Zygomatic Implants: A Review

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Abstract

Zygoma implants (or zygomatic implants) vary from traditional dental implants in that they attach in rather than maxilla (upper jaw) in the zygomatic bone (cheekbone). They can be used where the consistency or quantity of maxillary bone is insufficient for normal dental implant placement. Inadequate maxillary bone volume can be due to bone resorption as well as maxillary sinus pneumatization or a mixture of both. The required bone height for typical implant placement in the upper jaw posterior area should be approximately 10 mm to ensure appropriate implant survival. Where there is inadequate bone available, bone grafting procedures and sinus raising procedures should be done to increase bone volume. Procedures for bone grafting in the jaws have the downside of extended care, limiting denture wear, the morbidity of donor surgical site & graft rejection.

Keywords: *Zygomatic implants, maxillary bone.*

Introduction

People having a chief complaint of the missing tooth are sacrificed in the function of chewing, problems related to speech, esthetic look, and being self-confident in social gatherings. However, this is not something new in this profession. Dentistry is the first oral care professionals to improve from the invention of osseointegration by Per-Ingvar Branemark who was first to place implants inside the oral cavity in the year 1965, has become the genuinely acceptable modality of procedure in patients, who has lost their teeth: implant can be used as a substitute.[1] Modern dentistry aims to reimburse patients' to oral health in a predictable manner. The partial and complete edentulous prosthesis may not be able to recover normal form & function, esthetics, comfort, or speech.[2]

Accessing Quality of Implant: The benchmark for evaluating implant quality is mobility & pain. Probing depths might help to find any local disease or pre-existing thickness of tissue before the implant was inserted. When there is an increase in depth of probing it signifies bone loss, hyperplasia of gingiva, or hypertrophy. Loss of bone is best valued with probing depths than with IOPAR. Implant quality factors were established by Jarnes and modified by Misch in an implant quality scale that not only assesses the implant health-disease but affects the treatment and prognosis of the existing conditions.[2] Due to lack of internal bone (cortical & cancellous) stimulation and non-physiologic crestal bone loading, it causes of an atrophic edentulous maxillae's continuous resorption. The result is not being able to use a conventional full denture prosthesis.[3] A collection of strategies like composite or complex grafting with bone and Le Fort osteotomy to an easy procedure as sinus bone augmentation have a different success rate. Such treatment protocols have a separate surgical treatment and often requires one to two month of healing or even more, before placement of the implant. The substitute for such a stage-wise method requires the **zygomatic implant** invented by Branemark. [4]

The zygoma implant is a length-extended (30–52.5 mm) machined titanium screw which is inserted via the crestal bone(i.e palatal) part of the posterior (resorbed) maxillae trans-antrally inside the compact bone of the zygoma. Moreover, 2 or 4 conventional screws are inserted in the maxillae (anterior part). Starting support of these screws is assured by its contact with four bony cortices (Fig-1).

1. At the crestal ridge.
2. The floor of the maxillary sinus.

3. The sinus roof.
4. The superior border of the zygoma.

It has been reported that the zygoma implant gives posterior maxillary support when the surrounding bony structures don't permit implant insertion. The adjunct to the implant is an augmentation of bone graft (sinus lifts and on-lay grafts) along with the cost of their attendant, dis-comfort, prolonged treatment time, and high chances of complication rate. The zygoma screw is suggestive in instances like:

When the entire maxillary (edentulous) arch is associated with advanced posterior resorption which will need graft otherwise. Two or preferably four anterior implants are required along with both bilateral zygoma implants. In partial or incomplete maxillectomy individuals where more implants might be inserted in other areas i.e pyriform sinus, rims of the orbit, palatal shelves, or pterygoid plates to provide anchorage to cross-arch stabilization. [3]

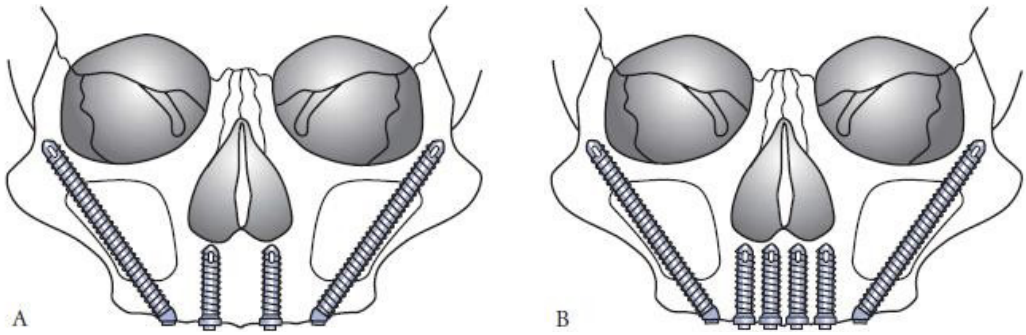

Figure 1A. Pictorial representation of recommended zygoma and standard implant fixtures cross-arch stabilization and fixed restoration. B. Diagramatic representation of zygoma and implant fixtures for restoration with cross-arch stabilization and fixed restoration.

Indications & contra indications: The zygoma implant is usually preferred in candidates having moderate to severe atrophy but it can be thought of as a beneficial choice in patients with or without any significant atrophy, requiring posterior maxillary implant support.

1. Moderate Atrophy.
2. Severe Atrophy.
3. Syndromicpatients e.g ectodermal dysplasia patient presents with partial anodontia.
4. Acquired & congenital defects. E.g cleft palate, rhinectomy usually required after malignant tumors of the nose.[13]
5. Partial edentulism.
6. Immediate loading.

Contra Indications:

1. Any sinus pathology.
2. Systemic diseases.
3. Zygoma implant is not required where there is adequate bone in the maxilla to facilitate implant placement in positions & numbers which can help in retention of a prosthetic appliance.
4. Where there is no enough pre-maxillary bony anchorage, for 2 stable implants with the best potential longevity. The volume and condition of the anterior bone of the maxilla are determining factors on which differential diagnosis often depends rather than existing posterior maxilla whether the edentulous patient may be suitable for this procedure.

Medical Evaluation: Medical history includes those medical conditions most likely to influence implant treatment decisions. The physical examination consists of a hands-on evaluation and recording of the patient's vital signs. The second, section (Laboratory Evaluation) reviews those laboratory tests of interest to implant dentistry. The evaluation includes a complete blood count (CBC), sequential multiple analysis (SMA), and bleeding disorder tests. The third section relates the medical and dental implications of the common systemic diseases found in implant patients, which have the greatest impact on implant dentistry.[5]

Pre-surgical assessment

Both physical and mental stability of the patient is required to withstand the surgical procedure approximately 2 hours long and to endure deep intravenous sedation or general anesthesia. Adequate mandibular range of motion of the patient is needed for proper access while the placement of fixtures 30-52.5 mm long transpalatally in the region of the zygomatic buttress. The placement of the zygoma fixture may be hindered in the presence of opposing mandibular teeth. In the case of deep sedation, local anesthesia in the mandibular arch, as well as in the surgical site itself, is advisable.[6]

Radiographically using an image-guided oral implantology system (IGOIS) is introduced including the framework, 3D-reconstruction, preoperative planning, registration, and the motion tracking algorithm to transfer the preoperative plan precisely. With the help of stereolithography technology, fabrication of the jaw model and a surgical drill guide with skeletal support is done referring to the finalized treatment plan. The main objective is the creation of an individualized drill guide that is suitable for the patient's bone profile. A CAD/CAM program utilizes the contour of the bone and the 3D information of the planned drill course for designing the drill guide. The drill guide is then made by using stereo lithography. Before performing the surgery, and intended simulatory operation is performed on the stereolithographic maxillary model using the surgical drill guides.[7]

Current trends in clinical dental implant therapy involve using endosseous dental implant surfaces embellished with nanoscale topographies. Existing data supporting the role of nanotopography have shown crucial steps in osseointegration can be modulated by nanoscale modification of the implant surface. Nanoscale modification of titanium endosseous implant surfaces can change the cellular and tissue responses that may be beneficial for osseointegration & dental implant procedure.[9]

Surgical Protocol: General anesthesia or deep intravenous sedation offers the best option for the zygoma implant placement surgery. Administration of local anesthesia- maxillary nerve blocks, vestibular infiltration and infiltration or percutaneous blocks laterally and superiorly to the zygomatic notch (just lateral to the orbital rim) should be done. When the surgery is performed with sedation, a bilateral inferior alveolar nerve block can be advantageous as it ensures adequate access because of the significant retraction of the lower lip, tongue, and mandible.[10]

A crestal incision is made in the region of the first molar-second premolar slightly to the palatal aspect of the ridge. It is placed from the right to left maxillary tuberosity regions and bilaterally releasing incisions are given at the incision ends. Sufficient full-thickness mucoperiosteal flap is reflected to expose the lateral maxilla which aids to visualize the zygomatic buttress from the crestal ridge to the superior surface of the zygoma at the zygomatic notch, just lateral to the orbital rim. To avoid tearing of the flap while retracting, the anterior maxilla is exposed till piriform rims, which facilitates the placement of the conventional pre-maxillary implants. A "slot" window is created vertically on the lateral wall of the maxillary sinus in close approximation to the height of the zygomatic buttress.[11] The slot is prepared with a fissure bur, generally a 703 or 702, in a straight surgical handpiece. The prepared slot on the lateral wall of the sinus should be parallel to the planned course of zygoma implant placement which lies just medial to it. The extension of the slot should be from close to the floor of the sinus just superior to the planned site of implant installation to near the sinus roof. The window is prepared by the surgeon for the direct visualization of the implant placement, passing of all drill preparations, and instrumentations. During the slot preparation, the Schneiderian membrane is removed from the sinus wall to facilitate better visualization and to prevent its interference at the time of site preparation and implant installation.[12]

For the incremental preparation of the planned site, a series of long drills are used. The length of the zygoma implant varies from 30 to 52.5 mm. The diameter of alveolar one-third and apical two-thirds is 5 mm and 4 mm, respectively. To enhance the visualization and aid in the position of the surrounding structure, a customized zygoma retractor with a toe-out tip is placed in a position over the zygomatic notch through the entire procedure of slot preparation. There is a midline marker on the retractor parallel to the site preparation which assists in the orientation of the drills in the proper direction. To complete the site preparation, these drills are used sequentially- 2.9 mm diameter long twist drills, 2.9 mm-3.5 mm pilot drill, and 3.5 mm twist drill. Direct visualization of the implant insertion is done through the slot preparation on the lateral wall of the sinus.[12]

Insertion of the implant is done along with substantial irrigation. The implant should be in the same plane as that of the drills during the implant placement to enable the engagement of the implant in the preparation site at the body of the zygomatic bone. On engagement of the apical portion of the implant 2-3mm into the dense zygomatic bone, the handpiece will come to a halt after the adequate preparation of the site. To complete the installation of the implant, a manual driver is employed when the handpiece comes to a stall. Determination of the proper abutment platform angulation is done with the help of the placement of a screwdriver into the screw head of the implant carrier and placing it until the screwdriver becomes perpendicular to the crest. It is then followed-up by the removal of the implant carrier and placement of a cover screw.[13] 2-4 regular platform (Mark III or Mark IV Nobel Biocare) implants are inserted in the pre-maxillary region following the installation of the zygoma implants. Subsequently, repositioning of the flap and suture placement is done. Relief is given in the maxillary denture by making it hollow at the site of implant emergence and relined with the tissue conditioner. The impression of the implant level is made before the closure. This facilitates fabricating a rigid bar which will be placed at the second stage of the surgery around six months later.[14]

Prosthetic Procedure:

Healing Phase: The existing or the provisional maxillary denture can be remodeled for immediate use for preserving the patient's esthetic. Significant limitations may be noted in the case of functional use like alteration in retention or masticatory ability, but an alternative of having teeth through the entire treatment process is usually far more pleasing than the interim periods of no prosthesis that accompanies many graft procedures.[15]

Protective splinting: On combining with splinting and cross-arch stabilization, the strength these implants provide is one of their unique features. If they are utilized or loaded independently, it is perceived that the off-axis load transfer can be pernicious and feasibly ineffective for the maintenance of osseointegration. It is recommended to take some precautionary measures to hinder the independent transfer of the stress from the base of the denture to the implants individually promptly following stage II surgery, or uncovering of all implants with abutment connections. A gold bar measuring around 2 mm in diameter is contoured accordingly so that it's in contact with a set of gold cylinders which are affixed to the abutment analogs on the cast. With the help of a micro-welding device, the soldering of the bar and the cylinders together can be accomplished and the fabrication of passive protective splint can be achieved within a short period. Within the next day usually, the bar splint is delivered and the denture is hollow ground for complete seating without the interference of the bar. An absolutesoftliner can be appliedat this time tothemaxillaryprosthesisfor the enhancement of retention and comfort. If the patient is not wearing a maxillary prosthesis, bar splint may not be necessary but in the case where constant denture wear is advisable, the bar splint protocol should be followed.[4-6]

Final prosthesis construction: After an adequate period of healing, final impressions can be taken which is usually after 3 to 4 weeks. With approved wax-up silicone putty indexes are made which are then used to provide a matrix for creatinga metal bar structure. After the evaluation of passive fit and esthetics in the second try-in appointment, with heat polymerizing resin the prosthesis is processed. Using appropriate screws and screw torques to provide even and complete seating, the delivery is accomplished.[7,8]

Discussion

The complete restoration of the severely atrophied maxilla along with the implant placement is a challenge faced by both the surgeons and the prosthodontists. In the case of exclusive conventional implant placement in this condition, the insertion of the implant requires extensive bone grafting and usually also involves sinus upliftment and onlay grafts with a larger amount of donor's bone. The important considerations are to be taken involve the inconvenience of the patient, prolonged duration of the treatment, potential complications, lower rates of implant success, donor site morbidity, and cost. This is further complicated by the patient's inability to wear a prosthesis for an extended period—a factor that hinders many patients from pursuing the treatment. Avoidance of bone grafts if not indicated, shortened treatment duration, no requirement of the donor sites, and the continuous use of transitional prosthesis by the patient are the perks of zygoma implant rehabilitation. As a result, greater patient compliance is achieved while furnishing the patient with a stable, well-tolerated, and esthetically accepted removable or fixed prosthesis at the time of treatment completion.[11-15]

The benefits for the consideration of the zygoma implant include the following:

1. Reduced or entire elimination of the donor site morbidity.
2. Markedly reduced or eliminated the treatment duration.
3. Survival of the bone grafts and consolidations are into considerations.
4. Reduced the total number of implants to support the prosthesis.
5. Relatively economical mode of treatment and less invasive than other alternatives.

The disadvantages include the following:

1. It's a demanding surgery— well trained technical skills are required. Experts capable of dealing with any surgical situation or complications that might arise should perform the surgery.
2. The risk to injure adjacent structures- orbital contents, orbit, lacrimal apparatus, infraorbital nerve, the facial nerve.
3. Chances of postoperative sinusitis, although relatively less than with the sinus liftprocedures.
4. Failure of the fixtures—although it is rare, more difficult to retreat the access. General anesthesia or deep sedation is required as with all properly planned and executed implant prosthetic surgery, it also requires extensive coordination between the surgeon and the prosthodontist before commencing the treatment.

Ideally, at the time of surgery, the prosthodontist should be available. Similarly, the prosthetic requirements andtechniques of fixture positioning and final restoration should be familiarized by the surgeon. Finally, the important steps of the procedure and its ultimate success include education of the patient, preparation, assessment, and informed consent. Before initiating treatment, patient understanding should include the need for meticulous oral hygiene and maintenance. Proper understanding and appropriate use of the zygoma implant, provides an alternative for several patients with atrophic edentulous maxillae.[11-15]

In conclusion, we recommend zygoma implants in the atrophied edentulous maxilla for the following reasons-

1. The rate of successful osseointegration is greater than 96% for the zygoma implant.
2. Decreased surgical interventions for the patients.
3. Does not require bone harvesting or grafting as a necessity.
4. Decreased overall operating and working time for the surgeon.
5. The surgery of a zygoma implant can be accomplished within the office setting.
6. Precise placement of the zygoma implant platform on the crest of the maxillary ridge permits the access screw hole of the zygomaimplant to surface in the central groove of the first molar.
7. There is no requirement for any angled or custom made abutments in the final restoration.
8. No additional restorative dental or laboratory time is required in comparison to the traditional implant techniques.
9. The entire laboratory and prosthetic charges for the zygoma implant rehabilitation are comparatively equal to or less than conventional implants.
10. Relatively the expense of zygoma implant therapy is quite economical than the grafting procedure for the patient.

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Conflict of Interests: None

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