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Implants in Atrophic Ridges

Dr Rohit Shah*, Dr Aamir Doctor, Dr Dipika Mitra***, Dr Silvia Rodrigues*, Dr Gaurav Shetty****, Dr Saurabh Prithyani******

*- Reader, **-Postgraduate student, ***- Professor and Head, ****- Lecturer

Department of Periodontology

TPCT's Terna dental college and hospital

Sector-22, Nerul, Navi Mumbai-400706

Abstract

Patients with severely atrophic maxillae and mandible may lack adequate bone height for endosteal implant placement. In such patient's placement of endosseous implants must be undertaken with numerous augmentation procedures. But due to extensive research numerous advances have been done which have opened up newer techniques and avenues for management of patients with atrophic ridges.

KEY WORDS: Atrophic ridges, implants, ridge augmentation, basal implants, pterygoid implants.

Introduction

Dental implantology has become an extremely predictable treatment option, with excellent long-term clinical results.[1] However, the success of implant therapy primarily depends on the amount of residual bone volume at the insertion site.[2] Unfavourable local conditions may provide

insufficient bone volume that negatively affects the prognosis of dental implants.[3]

Implant placement in severely atrophic jaws is especially challenging because of the poor quality and quantity of the implant bed. In some cases of completely edentulous patients, implant supported prosthesis treatment is almost impossible without complex techniques such as Calvarial or iliac bone grafts, displacement of the mental nerve and/or sinus augmentation to overcome the initially unfavourable anatomical and mechanical bony conditions.

Many techniques have been developed to regenerate atrophic alveolar jaws for the placement of dental implants, performed either in combination with grafting procedures or in second stage surgery after a period of healing.[4] However, patients are sometimes reluctant to undergo such extensive surgical procedures. A number of implant options or techniques have been developed over the years which can be used for rehabilitation of such patients without the above mentioned procedures and this article will briefly review some of them.

Basal implants were essentially developed for use in atrophied jaw bones and are also called cortical/lateral implants or disk Implants. These implants are not differentiated by the way they are placed but also by the way the forces are disseminated.

I) Basal Implants

TYPES OF BASAL IMPLANTS

There are two types of basal implants, BOI (Basal Osseo Integrated) and BCS (Basal Cortical Screw) specifically designed to utilize the strong cortical bone. Screwable basal implants (BCS brand) have been developed with a thread diameter of up to 12 mm for insertion into immediate extraction sockets.

BOI (LATERAL BASAL IMPLANTS)

These implants are placed in the jaw bone from the lateral aspect. The masticatory load transmission is confined to the cortical bone structures and horizontal implant segments.

Anterior Implants: With the availability of vertical space, the implants used in the anterior region are usually the ones with two disks. The basal implant disks have a diameter of 9 or 10 mm and the crestal disk has a diameter of 7 mm. The crestal and basal plate of multi-disc implants have different functions. The main purpose of the crestal plate is to provide supplementary support to the implant. The emphasis of crestal plate is lost once the basal plate has ossified to full load. The double disks are not inserted due to the lack of adequate bone as it leads to failure. A single BOI with a diameter of 7 to 9 mm and shafts between 8 to 13.5 mm can be used instead.

Posterior Implants: Square shaped basal implants are used in the posterior region that have a disk diameter of 9 to 12 mm or 10 to 14 mm with shafts of 10 to 13.5 mm in length, depending on the available horizontal bone.

BCS (SCREW BASAL IMPLANT)

The screw basal implants are flapless implants that are inserted through the gingiva, without giving a single cut, inserted like a conventional implant. Bicortical screws (BCS) are also considered basal implants, as they transmit masticatory loads deep into the bone, usually onto the opposing cortical bone. The screw basal implants provide initially some elasticity and they are not prone to peri-

implantitis due to the highly polished surface and thin mucosal penetration.

To insert BOI implants a T- shaped osteotomy has to be cut (vertical and horizontal cut) At the same time this instrument prepares the ground for the lateral cutters to be used in the next step. The lateral cutters are used to create the horizontal dimensions of the osteotomy. Several lateral cutters with incremental diameters are used successively, starting with 7mm.Twin cutters are used for double disk implants. They define disc to disc distance and ensure that both the cuts are parallel [5]. They are available in two diameters, 9mm and 7mm types define a disc to disc distance of 5mm and 3mm respectively.

Implant Abutment

The three abutment types are perfectly serviceable. These abutments have a more Internal/superior position of the internal threading as distinguishing features, allowing longer implant shafts to be adjusted in mucosal direction. Care must be taken to ensure that there should be no contact with the mucosa, since the apron style coverage tends to accumulate food. Abutment with an apically positioned neck area of 4mm length can be used if the transitional zones to the implant comes in close proximity to the submucosa.

Indications of Basal Implants

1. In situations when multiple teeth are missing or have to be extracted.
2. When a bone augmentation procedure has failed.
3. Cases of thin ridges – That is deficiency of bone in buccolingual thickness.
4. Cases where bone height is insufficient.
5. Atrophic alveolar ridges.
6. Patient preference to avoid extensive surgical augmentation procedures.

Contraindications of Basal Implants:

1. Medical conditions: A recent history of myocardial infarction (heart attack) would preclude the placement of dental implants. Cerebrovascular stroke, Immunosuppression also leads to the reduction in the efficacy of the immune system.
2. Medicines: Drugs of concern are those that are utilized in the treatment of cancer and drugs that inhibit blood clotting. (Anticancer and Antiplatelet drugs)

Advantages of Basal Implants: [5]

1. One-piece implantology – Basal implants are one piece implants that minimizes the failure of implants due to the interface problems between the connections that exist in conventional two and three piece implants.
2. Basal – cortical bone support – These implants take support from the basal bone which is a lot more resistant to resorption, unlike the conventional implants that mostly take support from the crestal bone. Basal cortical bone has a much faster and stable repairing capacity.
3. Works well in compromised bone situations – Bone augmentation / grafting, sinus lifting and nerve transpositioning procedures can be avoided. These implants particularly take advantage of the basal bone available to avoid bone augmentation procedures. Whereas for conventional implants the available bone has to be modified/augmented by surgical procedures to accept the implants.
4. Better distribution of masticatory forces – The basal implants are imbedded in high quality basal bone. Hence, the masticatory forces get distributed to the cortical bone areas that are highly resistant to resorption and have a very high repairing capacity.

5. Peri-implantitis incidence – Peri-implantitis is the common etiology leading to failure of conventional implants. This occurs mostly due to the roughness of the implant surface along with the interface problems between the multiple parts of the implant. The monobloc smooth surface basal implants eliminates the threat of peri-implantitis in around 98% of cases.
6. Medically compromised situations – Basal implants reportedly work well in controlled diabetics, in smokers and patients suffering from chronic periodontitis.

Disadvantages of the Basal implants: [5]

It is always necessary to keep a few more implants handy to avoid extensive planning including three-dimensional exploration of bone conditions. The technique poses substantial technical challenges, as far as the surgical and prosthetic treatment stages and the substantial knowledge requirements in the fields of biomechanics and bone physiology are concerned.

Complication of Basal Implants:

Functional overload osteolysis:[5] Masticatory forces transmitted through the basal implants may create local microcracks in the cortical bone. These microcracks are repaired by formation of secondary osteotomes, a process called as remodelling. However, this temporarily reduces the degree of mineralization and increases the porosity of the affected bone. Hence, basal implants have a good chance of reintegration, if loads are reduced to an adequate amount.

II) Zygomatic Implants

Indications for zygomatic implants are.[6]

- Treatment of severely atrophic maxillae without using any bone augmentation procedure.
- Treatment of severely atrophic posterior maxillae avoiding sinus lifting procedures.
- Maxillary reconstruction after partial or total maxillectomy.
- Zygomatic implants can be used to fix maxillary obturators as an alternative to non-implant retained obturators, local and regional flaps, and microvascular free flaps.

Advantages:

- Use of remote bone anchorage, either through the residual maxilla or in defect areas helps in reducing cantilever stress and enhancing the cross-arch effect.[7]
- Zygomatic implants use 4 cortical portions compared to 1 or 2 cortical portions with conventional implants in the maxilla which overcomes the unfavourable microarchitecture of zygoma bone. [8]
- Reduced treatment time and elimination of donor site morbidity. [9]

IMMEDIATE STABILIZATION OF ZYGOMATIC IMPLANTS AT STAGE II

Rationale

It is assumed that the only stability of the zygomatic implant is derived from the zygomatic bone. The remainder of the implant and the prosthetic component constitutes a considerable cantilever. However, because these implants were never intended to be free-standing pillars, immediate, rigid, cross arch stabilization is recommended at stage II to prevent micromovement, and thus microfractures around the osseointegrated structures.

Achieving such stabilization requires that the zygomatic implants be splinted to the other implants by a provisional rigid bar. Brunski[10] and Meredith[11]

suggested in their studies that this type of cross arch stabilization (splinting) appears to effectively reduce mechanical stress on the implants by reducing their movement.

All on 4® Implants / Tilted Implants

The "All-on-4® "treatment concept was developed by Paulo Malo with straight and angled multi-unit abutments, to provide edentulous patients with an immediately loaded full arch restoration with only four implants in each jaw, two placed vertically in the anterior region and two placed upto an angle of 45º in the posterior region. When used in the mandible, tilting of posterior implants makes it possible to achieve good bone anchorage and good anterio-posterior (A-P) spread without interfering with the mental foramina in severely resorbed maxillae. Tilted implants are also an alternative to sinus floor augmentation [1].

Surgical Procedure

Implants in the maxilla are placed with two distal implants in the posterior region which are tilted anterior to the maxillary antrum while in the mandible implants are positioned anterior to the mental foramen. They should be inserted at an angulation of 30º-45º. The use of the All-on-4® / Malo surgical guide assists in ensuring the placement of the implants with correct positioning, angulation and emergence. The guide is placed into a 2mm osteotomy that is made in the midline position of the maxilla or mandible and the titanium band is contoured to follow the arc of the opposing arch. The guide also assists in retracting the tongue in mandibular cases. The vertical lines on the guide are used as a reference for drilling at the correct angulation, which should not be greater than 45º. The other guides that can be used for implant placement are Template, Angulated pins and a Denture. Straight, 17º multiunit abutments and 30º angulated abutments with different collar heights are placed onto the implants. These are used to correct access/angulation allowing relative parallelism and ensure that the rigid prosthesis can be seated passively onto the abutment.

Advantages of the All-on-4® concept

- Angled posterior implants avoid anatomical structures
- Angled posterior implants allow longer implants to be placed anchored in better quality bone
- Reduces posterior cantilever (Good A-P spread)
- Eliminates bone grafting in the endentulous maxilla and mandible in majority of cases
- High success rates
- Implants well-spaced, good biomechanics, easier to clean
- Immediate function and aesthetics
- Final restoration can be fixed or removable
- Reduced cost due to less number of implants and avoidance of grafting in the majority of cases.

Limitations

- Good general health and acceptable oral hygiene is required;
- Sufficient bone for 4 implants of at least 10mm in length; and
- Implants need to attain sufficient stability for immediate function.

Disadvantages

- Free hand arbitrary surgical placement of implant is not always possible as implant placement is completely prosthetically driven.
- Length of cantilever in the prosthesis cannot be

extended beyond a limit.

- It is very technique sensitive and requires elaborate pre-surgical preparation such as CAD/CAM and a surgical splint/guide.

Ridge-Split Procedure.

There is some variability of surgical approaches to accomplish an alveolar ridge-split and expansion in implant dentistry. Most of the techniques are based on a controlled force of an operating surgeon in the process of mobilization of a thin facial (buccal or labial) bony fragment, usually in a closed-flap (partially "blind") environment. Thus, this is a technique-sensitive procedure that relies on the tactile sense of a surgeon and requires practice and time to master.

There are five important considerations of the ridge-split procedure (RSP) that recommended to be considered. They are the following:

1 Vascularization is a key principle in the RSP and a vascular bone flap needs to be developed in the process.

2 RSP utilizes the healing potential of bone similar to an extraction socket. Healing by secondary intention is emphasized.

3 Osteocondensation often occurs, especially in maxillary RSP cases.

4 Osteomobilization of the buccal cortical complex always occurs and is an inherent principle of the RSP.

5 RSP performed on maxillary and mandibular alveolar ridges is different and is based on bone density.

Common Mandibular Two Stage Alveolar Ridge Split Procedure.

A segmental staged alveolar ridge-split procedure for the mandible with Stage 1, corticotomy, and Stage 2, splitting with bone expansion and grafting is described here.

Stage 1: Corticotomy (preparatory stage)

This can be considered a preparatory stage. A superficial osteotomy of bone made only through its cortical (dense) layer is called corticotomy (cortical trough or cut through the cortex only). The goal of corticotomy in the RSP is to weaken a dense mineralized rigid cortical layer of bone in the designated (key) areas. Seaming or creating a trough through the cortical bone prior to split is particularly important in the mandible, where bony cortex appears to be especially dense.

Crestal and apical corticotomies (in addition to vertical ones) are made to allow future segment rotation or displacement. The buccal flap and periosteum are reflected and will be repositioned back. The Vertical cuts between two horizontal cuts called crestal and apical is mainly determined by the implant fixture (its length), which can be placed immediately or in a delayed fashion. A corticotomy length between two vertical bony cuts depends on the alveolar length of the edentulous area to be reconstructed. The shortest anterior– posterior (A-P) ridge length that is safe to reconstruct is about 7mm. The procedure performed on a ridge shorter than 7mm of height might be challenging and can compromise periodontal health of the adjacent teeth. It is always beneficial to attempt a papilla-preservation flap approach to keep the adjacent papillae and bone next to adjacent teeth roots intact. For the segmental RSP of a single edentulous area (one tooth missing, one implant planned), length–height corticotomy proportions can be remembered as a "7–8–9–10 rule" where a minimum of 7–8mm of bone length space between vertical cuts and a minimum of 9–10mm of bone height distance between horizontal ones are necessary for a single

implant of average dimensions. Finally, the width of the split needs to be considered. An operator should plan about the expansion of bone he/she would like to achieve. The final width of the ridge after the RSP is also ultimately defined by the diameter of an implant fixture that is planned to be placed for the area.

Summary

To summarise there are numerous techniques for patients with atrophic ridges like basal implants, zygomatic implants, all on 4, and ridge split. Depending upon the treatment plan, expertise and convenience a technique which gives a desired result can be selected to carry out the treatment.

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