Predictable Dental Implant Placement into Grafted Sinuses

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Introduction

In many patients, the edentulous posterior maxilla does not have enough vertical height to allow for implants to be placed without intruding the maxillary sinus. This scenario often creates a challenge to the clinician performing implant tooth replacement. Various techniques to treat the posterior sinus have been described.1,2

The classic lateral antrostomy pioneered by Tatum appears to be the most commonly utilized sinus lift procedure for the severely deficient posterior maxilla.3 The procedure consists of demarcating a window in the lateral maxillary sinus wall. With careful manipulation the sinus window is luxated or fractured inward and upward to form the “new” sinus floor, although some clinicians favor removal.4

Meticulous separation of the Schneiderian membrane from the inner wall of the sinus to avoid perforation is essential and can be accomplished with specific instruments. The newly formed space is then filled with a graft material and the surgical site is closed.

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Bone Grafting Materials

Bone substitute materials have played an important role in dentistry for many years. Today there exists a wide array of graft materials used either alone or in combination that can fill the elevations (4-5 mm) in height.5

Bone graft materials such as autogenous bone, allografts, xenografts or alloplasts have all been advocated for this procedure.6

Of the various bone augmentation materials available, allografts provide easily procured graft materials.5 Unlike autogenous bone, allografts do not contain live bone cells, but provide type I collagen, which is composed mostly of the organic component of bone.

All grafts contain BMPs, which help stimulate bone growth. These proteins, 13 of which have been identified so far (BMP1-13), are considered osteoinductive compounds.6 Osteoinductive materials encourage new bone formation by acting as a signaling agent in initiating and regulating specific tissue formation. This activity leads to a series of developmental processes that result in the differentiation of mesenchymal cells into osteoblasts.7

Materials and Methods

A total of 42 patients underwent sinus grafting procedures. Patients were treated if determined to have no contraindication for minor oral surgery with local anesthesia and/or conscious sedation. Both smokers and non-smokers were included in this study. A total of 56 sinuses were tabulated for these patients.

Each patient was given a complete hard and soft tissue exam, periodontal evaluation and oral examination as indicated. The sinus area was evaluated carefully for mucosal thickening, polyp formation and the presence on any septum (Fig. 1). Diagnostic study models and photographs were obtained pre-operatively as required.

Patients were administered pre-operative surgical antibiotic prophylaxis (amoxicillin 2 g by mouth 1 hour pre-op, or clindamycin 600 mg by mouth 1 hour pre-op, followed by 1 week postoperative three times per day coverage) and corticosteroid therapy pre-operatively (Medrol® Dose Pack, dispense once pack and follow pack instructions) began on the morning of surgery.

Patients were scheduled for sinus grafting with local anesthesia with or without conscious sedation. 0.5% bupivacaine with 1:200,000 epinephrine or 2% lidocaine with epinephrine 1:100,000 (Cook-Waite, Abbott Labs North Chicago, IL) was administered via infiltration and greater palatine nerve blocks.

A full thickness mucoperiosteal flap was elevated with an incision over the crest of the ridge and vertical releasing incisions were made anterior and posterior to the sinus cavity.

The sinus area was located and a lateral window osteotomy was outlined with an 8-round bur. The bony plate was fractured and the sinus mucosa was carefully elevated (Fig. 2).

The sinuses were then carefully filled with cancellous mineralized bone allograft material 1-2 mm particle size (Puros® Tutogen) (Fig. 3). Larger sinus cavities were grafted with a mixture of Puros and resorbable HA (Osteogen® Implant or Osteograft® N-300 Ceramed).

A collagen membrane (BioMed®, Zimmer Dental, Inc.) was placed over the lateral window prior to closure to produce a “caging effect” (ref105). Closure was made with 3-0 or 4-0 silk, chromic gut, or Vicryl® (Ethicon, Inc. Piscataway, NJ) sutures.

The patients were given postoperative instructions. Prescriptions for 500 mg amoxicillin 3-times daily for 5 days (clindamycin 150 mg for those allergic to amoxicillin) and analgesics for 3 days (oxycodone 5 mg/325 acetaminophen every 4 hours as necessary).
were given to the patients. Sinuses grafted were allowed to heal for 4–6 months, depending upon the size of the area grafted.

Grafted sinuses were evaluated radiographically several months post surgically (Fig. 4). After the patients were given local anesthesia, a full thickness periosteal flap was elevated. The sinus windows were evaluated for the density of bone, and surgical rotary instruments were utilized with or without osteotomes (Salvin Dental, Charlotte, NC) to prepare the osteotomy sites for implant surgery.

Dental implants were placed in proper tooth positions with or without a surgical stent. The implants were submerged in a standard two-stage surgical protocol for patients wearing a removable prosthesis and in a single-stage surgical procedure for others (Fig. 5).

Implants were allowed to heal for 3–6 months, after which radiographs were taken and implant exposure was performed. Hand reverse torque of the implant was applied to implants prior to abutment placement. Implants were then restored with either fixed, cementable porcelain fused to metal prosthesis or screw-retained bar overdentures (Fig. 6).

**Results**

The ages of the patients ranged from 26 years old to 77 years old. The greatest number of patients was between ages 51 to 60. Of all the patients involved, the 51–60 age group was highest for males, and the 61–70 age group were highest for females (Chart 1).

Analysis of the patients revealed that a total of 42 patients were treated with sinus graft surgery. A total of 56 sinuses were grafted with mineralized bone allograft over a 36-month period. Most of the patients had slight to moderate postoperative pain and swelling after surgery. Some patients mentioned bruising a few days postoperatively.

Postoperative follow-up visits revealed most surgical sites healing well over a 1 to 2 week.
 period. One sinus graft complication occurred when a patient in this group presented with an infection two weeks postoperatively. The patient was placed on amoxicillin/clavulanate pills of 875 mg two times per day for 10 days and healed uneventfully. Following a 4- to 6-month healing period, grafted sites deemed to be implant surgical sites were re-entered via a full thickness mucoperiosteal flap. Examination of the lateral windows grafted appeared to be bony hard in consistency. The grafted sites were not penetrable with the periosteal elevator. 136 Tapered Screw Vent® implants were placed into 52 grafted sinuses. Of the 136 implants placed, all were uncovered and restored to date, except for 3 implants, making a total of 133 restored implants.

Loading with either a fixed prosthetic restoration or bar over-dentures was performed over a 4- to 6-month period. A total of 3 implants were considered failures. The remaining 133 implants showed good soft tissue anatomy that was clinically acceptable. Radiographic examination of all remaining implants did not show any peri-implant radiolucency. The total failure rate was concluded to be 2.3%. A total implant success rate of 97.7% was established (Chart 3).

Discussion

Patients often need to be evaluated for the amount of bone in the posterior maxilla. The posterior maxilla often presents a challenge to the implant dentist due to inadequate bone volume from the crest of the bone to the floor of the maxillary sinus. Unpredictable bone loss can occur after tooth extraction, particularly if there is an existing bony defect or radiolucency present. Early tooth loss often leads to pneumatized sinuses. The lack of bone in the posterior maxilla is a challenge to the clinician needing to place dental implants.

Many techniques have been advocated for treating the posterior maxilla including subperiosteal implants,14 zygomatic implants,15 osteotomy sinus elevation (Summer’s Technique) and hydraulic sinus condensation.16

The lateral window osteotomy technique, as first described by Tatum, is a highly predictable method to induce bone augmentation material to the elevated sinus floor. Although many augmentation materials have been described in the literature, there is always the risk that any material may not mature into living bone. Although alloplastic materials are plentiful and inexpensive, concerns arise as to their predictability in achieving bone replacement prior to implant placement. Oftentimes fibrous connective tissue encapsulation of the residual graft particles occurs, which can delay or complicate dental implant placement.17 The use of human allograft has been long established as a good alternative to patient autogenous grafting since it avoids the need for bone grafting from other sites. Allogenic bone allograft into the grafted site, which allows the surgeon to place implants in a conventional manner. The cases in which resorbable HA was mixed with mineralized allograft did not appear to have any different clinical healing. Upon reentry for dental implant surgery, the material generally appeared hard and resistant to periosteal probing on the lateral wall preparation. This material was clinically useful to develop bone volume prior to implant placement. The grafted sinus sites were sufficiently dense enough to withstand an osteotomy drilling procedure within a period of 4 to 6 months. The density of the bone was usually of D3 or D4 quality. Tapered shaped root form implants were placed in these patients to provide compression into immature bone for greater implant stability.

Following a 4- to 6-month healing period, examination of the lateral windows grafted appeared to have a bony hard consistency. 136 Tapered Screw Vent implants were placed into 52 grafted sinuses. Of the 136 implants placed, all were uncovered and restored to date, except for 3 implants, making a total of 133 restored implants. The total failure rate was concluded to be 2.3%. A total implant success rate was 97.7% was established (Chart 3).

The implants placed in this study ranged from 27 months.
to 54 months post implant placement. Although this is a short time frame for statistically meaningful survival rate follow-up, the graft material appears to be beneficial in creating new bone to allow for successful implant placement.

Conclusion
In many patients, the edentulous posterior maxilla does not have enough vertical height to allow for implants to be placed without intruding on the maxillary sinus. Given the available scientific literature about bone grafting materials, there are many different bone grafting materials available to the implant dentist.

Mineralized bone allograft (Puros) alone or mixed with resorbable HA (Osteogen or PUROS) alone or mixed with mineralized bone allograft materials. A total of 56 sinuses were grafted with mineralized human allograft (Puros (R)) and 136 mineralized bone allograft placed into lateral window si-

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Among the over seven hundred attendees there were some VIPs to be mentioned in particular: Chen, Xiaohong vice minister of the China Ministry of Health, Yang, Jing, vice-chairman of the Chinese Medical Doctor Association and Huang, Guoqiang, vice-secretary-general of the Shenzhen city council. Together with the distinguished experts in stomatology and specially invited guests as well as dental professionals from Taiwan, Hong Kong, Macao and overseas, the members celebrated the tenth anniversary of the CSA.

The welcome speech was addressed by prof. Zhang, Zhenkang, president of the CSA. Representing the national government and the Shenzhen city council respectively, vice-minister Chen Xiaohong and vice-secretary-general Huang Guoqiang gave their congratula-

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The secretary-general of the CSA Yan Jingfang gave the audiences a presentation titled “Sino-American dental development and innovation, a new era of the CSA”. He reviewed the work of the 2nd council. During CSA’s second administrative term, 72 academic congresses were held nation wide with over 18,000 participants. This year’s successful FDI congress marks one of the key moments. In addition, the association has also sent its members abroad for scientific exchange programs and international academic congresses. More than 9,000 people are present in 61 different international post-academic education programs, and that number rises to 12,000 for trainings inside China. With the support from the China State Council and China Ministry of Health, the CSA drafted out the “Authoritative guideline and standardization processes of oral health supplies” with the purpose to legalize and standardize the whole testing and registration system. The CSA owns one website, two internal journals for the members and three public academic journals. Furthermore, it provides technical support for 17 national scientific journals. As a professional association, the CSA has recently completed the “Diagnosis and operation protocols” for dental treatment. Numerous research projects have been carried out. The next step for the CSA is to establish a tele-education network which covers the whole country. Public oral health is another main concern of the CSA. Public oral health education, media presentations as well as oral health surveys are among the activities that the CSA holds for better dental health for the Chinese people.

The third administration has been elected by the CSA members. Prof. Wang Xing is the new presidents elect, Shi Xuzhen, Bian Zhan, Sun Zheng, Zhang Zhiyuan, Zhou Xuedong, Yu Guanyang, Zhao Yimin, Luan Wenmin and Huang Hongzhang as the vice presidents. M.S Wang Bo is made the secretary-general, Prof. Zhang Zhenkang, Qiu Weiliu, Fan Minhang and Wang Dazhang have earned their honor president title for their outstanding work for the Chinese dentistry.

Many high rank officials in the country sent their congratula-
tions to the CSA. Among them were: Mr. Han Qide, deputy chairman of the China State Council, president of the Chinese Scientific Association; Ms. Peng Peiyun, former deputy chairperson of the China State Council; Mr. Tian Jinyun, former vice-premier of China; Mr. Gao Qiang, minister of the China Ministry of Health; Mr. Zhong Nanshan, president of the Chinese Medical Association and Cao Ronggui, president of the Chinese Hospital Association.

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