. Thus, with a blocking-up volume of 1.0 cc, the balloon lifts the membrane up to 10 mm. This means that the total subantral space amounts to 1.2 cc of volume

Last but not least, the elasticity and the retraction forces of the sinus membrane elevated with the balloon remain unchanged. Consequently, the balloon-lifted membrane will compact the augmentation material after its implantation, thus supporting the process of stabilization and vascularisation of the

Fig. 14_Case report, patient Z. E., 43 year-old, male: (a) Following the mobility test, the mandrin is substituted by the balloon catheter; this is blocked-up 5 times with a radio-opaque fluidity. (b) After the membrane-elevation procedure, the osteotome instrument is replaced by the balloon catheter, which is blocked-up by 1.5 cc of the radio-opaque fluidity. (c) Panoramic x-ray scan of this balloon in situ.



mixture of autogenous bone chips harvested during milling, alloplastic bone defect filler granules (with internal interconnecting pores) and freshly withdrawn venous blood from the patient.

_Summary

The Balloon-Lift-Control (BLC) System—basically derived from the skin-expansion technique of dermatologists—was primarily discussed by the authors as a sinus-membrane- elevation system in the early 1990s. In 1996, the first experiments were begun using self-constructed PVC catheters to the tip of which condoms were glued. These first experiments were performed on human formaldehyde-fixed head preparations.The resulting PhD thesis[6] was presented before the Medical Faculty of the Ludwig-Maximilians-University of Munich in 2002.

Thereafter, in cooperation with industrial companies and escorted by further in-vitro experiments, a step-by-step system was developed consisting of: (a) a secure bone drilling device for the preparation of the access to the sinus floor, (b) an osteotome set to impress the residual bone into the maxillary sinus, and (c) a balloon catheter to elevate the sinus mucosa to the height necessary for a functionally effective bone augmentation.

In the meantime, numerous results of pre-clinical and clinical tests employing this BLC system have been published. The common consent of these observations is that this technique combines the advantages of a minimal invasive, mostly complication-free treatment with the possibility of creating a vertically optimal implant bed. The application of the BLC System is systematically described and discussed.

The case presented gives a short review of the application of the components of the BLC System and the anticipated results. Despite the prima vista simplicity of the system components and its relatively easy application, it is highly recommended that use the BLC System should be restricted to surgically experienced dentists in possession of a profound knowledge of the orofacial topographic anatomy and having a command of the basics of bone atrophy, osseous regeneration and bone remodelling._

Refernces

[1] Baumann, S (2007): Untersuchungen zum BLC-System an frischen Sägetierkiefern. Masterthesis DUK Krems.
[2] Bauer, FM, and KU Benner (2005): Die Ballon-assistierten Sinusboden-Schleimhaut-Elevation – erste klinisch Resultate. Implant. J. 3:62–65.
[3] Benner, KU, Bauer, FM, and KH. Heuckmann (2005): Die Ballon-assistierte Sinusboden-schleimhaut –(BASS)-Elevation – Anatomische Studien mit einer minimalinvasiven Technik. Implantologie 13/1:53–60.
[4] Bieker, WM (2006): Balloon-Assisted Sinus Floor Elevation—An Alternative to open Sinus Elevation? EDI Case Studies 26–30.
[5] Bieker, WM (2006): Balloon Lift Control—The better alternative to a lateral sinus floor elevation? Identity, 40–45.
[6] Black, P (2002): Sinusbodenelevation: Entwicklung eines ballonassistierten Verfahrens. Inaug. Diss. LMU München.
[7] Eenhuis, U (2007): Sinusboden-Schleimhaut-Elevation: Klinische Untersuchungen zum Ballon-Lift-Control (BLC) System. Masterthesis DUK Krems.
[8] Kirste, M (2007): Das Ballon-Lift Control (BLC)-System mit 'in vitro' und 'in vivo' Studien. Masterthesis DUK Krems.
[9] Summers, RB (1994): The Osteotome Technique: Part 3 – Less invasive methods of elevating the sinus floor. Article 1. Compend Contin Educ Dent of volume XV NO. 6, 698–708.
[10] Tatum, OH Jr (1986): Maxillary and sinus implant reconstruction. Dent Clin North AT 30:207–229.

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Fig. 15_Case report, patient Z. E., 43 year-old male: (a) Augmentation mixture put through the bore hole into the submucosal space. (b) Final view of the operation site before closing the soft tissue defect with the gingiva punch kept in sterile saline (mirror view). (c) Panoramic x-ray scan with the implanted augmentation material.