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The BIG B of Implant Dentistry - Basal Implants: A Narrative Review

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ABSTRACT

Conventional implant-based restoration of jaws with moderate to severe atrophy necessitates extensive and costly surgical procedures. Additionally, it involves considerable post-operative discomfort and offers no guarantee of success or desired rehabilitation outcomes. However, basal implants have emerged as a viable solution in such cases. These implants are specifically designed to provide fixed rehabilitation in severely atrophic jaws, and there are various implant designs available that offer flexibility to accommodate any situation. Implant insertion is a challenging procedure in rehabilitating atrophied edentulous jaws. Today, several bone augmentation procedures, such as ridge augmentation and sinus lift, are possible, but they increase the risks and costs associated with dental implant treatment, as well as the number of required operations. Unfortunately, patients with severely atrophied jawbones often receive minimal or no treatment. Basal implants rely on the basal bone, which is typically free from infection and less susceptible to resorption, to provide support and stability. The present narrative review article provides a comprehensive explanation of the basal implant systems.

Keywords: Basal implant; Basal implantology; BCS implant; Basal osseointegrated implants (BOI); Bone multicellular unit (BMU); Disk Implant; Osseoadaptation

Introduction

Implant-based restoration of edentulous maxilla or mandible has become a common and predictable treatment nowadays. Adequate bone availability is crucial (at least 13-15mm length and 5-7 mm width) for trouble-free and successful implant placement. If this criterion is not met, the treatment planning for implant placement becomes more challenging. Restoring lost alveolar dimensions through procedures like inlay or onlay alveolar grafts, nerve repositioning, sinus lift, and nasal lift becomes necessary for a predictable and successful treatment outcome. Without these procedures, conventional implants may not yield satisfactory results[1].

Such lengthy surgical treatments do, however, offer their own set of benefits and risks. Changing the implant design is a different approach for replacing missing teeth in atrophic jaws in order to avoid these surgeries. Mini Dental Implants and Basal Implants are two effective implant designs and protocols that have been shown to work for atrophic jaws[2].

For implant retention, basal implants use the basal cortical region of the jaws. These implants have undergone numerous revisions throughout the years and are specifically made to gain anchorage from the basal cortical bone. Modern basal implants have a complex yet straightforward design, a straightforward surgical procedure, and prosthetic-friendly systems. As a result, basal implantology has been adopted by numerous practitioners across the globe with generally positive results. This essay seeks to present a thorough analysis of this distinctive implant and provide insights into the basal implantology philosophy[3].

Endosseous implants come in the form of cover screws, cylinders, and blade implants. While the anterior mandible generally has sufficient vertical bone height to accommodate a 10-13mm screw, this design cannot be applied to patients with severely resorbed mandibular ridges. Consequently, basal implantology was developed, involving the placement of implants in the basal cortical bone, which provides excellent quality cortical bone for retaining these advanced implants. Basal implants are also referred to as cortical or biocortical implants, and they follow the principles of orthopedic surgery. They are also known as disk or lateral implants. Another significant advantage of using the basal cortical bone for these implants instead of the alveolar bone is the ability to load the stress-bearing area of the implant site immediately with teeth. Basal implants provide multicortical support, ensuring primary implant stability in dense native bone[4].

Evolution

Basal implants have undergone several stages of development and improvement, primarily by German and French dental surgeons. In 1972, Dr. Jean-Marc Julliet introduced the first single-piece implant, which continues to be used successfully to this day. However, one disadvantage was the absence of a surgical kit[5]. In the mid-1980s, French dental surgeon Dr. Gerard Scortecci enhanced the basal implant system by introducing matching surgical tools, external and internal connections for the prosthetic superstructure, which he named "Diskimplants"[6].

German dental surgeons improved upon Dr. Gerard Scortecci's Diskimplant concept by creating new implant systems and surgical instruments, which resulted in the creation of the contemporary Basal Osseointegrated Implant (BOI), also referred to as the "Lateral Implant"[7]. The transmission of masticatory loads in both the vertical and basal regions was made easier by the design of these implants.

In 1997, Dr. Stefan Ihde started producing Diskimplant-like lateral basal implants[7]. These lateral implants were initially only available in a few sizes and forms, and their surfaces were roughened. However, improvements were made over time. Round base plates were modified to include edges, preventing early rotation of the implants in the bone before integration. In 2002, fracture-proof base plates were invented and later patented, and bending zones in the vertical implant shaft were introduced. Screwable designs (BCS, GBC) were introduced in 2005[8].

The vertical shaft surfaces of the implants were polished in 1999. Since 2003, the entire basal implant has been produced with polished surfaces. Polished surfaces exhibit no tendency for inflammation, and in the case of sterile loosening, implant reintegration is possible if the load is adjusted in a timely manner. This structure was created to have just the right amount of flexibility for bone growth and functional stimulation[9].

Reasons Why Basal Implants are Used

The tooth-bearing alveolus or crestal section and the basal bone are the two components of the jaw bone, according to the basal implantology theory. The crestal bone is less dense and more susceptible to infections, injuries, and resorption, while the basal bone is heavily corticated, rarely subject to infections and resorption, and offers excellent support to implants. The load-bearing capacity of the basal bone is much higher than that of the spongy crestal bone. This rationale is derived from orthopedic surgery, where cortical areas are known to be resistant to resorption, leading to the designation of basal implants as "Orthopedic Implants"[10].

There are four standard varieties of basal implants[11].

I. Screw Form

- Compression Screw Design (KOS Implant)
- Bi-Cortical Screw Design (BCS Implant)
- Compression Screw + Bi-Cortical Screw Design (KOS Plus Implant)

II. Disk Form

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

1. According to abutment connection:

- Single Piece Implant
- External Threaded Connection
- Internal Threaded Connection (External Hexagon or External Octagon)

2. According to basal plate design:

- Basal disks with angled edges
- Basal disks with flat edges (S-Type Implant)
- 3. According to the number of disks:
- Single Disk
- Double Disk
- Triple Disk

III. Plate Form

- BOI-BAC Implant
- BOI-BAC2 Implant

IV. Other Forms

- TPG Implant (Tuberopterygoid)
- ZSI Implant (Zygoma Screw)

The morphology of basal implants varies depending on the type. The BOI and BCS implants have smooth and polished surfaces to reduce inflammation, while the KOS and KOS Plus implants have surface treatments and highly polished necks. The BOI implant can be single piece or two-piece, with an exposed conical abutment portion. The BCS implant is a single piece with wide diameter cutting screws for primary stability and load-bearing capacity. The KOS and KOS Plus implants are compression screw designs, with different abutment options and highly polished necks[12].

Indications of basal implants[13].

1. Situations where multiple teeth are missing or require extraction.
2. A two-stage implant insertion or bone augmentation treatment that fails.
3. All types of bone atrophies, including very thin ridges and insufficient bone height.

Contraindications of basal implants[14].

1. Heavy bruxism, clenching, or uncontrolled malocclusion, especially if associated with psychological problems.
2. Use of high-dose IV bisphosphonates for severe osteoporosis or cancer treatment (risk of osteonecrosis of the jaw).
3. Facial and trigeminal neuropathies associated with a depressive state or epilepsy.

4. Severe heart disease, recent stroke, or heart attack (risk of infective endocarditis), uncontrolled diabetes, untreated renal insufficiency.
5. Ongoing radiotherapy for cancer (risk of osteoradionecrosis of the jaw, especially after radiation of the head and neck region).
6. Age less than 15 years.
7. Allergies or hypersensitivities to chemical ingredients of the implant material, such as titanium alloy (Ti6Al4V6).
8. Certain diseases of the oral mucous membranes.
9. Unbalanced relationship between upper and lower teeth, poor oral hygiene, or infections in neighboring teeth.
10. Infections in the neighboring teeth, pockets, cysts, granulomas, major sinusitis.

Benefits of basal implant[15].

1. Prosthesis can be fixed within 72 hours of implant surgery, saving time and costs significantly.
2. Basal implants take support from the resistant basal bone, which has a faster and stable repairing capacity.
3. Basal implants utilize available bone without the need for bone augmentation procedures.
4. They work well in controlled diabetics, smokers, and patients with chronic destructive periodontitis.
5. Cost savings by avoiding bone grafts and second-stage surgery, as well as a reduction in total treatment time.
6. Smooth surface of basal implants helps avoid peri-implantitis.

Shortcomings of basal implants[16].

1. Compromised aesthetics in single-tooth replacements.
2. Skilled surgeons with sound anatomical knowledge are required for successful surgery.
3. Excessive bone reduction may be needed in cases of good bone support.
4. Improper load distribution can lead to overload osteolysis.

Surgical Technique

Unlike conventional implants, basal implants have a simpler surgical approach. The technique does not involve extensive drilling of the bone, reducing the risk of thermal injury. During the surgery, external irrigation is used, and a single pilot osteotomy with a "Pathfinder Drill" is usually sufficient for KOS, KOS Plus, and BCS implants. Manual drills are also available in the kit for controlled osteotomy preparation.

Basal implantologists do not recommend raising a flap for these implants. Raising a flap decreases blood supply, and due to the design of basal implants, raising a flap is unnecessary. Additionally, considering the immediate loading of these implants, a sutured site is not ideal for receiving an immediate prosthesis[17].

For the BOI implant, the approach to the bone involves raising a flap laterally and creating a "T" shaped osteotomy by cutting into the bone with disk drills of the required size. The implant is then placed laterally, and the flap is closed over it.

Peri-Implant Healing[18]

In basal implantology, the healing process around the implants is referred to as "Osseoadaptation," which is different from what conventional implantologists call "Osseointegration." Osseoadaptation refers to the continuous remodeling and adaptation of bone over the surface of the implant due to continuous functional loads. This remodeling of bone under functional loads is considered the "4th Dimension" in basal implantology.

A "Bone Multicellular Unit" (BMU) is said to be responsible for the Osseoadaptation process in accordance with the idea of basal implantology. The BMU is described as a cutting cone with a tail, where the osteoclastic cells in the cutting cone eat away the peri-implant bone, while the osteoblastic cells in the tail lay down new bone. As this unit moves through the bone, osteoclastic activity is followed by osteoblastic activity, leading to the remodeling and healing of bone around the implant.

The cascade of processes involved in Osseoadaptation is as follows:

I. Activation Phase: This stage lasts three days and involves progenitor cells or human mesenchymal cells.

II. Resorption Phase: Osteoclastic activity takes place during the second phase of bone resorption, leaving behind soft, porous bone. Around 40 m/day is the osteoclastic activity rate.

III. Reversal Phase: Osteoblastic activity occurs in the third phase, known as the reversal phase. In the haversian canals, osteoblasts deposit new bone at a pace of 1-2 m/day.

IV. Progressive Phase: In the haversian canals, osteoblasts create concentric lamellae, which reduce the diameter of the canal and enhance bone density. At this point, the haversian canal has a 40–50 m diameter. This phase lasts for three months and results in non-mineralized osteoid bone formation.

V. Mineralization Phase: The mineralization phase starts after ten days of osteoid development. It involves the basic and secondary processes of mineralization, giving the bone its ultimate shape and hardness. This stage lasts for six to twelve months.

VI. Dormant Phase: Osteoblasts transform into osteocytes and line the haversian canals during the sixth phase of dormancy, when they perform mechanical, metabolic, and homeostatic tasks.

Throughout these phases, the implants are subjected to functional loads, which continuously stimulate the BMU over the life of the implant. This stimulation leads to the densification and adaptation of peri-implant bone over the implant surface, giving rise to the term "Osseoadaptation" and the concept of the "4th Dimension" in basal implantology.

In simple terms, peri-implant healing in basal implants is a lifelong process that utilizes the concept of micro-motion and bone compression. This is why basal implants are also referred to as "Orthopedic Implants" because they employ similar principles of peri-implant healing and bone densification. However, for surface-treated implants like KOS and KOS Plus, peri-implant healing follows the concept of osseointegration, where remodeling is also a lifelong process.

Basal Implants for Atrophied Ridges[19-23]

Using fixed or detachable prostheses, prosthodontists may find it difficult to restore atrophied ridges. In conventional implantology, ridge augmentation is often necessary to provide adequate dimensions for implant placement. However, basal implantology eliminates the need for extensive surgeries and can be used in combination with any implant and in any size.

When rehabilitating atrophied maxilla and mandible, several factors are considered:

I. General Systemic Considerations: Basal implantologists consider recent myocardial infarction, cerebrovascular accident, immunosuppressant therapy, chemo and/or radiotherapy, and bisphosphonate therapy as potential concerns. Diabetes is not a major issue as long as blood sugar levels are well-controlled, and smoking status does not significantly affect treatment.

II. Biomechanical Considerations: Basal implantology does not rely on the bone density grades proposed by Dr. Carl E. Misch, as the drilling sequence and placement method are different. Measuring bone density is also not relevant, as the parameters may change upon insertion and loading of the implant. Stress shielding, a phenomenon where the implant absorbs most of the load, is avoided due to the viscoelastic nature of both the bone and the implant.

III. To Load or not to Load: Basal implantology recognizes that cranial bone is constantly subjected to lateral stresses due to the action of facial muscles. Therefore, there is no such thing as an "unloaded" implant, as lateral forces always exist. Basal implants can be left without a superstructure until the completion of the healing phase, or they can receive a superstructure immediately, after 3 days, 1 week, 6-8 weeks, or temporary restoration can be done for 3-6 months followed by definitive restoration.

IV. Which Jaw to Restore First: Considering the role of the maxilla as the stationary component and the mandible as the mobile component of the stomatognathic system, it is recommended to restore the mandible first. Conventional mandibular dentures resting on an atrophied foundation are unstable, which causes poor chewing performance and muscular atrophy. Fixed rehabilitation stays clear of these problems.

V. Treatment of Atrophied Ridges:

a. Atrophied Mandible: Regarding implant restorations in the atrophied mandible, there are two schools of thought. The Multi-Implant Concept of the French School favors a larger number of basal implants (7-12) combined with crestal implants, which may lead to implant failure due to excessive forces caused by mandibular torsion. According to the German School's Strategic Implant Positioning Concept, four implants should be placed, preferably in the canine and second molar regions, to allow for mandibular torsion and force reorientation and prevent overload osteolysis and implant failure. The Infraneural Implantation Technique allows placement of BOI implants below the inferior alveolar nerve without the need for extensive procedures.

a. Atrophied Maxilla: Implant placement in the resorbed maxilla is challenging due to the pneumatized sinus and porous bone. Compression screw implants address porous bone, while two techniques are described for managing the sinus. In order to make it easier to install the basal disc, the sinus is sectioned along two or three of its walls using the sinus split technique. The surgeon has the option of lifting the sinus membrane and grafting. To give the prosthesis more support, the Tuberopterygoid (TPG) Screws are inserted into the pterygoid bone. The Sinus Section Technique can be combined with these. Bi-cortical support is also offered by Zygomatic Screw Implants (ZSI), which are inserted with cortical screws that have sharp edges in the zygomatic bone.

a. Dr. Henri Diederich developed the Cortically Fixed @ Once procedure, which attempts to restore atrophic jaws without the need of augmentations. It involves the use of plate-form implants with a flexible, surface-adaptive abutment platform. Bone-expanding micro screws are used to secure the implants to the bone. This basal cortical implantology-based technique has produced encouraging outcomes, but more clinical study is needed.

These considerations and techniques guide the rehabilitation of atrophied ridges in basal implantology, providing options for restoring function and aesthetics to patients with compromised bone structures.

Prosthetic Rehabilitation[24-26]

Prosthetic rehabilitation's main objectives are aesthetics, encouraging good oral hygiene habits, and preventing overload osteolysis. Esthetics can be addressed by following the three FPs (Form, Position, and Color) recommended by Dr. Carl E. Misch. Overload osteolysis, which refers to the excessive bone loss around implants due to overload, can be prevented by implementing appropriate occlusal schemes.

Various occlusal schemes can be utilized to distribute forces evenly and minimize stress on the implants and surrounding bone:

1. Bilateral Balanced Occlusion: This occlusal scheme aims to achieve simultaneous bilateral contact of the teeth in both static and dynamic occlusion. It provides stable occlusal contacts and balanced forces during chewing movements.
2. Group Function Occlusion: In this occlusal scheme, occlusal contacts occur predominantly on the posterior teeth in the working side of the jaw. The anterior teeth disengage during lateral movements, and the posterior teeth distribute the occlusal forces.
3. Mutually Protected Occlusion: This occlusal scheme emphasizes the protective role of the anterior teeth. The anterior teeth provide guidance and disengage the posterior teeth during lateral excursions, minimizing lateral forces on the implants.
4. Lingualized Occlusion: This occlusal concept combines the stability of bilateral balanced occlusion with the protective guidance of the anterior teeth. The posterior teeth have occlusal contacts on the lingual cusps, reducing the lateral forces on the implants.

Complications

Complications that can arise during prosthetic rehabilitation include temporary and more persistent symptoms:

Pain, swollenness, phonetic trouble, and gingival irritation are examples of temporary symptoms.

More persistent symptoms can include chronic pain related to implants, permanent paraesthesia (persistent altered sensation), dysesthesia (abnormal or uncomfortable sensation), loss of maxillary/mandibular ridge bone, localized or systemic infections, oro-antral or oro-nasal fistulae (abnormal connections between the oral cavity and the sinus/nasal cavity), unfavorable effects on adjacent teeth, implant fracture, jaw/bone/prosthesis/aesthetic problems, nerve damage, prosthesis failure, and hyperplasia (excessive tissue growth)[27].

Proper diagnosis, treatment planning, meticulous surgical techniques, and appropriate prosthetic design, along with regular follow-up care and maintenance, can help minimize the occurrence of complications and ensure successful prosthetic rehabilitation.

Conclusion

Basal implantology has emerged as a viable option for restoring atrophied jaws due to its unique features and advantages. These implants have undergone extensive research and development, making them suitable for cases where extensive bone augmentation is not required. They allow for immediate loading and can be placed using a flapless technique, minimizing surgical invasiveness. Additionally, basal implants can be combined with any other implant system, providing flexibility in treatment planning.

Despite the success reported in various cases, basal implants have faced skepticism from conventional implantologists. More research, development, and concrete data from clinical cases are needed to establish their efficacy as a reliable alternative to conventional implants.

However, it is important to note that basal implantology aligns with the principle of "Primum Nihil Nocere" or "First Do No Harm." These implants offer a solution that avoids extensive surgical procedures associated with conventional approaches. In certain cases, unconventional solutions can provide the best outcomes.

Conflicts of Interest

This study does not have any conflict of interest.

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