Chapter 3

Sinus Lifting and Leucocyte- and Platelet-Rich Fibrin

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Abstract

The insufficient alveolar bone height due to the maxillary sinus in the posterior maxilla and postextraction bone resorption may limit implant placement. The sinus lifting procedure creates space between the maxillary alveolar bone and the Schneiderian membrane, which is filled with graft materials to maintain adequate space for new bone formation. Leucocyte- and platelet-rich fibrin (L-PRF)-mixed bone substitute or L-PRF has been used solely as a graft material for sinus lifting. The clinical and radiological findings of the application of PRF for sinus augmentation have been shown to have good results regarding new bone formation. The L-PRF can be an efficient biomaterial for graft particles in maxillary sinus lifting.

Keywords: sinus lifting, leucocyte- and platelet-rich fibrin, bone graft, L-PRF block, Schneiderian membrane

1. Introduction

Alveolar bone resorption in the edentulous ridge can cause insufficient bone volume for placing dental implants and consequently cannot be rehabilitated by prosthetics. Sinus lifting is a surgical approach with the elevation of the Schneiderian membrane to place the bone grafts for treatment of atrophic posterior maxilla [1]. This surgical technique is a successful treatment for augmentation of the atrophic posterior maxilla and to gain bone volume for dental implant procedure [2].

Sinus lifting shows complexity due to anatomical variations and Schneiderian membrane. The lateral bone's thickness changes the risk of membrane perforation. Evaluation of the thickness of the lateral wall before surgical treatment may affect the integrity of the Schneiderian membrane during the surgery [3].

Sinus lifting is a predictable technique, but various complications can occur during surgery or postoperative period [3]. These complications can be listed as edema, perforation of Schneiderian membrane, sinusitis development, bleeding, wound dehiscence, postoperative wound and bone graft material infection, implant failure if it is placed simultaneously, and disruption of normal sinus physiologic function. These complications can delay the healing process and may require additional surgeries [4–6]. Cone-beam computed tomography (CBCT) provides an accurate evaluation of the sinus and related anatomical structures. Danesh-Sani et al. recommend using CBCT before surgery to minimize the risk of Schneiderian membrane perforation [7].

Presurgical evaluation with CBCT has become an essential tool for diagnosis and surgical planning, including sinus lifting. Before performing a sinus lift, the clinician's attention should not be only directed to the patency of the ostium through CBCT, because many anatomical features could influence the surgical approach of sinus lifting.

Postoperative swelling of the Schneiderian membrane mostly occurs with maxillary sinus lifting procedure. The mucosa of the Schneiderian membrane heals rapidly and recovers its homeostasis. If the ostiomeatal complex is unfavorable due to anatomic variations, its healing can be delayed, and risk of sinusitis is increased. The ostiomeatal complex plays an essential role in the development of maxillary sinusitis by dysfunction of the mucociliary system. If the patency of the ostiomeatal complex is interrupted, clearance of the maxillary sinus can be delayed and can increase the risk for development of sinusitis [8].

Surgeons must consider the risk of infectious sequelae after sinus lifting. The inflammatory reaction after any surgical procedure is unavoidable. Because of the interference of ciliary activity caused by the elevation of the Schneiderian membrane, altered mucous composition and bacterial infection can occur [9]. After sinus lifting, the maxillary sinus may be filled with hematoma or seroma. However, a mild inflammatory reaction can occur as a regular physiological activity of the nasal airway, and swelling of the mucosa can cause obstruction of the patency of the ostiomeatal complex. As a result, sinus lifting might compound the physiological drainage of the maxillary sinus into the middle meatus by inflammatory swelling on the mucosa of the ostium can predispose the patient to acute maxillary sinusitis [10]. Persisting effect on the ciliated mucosa can be expected because of raising the mucosa of the maxillary sinus [11]. The maxillary sinus mucosa can adapt adequately to the alteration following sinus lifting [12]. It is generally assumed that altered maxillary sinus, such as elevation of the Schneiderian membrane with curving outward or injured sinus mucosa, might change the physiological activity of the maxillary sinus.

Anatomic variations of the maxillary sinus are commonly detected, with an estimated prevalence of 68% [13]. Some anatomic variations on the lateral nasal wall, such as the deviated nasal septum, concha bullosa or paradoxical middle turbinate, and bending of the uncinate process are significant because of their help to the blockage of ostiomeatal complexes. These variants can interfere with drainage and ventilation of the maxillary sinus, and can affect the risk of sinusitis [14]. Compromised maxillary sinus drainage is closely associated with a reduction of the maxillary ostium. Reduced size of the ostium diameter can cause sinusitis [15].

The risk of Schneiderian membrane perforation during sinus lifting, in the presence of antral septa, can be increased [1]. Antral septa divide the sinus into compartments and smaller accessory sinuses [16, 17]. The presence of septa may constitute a risk factor by causing the Schneiderian membrane to become perforated during surgery. The development of sinusitis is one of the possible complications associated with perforation of the Schneiderian membrane [9]. For the repair of such perforations, there are a variety of techniques, including a buccal fat flap, fibro-mucosal grafts, connective tissue, resorbable collagen membranes, amnion-chorion barriers, and the leucocyte- and platelet-rich fibrin (L-PRF) [18]. Obtaining L-PRF consists of a very simple and inexpensive protocol that produces a strong membrane after compression [19].

L-PRF acts as a bioactive bridge and releases growth factors. The release increases day by day and reaches its highest level on the 14th day and continues until the 28th day [20–22]. L-PRF has certain effects on wound healing [19]. The leukocytes and cytokines have a significant role in controlling infectious and inflammatory processes. While the fibrin matrix is resorbed, cytokines are released to accelerate neovascularization and protect from infection. So, when L-PRF is used in membrane form, it stabilizes the graft material, covers the perforation since it has an inherent attachment to the Schneiderian membrane [23], and protects the wound [18, 24] (https://youtu.be/vuHPSpBVCl8).

The limited quantity of autogenous bone graft in sinus lifting with high morbidity rates is important for the clinicians using bone substitutes rather than the autogenous grafts. So, the investigation of optimal biomaterial combinations to enhance bone regeneration properties is in progress [25, 26]. L-PRF with bone graft for sinus lifting is accelerating bone regeneration. Choukroun et al. reported that healing time between sinus lifting and implant placement could be reduced by using L-PRF [27].

The use of L-PRF with a high concentration of platelets, growth factors, and leucocytes may increase the development of new bone. The liquid L-PRF (i-PRF) has been proposed to agglutinate the bone substitute [28]. Mixing i-PRF with bone substitute creates the L-PRF block.

2. L-PRF block

Prior to sinus lifting surgery, 8–16 tubes of venous blood needed to be collected from the patients. Two tubes should be separated as a white cap, plastic coating, and placed in the centrifuge at 2700 rpm for 3 minutes. The remaining tubes as a red cap, glass coating should be placed in the centrifuge at 2700 rpm for 12 minutes.

The liquid fibrinogen in the white cap tubes has to be aspirated with a sterile syringe. When the centrifugation of the red cap tubes finishes, the L-PRF clots can be removed from the tubes and compressed using a sterile metal box to mold membranes (**Figure 1**).

For the preparation of the L-PRF block as described by Cortellini et al., L-PRF membranes are cut and mixed with a bone substitute at a ratio of two membranes with 0.5 g bone substitute. The liquid fibrinogen needed to be added to the homogenous mix and stirred for at least 10 seconds for the ideal form. By the chopped membranes, fibrinogen is polymerizing into platelets and leucocyte, forming the L-PRF block (**Figure 2**).

Figure 1. The ready-to-use L-PRF membranes in preparation kit.

Figure 2. The L-PRF block.

3. Conclusion

The L-PRF block is secreting bioactive molecules like; a platelet-derived growth factor, bone morphogenetic proteins, insulin-like growth factor, vascular endothelial growth factor, transforming growth factor-β1, and transforming growth factor-β2 [29].

L-PRF can have a positive effect on bone regeneration and osseointegration. Easy preparation of L-PRF, biological properties, and low cost could be considered as reliable support in sinus lifting surgery. The use of sufficient L-PRF clots and membranes, avoiding to close the patency of ostium, is crucial to gain a covetable bone volume [30] (**Figure 3**).

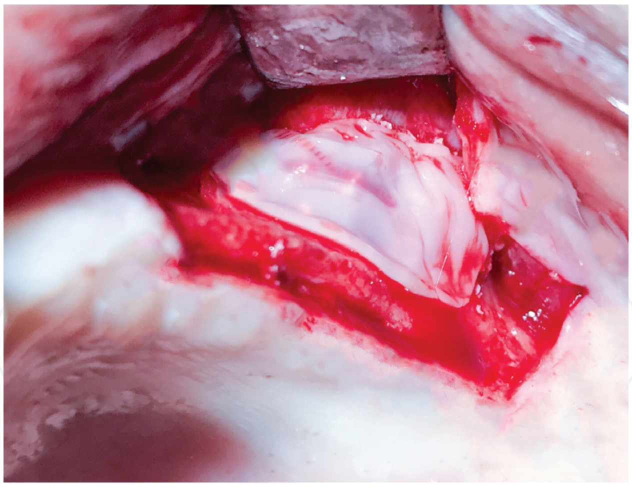

Figure 3. The use of the L-PRF membrane to cover the lateral window.

The L-PRF block maintains the volumetric stability of the biomaterial during healing and by this way, it can prevent the shrinkage of the scaffold. The effects of L-PRF on tissue healing by the release of growth factors and increasing angiogenesis and osteogenesis can lead to the higher volume of newly formed bone with the L-PRF block [31]. The L-PRF block can be a successful new procedure for sinus lifting after further investigations with histological analysis and randomized controlled clinical trials.

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