Immediate Implantation of Endosseous Dental Implants in the Posterior Maxilla and Anatomic Advantages for This Region: A Case Report

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A procedure is presented whereby treatment planning for the long-term restoration of imminent loss of well-rooted posterior maxillary teeth by immediate endosseous dental implant placement may aid the patient in avoiding major surgical reconstruction. The clinical case report presented illustrates the advantages of an immediate dental implant placement technique that is especially relevant and unique to the posterior maxilla. Anatomic advantages are discussed. (INT J ORAL MAXILLOFAC IMPLANTS 1996;11:529-533)

Key words: immediate implant, maxillary molars, maxillary sinus, pneumatization

Once tooth loss has occurred, alveolar bone begins the process of remodeling and resorption. In the posterior maxilla, the process of ridge reduction is bidirectional. Alveolus resorption following tooth loss is compounded by a similar process on the sinus floor related to osteoclastic activity of the sinus membrane and the pneumatizing behavior of the sinus overlying the basal bone. The overall result is a rapid loss of bone volume and height of the alveolar ridge. Thus, only short-length implants are possible without surgical ridge reconstruction necessary for the placement of maximum-length implants. Short implants of less than 10 mm have been shown to be more likely to fail than longer implants, especially in the posterior maxillary region where the most common bone type is type IV.[1-5]

This unique situation creates a difficult restorative problem for rehabilitation of the posterior maxilla with fixed prostheses. Reconstructive surgery is required, either to recreate bone volume and height for the placement of long endosseous dental implants to support a fixed dental prosthesis, or for the utilization of the subperiosteal implant technique, which is very technique sensitive.

Reconstruction of posterior maxillary bone volume has been achieved by performing ridge augmentation procedures, onlay rib[6] and mandibular onlay grafts,[7] and Le Fort I osteotomies with interpositional bone grafting.[8] Some of these techniques have been found to be unpredictable for long-term retention of the graft.[9] However, the most important disadvantages of these techniques include the surgical trauma, hospitalization, and extended convalescent periods that are required when donor and recipient sites may be complicated by adverse healing, bleeding, infection, and postoperative trauma associated with major surgery. In addition, these extensive

procedures do not offer the patient a predictable result.

The technique known as sinus manipulation and bone augmentation is the least invasive and has low morbidity. This method is well documented[9-12] and, if performed within strict criteria, can offer predictable success rates. However, the technique is demanding and requires a high level of tactile and surgical skill, and it is an invasive surgical procedure that may impinge on vital structures with associated complications.[10] In addition, the condition of the schneiderian membrane must be healthy, which precludes many patients who have a compromised medical history of chronic rhinitis, sinusitis, upper respiratory infections, allergies, and heavy tobacco use. In these patients, the schneiderian membrane may have undergone irreversible changes that can jeopardize the success of any surgical grafting procedure. Such patients who have lost posterior maxillary teeth may find that restoration with fixed prostheses supported by endosseous implants is contraindicated.

Immediate Implant Placement Technique

This report presents an alternative treatment for selected patients. The treatment may prevent the necessity for major surgery at a later date, and it involves the immediate replacement of terminal posterior maxillary teeth with Brånemark implants (Nobel Biocare AB, Göteborg, Sweden) into the root sockets. Many studies[13-17] have shown that the immediate implantation of dental implants is as successful as delayed placement in healed mature bony sites, with the additional advantage of shorter treatment times. This technique has further advantages when applied to suitable situations in the posterior maxilla. Radiographs of the root structure in this region will often show that the roots appear to intrude into the maxillary sinus, such that the root apices are superiorly placed relative to the floor of the antrum. For this reason, the radiographic appearance of roots intruding into the sinus can often be misleading because these roots are actually located in alveolar bone straddling the concavity of the sinus floor. If tooth removal takes place without this interpretation, the available bone height for implant placement may be unnecessarily reduced.

Patient selection is based on the absence of medical contraindications to general dental implant surgery together with panoramic radiographic analysis. Not all patients acceptable for implant surgery are necessarily suitable for this procedure. In selected situations in which posterior maxillary teeth are designated unsalvageable and suitable for implant treatment, a panoramic radiograph is obtained. The roots of the terminal maxillary molar teeth are identified and outlined in pencil. If the roots are superior to the floor of the sinus, measurements are taken with a radiographic implant diagnostic template, which has magnifications that are appropriate for the panoramic technique. The height between the alveolar crest adjacent to the tooth to be removed and the floor of the sinus is measured as A in millimeters (Fig 1). The height of the root apices, as outlined in pencil above the floor of the sinus, is measured as B. The sum total of A + B is the estimated height of alveolar bone that

is available for an endosseous implant placement. If the sum total of these measurements for any root structure is 10 mm or greater, this technique is indicated.[1-5] If the measurement is less than 10 mm, only shorter-length implants can be accommodated; in these cases, the patients are best advised to accept the loss of the teeth and to reconsider their options for tooth replacement once wound healing has taken place. Likewise, if the roots do not extend above the sinus floor and the height of bone A is less than 10 mm, this immediate implant placement technique is not advantageous. Through this selective process and in conjunction with the requirements for successful immediate implant placement, suitable patients can be advised of the advantages and preventive aspects of this technique.

Patient Report

A 40-year-old white man was referred by his dentist for restoration of the right posterior maxillary region. The roots of the first and second premolars were considered by the endodontist to have a poor prognosis because of vertical root fracture and canal obliteration, with only the roots of the first molar remaining. The second molar was also unrestorable as the result of crown fracture, which passed through the bifurcation. The third molar was overerupted, mobile, and poorly rooted. Tracing the roots of the second molar on the panoramic radiograph revealed that the root apices lay well above the floor of the sinus with fusion of the mesial and distobuccal root (Fig 2).

Following removal of the molars, measurement of alveolar bone height for dental implants on the radiographs was estimated to be 7 mm, from the floor of the sinus to the crest of the alveolus. However, the position of the root apices provided an additional 5 to 6 mm of bone height to allow the placement of a 13-mm implant without invasion of the sinus for augmentation procedures. Treatment planning for this case was finalized, and the patient agreed to the utilization of this extra bony advantage by immediate implant placement into the root socket following careful tooth removal so as to maximize implant support for a fixed porcelain prosthesis.

Preoperative medication of ibuprofen and clindamycin was administered orally prior to surgery for implant placement under intravenous sedation. All posterior teeth and roots in this region were removed, and the sockets were curetted to ensure complete debridement of soft tissues and remnants of the periodontal ligaments. Measurements of the root lengths of the extracted second molar tooth were made and related to the root sockets. The most substantial root socket was buccally located and selected for implant placement because of its robustness and 6-mm length. Four implant recipient sites were prepared according to the Brånemark protocol, except that countersinking was not required because of the anatomy of the crestal root sockets. The most distal implant was placed into the selected extraction socket of the second molar buccal roots, which were angled buccally at 5 degrees from the vertical axial plane of the alveolus. Depth preparation allowed an additional 2 mm to be gained apically from the position of the original root. Care was taken to ensure that

sinus penetration did not occur during recipient site preparation.

The second most distal implant was placed 5 degrees palatally from the vertical axial plane in the opposing direction to lie in close proximity to the cortical palatal wall and located on the midline of the alveolar crest for biomechanical reasons. The mesial implant was placed in the palatal aspect of the root socket of the removed first premolar tooth, and the next implant was placed to favor the buccal aspect of the root sockets of the second premolar. This provided a staggered tripodial arrangement of the implants for maximal biomechanical support in occlusion. It was possible to tap all implant sites, and the implants were placed securely without mobility.

Bony defects were augmented with a mix of demineralized freeze-dried bone (250 to 500 µm) (Pacific Coast Tissue Bank, Los Angeles, CA), mixed in a ratio of 10 parts bone with 1 part resorbable hydroxyapatite (300 to 400 µm) (OsteoGen, Stryker dental implants, Kalamazoo, MI). Wound closure was facilitated by scoring the periosteum of the periosteal flaps to gain primary closure of the wound. A combination of mattress and interrupted closure technique was employed to appose the soft tissue flaps for wound closure.

Routine postoperative implant surgery instructions for sinus augmentation procedures given to the patient included the avoidance of buildup of intranasal and sinus pressures by not blowing his nose, and keeping his mouth open when sneezing, for a period of 1 month. A postoperative course of drugs included 400-mg tablets of ibuprofen four times a day for 2 days, 150-mg capsules of clindamycin four times a day for 5 days, and 1,000-mg vitamin C supplements daily for 30 days. Postoperative radiographs showed what appeared to be the extension of the most distal implant penetrating the sinus by 6 mm (Fig 3) but did not indicate that this implant actually was securely located in the bone of the lateral wall of the zygoma. Healing was uneventful, and the patient felt no discomfort from the procedure following suture removal at 10 days postoperatively.

The implants were exposed at 6 months and were progressively loaded according to the Misch protocol.[18] Each implant was tested for osseointegration by percussion and mobility. All implants gave a definitive, clear audible ring on percussion. No mobility was detected clinically prior to the final seating of the porcelain prosthesis. All hard and soft tissues surrounding the prosthesis demonstrated excellent tissue tone and health (Fig 4). The patient has functioned with the prosthesis for more than 2.5 years since completion of treatment and has experienced no mobility or discomfort, and the bone levels remain stable.

Discussion

Major Anatomic Advantages for the Posterior Maxilla. In addition to the advantages of immediate placement of an endosseous implant outlined by Arlin,[17] there are two additional major anatomic advantages to be obtained in the posterior

maxilla using this approach. The first anatomic advantage is the preservation of bone height, which would otherwise be lost in delayed reconstruction. Radiographs of the root structure often show that the roots appear to intrude into the maxillary sinus such that the root apices are superiorly placed relative to the floor of the antrum. If the roots are removed, extraction sites are allowed to heal, and further radiographs are taken of the exact views as prior to extraction, it could be seen that not only has the alveolus reduced in height as a result of the removal of the teeth at the crestal bone level, but there has also been complete loss of the bony support superior to the floor of the sinus, which had previously housed the root apices of the extracted tooth. As a result, the bone volume and height are severely reduced in that area, which is viewed between the floor of the sinus and the healed, but reduced, crest of the alveolus.

The second anatomic advantage is the close apposition of the implant to the cortical plate of the lateral wall of the zygoma, which is achieved by utilizing the buccal root sockets of the extracted permanent molar tooth. Anatomic descriptions[19] of the maxillary molars reveal that the root structure is commonly trifurcated for first and second molars, the latter sometimes bifurcated by the fusion of the mesiobuccal and distobuccal roots, with the roots straddling the crestal midline of the alveolus. Such observations indicate that these root structures, as outlined, are located toward the medial and lateral aspects of the maxillary alveolus, which are bounded by the cortical plates of the palate and lateral wall of the zygoma. An implant placed into the same root locations with close cortical bone apposition to the implant will maximize the mechanical support. Any masticatory occlusal forces will be transmitted through the implant in an axial direction directly into and up the lateral wall of the zygoma and palatal structures. This has clinical significance because of the prevalence of type IV bone, which predominates this region of the maxilla[20] and has poor mechanical support qualities.

Disadvantages. Utilization of root location dictates the placement of implants. This is especially true in relation to the angulations of the natural roots from the axial plane of the alveolus. In this patient, only a 5-degree offset from the axial plane occurred, enabling prosthesis fabrication and placement with conventional ceramic techniques.

Summary

The concept of immediate dental implant placement following tooth removal is now a well-established treatment modality. Application of this treatment to the posterior maxilla with additional selection criteria can offer the patient treatment advantages over a delayed implant treatment program. A clinical case of immediate tooth replacement with dental implants in the posterior maxillary region is presented, and it demonstrates the preservation of available bone height for the placement of longer dental implants, a technique that has anatomic advantages unique to this region. This preliminary approach to imminent tooth loss of posterior maxillary teeth may help

suitable patients avoid major surgical reconstruction involving implant treatment of this region at a later time.

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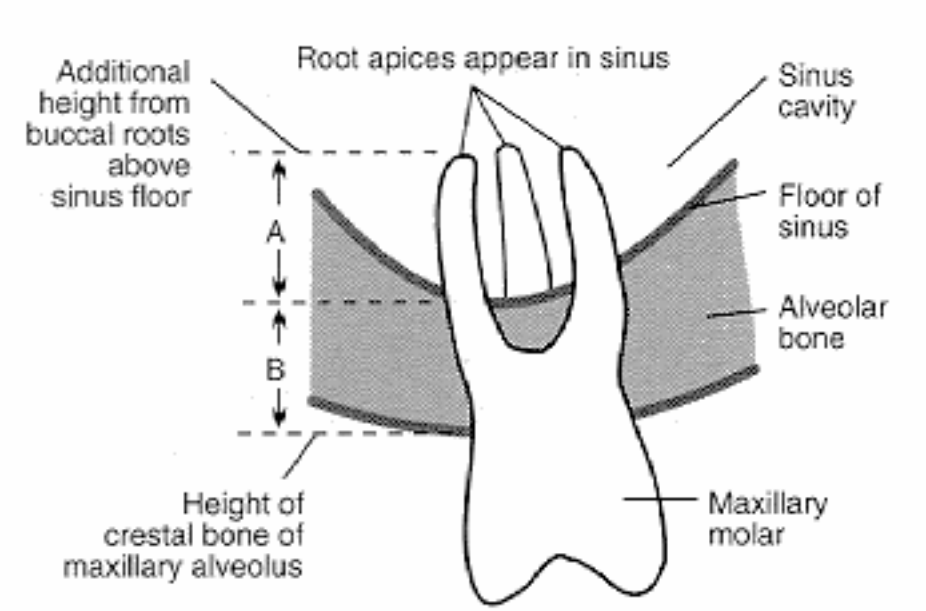

Fig. 1 Selection technique by which measurement of additional available bone height of the root apices of a maxillary molar for implant placement can be made. If A + B is greater or equal to 10 mm, this technique is indicated.

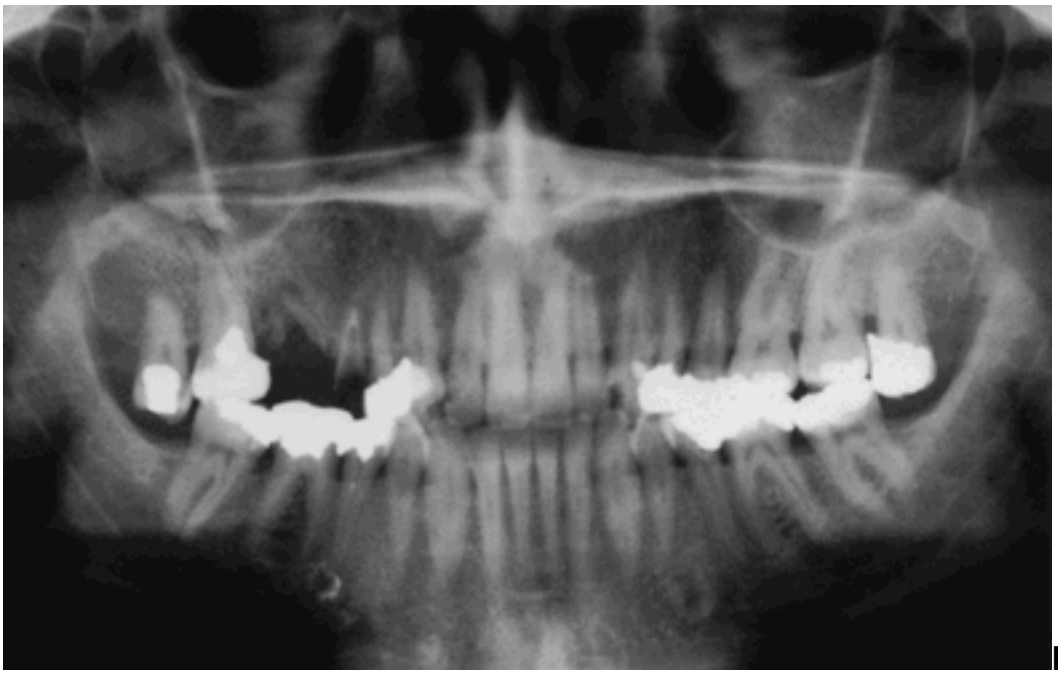

Fig. 2 Panoramic radiograph of patient with the root apices of the second molar situated 5 mm superior to the sinus floor.

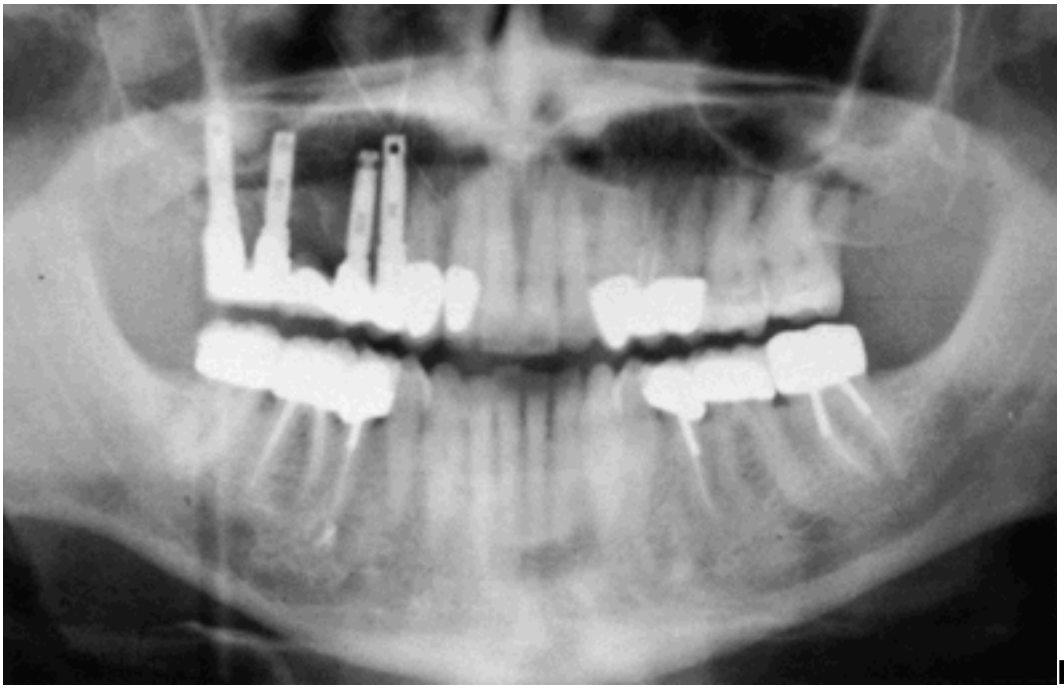

Fig. 3 Panoramic radiograph revealing completed treatment with the distal implant intruding above the floor of the sinus. Note also the regenerated alveolar bone around the next implant augmented with demineralized freeze-dried bone mix.

Fig. 4 Porcelain prosthesis in place showing the buccal placement of the distal implant, which has healthy surrounding soft tissues at 6 months following completion of treatment.