Chapter 25

Management of Bone Grafting Complications in Advanced Implant Surgery

Mehdi Sezavar, Vahid Mesgarzadeh,
Shahrouz Shafayifard and M. Reza Soleimanpour

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/59967

1. Introduction

1.1. The perfect bone graft

In spite of the fact that the bone materials that are currently being used are not absolutely perfect,the bone graft material of choice must have 2 mandatory features:

1. Immunologically neutral
2. Physiologically safe

In an immunological point of view, the graft should neither be rejected nor be contaminated to transmit microbial diseases. The graft should be biologically compatible, preferably resorbed after formation of new bone, though supplying a scaffold and sustaining mechanical stability for new bone regeneration. In a physiological point of view, a perfect bone graft substance should support the host osteogenically,osteoinductively and osteoconductively.

2. Biosafety of bone grafting material

Contagious substances should be absent in an ideal biocompatible bone grafting material. Carbonate, Calcium phosphate and Sulfate bone graft materials are typically biocompatible with no risk of being rejected by the host. Virus, Prion and bacterial contamination of bone grafting materials are not of our concern in autogenous or alloplastic bone grafts. The prevalence of HIV infection in freeze-dried bone and demineralized freeze-dried bone allografts has been reported to be 1 in 8,000,000 and 1 in 2.800.000 respectively. The prevalence of bovine

spongiform encephalopathy transmission with bovine xenograft reckoned to be less than that of being hit by lightning.

Thus, the risk of disease transmission from an allograft or xenograft is almost zero as long as the disinfection/sterilization protocols are followed by manufacturers. The world health organization affirmed that bone is classified as type IV (no transmission) for prion diseases. Therefore all currently available bone graft materials are secure and reliable concerning disease transmission potential.

3. Bone grafting drawbacks

3.1. Preservation of the alveolar socket

Socket preservation procedure serves to maintain the alveolar bone existing volume including height and width by delivering graft materials into the alveolar socket after extraction and to enhance new bone formation inside the socket. Various techniques and materials have been applied and so far they have shown favorable results. Complications may either be caused by surgical procedures or treatment planning. Excessive amounts of graft should be avoided. Graft materials should gently be compacted keeping adequate between its particles to allow revascularization and penetration of proteins and growth factors. Furthermore the flap design has to be considered regarding the augmentation site specially in critical sites such as esthetic zone. Park and Wang introduced the mucogingival pouch flap design to preserve the papil-la,improve graft retention and reduce exposure of the membrane. However in case that the interdental space is less than 6mm, the mucogingival pouch flap may threaten the overall blood supply of the flap caused by the vertical releasing incision. Thus wise treatment planning is needed to avoid possible complications. Disappearance and contamination of the grafts placed inside the dental socket may be expectable. Membranes used for GBR also strengthen the risk of exposure and infection. Froum evaluated the healing of sockets underwent preservation using hydroxyapatite and nonabsorbable inorganic bovine bone mineral covered by either ePTFE membrane or acellular dermal matrix allograft. Having not adequately covered the socket with soft tissue, 1 of 8 sockets covered by acellular dermal matrix and 6 of 8 sockets covered by ePTFE exhibited exposure of membranes which consequently led to early removal of the membranes because of potential infection. Reduction of facial facial keratinized tissue followed by primary closure itself can be considered as a complication. Though this can be avoided by wise treatment planning and allowing the socket to heal for 6 to 8 weeks in advance before grafting. Recently formed keratinized tissue growing over the dental socket will provide adequate coverage without giving away the facial width.

3.2. Guided bone regeneration or ridge augmentation

Guided bone regeneration (GBR) was proved to be effective in regenerating new bone on alveolar ridges with atrophies both vertically and horizontally accompanied with membranes. Much the same as onlay bone graft which also acts as a space maintainer, GBR may serve similar complications related to the use of onlay grafts. Furthermore, GBR may also include

http://dx.doi.org/10.5772/59967

the use of membrane and sometimes microscrews. Thus, complications that pertain to GBR may vary such as membrane exposure, microscrew exposure and infection. Critical inflammatory reactions have also been recorded. The prevalence of flap sloughing associated with nonabsorbable membranes was high. Exposure of fixation screw or membrane may often lead to local inflammations accompanied with decreased new bone formation. There have been arguments over the significance of early membrane exposure on regenerative outcome of guided tissue regeneration and GBR operations. Several studies have reported that the responses were better when the membranes remained submerged while some other studies cast doubt on this issue.

3.3. Monocortical onlay grafts

Complications with regard to ridge augmentation using the onlay bone grafts mainly include infection, opening of the incision line, bone fracture, Nerve malfunction, rupture of mucosa over the implant, loss of portion of the bone graft, dehiscence of the wound and graft movement. While the most common complication is the incision line opening that leads to contamination of graft, delay in vascularization and loss of graft material, the most deleterious outcome on survival of implants in the augmentation site is related to wound dehiscence.The prevalence of unintentional skin/mucosa perforation was 5.2% for mandible as augmentation site with onlay bone graft and the incidence for infection occurred in 1 of the 11 patients(9.1%) that resulted in partial loss of graft. Infection of the graft can be caused by endogenous bacteria, deprived aseptic surgical technique or inadequacy of primary closure. Antibiotics were used to prevent bacterial infection and to enhance collagen formation. However it was found that tetracycline arrests the bone formation chelating calcium at the graft. Thus, other antibiotics such as penicillin or clindamycin have been suggested.

3.4. Sinus lifting

Sinus lifting procedure is performed when there is insufficient height for implant placement by lifting the Schneiderian membrane apically with bone grafting materials at the posterior maxillary edentulous ridge. Perforation of the Schneiderian membrane, opening of the incision line, sinusitis, formation of cysts, misplacement of graft particles and mucosal dehiscence are complications with regard to sinus lift procedures. Perforation of sinus membrane can either be pre existing or be caused by tearing during the operation and its prevalence has been reported ranging from 10% to 34%. Sinus perforation can be managed using an absorbable membrane. Pathologic conditions affiliated with paranasal sinuses are very prevalent. More than 31 million people around the world suffer from sinusitis each year. The infection of sinus may potentially cause critical complications such as sinusitis, orbital cellulitis, meningitis, cavernous sinus thrombosis and osteomyelitis. The incidence of acute sinusitis is reported to be around 3%. Moreover sinusitis may result in more complicated situations. Loss of bone graft particles and sequestrae is not prevalent but possible. Failure of Branemark implants at the grafted sites after a mean period of 32 months was 6.7%. A comprehensive pre operative assessment is important to detect any existing pathologic condition in maxillary sinus. This surely can reduce the risk of mucus and bacterial infection in the surgical field and compromising bone healing. Moreover due to vicinity of the maxillary sinus to vital structures such as brain, cavernous sinus, etc, post-operative complications can be critical and life threatening.

4. Etiologies related with bone grafting complications

4.1. Technique associated

Precautions have to be taken while harvesting bone from the ramus when the inferior cut is below the inferior alveolar canal. Elevation of the bone graft should be avoided unless assured that the nerve is not attached to the inside surface of the bone graft. As the thickest area of the ramus is 12.23 mm and the thinnest area is 2.35mm, the thickness of bone graft will not be homogenous. About 60% of the inferor alveolar canals were reported to be notched to the inner surface of the mandibular cortical plate or the third molar root surface. Thus it is recommended that whie performing the osteotomy, after 2 mm of penetration great care be taken with the surgical bur short before reaching cancellous bone to avoid damaging the inferior alveolar nerve. The mean thickness of the lateral cortical wall of the maxillary sinus has been reported to be 0.91±0.43 mm. Cautious removal of the bone with surgical bur while performing the sinus lift procedure is crucial in preservation of sinus membrane integrity. A recently developed piezoelectric ultrasonic surgical device(piezotome, Acteon, Bordeaux, France) presents an alternative way to safely remove hard tissue keeping the soft tissue intact,is an effective tool for sinus lift procedures as well as harvesting autogenous bone from the ramus. Attaching an onlay bone graft to the host site can affect revascularization of a graft. A loose graft may develop nonunion and become compressed and encapsulated. To ensure close adaptation, the fixation screws should be tightened. Contamination is usually an outcome of poor infection control during the surgery. Rinsing with chlorhexidine before surgery is recommended before the surgery on order to reduce the risk of infection. A study showed that infections were more prevalent when using nonresorbable membranes for GBR comparing with the use of bioabsorbable membranes over a bovine bone xenograft. A suitable membrane and proper membrane removal timing may be effective in reduction of the risk of infection. To prevent exposure of membrane or fixation microscrews, tension free flap is mandatory.

4.2. Anatomy related

Ramus

Complications with regard to harvesting bone from the ramus may include damage to the nerve, opening of the incision line, fracture of the mandible and trismus. The prevalence of nerve damage caused by harvesting autogenous bone from the ramus is far less comparing to that of the mandibular symphysis. Buccal nerve damage followed by incision along the external oblique ridge is expectable. Nevertheless rarely are any reports present with regard to the incidence of buccal mucosa sensory loss and patients do not often pay attention to the change. On the contrary in this procedure, the potential of injuring the inferior alveolar nerve is of great consideration. A great understanding of the local normal anatomy is required to prevent such complications. Trismus may also be experienced by the patient underwent bone harvesting from the ramus area because of the masseter muscle retraction. But the symptom is not permanent. Furthermore, other complications related to ramus harvesting procedure may consist of third molar involvement and mandibular fracture ; though not reported.

http://dx.doi.org/10.5772/59967

Mandibular symphysis

Associated with mandibular symphysis/chin graft, complications such as insufficient bone regeneration, altered sensation, nerve damage, pulp necrosis, vascular damage, opening of the incision line and bone fracture may occur. Incomplete bone regeneration was found more prevalent in old patients. Nevertheless, it was reported that the change in profile was not obvious. Change in sensation of mandibular anterior incisors after loss of support of the mentalis muscle was reported. The manifestation of dullness usually resolved within 6 months. A high incidence of anterior mandibular incisors pulp necrosis was reported. Negative pulpal reaction and canal obliteration may be caused by damage to pulp vasculature. There have been reports on prevalence of nonvital teeth after genioplasty or subapical osteotomy. An effective preventive way is to keep about 4 to 5 mm clearance from the root apices and avoidance of harvesting bone close to them. Patients should also be informed about possible disturbances that may occur in the function of the inferior alveolar nerve which may last longer than 12 months. Damage to incisal branch of the inferior alveolar nerve is expectable if the graft is harvested too deep into the cancellous bone. Similarly mental nerve damage may occur if the graft is harvested too distally. Fracture and posterior displacement of the lingual cortical plate of the anterior mandible was reported as a specific complication which occurred during the healing phase but not at the time of surgery. On the whole, careful measurement and assessment before the surgery are required to avoid facing most of the complications.

Maxillary tuberosity

Precaution has to be taken with regard to the adjacent anatomical elements such as the maxillary sinus, pterygoid plates, proximal teeth and the greater palatine canal when using the maxillary tuberosity as harvesting site. Although rare, oral-antral communication may occur when harvesting bone which can be closed using the buccal fat flap as coverage, antibiotics and decongestants. Bleeding and tethering of the lateral and medial pterygoid muscles has been reported to be a potential complication when the tuberosity was fractured.

4.3. Patient related

Systemic issues affecting bone grafting include smoking, diabetes, alcoholism, radiation, osteoporosis and medication.

4.3.1. Bisphosphonates

An inorganic analog of pyrophosphate, Bisphosphonate has recently been used to treat osteoporosis or bone metastatic malignancies by reduction of osteoclastic differentiation and induction of osteoclastic apoptosis. Bisphosphonate lets remodeling spaces be filled with new bone by its anti-osteoclastic effect and as a result, abates the prevalence of fractures and also increases the bone strength. Nevertheless, it was also found that not only does the bisphosphonate suppress bone turnover but also interacts with micro-damage repair mechanism of bone. The accumulation of the micro-damage reduces the strength of the bone resistance against traumas. Furthermore, another drawback of the bisphophonate is that it decreases vascularity in regenerative connective tissue. It was found that IV use of bisphosphonate in metastatic

malignancies may contribute to osteonecrosis of the jaw. However the relationship between osteonecrosis and use of bisphosphonate has not yet been recognized. Bisphosphonate related osteonecrosis appears to be multifactorial. The susceptibility of osteonecrosis in patients underwent IV bisphosphonate therapy for cancer was four times more than others. For patients who receive IV bisphosphonate, aggressive dental procedures should be avoided due to risk of jaw osteonecrosis. With insufficient research documents, guided regeneration and bone grafts should be applied with great caution (see Dental management of patients receiving oral bisphosphonate therapy, expert panel recommendations, report of the council on scientific affairs, ADA, June 2006)as reduced integrity of the bone and decreased vascularity may have negative drawbacks on grafted site. The incidence of osteonecrosis caused by oral administration of bisphosphonate is considered to be very low among the most common alendronates prescribed. Thus, patients underwent IV bisphophonate therapy are contraindicated for advanced surgical operations. This includes but not limited to implant placement, dental extraction and periodontal procedures. Latterly, suggested that dentist should discuss the risks, benefits and alternative treatments with the patients underwent bisphosphonate therapy before any surgical procedures. Before starting the treatment, the discussion and the patient informed approval should be documented.

4.3.2. Smoking

Almost 75% of the patients referred to periodontists were either current tobacco users or claimed previous use of tobacco. It was reported that smoking has negative effects on revascularization of the bone regenerative treatments such as bone grafting, majorly because of its vasoconstriction effect on arteries. Retardation of graft integration is caused as a consequent of decreased blood supply. The rate of infection caused by smoking-induced change in oral flora is 2 to 3 times more in smokers contributing to negative effects on complications of periodontal procedures, including bone grafting. Levin and Schwartz-Arad reported that nicotine, carbon monoxide and hydrogen cynide from smoking are possible risk factors that result in weakened wound healing. This consequently threatens the success of bone grafting and implant surgeries. Notwithstanding the cigarettes smoked, a patient with a smoking history, presented higher rate of failure of implants placed in grafted maxillary sinus. Smoking has negative influences on onlay grafts. While nonsmokers presented only 23.1% rate of complications in monocortical onlay grafts,smokers had a 50% rate. Nevertheless no relations were found in this article between sinus lift procedure complications and smoking tendency. Surprisingly failure rate in maxillary bone was 1.6 times more than that of mandible undergoing the same periodontal procedure showing that the maxilla was more prone to negative reactions of tobacco. Furthermore bone grafting procedures are negatively affected by use of tobacco with bone loss of 4 times as much as in nonsmokers. Such bone loss was majorly a consequent of estrogens suppression caused by over expression of interleukin-1, interleukin-6 and tumor necrotising factor(TNF)-α. Quitting smoking has been shown to decrease the progression of periodontal diseases and contribute the healing process of the bone graft.

4.3.3. Diabetes

Diabetes is able to enhance expression of TNF-α which has been blamed to be responsible for apoptosis of osteoblasts and their precursors. This enhanced apoptosis is considered to be

influential to the bone healing process. cellular malfunctions such as prolonged infiltration of inflammatory cells, decreased production of growth factors and cell synthesis and increased proteolytic activities are all assumed to be blamed for delayed healing and failure of bone grafts. Osteopenia and delayed bone healing are both characteristics of diabetic bone disease. Moreover, recurrent nonenzymatic protein glycation contributes to formation of advanced glycation end product(AGE) that can be accumulated in different tissues such as bone. Further alveolar bone loss can occur followed by accumulation of AGE.

4.3.4. Radiation

Osteopenia may be experienced, after one yearin mature patients underwent head and neck radiotherapy. Osteoblasts activities may be diminished by radiation and results in decrease of bone matrix. Moreover, following long-term vascular damage caused by radiotherapy, osteonecrosis might happen. Due to poor blood supply and superficial location of mandible, most cases of head and neck radionecrosis were found in that area. Weakened areas of the bone are more susceptible to fracture. However, Despite the drawbacks mentioned above, one study reported that bone grafting in radiated bone tissues showed a survival rate of 89%. Another study reported that the prevalence of post-radiotherapy operative complications was 42%, while bone grafting procedures in nonirradiated sites had a 28% complication rate.

4.3.5. Alcoholism

The use of alcohol is shown to have adverse impact on intraoral bone grafting operations by increasing osteoclast activities and weakening oseoblast proliferation. An animal study reported that alcoholic beverages caused considerable delay in reparative process of alveolus. Another study demonstrated that use of ethanol led to suppression of bone turnover and provoked bone resorption. Other negative effects on bone grafting procedures attributed to the use of alcohol may be ascribed to possible direct toxic effect of ethanol in periodontal structures and other elements in oropharynx. Even a higher rate of complication in surgical procedures of the mandible was presented by patients consuming large amounts of alcohol when combined with other predisposing factors such as poor nutrition. Thus, it has been suggested that quitting ethanol consumption should be applied a few weeks before aggressive dental operations to minimize complications.

5. Complications of autogenous bone grafting

The use of autogenous bone graft with dental implants was originally discussed by Branemark.

5.1. Maxillary tuberosity bone graft

The major complication with maxillary tuberosity graft harvesting is oroantral communication. Grafts may be harvested with a chisel or rongeurs. The chisel edge should be kept slightly superficial to the maxilla to shave off pieces of tuberosity bone and prevent inadvertent sinus communication.

5.2. Mandibular symphysis bone graft

A CT scan or panoramic radiograph is used to evaluate the available bone at this donor site. Lateral cephalometric radiograph can be useful to determine the anteroposterior dimension of the anterior mandible. A vestibular incision is made in the mucosa between the cuspid teeth. Limiting the distal extent of the incision will reduce the risk of mental nerve injury. The mandibular symphysis is associated with a higher incidence of postoperative complications. Incidence of temporary mental nerve paresthesia for symphysis graft patients is usually low. Ptosis of the chin has not occurred and can be prevented by avoiding complete degloving of the mandible.

5.3. Mandibular ramus

The limits of the ramus area are dictated by clinical access. After graft preparation, the donor site is not augmented with bone substitutes because the inferior alveolar nerve may be exposed and irritated by the graft particles. The potential for damage to the IAN, as opposed to its peripheral mental branches is of greater concern with the ramus graft technique. Patients may experience trismus following surgery and should be placed on postoperative glucocorticoids and NSAIDs medications to help reduce dysfunction.

5.4. Tibia

There has been a low reported incidence of significant complications with this procedure. Complications may include hematoma formation, wound dehiscence, infection and fracture. The patient should avoid strenuous exercise for 4 to 6 weeks. Although quite rare most cases of tibia fracture are due to a bony access too low on the leg.

5.5. Ilium

The grafting of larger areas of bone deficiency often requires bone harvesting from the ilium. The crestal incision is made about 2cm below the anterior superior iliac spine and extending caudally 4 to 5 cm. Care is taken not to cut through the external oblique or gluteal muscles during this incision because this increases postoperative discomfort and slows ambulation. All bleeding from the marrow is controlled with small amounts of bone wax or collagen hemostatic. The patient is advised to avoid any lifting or twisting for the next 6 weeks to preclude hip fracture. The use of a pain pump with long acting local anesthetics has dramatically reduced the level of postoperative pain from the hip area.

5.6. Rib graft

The preferred donor ribs are the fourth and fifth ribs. The fifth rib is superior to the fourth in growing female patients. A major complication in rib harvesting is pleural perforation. In this case a chest tube catheter is inserted in to the area of pleural compromise to a length of approximately 1 to 2 cm; with the red rubber catheter in position, a purse string suture is placed to fix the tube which should be attached to a chest tube bottle. For small perforations the anesthesiologist provides positive pressure and maintains this position while a surgical knot

http://dx.doi.org/10.5772/59967

is tightened. All patients having costochondral or rib harvests require a postoperative chest radiograph performed and clinical inspection for pneumothorax. If a pneumothorax is noted a chest tube may be placed.

5.7. Cranial bone

Cranial bone just superior and posterior to the temporal crest is generally quite thick and accidental full thickness harvest and or dural perforation is minimized. An incision is made beginning 1cm inferior to superior temporal line to avoid main arterial trunks of the superficial temporal and posterior auricular arteries thus reducing bleeding; the parietal bone, which is flat and also quite thick as compared with other areas of the cranium.

5.8. Grafting recipient sites

The bone graft should have intimate contact with underlying host bone. Following harvest, the bone graft may be stored in sterile saline. The graft is mortised into position and fixated to the ridge with screws. Complete flap coverage and tension free closure is essential to the successful incorporation of the bone graft. After the periosteal releasing incision is made, the flap is gently stretched to assess closure without tension. Although it is important that the flap margins are well approximated, the sutures should not be pulled too tightly or ischemia will occur. It is imperative that the graft is immobilized during healing postoperatively. The patient should continue antibiotic therapy for at least 1 week. Smoking has been associated with a high rate of wound dehiscence and graft failure. Cholorhexidine rinsing is used for oral hygiene until the sutures are removed.

6. Complications of inferior alveolar nerve repositioning

Nerve mobilization procedures are precise methods that require clinical experience, knowledge of anatomy, and the ability to intervene in the event of potential accidents and/or complications. [1] In the last few years, IAN repositioning has been used widely as an alternative to short implants or bone grafts for osseointegrated implant placement in the posterior mandible of patients who do not have sufficient bone height for conventional treatment. Among the advantages of IAN repositioning is the option to use standard implants with bicortical anchorage, increasing primary stability, which is essential in the osseointegration process. Osseointegrated implants placed in combination with IAN repositioning present a lower risk of bone loss than short implants when both are placed in similar circumstances. [2] For clinical situations with less than the minimum height for short implants (5 mm), IAN repositioning is the technique indicated. [3] This procedure also increases the resistance to occlusal forces and promotes a good proportion between implant and prosthesis. [4] Compared to the option of performing a graft to allow placement of standard implants, in addition to the lower cost, IAN repositioning can be performed under local anesthetic, does not require a donor site, and has a lower morbidity rate. [5, 6]

IAN repositioning also presents many disadvantages. The technique does not recover the alveolar ridge anatomy and temporarily weakens the mandible. Mandibular fractures associated with endosseous implants have been documented and are generally related to high levels of resorption in edentulous mandibles. Also, nerve mobilization leads to many factors that can increase the occurrence of fractures. [7, 9] A large portion of the buccal cortex is removed, reducing the structural integrity of a region that is under constant stress during chewing. [8] In addition to that, sites that have been prepared and subsequently abandoned due to bad angulation or insufficient initial stability are areas of bone fragility susceptible to fracture. [7] Poor nutrition as a consequence of blood perfusion changes associated with this nerve mobilization can also be a cause of fracture. [10] Another disadvantage of IAN repositioning is the risk of nerve damage. The duration and degree of neurosensory disturbance has been related directly to the amount of compression and tension applied to the nerve during the procedure, [11] or to chronic distension/compression of the nerve after the surgery. [12] Hypoesthesia, paresthesia, and hyperesthesia are the most common complications. [13]

The success rate of the lateralization procedure, regarding the osseointegration process, varies from 93.8% to 100%, and thus both patients and surgeons believe this to be a safe procedure; however, a small percentage of patients will have nerve damage for the rest of their lives. [14] Concerning the use of materials as barriers between the implant and nerve, there is controversy in the literature, because while some authors consider the use of resorbable membranes to be helpful, [4] others have observed faster healing of the bone wound without barriers, followed by the restoration of the mandibular canal. [15] One advancement is the utilization of piezoelectric devices, which allow the surgeon to perform the osteotomy without damaging soft tissue, because piezoelectric devices only affect mineralized tissues. In vitro tests have shown a lower risk of injury when piezoelectric devices are used compared to conventional rotary devices. [16]

7. Complications of sinus lifting

A variety of complications can happen during and after sinus lifting. As all the other surgical techniques, this procedure is prone to all common complications of oral surgery but in this chapter we will focus on complications of this procedure.

7.1. Membrane perforations

The most common complication during sinus graft surgery is tearing of the sinus membrane. Causes of this condition include: Pre-existing perforations, tearing during scoring of the lateral wall window, existing or previous pathologic condition, and elevating of the membrane from the bony walls. This complications occurs about 10% to 34% of the time. The perforation of the sinus membrane should be sealed to prevent contamination of the graft from the mucus and the contents of the sinus and to prevent the graft materials from extruding into the sinus proper. The surgical correction of a perforation is initiated by elevating the sinus mucosal regions distal from the opening. Once the tissues are elevated away from the opening, the membrane

http://dx.doi.org/10.5772/59967

elevation with a sinus curette should approach the tear from all sides so that the torn region may be elevated without increasing the opening size. The antral membrane elevation technique decreases the overall size of the antrum, thus folding the membrane over itself and resulting in closure of the perforation.

If the sinus membrane tear is larger than 6 mm and cannot be closed off with the circumelevation approach, then a resorbable collagen membrane, but of a longer resorption cycle, may be used to seal the opening. The remaining sinus mucosa is first elevated as described previously. A piece of collagen matrix is to cut to cover sinus tear opening and overlap the margins more than 5 millimeters. Because no antibiotic is used on the collagen to make this procedure easier to perform, additional antibiotic is added to the graft material. Once the opening is sealed, the sinus graft procedure maybe completed in the routine fashion. A sinus perforation may cause an increased risk of short-term complications. A torn membrane may increase the risk of bacterial penetration into the graft material. Furthermore, mucus may violate the graft influencing the amount of bone formation. Drip of the graft material into the sinus proper may occur as a result of torn membrane, travel to and through the ostium and either be abolished through the nose or block the ostium and prevent normal sinus drainage. Ostium obstruction is also possible from swelling of the membrane related to the surgery. These conditions increase the risk of infection. However, despite these potential complications, the risk of infection is low (less than 5%)

7.2. Antral septa

Antral septa are the most common osseous anatomical variant seen in the maxillary sinus. Sinus septa may create added difficulty at the time of surgery. Maxillary septa can prevent adequate access and visualization to the sinus floor; therefore inadequate or incomplete sinus grafting is possible. These dense projections complicate the surgery in several ways. After scoring the lateral-access window in the usual fashion, the lateral-access window may not fracture and rotate into its medial position. The strut reinforcement is also more likely to tear the membrane during the releasing of the access window.

7.3. Management of septa based on location

The septa maybe in the anterior, middle, or distal partof the antrum. When the septum is found in the anterior section, the lateral access window is divided into sections: one in front of the septa and another distal to the structure. This permits the release of each section of the lateral wall after tapping with a blunt instrument. The elevation of each released section permits investigation into the exact location of the septa and to continue the mucosal elevation.

When the strut is located in the middle region of the sinus, it is more difficult to make two separate access windows within the direct vision of the surgeon. As a result, one access window is made in front of the septa. The sinus curette then proceeds up the anterior aspect of the web, towards its apex. The curette then slides toward the lateral wall and above the septum apex. The curette may slide over the crest of septum approximately 1 to 2 mm. A firm pulling action fractures the apex of the septum. Once the septum is separated off the floor, the curette may proceed more distal along the floor and walls.

When the septum is in the posterior compartment of the sinus, it is often distal to the last implant site. When this occurs, the posterior septum is treated through the posterior wall of the sinus.

8. Short-term postoperative complications

8.1. Incision line opening

Incision line opening is uncommon for this procedure because the crestal incision is in attached gingiva and at least 5 mm away from the lateral access window. Incision line opening occurs more commonly when lateral augmentation is performed at the same time as sinus graft surgery, or when implants are placed over above the residual crest and covered with the soft tissue. It may also occur when a soft tissue-supported prosthesis compresses the surgical area during function before suture removal. The consequences of the incision line opening are delayed healing, leaking of the graft material into the oral cavity, and increased risk of infection. However, if the incision line failure is not related to the lateral onlay graft and is only on the crest of the ridge and away from the sinus access window, then the posterior crestal area is allowed to heal by secondary intention. If incision line opening includes a portion of nonresorbable membrane, then the membrane should be cleaned at least twice daily with oral rinses of chlorhexidine. If the incision line does not close after two months, then a surgical procedure should reenter the site, expand the tissues, remove the bone regeneration membrane, and reapproximate the tissue.

8.2. Nerve impairment

In severely atrophic maxillas, the infra orbital neurovascular structures exiting the foramen may be close to the intraoral residual ridge and should be avoided when performing sinus graft procedures to minimize possible nerve impairment.

8.3. Acute maxillary sinus rhinosinusitis

Acute postoperative sinusitis occurs as a complication in approximately 3% to 20% of sinus graft procedures, and it represents the most common short term complication. Most often the infection begins more than 1 week after surgery.

Radiographic evaluation of acute rhinosinustis is both expensive and often inaccurate. As such, a patient history for acute sinusitis is a benefit and is diagnostic when two or more of the following factors are present: (1)facial congestion or fullness, (2)nasal obstruction or blockage, (3)nasal discharge, (4)purulence or discolored postnasal discharge, (5)facial pain or pressure, (6)hyposomia or anosomia, (7)purulence in the nares on physical examination, (8)fever, (9)headache, (10)halitosis, (11)dental pain, (12)cough, (13)ear pain.

Previous studies and treatment modalities used amoxicillin as the first drug of choice. However, with the increasing prevalence of penicillinase and beta-lactamase producing strains

of haemaphilus influenza and moraxells catarrhalis, along with penicillin-resistant strains of streptococcus pneumonia, other alternative antibiotic drugs should be selected. If symptoms are not alleviated with antibiotic and decongestant medications, then possible referral to the patient's physician or otolaryngologist is warranted.

8.4. Overfilling the sinus

The maximum length requirement of an implant with adequate surface of design is rarely more than 15 mm, and as a result, the goal of the initial sinus graft is to obtain at least 16mm of vertical bone from the crest of ridge. Overfilling the sinus can result in blockage of the ostium, especially if membrane inflammation or the presence of a thickened sinus mucosa exists. The majority of sinus graft overfills do not have postoperative complications. If, however, a postoperative sinus infection occurs without initial resolution, re-entry and removal of a portion of the graft and changing the antibiotic protocol may be appropriate. [17, 18]

Author details

Mehdi Sezavar*, Vahid Mesgarzadeh, Shahrouz Shafayifard and M. Reza Soleimanpour

*Address all correspondence to: m_s7605@yahoo.com

Department of Oral and Maxillofacial Surgery,Islamic Azad University,Dental branch, Tehran, Iran

References

[1] Babbush CA. Transpositioning and repositioning the inferior alveolar and mental nerves in conjunction with endosteal implant reconstruction. Periodontology 1998;17: 183–90.

[2] Vasco MA, Hecke MB, Bezzon OL. Analysis of short implants and lateralization of the inferior alveolar nerve with 2-stage dental implants by finite element method. J CraniofacSurg 2011;22:2064–71.

[3] Fernandez Dıaz J.O., Naval Gıas L. Rehabilitation of edentulous posterior atrophic mandible: inferior alveolar nerve lateralization by piezotome and immediate implant placement. Int J Oral MaxillofacSurg 2013;42:521–6.

[4] Sethi A. Inferior alveolar nerve repositioning in implant dentistry: a preliminary report. Int J Periodontics Restorative Dent 1995;15: 474–81.

[5] Rosenquist B. Fixture placement posterior to the mental foramen with transpositioning of the inferior alveolar nerve. Int J Oral Maxillofac Implants 1992;7:45–50.

[6] Dario LJ, English Jr R. Achieving implant reconstruction through bilateral mandibular nerve repositioning. J Am Dent Assoc 1994;125:305–9.

[7] Luna AH, Passeri LA, de Moraes M, Moreira RW. Endosseous implant placement in conjunction with inferior alveolar nerve trans-position: a report of an unusual complication and surgical management. Int J Oral Max-illofac Implants 2008;23:133–6.

[8] Karlis V, Bae RD, Glickman RS. Mandibular fracture as a complication of inferior alveolar nerve transposition and placement of endosseous implants: a case report. Implant Dent 2003;12:211–6.

[9] Kan JY, Lozada JL, Boyne PJ, Goodacre CJ, Rungcharassaeng K. Mandibular fracture after endosseous implant placement in con-junction with inferior alveolar nerve transposition: a patient treatment report. Int J Oral Maxillofac Implants 1997;12: 655–9.

[10] Bradley JC. The clinical significance of age changes in the vascular supply to the mandible. Int J Oral Surg 1981;10(Suppl. 1):71–6..

[11] Robinson PP. Observations on the recovery of sensation following inferior alveolar nerve injuries. Br J Oral MaxillofacSurg 1988;26:177–89.

[12] Nocini PF, De Santis D, Fracasso E, Zanette G. Clinical and electrophysiological assessment of inferior alveolar nerve function after lateral nerve transposition. Clin Oral Implants Res 1999;10:120–30.

[13] Sandstedt P, Sorensen S. Neurosensory disturbances of the trigeminal nerve: a long-term follow-up of traumatic injuries. J Oral MaxillofacSurg 1995;53:498–505.

[14] Hirsch JM, Bra°nemark PI. Fixture stability and nerve function after transposition and lateralization of the inferior alveolar nerve and fixture installation. Br J Oral MaxillofacSurg 1995;33:276–81.

[15] Yoshimoto M, Watanabe IS, Martins MT, Salles MB, Ten Eyck GR, Coelho PG. Microstructural and ultrastructural assessment of inferior alveolar nerve damage following nerve lateralization and implant placement: an experimental study in rabbits. Int J Oral Maxillofac Implants 2009; 24:859–65.

[16] Metzger MC, Bormann KH, Schoen R, Gell-rich NC, Schmelzeisen R. Inferior alveolar nerve transposition—an in vitro comparison between piezosurgery and conventional bur use. J Oral Implantol 2006;32:19–25

[17] Misch CE: Contemporary implant dentistry, 2008,third edition

[18] Lindhe J: Clinical periodontology and implant dentistry,2008, fifth edition

[19] Fonseca Raymond.J; Oral and Maxillofacial Surgery; 2009; Vol 1 Second Ed

[20] Epker Bruce; Dentofacial Deformities: Integrated Orthodontic and surgical correction; Volume III