Management of Complex Edentulousness: A Prosthodontic Panorama

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Introduction

Effects of residual ridge resorption are irreversible following the loss of teeth in the oral cavity. Dental implant treatment are rapidly eliminating the conventional treatment modalities such as a conventional complete denture or a cast partial denture due to the advancements in the field of osseointegration and is considered as a panacea for completely and partially edentulous situation. Even though, the same holds true, there are alveolar ridges that have undergone extensive resorption and are considered unfit to receive a dental implant treatment. The patients may deny expensive grafting solutions which may not give a predictable result in all situations. Also many patients deny such solutions because of the long waiting period during the healing period of the implant.

With this problem in hand, alternative sites for implant placement were sought, where the implants could receive adequate primary stability and subjected to immediate loading. Few such sites in the maxilla are the zygomatic and pterygoid bone.

Zygoma implants are not placed in the conventional axial manner, but rather at an angle, such that the apical portion is completely embedded into the bone and the coronal portion of the implant emerges slightly palatal to the crest of the ridge. For any prosthesis to be inserted with ease, the path of insertion is of great significance. In angled implant situations, the clinician must have a sound understanding of the prosthodontic principles before rehabilitation. The same scenario appears in the All-on-4® concept, where the implants are intentionally angulated to increase the anteroposterior spread of the prosthesis for stability and uniform distribution of forces.

Case Report

A 57-year-old female patient visited the Department of Prosthodontics and Implantology, Pushpagiri College of Dental Sciences, Tiruvalla, with a chief complaint of completely missing upper and lower teeth and requested a fixed replacement. The pre-operative orthopantomogram revealed extensive resorption in the posterior maxillary and mandibular regions. Pneumatization of the maxillary air sinus had taken place superiorly and anteriorly in the right and left side of the arch.

The posterior edentulous maxilla had been severely resorbed and had to be extensively grafted for rehabilitation with dental implants. However, the patient denied this mode of treatment because of the extended healing period and the restriction of a transitional denture during this phase. So, after informed consent, it was decided to rehabilitate the maxillary arch bilaterally with zygomatic implants and with four conventional implants in the anterior region and the mandibular arch by placing implants based on the All-on-4® concept.
Surgical phase
The patient was treated under general anesthesia. In the maxillary arch, after administration of local anesthesia (lidocaine 2% with epinephrine 1:100, 1000), a crestal incision was placed slightly palatal to the center of the ridge in the first molar - second bicuspid region on the right side extending to its left counterpart. Mucoperiosteal flaps were elevated to expose the alveolar ridge, lateral wall of the maxillary sinus, and the inferior rim of the zygomatic arch.1

Two zygomatic implants of (4 mm × 45 mm) (Nobel Biocare, Gothenburg, Sweden) were placed using the transsinus approach as described by Branemark. The decision to go ahead with the approach was based on the anterior limitations of the surrounding structures during the time of surgery. In the premaxillary region, four implants of (3.5 mm × 11.5 mm) replace select tapered (Nobel Biocare, Gothenburg, Sweden) were placed in the conventional axial manner.

In the mandibular arch, a full thickness crestal incision was performed from the right first molar region to the left first molar region. A 2 mm osteotomy was made in the center of the ridge to facilitate the placement of the all on four guides (Nobel guide). After locating the mental foramen on either side, two implants of (4.3 mm × 13 mm) were placed in an angulation within the confinement of the vertical lines present on the reference guide. All the implants were submerged, and the mucoperiosteal flaps were sutured back in position with resorbable 3-0 vicryl sutures. Transitional dentures were inserted ensuring the absence of any direct contact with the mucosa above the implant sites. The patients was recalled after 1 week to evaluate for any denture related soreness, which was corrected.

Prosthetic phase
The patient reported 6 months later for the prosthetic phase. An orthopantomogram confirmed the integrity of all the implants within the bone (Figure 1a). On examination, all the sites were healed, with no signs of inflammation. The surgical sites were exposed, and the cover screws were replaced with their corresponding healing abutments. After 2 weeks, the gingiva collared around the healing abutments and site was ready for the impression. The primary impression was made with Alginate impression material, and special trays for the open tray technique were fabricated.

While fabricating the special tray, excess wax was build up over the implant sites occlusally such that the screw vent for the open tray transfer lied at 2 mm above the height of the tray after the exposition. All the healing abutments were replaced with their respective multi-unit abutments (Nobel Biocare, Gothenburg, Sweden). In the maxillary arch, the anterior implants received a 17° abutment while the zygomatic implants were fastened with a 45° angulated implant. The abutments were placed over the fixture with the help of a premounted holder (Figure 1b).

In the mandibular arch, the anterior implants received a 17° abutment and the posterior angulated implants received a 30° abutment. The abutments were torqued to 15 N/cm using a manual torque wrench. The impression copings were tightened onto the multi-unit abutment (Figure 2a and b).

The impression copings were stabilized with multiple knots using a dental floss. Light cure composite material was adapted in rolls over the dental floss for additional reinforcement. Any mild movement of the copings would result in an improper fit of the final prosthesis. An open tray impression was made with elastomeric impression material (Aquasil soft putty and Aquasil LV, Dentsply, Noida, India). The impression was removed after loosening the copings through the exposed screw vent (Figure 3a and b), and the implant analogs were tightened onto the copings which were then sent to the lab for a jig trial. The jig trial ensured the level of accuracy of the impression made. The exposed vents of the abutments were temporarily sealed with their corresponding healing caps (Figure 4a and b).

Maxillary and mandibular jigs were tried in the patient’s mouth (Figure 5a) and a passive fit allowing complete seating of the jig and the titanium screws were confirmed with the help of multiple intraoral periapical radiographs.

Face bow transfer and centric jaw relationship
The maxillomandibular relationship was recorded using a customized shellac base plate. Holes were incorporated through the base plate and were fastened to the ridge with screws. The rims were contoured according to the functional and esthetic demands of the patient. Face bow transfer was done and a bite record was made using light body addition silicone impression material.2

Try in
The anterior and posterior teeth were set in the established relation. The wax set up was tried and was evaluated for

Figure 1: (a) Post-operative orthopantomogram revealing well-osseointegrated implant fixtures. (b) multi-unit abutments placed over the fixtures with the help of premounted holder.

Figure 2: Impression coping fastened onto the (a) maxillary and (b) mandibular arches.
esthetic show up and the vertical and centric relationships were confirmed based on the established jaw relation record (Figure 5b). The trial wax up was sent to the lab for assessment of sufficient space for the restoration followed by the fabrication of the framework. In the lab, the approved wax trial was adapted onto the milled framework without altering the established teeth position. The substructure was tried in the patient’s mouth, and a passive fit was ensured. A radiograph was taken to ensure complete seating of the prosthesis.

Minor changes in tooth position, occlusion, speech, and border extensions were evaluated. Sufficient space for oral hygiene maintenance was ensured. The trial wax up was then sent to the lab for processing.

**Final insertion of prosthesis**

The trial, which was confirmed in the earlier step, was processed on to the computer-aided design and computer-aided manufacturing substructure (Figure 6a and b). Plastic healing caps were removed, and the straight multi-unit abutments were torqued to 35 N/cm, whereas the angled multi-unit abutments were torqued to 15 N/cm. The prosthesis was then placed over the abutments, and prosthetic screws were torqued to 15 N/cm (Figure 7a and b). The torque recommendation was followed as per the manufacturer’s instructions. The screw holes were covered with a small piece of Gutta-percha, and the vent was sealed with the light cure composite material. The patient’s occlusion was assessed for any interferences (Figure 8a). She could smile confidently and was completely satisfied with the treatment (Figure 8b).

**Follow-up and maintenance**

The patient was recalled after 1 week and was evaluated for any soft tissue reactions and maintenance of oral hygiene. She was asked to report every 6 months for a follow-up.

**Discussion**

Prosthetic rehabilitation of the posterior maxillary ridge due to residual ridge resorption remains a challenge to the surgeon and the prosthodontist. Such situations are usually managed by extensive grafting procedures. During the healing period, the patients are prohibited from wearing a transitional prosthesis as this could result in unexpected load over the graft regions.
The placement of a zygoma or a pterygoid implant mitigates the problem by utilizing the support from the external sites such as the zygomatic buttress or the pterygoid bone. This treatment allows the patient to wear an immediate prosthesis, provided adequate primary stability was achieved during placement of the implant.

The zygomatic implant is a viable treatment alternative for grafting procedures and is indicated in posterior ridges where pneumatization of sinuses with <3 mm alveolar height has occurred.\(^3\)

The zygomatic implants were placed through the intra-sinus approach after elevating the Schneiderian membrane. The emergence of the zygomatic implant in the oral cavity is about 10-15 mm medial to the alveolar ridge.\(^4\) Usually, the palatal location of the abutment do not interfere with the patient’s speech or comfort.\(^5\) However, patients must be motivated well to maintain their oral hygiene using floss threaders and interdental brushes. There have been modifications to the conventional Branemark approach, which permits the implants to emerge at or very near to the alveolar ridge.\(^6\)

This case required the need for angulating the implants in both, the maxillary and the mandibular arches. The practice of using angulated implants and abutments requires the clinician to have a sound understanding of the prosthodontic principles undergirding it. The purpose of tilting the implants is to increase anteroposterior spread (A-P), bypass the anatomic structures such as the maxillary sinus and the inferior alveolar nerve, and reduce the cantilever effect on the final prosthesis. The resultant stress and strain in these implants were found to be within the physiologic limit.\(^7,8\)

Conventional abutments are replaced with multi-unit abutments in the case of tilted implants. Angulated abutments <45° have found to increase the bone mass and mineralization. Greater angulation can increase the strain and result in crestal brown breakdown.\(^9,10\)

Protective splinting and cross arch stabilization is of paramount importance while planning for a zygomatic implant-supported prosthesis as isolated implants can cause an offline axis load transfer which is detrimental to survival of the implant.\(^11\)

One of the advantages of using zygomatic implants over the grafting treatment modality is that the patient can wear an interim denture during this phase. However, the load transmitted to these implants must be controlled. Frost, in 2004, stated that the bone could function normally within a stress range of 50-1000 microstrain. A mild overload which is repairable results, if the limit is within 1500-3000 microstrain. Repeated stress >3000 microstrain causes microdamage which is irreparable and results in fatigue failure.\(^12\) In our case, a conventional denture was inserted during the healing phase after eliminating all tight contacts and possible areas from the intaglio surface that could contact the mucosa overlying the implants.

While designing for the location of the implant placement, the prosthodontist must consider the A-P spread of the implants. The distance from the center of the most anterior implant to a line joining the distal aspect of the most distal implant is called the A-P distance. According to Misch, A-P distance is one of the factors that governs the cantilever distance, others being the number of implants (denoting the surface area through which the force is distributed) and number of prosthetic components (as the number increase force distributed is minimized). Greater the A-P spread, greater the distance the cantilever can cover. Misch recommends the cantilever in a prosthesis must not exceed 2.5 times the A-P spread.\(^13\) Taruna et al. suggest as a rule of thumb, a cantilever of 6-8 mm and 10-12 mm is acceptable in the maxillary and mandibular prosthesis, respectively.\(^14\) In our case, an All-on-4 treatment concept in the maxillary arch was not planned because of the pneumatization of the sinuses anteriorly in the left side of the arch which results in a reduced A-P spread.

A sound knowledge of the underlying principles of occlusion is of paramount importance in determining the success of the final prosthesis. The neurophysiological system is so designed that it could easily accommodate for the subtle changes in the morphology. Hence, it would be difficult to justify the usage of one scheme over the other. However, certain principles are mandatory while designing the occlusion for an implant-supported prosthesis.\(^15,16\) Misch has collectively termed these principles under an “implant protective occlusion scheme.” These include:

1. Flat fossa and grooves for wide freedom in centric
2. Reduced cuspal inclination
3. Absence of any interference between retruded contact position and maximum intercuspal position
4. Bilateral stability in centric occlusion
5. Smooth and even labial excursive movements without working/non-working interference.

Motivating the patient to maintain the oral hygiene if of utmost importance and cannot be overemphasized. Dental flossing and use of various types of cleansing aids must be demonstrated by the dentist in the patient’s mouth with the help of a face mirror. It must be specified that all expensive treatment will amount to nothing if this one vital step is compromised.

**Conclusion**

The zygomatic implants are a viable alternative in the management of posterior maxillary atrophy when other treatment modalities involving extensive grafting procedures may not be feasible. Immediate loading could be planned if adequate primary stability of the implants was achieved,
and an interim denture could be given which would suffice the patient’s immediate esthetic requirement. If the implantologist has a sound understanding of the anatomical limits in the maxilla, placing a zygomatic implant should not be difficult procedure. The current article strives to rekindle the awareness of utilizing this treatment modality which has shown a substantially promising track record in the past years. Furthermore, the various prosthodontic aspects that needs to be considered while designing a fixed arch implant-supported prosthesis have also been discussed. In the mandibular arch, implants were placed based on the All-on-4 treatment concept. However, details of this technique have not been elaborated, as this is beyond the goal of this report.

References