Chapter 13

Novel Techniques in Dentoalveolar and Implant Surgery

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Additional information is available at the end of the chapter

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Abstract

The topics of this chapter can help manage or prevent several common intraoperative problems facing clinicians during dentoalveolar and implant surgery. Three novel techniques are presented: (1) a technique for the stabilization of mucoperiosteal flaps following exposure of an impacted tooth requiring the apical repositioning of the gingival flap to allow for bonding of an orthodontic bracket, (2) a technique for the management of bone loss after tooth extraction and immediate dental implant placement, and (3) a technique to repair maxillary sinus membrane perforations during sinus lifting for implant placement.

Keywords: apical reposition flap, sinus membrane repair, bone grafting, implants, dentoalveolar surgery

1. Introduction

Dentoalveolar surgery may be associated with intraoperative complications; these complications may impede treatment, hinder healing, preclude immediate implant placement, or complicate delayed implantation [1–3]. Several new concepts and techniques presented in this chapter can help manage or prevent some of the common intraoperative sequels facing clinicians during dentoalveolar surgery. Three novel techniques in dentoalveolar surgery are presented herein, including "bone anchorage" (the stabilization of mucoperiosteal flaps following exposure of an impacted tooth requiring the apical repositioning of the gingival flap to allow for bonding of an orthodontic bracket), "crescent graft" (a technique to manage bone loss after tooth extraction and immediate dental implant placement), and "sinus membrane repair" [a simple technique to repair maxillary sinus membrane perforations (SMPs) during sinus lifting].

2. Bone anchorage: a fail-proof technique for the apical repositioning of the gingival flap following exposure of impacted teeth

Exposure of impacted teeth is a prerequisite for bracket bonding and orthodontic therapy. Sometimes, exposure of an impacted tooth requires the apical repositioning of the gingival flap to allow for bonding of an orthodontic bracket. In some cases, this procedure can be very difficult; this is particularly true in the posterior regions of the mandible where anatomical hindrances such as the external oblique ridge and muscle insertions are obstacles preventing the apical fixation of the flap [1]. In the anterior regions, we may also face difficulties if the impacted tooth requiring exposure is in the depth of the oral vestibule. In these cases, the mobility of the oral mucosa and muscle pull in the vestibule precludes the fixation and stabilization of the gingival flap impeding orthodontic bracket bonding. We present an effective approach by which these obstacles can be overcome. Our technique can effectively reposition the attached gingival flap apically after exposing the crown of the impaction and secure it until orthodontic bracket bonding.

2.1. Technique

To apically reposition the gingival flaps of attached gingiva after exposure of an impacted tooth and allow for orthodontic bracket bonding, surgery is indicated. After injection of local anesthesia, a full-thickness trapezoid-shaped mucoperiosteal flap is reflected using periosteal elevators to expose the bone. Buccal bone removal is then started laterally over the impacted tooth using an electric-driven hand piece and a rose bur. After tooth exposure, the buccal cortical bone is removed towards the cervix to sufficiently expose the crown. Care is taken not to remove the bone over or below the cervix of the tooth, as this may endanger the bifurcation or trifurcation in molar teeth. Using a 704 fissure or rose bur, a hole is drilled through the buccal cortex; this is often possible when there is a gap created via the dental follicle separating the tooth from the buccal bone or when a tooth adjacent to it has been removed (i.e. third molar). This gap provides room for passing the suture. Next, a 3-0 silk or polyglactin suture is passed through the superior part of the flap and then through the buccal cortex and tied securely to

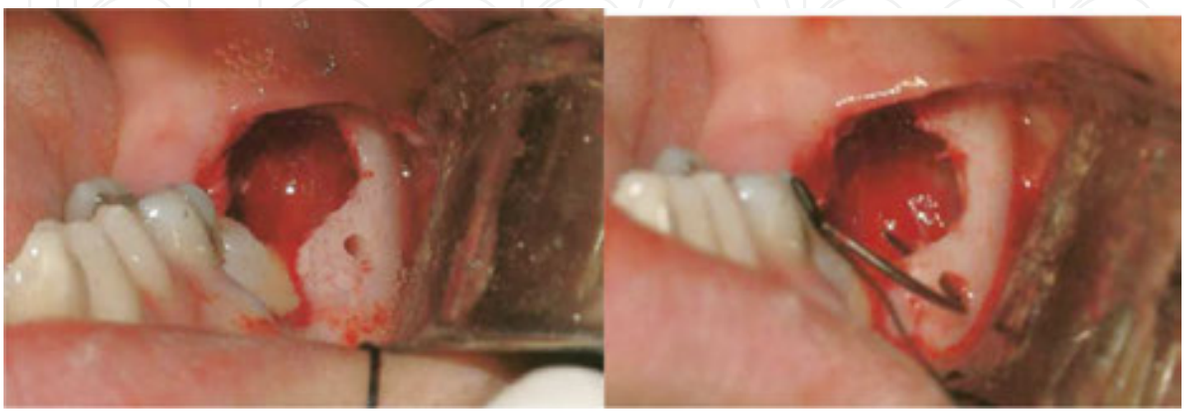

Figure 1. Bur hole drilled through the buccal cortex after the removal of an impacted third molar. A polyglactin or silk suture is passed through the mucosa and then through the hole drilled in the buccal cortex.

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the bone to anchor down the flap apically below the crown of the tooth. The crown should be exposed sufficiently for bracket bonding (**Figures 1** and **2**).

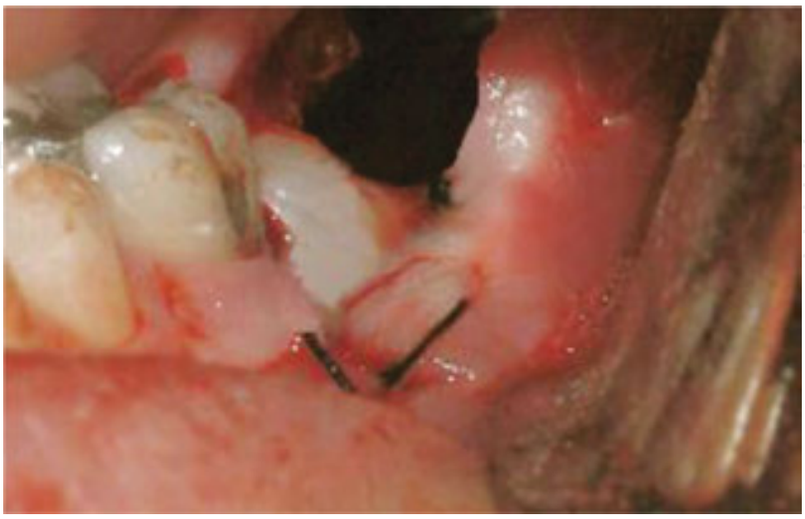

Figure 2. The suture is tied down to anchor the flap securing the exposure of the horizontally impacted second molar tooth for orthodontic bracketing.

2.2. Discussion

The apical repositioning of the gingiva for orthodontic bracketing is problematic in the posterior part of the mandible because of the external oblique ridge and shallow vestibule. The disruption of the gingival attachments and flap reflection of the attached gingiva will cause an immediate loss in vestibular depth due to the upward pull of facial muscles, such as the buccinator. In the anterior regions, we may also face difficulties if the impacted tooth requiring exposure is in the depth of the oral vestibule, because, in these cases, the mobility of the oral mucosa and muscle pull in the vestibule precludes the fixation and stabilization of the gingival flap impeding orthodontic bracket bonding. Securing the flap to the overlying bone is an optimal way to manage such cases [1].

3. Managing alveolar bone loss after tooth extraction for immediate implant placement: the "crescent graft"

3.1. Introduction

Although immediate implantation after tooth extraction has its merits, it may not always be feasible. The most common dilemma in such cases is the confrontation of postextraction bone loss due to difficult extraction of the tooth or preexisting periodontal disease. Many techniques exist with which to manage such complications, namely, autogenous bone grafts (the gold standard), which possess osteoinductive properties and other graft materials with osteoconductive properties. There are numerous sites from which to harvest autogenous bone, each

having inherent advantages and disadvantages. Chronic periodontitis is one of the major causes of excessive bone loss. After initial evaluations, the pocket depth must be assessed upon tooth extraction; periodontal bone defects may be encountered (vertical defects, crater defects, bone dehiscence, etc.) in the tooth socket of the extracted tooth. Defects may also be caused by traumatic extraction of a tooth without a defect preoperatively. Such defects may preclude immediate insertion of dental implants and require reconstruction either before or simultaneously upon insertion of the implant. It is generally believed that autogenous bone grafts are better than alloplasts; this is because of their osteoconductive and, more importantly, osteoinductive properties [4, 5]. Many sites exist from which to harvest bone and many techniques exist from which to do so. Herein, we present a new site and a novel technique for graft harvesting and restoring bone loss in implantology.

3.2. "Crescent graft" technique to manage bone loss after tooth extraction and immediate implant placement

When the clinical and radiographic examination of a tooth shows evidence of cortical bone loss, the patient may be a candidate for corrective bone grafting of the defect site after tooth extraction and immediate implant placement (**Figure 3**).

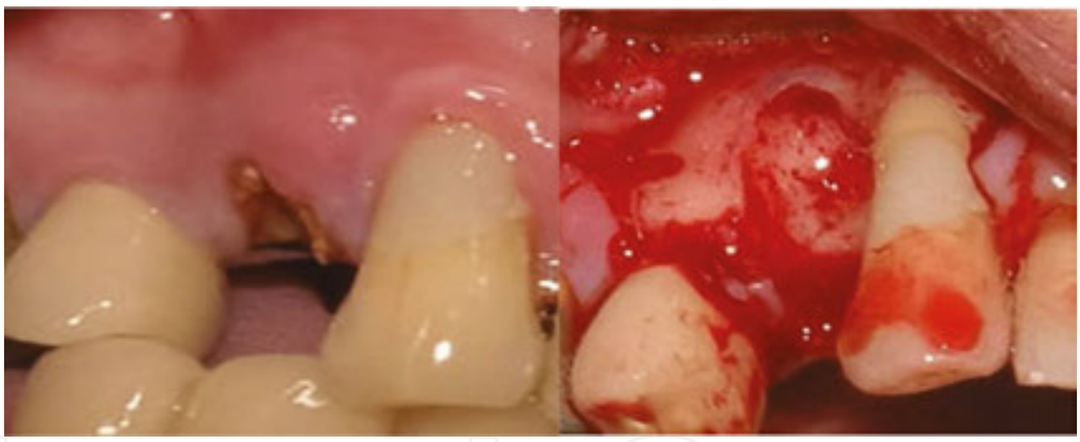

Figure 3. Patient requiring extraction of a hopeless "first" maxillary premolar. After the reflection of a mucoperiosteal trapezoid flap, a large cortical bone defect was seen.

After tooth extraction, the recipient site must be assessed and the amount of autogenous bone needed should be determined. Cross-sectional tomography or cone beam computerized tomography can be used to estimate the amount and thickness of available bone and the safest graft harvesting site.

3.3. Surgical technique

After local anesthesia and tooth extraction, a buccal mucoperiosteal flap is reflected. The defect is exposed and measured with a periodontal probe. The implant is inserted into the extraction socket. Then, the exposed implant surface area needing coverage is assessed; the volume of bone needed is reestimated (**Figure 4**).

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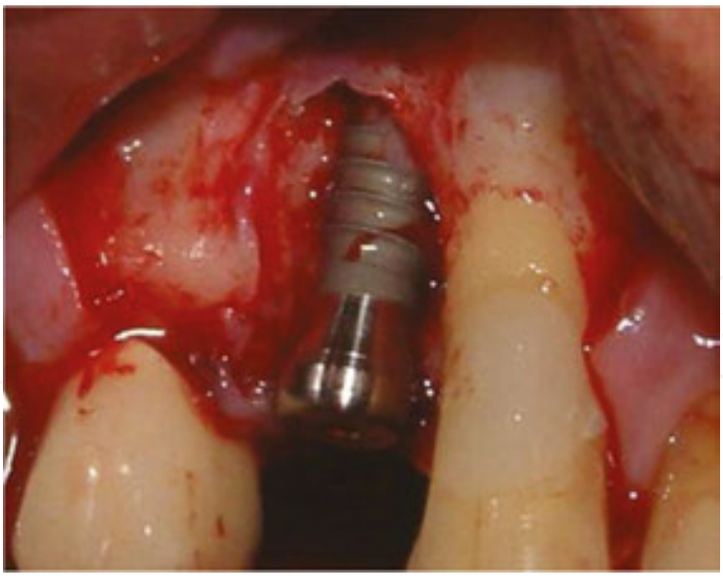

Figure 4. Implant inserted into fresh tooth socket.

The donor site and the size of the trephine bur are determined and a mucoperiosteal envelope flap in the palate is reflected. In our case, we used a trephine bur (5 mm in diameter); two overlapping insertions of the trephine are made parallel to the roots of the incisors and 2 to 4 mm away from them (**Figure 5**).

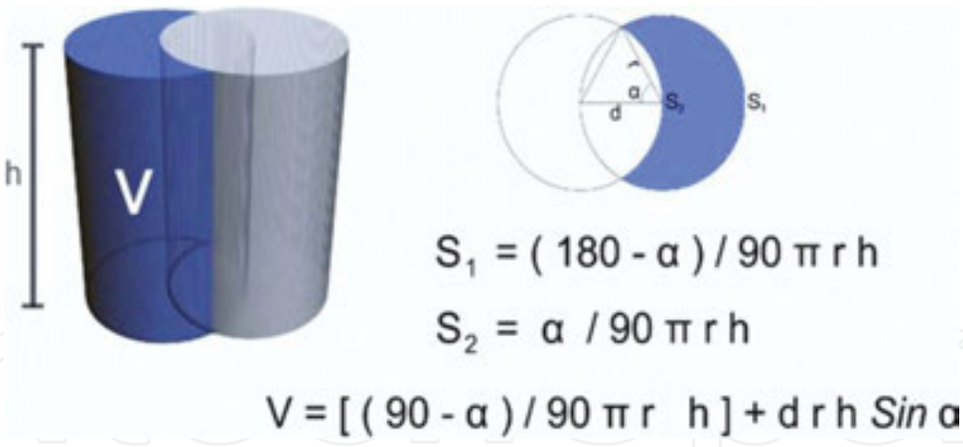

Figure 5. Two circles overlapping each other shape two crescents. S_1, area of outer surface of graft; S_2, area of implant facing surface of graft; V, volume of graft; h, depth of bur penetration; r, radius of trephine bur; d, intercentral distance; a, arcos (d/2r).

The trephine penetration depth is predetermined according to the sagittal tomogram. Extreme care should be taken not to penetrate the nasal floor by perforating the anterior palate. However, should this occur, it is not a problem because the palatal mucosa is intact and this precludes the formation of an oronasal fistula. It is essential to have a proper three-dimensional concept of the incisor roots to prevent iatrogenic damage [4]. A periodontal probe is used to determine the bur penetration depth during bone removal. Bone harvesting from the palate

produces two crescents, one of which is used in the procedure as a free graft with the concave inner side of the graft placed to cover the convex outer surface of the implant (**Figure 6**).

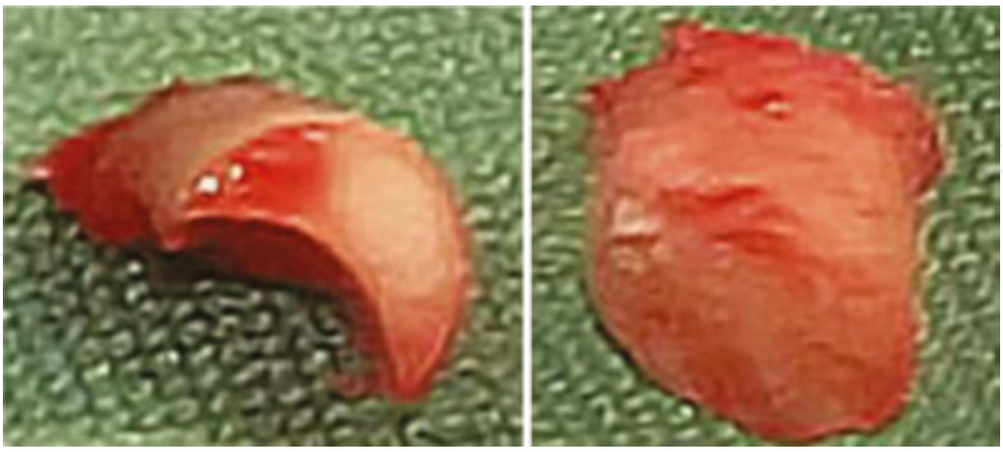

Figure 6. Two insertions of the trephine bur are done to harvest bone; two crescents are produced, one of which is used in the procedure as a free graft. The remaining harvested bone is blended and placed over the recipient site.

The crescent graft is placed into the recipient site (**Figure 7**). The remaining harvested bone is blended and placed over the recipient site.

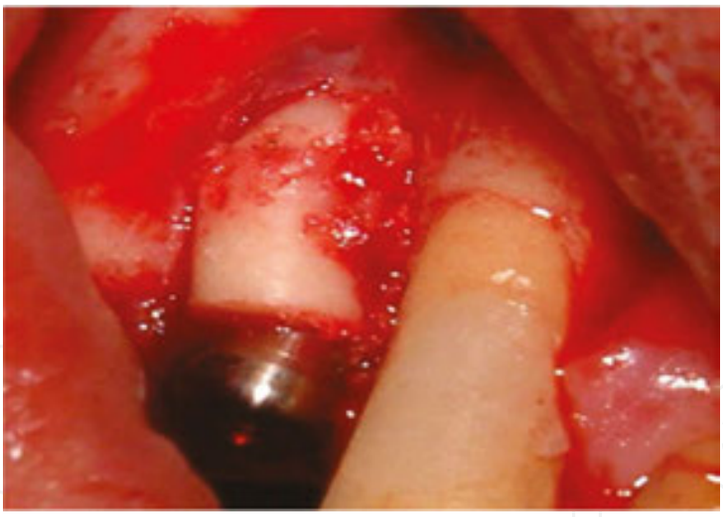

Figure 7. Crescent graft placed into the recipient site.

The small size of the graft precludes fixation with mini-screws. Therefore, a slot is made in the defect via a fissure bur, and the crescent graft is wedged into it. Then, the flap is repositioned and sutured. Postoperatively, the patient is prescribed antibiotics and instructed to use normal saline rinses the next day. The sutures are removed after 7 to 10 days. After 3 months, the cover screw is removed, and the abutment is placed and restored by the use of a cement-retained metal-ceramic crown. The patient is examined at 6 and 12 months after surgery. Vitality tests of the maxillary canines and incisors are performed to ensure vitality.

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3.4. Discussion

Dental implants can improve the quality of life, especially in edentulous patients [6]; however, implants are not without complications [4, 7, 8]. A common problem is bone loss or defects. Many studies have assessed the use of different grafts in such defects [9]. Several have shown advantages in using guided bone regeneration on autogenous grafts to avoid soft-tissue ingress [10–12]. Behneke et al. [13] advocated the use of autogenous bone grafts. Common sites in the jaws used as donor sites in autogenous harvesting procedures include the anterior border of the external oblique ridge, lingual exostosis, maxillary tuberosity, and the chin (**Figure 8**) [5, 14–16].

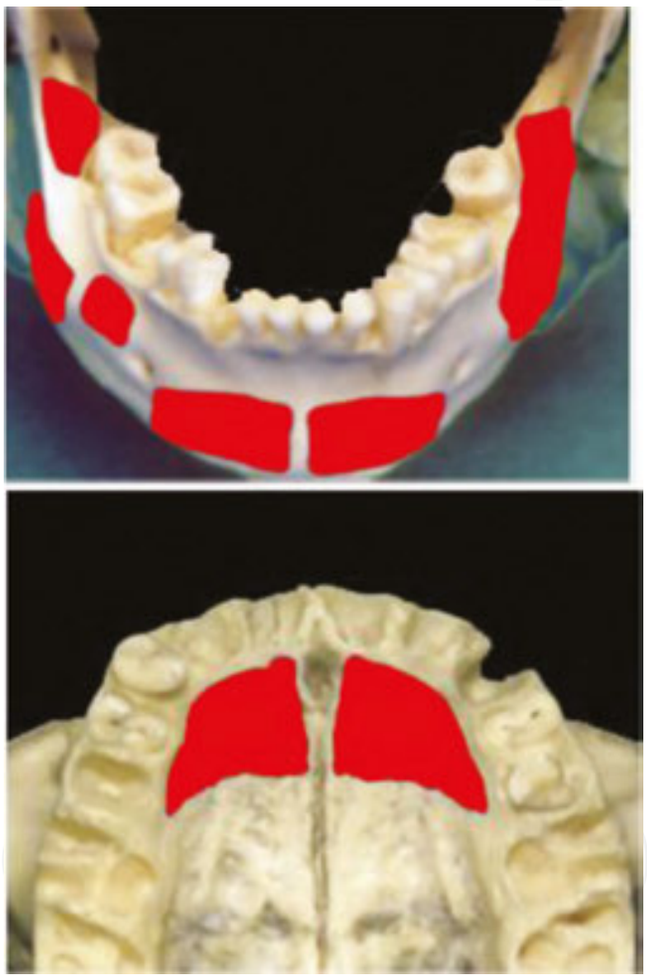

Figure 8. Intraoral donor sites.

The anatomic form of the donor site is as important as the bone quantity and quality [16]. Hassani et al. [17] first introduced the anterior palate of the maxilla as a quantitative donor site in cadavers. The bone is corticocancellous in nature despite its small volume. However, the curvature of the hard palate conforms conveniently to the implant. When two circles with equal radii cross each other in such a way that the perimeter of one circle crosses the center of the other, two crescents result. The use of a trephine bur to achieve this produces a favorably

shaped bone graft for implants. This design (the "crescent" graft) has a concave surface (cortex) that conforms nicely to the dental implant surface for coverage. Harvesting chin grafts should be done primarily in those presenting with an edentulous anterior mandible or a large chin protuberance with short roots of the anterior mandibular teeth [18]. Using a local donor site has the advantage of convenient surgical access, which means shorter duration of surgery and anesthesia [19, 20]. Bone harvesting can be performed in the office setting or at the hospital. The procedure is more cost-effective and is estimated to have less donor site morbidity than procedures involving extraoral approaches. Cross-sectional tomograms and lateral skull images can help prevent injury to the anterior maxillary teeth. The intramembranous origin of the harvested bone causes rapid vascularization and improves bone formation [17]. The bone harvested from the anterior palate has a corticocancellous nature. Revascularization occurs more rapidly with cancellous autografts than with cortical grafts. Cancellous autografts tend to be completely integrated with time, whereas cortical grafts tend to remain as admixtures of necrotic and viable bone [21, 22].

4. Sinus membrane repair: a novel technique to repair maxillary sinus membrane perforations during sinus lifting

4.1. Introduction

Boyne and James [23] first reported maxillary sinus lifting in an atrophic maxilla. Sinus lifting for implant placement has now become an established procedure in implantology. It is a predictable method used to augment bone in the posterior maxilla. Increased sinus lifting procedures and bone grafting for the implant placement in the posterior maxilla has in turn increased the complication rate. The most common complication in sinus lifting is the inadvertent perforation of the sinus membrane; if left untreated, it may result in the loss of graft material into the sinus cavity, infection, oroantral fistula, or impairment of the physiologic function of the antrum [24–27]. Fugazzotto and Vlassis [28] classified sinus membrane perforations or SMPs into three groups (class I, class II, and class III) based on their location [29, 30]. The most common location of perforation is the apical wall of the cavity (class I) followed by the mesial surface of the lateral wall (class II) and within the window extension (class III). SMPs are usually classified based on two factors, namely, perforation size and site. SMP has been reported to be as high as 58%, and it is more common in cases where the membrane is too thin or when septae are present [31, 32]. Thus, a method to manage this complication is warranted. We introduce a new, simple, feasible, and effective method to manage SMPs during sinus lifting.

4.2. Technique

Should inadvertent SMP occur after access to the maxillary antrum, the initial step is to evaluate the perforation size and determine whether biomaterials are necessary or not. After severe perforation (class I or II) of the sinus membrane (class II, mesial wall) during sinus lifting, if the quality of the sinus membrane is acceptable, first the membrane margins are gently

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released. For class II perforations or class I perforations in the apical wall, two holes are made 3 to 4 mm from one another using a fissure bur in the lateral wall near the access window. Next, a 4-0 absorbable suture with a round needle is passed through one of the cortical holes from the outer surface then into the antrum and then passed through 2 sites in the membrane (to reduce tension and prevent membrane tearing). The suture is then passed through the other hole, exiting from inside of the sinus outward; the knot is tied outside the antrum via a horizontal mattress technique; the sinus membrane abuts the bone as a result of the tension applied (**Figures 9** and **10**).

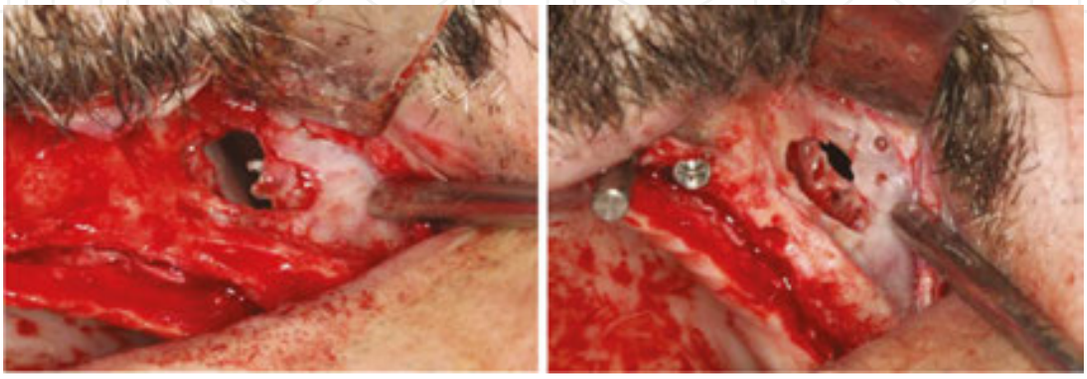

Figure 9. The sinus membrane is carefully released. Two holes are gently made 3–4 mm from one another using a fissure bur.

The perforation is closed in this manner; the integrity of the maxillary sinus floor is preserved, and the sinus lift procedure is resumed; bone grafting and the insertion of biomaterial under the sinus membrane can be done and implants may also be placed. For large perforations, it is prudent to place a membrane to ensure the closure and prevention of graft material from migrating into the sinus cavity. Alternatively, buccal fat can be used for perforation closure or as a barrier between the sinus membrane and the graft material. This fixation method can be used along with a variety of biomaterials.

4.3. Discussion

The growing popularity of implant treatment runs hand in hand with procedural complications. One example is SMP during sinus lifting in the atrophic posterior maxilla, complicating implant placement. In 1980, Boyne and James [23] performed the first sinus lift procedure. Since then, sinus lifting has been the treatment of choice for implant placement in an atrophic maxillary ridge. Like every other conventional treatment, sinus lifting has its inherent risks and complications. The most common potential complication of open sinus lift surgery is SMP intraoperatively, which if left untreated, may result in the leakage of graft material into the sinus, infection, oroantral fistula, and impairment of physiologic sinus function [24–27]. The risk of SMP has been reported to be as high as 58%, especially when the membrane is thin or when bone septae are present [31, 32]. The most common factor that can cause SMP is the use of excessive force upon elevation of the sinus membrane [33] or the inadequate reflection or release of the periphery [29]. Anatomic variations can also increase the risk of SMP [30]. These

anatomic variations associated with the risk of SMP are as follows: thin sinus membrane (28%), presence of septae (22%), membrane adhesion (17%), previous surgery (17%), presence of scar tissue(11%), and presence of cysts (5%) [11].

4.4. Repair

In SMPs smaller than 5 mm, the perforation can usually be closed by applying a direct suture, covering it with a collagen membrane or fibrin tissue sealant [34–36]. Larger perforations require application of other techniques. Various methods have been used [35–40]. Some recommend to abort the procedure and postpone it for 6 to 9 months to let the membrane heal [41]. In contrast, others believe that the perforation can be managed efficiently using biomaterials and grafts placed at the same time of repair [42]. Shin and Sohn [43] repaired SMPs using fibrin adhesive and implant placement. These were only for small perforations and not medium or large perforations. Pikos [27] offered a method for the repair of sinus perforations. He created four notches in four corners of the membrane, adapted it to the cavity, and used a tack to stabilize it. Testori et al. [32] introduced a method for repair of large SMPs. They used a few stitches on the sinus wall and created a strut for placement. However, a membrane was not attached to these sutures, and the stitches only worked as a strut. In general, suturing the two edges of the perforated membrane inside the sinus or keeping them close to each other for use of fibrin adhesive is not an easy task. In contrast, fixing the perforated membrane to the bone is simple.

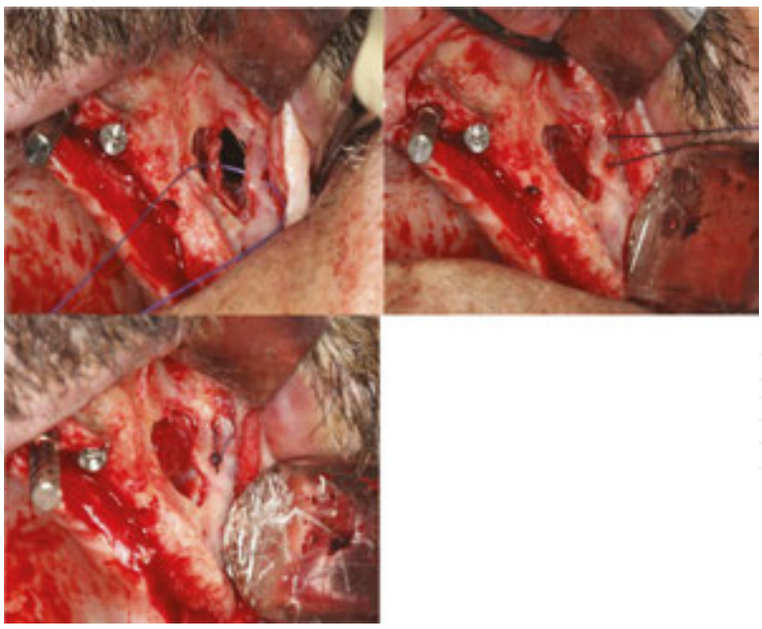

Figure 10. The suture enters through the first hole from the outside, towards the inside of the cavity and traverses the sinus membrane. The suture exits through the second hole. After tension is applied, the membrane is pulled adjacent to the bone.

The suture is tied and the knot is tightened on the external sinus wall. The perforation is completely closed. The perforated membrane will be fixed to the bony sinus wall. In our study,

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14 patients in whom perforations of maxillary sinus membrane developed and who were treated using our technique were assessed; perforations developed after sinus lifting in 10 patients, after the removal of impactions in 3 patients, and after cyst removal in 1 patient. There were six perforation sites on the apical part of the window (class I), six on the lateral part (class II), and two within the window extension (class III). Patients were followed for an average of 13.7 months (range, 12–18 months). All were treated and complications were minor.

5. Conclusion

Our technique is an easy, feasible, and predictable technique that helps the surgeon easily manage SMP during sinus lifting. Other operations not related to implant placement might also be associated with this complication. In such situations, it is necessary to use a simple applicable method for management. Using the double-hole bone fixation technique allows for safe repair.

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