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Basal Implants: A Possible New Alternative Treatment Modality for Atrophic Ridges

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Abstract

This article aims to review the literature of basal implants an alternative treatment modality with added benefits of ignoring unnecessary augmentation procedures for patient's with severely atrophic ridges. Which may lead the patient in jeopardize. The present systematic review states the advantages and effectiveness of the bicortical screw implant system over the traditional crestal implant system. Materials and Methods: Electronic and manual literature searches were conducted on databases: PubMed/Medline, Science direct for the studies and reviews published. Systematic literature review was performed. Conclusion: Development of basal cortical implant system gave a possibility for the patients with atrophic ridges for the replacement of lost teeth, adding to its advantage the cost effective treatment with positive results.

Keywords: Basal Implants, Crestal Implants, Immediate loading, Atrophic Ridge, BCS Implants, BOI Implants, KOS Implant.

Introduction

Submission of crestal implantology gave an opportunity to basal implantology to flourish, proving an amazing opportunity to the implantologists in treating cases unable to be treated with the conventional implant systems.[1]

Traditionally, the techniques used for the replacement of lost tooth require a two-stage surgical approach, involving a period of healing for the integration of implant with a transitional period during which the patient wears a temporary removable prosthesis.[2-5] Branemark and

colleagues have recommended a stress-free unloaded healing period to ensure the osseointegration of the endosseous implants.[6,7] High success rate for the immediate implant placement in an extraction socket is well documented.[8]

The conventional crestal implants are indicated when an adequate vertical bone height is available, as they are placed into the crestal alveoli of the jaw bone, whose main load transmitting surfaces are vertical. Though, the prognosis is not good as soon as the augmentation becomes part of the treatment plan. Ridge augmentation procedures tend to increase the risk, cost and number of surgical procedures. Thus patients with severely atrophic ridges paradoxically receive little or no treatment.[9] Basal implantology also known as bicortical implantology or just cortical implantology is a modern implantology system which utilizes the basal cortical portion of the jaw bones for the retention. They are uniquely designed and highly advanced implant system to be accommodated in the basal cortical bone. These basal implants are also known as lateral implants or disk implants.[9]

Bicortical screws (BCS) are also considered as basal implants as they transmit masticatory loads deep into the bone, usually into the opposite cortical bone. They provide some elasticity and are not prone to peri-implantitis due to their polished surface and their thin mucosal penetration diameter.[9,10] Screwable basal implants have been developed with 3.5mm to 12mm thread diameter and length of 10-38 mm.[9]

With respect to the accepted principle “primum nihil nocere”, i.e. limiting treatment, basal implants are the devices of first choice, whenever (unpredictable) augmentations are part of an alternative treatment plan.[9,10]

History of Basal Implantology

Back in 1952 a Swedish physician Dr. Per-Ingvar Branemark serendipitously discovered bone bonding properties of Titanium metal. The first ever Titanium Implant was placed in a patient in 1965. [7,10,11,12,23]

In 1972 Dr. Jean-Mark Julliet developed a single piece implant requiring no need of any homologous cutting instrument for its placement.

In mid-1980’s a French dentist Dr. Gerard Scortecci, invented and improved basal implant system with the matching cutting tools-disk implants.

Efforts have been made to improve more appropriate tools and new implant types since mid-1990’s giving rise to modern basal implantology. In this design, load transmission was supposed to take place both in the vertical and in the basal implant part.[1,13] Soon Dr. Stefan Ihde introduced bending areas in the vertical implant shaft. In 2005, the lateral basal implants were modified to screwable designs (BCS).[7]

Basal Implantology

Basal implantology also known as bicortical implantology or just cortical implantology is a modern implantology system which utilizes the basal cortical portion of the jaw bones for retention of the dental implants which are uniquely designed to be accommodated in the basal cortical bone areas. Since the basal implantology includes the application of the rules of orthopedic surgery, the basal implants are also called as “orthopaedic implants”[10] to mark a clear distinction between them and the well-known term “dental implant”. It has already been scientifically proven in orthopaeduc implants (Hip / Knee replacements). Immediate usage is suggested once the patient is fitted with the artificial implant. These basal implants are also called as lateral implants or disk implants. [1,4]

Conventional Crestal Implantology

Traditional crestal implants use the alveolar bone as a support, which is lost after tooth extraction & continues to decrease throughout the life due to functional loss. Crestal implants load-transmitting surfaces are vertical. For a successful implant placement there is need for sufficient bone availability (at least 13-15mm length, 5-7mm width).[2,19,20] Not fulfilling this criteria necessitate additional treatment planning which includes inlay or onlay alveolar grafts, nerve repositioning, sinus lift, nasal lift.[1,2,19] It is a common practice to insert screws of atleast 10-13 mm in length in the anterior mandibular region due to sufficient vertical bone. Although, they are contraindicated in atrophic ridges. [20]

Rationale of Using Basal Implants

Alveolar bone, which is less dense bone of the jaw, comprises the teeth, also known as crestal bone. Once the teeth are lost, this crestal bone starts to resorb with due course of time. Thus, leaving a highly dense, corticalized basal bone beneath it, which is less prone to resorption and infection. Basal bone offers excellent support for long term to the dental implant. Furthermore, the load- bearing capacity of the cortical bone is way more than the spongious bone. [20]

Types of Basal Implants [22]

There are four types of basal implants available based on Morphology:

1. Screw Form
2. Disk Form
3. Plate Form
4. Other Forms

Screw Form

a) Compression screw design (KOS Implant)
b) Bi-Cortical Screw Design (BCS Implant)
c) Compression Screw + Bi-Cortical Screw Design (KOS Plus Implant)

Disk Form

Basal Osseointegrated Implant (BOI) / Trans-Osseous Implant (TOI) / Lateral Implant

1. According to the abutment connection:
a. Single Piece Implant
b. External Threaded Connection
c. Internal Threaded Connection
    - External Hexagon
    - External Octagon
2. According to basal plate design:
a. Basal disks with angulated edges
b. Basal disks with flat edges also called as S-Type Implant
3. According to number of disks:
a. Single Disk
b. Double Disk
c. Triple Disk

Plate Form

a. BOI-BAC Implant
b. BOI-BAC2 Implant

Other Forms

a. TPG Implant (Tuberopterygoid)
b. ZSI Implant (Zygoma Screw)

The BOI and BCS Implants has a smooth and polished surface due to the fact that the polished surfaces are less prone to inflammation (mucositis, Peri-implantitis) rather than the rough surfaces.[21,22,23,24] while the KOS and KOS Plus implants are surface treated (sand and grit blasting with acid etching), though the implant neck is polished. In KOS Plus implant the neck and basal cortical screw part are polished.[21,22]

BOI (Lateral Basal Implants) (Figure 1)

They are manufactured either from pure Titanium or from Titanium Molybdenum in order to enhance the strength of the implant, having the following parts: [21]

1. Abutment portion

2. Neck
3. Vertical shaft
4. Crestal Disk
5. Basal Disk

These are inserted into the jaw bone from the lateral aspect. The masticatory load is restricted to the horizontal segment of the implant, fundamentally to the cortical bone. [7,25]

Anterior Implants

For the anterior jaw bone region, if the vertical bone is sufficiently available, two disk implant are commonly used (consisting of basal disk and crestal disk). The basal disk has a diameter of 9 or 10 mm, however the crestal disk is 7 mm in diameter. The crestal disk has the purpose to provide additional stabilization untill, the basal disk has ossified to its full load bearing capacity. In case of insufficient vertical bone available, a single disk implant is inserted having 7-9 mm diameter and shafts between 8 to 13.5 mm. [7,25]

Posterior Implants

The implant placed in the posterior region, have square shape (disk size 9 to 12 mm or 10 to 14 mm) with shafts of 10 to 13.5 mm in length. If the vertical height of available bone is 2 mm above the mandibular nerve, an infra-nerve implant placement (also known as Infranerval/ Infraneural Implantation Technique) (Figure 2) is indicated (disk is inserted below the nerve with the threaded carrier located at the side of the nerve). [7,9,20,21,25,26,54]

BCS Implant (Bicortical Screw) (Figure 1)

BCS Implants are the single piece implants with a little modification in design from BOI Implant, which is the abutment and the implant portion. The abutment is available in various forms, such as conical straight, conical angled, multi-unit abutments. In contrast with the BOI, BCS implant has wide diameter cutting screws helpful in engaging the buccal and palatal/lingual cortical plates, providing primary stability with load bearing capacity.[19,22,23] Due to their polished surface and thin mucosal penetration diameter, BCS are not prone to peri-implantitis.[21,27]

Parts of BCS Implant: [25]

1. Implant surface
2. Implant body
3. Implant neck

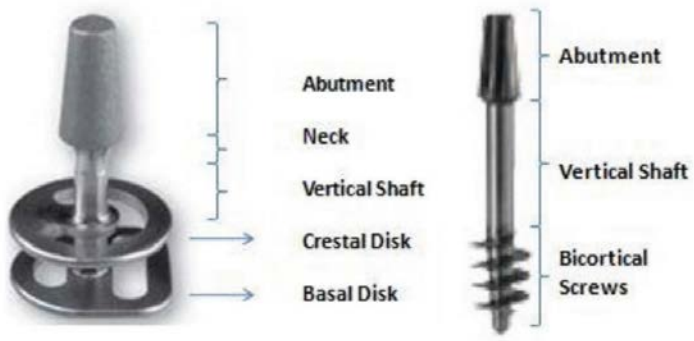

Figure 1: Single Piece (MONOBLOC) [21]

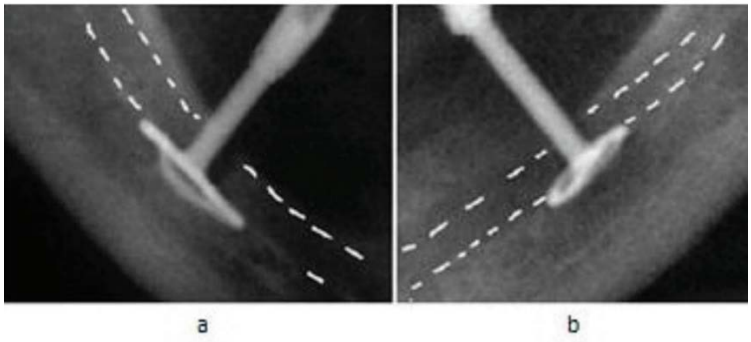

Figure 2: A And B Shows Infranerval/ Infraneural Implantation of Basal Disk Implant (Dotted Line Represents I.A Nerve) Kos And Kos Plus Implant (King Of Single Piece Basal Implant) [28]

These single piece implants are manufactured from Titanium Molybdenum or Titanium Aluminum Vanadium alloy, designed like compression screws (i.e. when inserted into the bone, they compress the cancellous bone around the implant to form more dense and compact bone).[8,22,30] [Figure 3]

1. Abutment

2. Neck
3. Implant portion

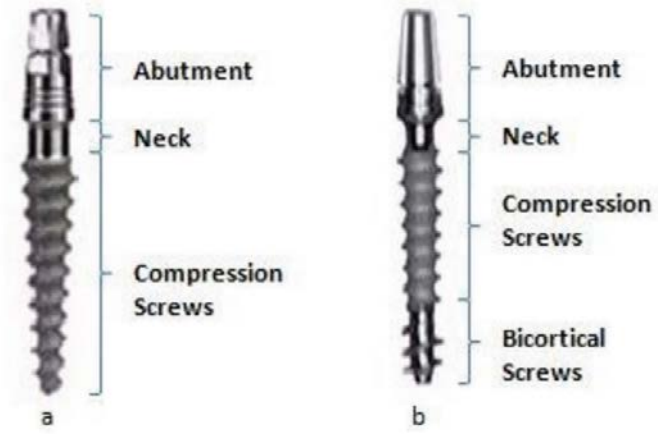

Figure 3: (A) Kos Implant With Compression Screws (B) Kos + Implant With Compression And Bicortical Screws [21]

Discussion

As the basal implants attain high primary stability, immediate loading of basal implants can be done. [20] Basal bone refers as the osseous tissue of the mandible and maxilla beneath the alveolar process. The fact that the implants inserted in basal bone can be immediately loaded with prosthesis has been scientifically proven, in case of orthopaedic implants (Hip / Knee replacements). Patient is advised to begin the use of the artificial joint immediately. [25]

Izchak Barzilay et al. (1993) [30] concluded that immediate implants are implants placed into a prepared extraction socket following tooth removal and are comparable to implants placed in healed bones. This procedure reduces the surgical sessions, eliminates the waiting period for socket healing, reduces cost as well as preserves the bone height and width.[19]

Cesar G Luchetti et al. (2009) [31] used a septal expansion technique for placement of immediate implants in maxillary molars without bone grafting substitutes. They found minimal bone loss and demonstrated promising results in osteointegration of implants.

These screwable basal implants are flapless implants and are inserted through gingival crest, without giving a single cut after extraction of teeth. Bicortical screws (BCS) are also considered basal implants, because they transmit masticatory loads deep into the bone, usually into the opposite cortical bone, while full osseointegration along the axis of the implant is not a prerequisite. BCS provide initially some elasticity and they are not prone to peri-implantitis due to their polished surface and their thin mucosal penetration diameter.[16]

Laurens den Hartog et al. (2008)[32] **and Stelios Karamanis et al. (2008)**[33] compared immediate implant placement with conventional delayed implants in aesthetic zone. He concluded that promising short-term results could be achieved with immediate implants in the aesthetic zone.

One-piece dental implant is better in comparison with two-piece dental implant, as there is no microgap formation between the implant and abutment, with additional advantage of less vertical and crestal bone loss.[34,35] the basal bone resorption is last to begin due to high bone density and muscle stimulation.[34,36] Some studies showed that use of immediate loaded implants for single tooth has a success rate of 99%.[34,37,38]

Maria A. Peñarrocha et al. (2011)[39] evaluated bone healing by placing immediate implants in fresh extraction sockets. They found that there is enhanced bone healing and minimal bone loss. The authors also concluded that the osseointegration in immediately placed implants is better than delayed implants during the same healing period.

Kopp S et al (2008)[40] in a study compared the outcome after exclusive use of basal implants for treating patients in healed jaw bone regions and at immediate extraction sites. The implants placed immediately in alveoli of extracted teeth showed a higher survival rate (97.7%) than

those placed in healed bone (95.6%). These results indicate that the immediate placement of basal implants even in infected extraction sockets under real immediate prosthetic loading conditions is a safe and effective way of treatment. Waiting for the healing of the socket after extraction does not improve the success rate of BOI implants and may be generally avoided.

The basal implantology utilizes the basal bone which is resistant and structurally stable. Thus, in the mandible the structurally stable areas are the basis and symphysis region. While in the maxilla the existing structurally stable areas are nasal spine, the mesial and distal parts of maxillary sinus, the palatal process of the maxilla and the pterygoid plate (where the sphenoid bone is connected to the maxilla). [41,42]

Chandana Nair, Swarajya Bharathi, Rashmi Jawade, Meenu Jain (2013)[7] discussed the value of using basal implants in atrophic alveolar ridge cases. They concluded that immediate loading of laterally inserted disk-design implants with a fixed, functional prosthesis is a safe and reliable method for management of the completely edentulous maxilla and mandible. With respect to the accepted principle “primum nihil nocere”, i.e. limiting treatment, basal implants are the devices of first choice, whenever (unpredictable) augmentations are part of an alternative treatment plan.

Aleksandar Lazarov (2013)[43] described the treatment steps to resolve a case of conventional dental implant failure with the help of basal implants and conventional bridges. By utilizing the remaining corticals (lingual, vestibular, basal) immediate implant treatment was possible, although a large vertical bone groove had developed due to the failure of three implants on the right mandible of the patient. Due to the usage of basal implant, bone augmentations and healing (waiting) times were avoided.

Vivek Gaur (2013)[6] did full mouth rehabilitation of a 64 year female patient with basal implants. The treatment opted was extractions and implant placement in a flapless immediate procedure, followed by a fixed implant prosthesis.

Immediate functional loading with a semi-permanent fixed bridge within three days. In the upper jaw 12 BCS implants were placed flaplessly utilising all the available zone of maxilla engaging in the second corticals, using hand-grip insertion tools. In the lower jaw 8 BCS and 2 KOS implants (compression screws) were placed. On day 3 the case was completed with two metal-to-ceramic prostheses, providing bilateral balanced occlusion with occlusal contacts from distal surface of the canine to the mesial half of the first molars. He concluded that, Basal implantology allows successful treatments independent of preoperative periodontal involvement, extractions and the available bone supply.

Idhe S (2009)[10] suggested that the term “basal implant” refers to the principles of utilizing basal bone areas free of infection and resorption, and the employing of the cortical bone areas. This rationale stems from orthopaedic surgery and from the experience that cortical areas are needed in the structure, therefore, are resistant against resorption and reconstitute itself easily. At the same time, load bearing capacities of the cortical bone are many times higher than those of the spongious bone. In basal implants, the vertical implant parts (which connect the base plate(s) with the abutment) do not participate in load transmission to bone primarily, and that is why they are provided thin and polished. Lateral basal implants which are inserted from the lateral aspect of the jaw bone, provide a disk-diameter of 7mm or more, and are inserted through a T-shaped slot into the jaw bone (the T-shape slot is inverted in the mandible). Screwable basal implants (BCS brand) have been developed with up to 12mm thread diameter that can

be inserted into immediate extraction socket. The polished smooth surface especially in the area of gingival penetration is a built-in prophylaxis that makes peri-implantitis preventable forever.

Vineet Bhatia, Kapil Jain, Sumit Narang, Anu Narang (2014)[44] presented a case report that highlighted the placement of three bicortical screw (BCS) implants into fresh extraction sockets and one KOS implant in edentulous area with flapless technique. All the implants were immediately loaded and followed up for a period of 6 months. Satisfactory primary stability was achieved with all the four implants and immediate orthopantomogram (OPG) showed good parallelism as well. All these implants were immediately loaded at 1 day interval. The OPG taken 6 months postoperatively showed good healing at the implant-bone interface.

An adequate amount of data is accessible to confirm the certainty of implant placement in a fresh extraction socket as an alternative option to the implant placement in a healed socket.[45,46,47] This necessitate the need to have an implant stability similar to that when placed in a healed site. Various studies on animal models have shown that the dimensions of peri-implant soft tissues remain within the biological limit and are also not negatively influenced by the immediate loading.[45,48,49,50] Mijiritsky et al.[45,51] in their study researched the long term survival of single tooth implants placed in fresh extraction socket with a follow-up period of 6 months. An overall implant survival rate of 95.85% was observed, with a conclusion that successful osseointegration can be achieved with immediate loading implants in a fresh extraction socket.

Considerations for Atrophied Ridges

Replenishment of atrophied ridges presents a challenging situation. Treating such cases includes extensive planning such as pre-prosthetic surgery. Basal implantology does not require the need for extensive surgeries. Certain questions arises: [20]

1. "Should we load or not"?? [9,20,21,53]

The cranial bone is considered permanently in a state of torsion i.e. constant lateral stresses acting on the cranial bone at all times due to the action of attached facial muscles. As a matter of fact the there is no such thing as unloaded implant, there will always be lateral forces acting. Thus the basal implant can be left as it is or can be loaded immediately, after 3 days, one week , 6-8 weeks or the temporary restoration can be done for 3-6 months which is followed by permanent prosthesis.

2. "Which jaw to restore first maxilla or mandible"?? [20, 21]

Maxilla (stationary) and mandible (mobile) are the two components of the stomatognathic system, the role of the mobile component is to apply forces and to absorb for the stationary component. Thus, the mandible should be restored first as the fixed rehabilitation does not alloy the associated facial muscles to loss their tonicity.

Two Schools of Thought; For Restoration of Atrophied Ridges

Atrophied Mandible

Concept of French School (Multiple- Implant Concept)

Scortecci founded this concept, suggesting placement of multiple basal implants in the mandible (7-12 implants). According to this school the basal and the crestal implants are inserted in combination resulting in a rigid restoration that does not allow any torsion across the mandible and the the jaw system to reorient forces. As a matter of fact, it is not possible to cease the mandibular torsion, there is generation of excessive forces over the implant body resulting into overload osteolysis and implant failure.[20, 21, 23]

Concept of German School (Strategic Implant positioning concept) [9,20,21]

Dr. Ihde was the founder of this concept. He proposed placement of 4 implants in the canine and premolar regions, permitting mandibular torsion and reorientation of forces, which is thereby compensated by flexibility of the prosthesis, thus, avoiding osteolysis and implant failure.

Atrophied Maxilla: [9,20,21,23,55]

Restoration of resorbed maxilla is quite a tough task, due to the porous bone and pneumatized sinus. The porous bone is handled with the compression screw implants, however the there are alternative techniques for sinus:

Sinus Section Technique: Basal disk placement is done by sectioning two/three walls of the sinus. With this technique only one implant can be placed in each sinus. The only aim of this technique is to gain bicortical support (Figure 4).

Tuberopterygoid Screws (TPG): These are the type of implants are placed in the pterygoid bone, in conjunction with the sinus section technique with an angle of 20º- 45º in the bone, angulation between BOI and TPG not exceeding 90º, which may increase difficulty in prosthesis placement (Figure 5a).

Zygomatic Screw Implant (ZSI) : Like BCS implant, these are placed in the zygomatic bone, having sharp edged cortical screws for gaining the bicortical bone support (Figure 5b).

Cortically Fixed @ Once: Dr. Henri Diederich in 2013 introduced a protocol based on basal cortical implantology. These implants are known as sub-periosteal implants. These have an appearance of a mini plate (used for fracture reduction) with an abutment platform. Adding to this advantage is that the number of holes can be reduced as per the requirement, the isoelasticity to mimic bone, ability to be bent and adapt to bone using bone expanding mini screws. Till date has shown good results, still require more clinical trials. [20,56,57]

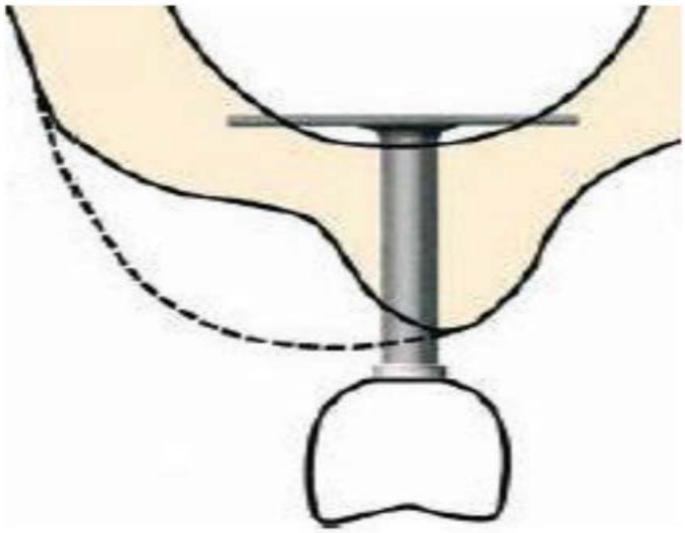

Figure 4: Sinus Section Technique

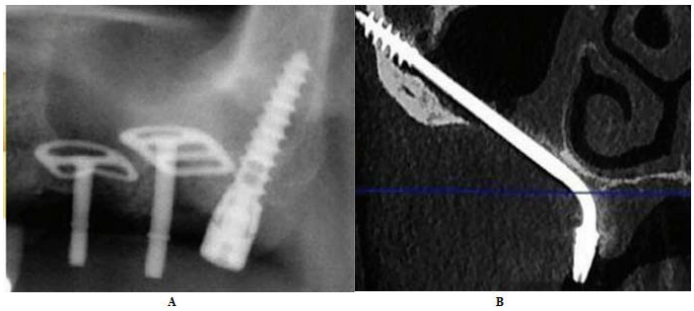

Figure 5: (A) Tpg Implant Insitu (B) Zygoma Implant Insitu

Table 1: Indications & Contraindications Of Basal Cortical Implants [1]

Indications	Contraindications
When bone grafting has failed(2 stage surgery)	Patient on drug therapy like Cancer drugs, anti-blood clotting drugs such as warfarin & bisphosphonates (a class of drugs used in the treatment of osteoporosis)
In atrophic jaw bone • With insufficient bone height • With insufficient bone width	Systemic Conditions such as Recent MI (heart attack), immunosuppression, cerebrovascular accidents (stroke)
When several teeth are	Cases where bilateral equal

missing, complete edentulous mouth, numerous teeth are to be extracted.	mastication is not possible (when muscles of mastication or their innervations are partially missing)
It can be placed in already infected sockets.	

Advantages of Basal Cortical Implantology [1]

Immediate loading

Single piece implant system

Basal bone support

Minimally invasive, minimal surgical complications

Advance option for atrophic ridges

Eliminate the threat of peri-implantitis (98%)

Medically compromised patients (controlled diabetics, smokers, periodontitis)

Cost effective

It avoids the phenomenon of stress shielding (as both bone & implant are visco-elastic)

Disadvantages of Basal Cortical Implantology [1,12, 44,52]

Technique sensitive procedure

Functional overload osteolysis : Local microcracks in the cortical bone may be created via masticatory forces transmitted through the basal implants. Through a process known as “remodeling” these microcracks are repaired by the osteotomes, which in turn temporarily reduces the degree of mineralization and increasing the porosity of bone. Therefore, if the loads are reduced adequately, the basal implants have a good chance of reintegration.

Conclusion

With the development of basal cortical implant system a new era of tooth replacement has began, giving a possibility for the patients with atrophic ridges, adding to its advantage the cost effective treatment with positive results, lesser time span, immediate loading of prosthesis for esthetically concern and functionally compromised patients, without going through the unnecessary augmentation procedures. Since dental implantology became unpredictable and expensive, when the augmentation becomes part of the treatment plan, basal implants become patient’s first choice.

Declaration of Patient Concent

The authors certify that they have obtained all the appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their/images and other clinical information to be reported in the journal. The patient(s) understand that their name and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be granted.

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