BASAL IMPLANTS

Dr. Manisha Balasubramanyam

Medical and Research Publications

Basal Implants

Written by

Dr. Manisha Balasubramanyam

(MDS, Periodontics)- Researcher, Literature Search, Manuscript Writing

Department of Periodontics, Vokkaligara Sangha Dental College and Hospital, Bangalore.

Dr. Rekha Jagadish

Associate Professor

Department of Periodontics, Vokkaligara Sangha Dental College and Hospital, Bangalore.

Dr. Sandeep JN

Reader/ Associate Professor

Department of Periodontics, Vokkaligara Sangha Dental College and Hospital, Bangalore.

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ABBREVIATIONS

BOI	Basal Osseointegrated Implants
BCS	Basal Cortical Screw Implants
TOI	Trans-Osseous Implant
TPG	Tubero-pterygoid Implant
ZSI	Zygoma Screw Implant
KOS	King Of Single Piece Implant
KOC	King of Compression Implant
EDI	External Design Implant
IDI	Internal Design Implant
TCP	Tricalcium Phosphate
HA	Hydroxyapatite
PRF	Platelet Rich Fibrin
BMU	Bone Multicellular Unit
GBR	Guided Bone Regeneration

INTRODUCTION

The dental system is an integral part of the oral cavity, which helps in masticatory function and nutrient intake. The most common cause for tooth loss in patients is due to periodontitis followed by dental caries, trauma, genetic defects and disorders. The goal of modern dentistry is to restore normal contour, function, comfort, esthetics, speech, regardless of atrophy/disease/injury of the stomatognathic system. The need for the restoration of function and esthetics due to tooth loss is mainly seen in elderly patients. Moreover, in the past dental services for geriatric patients involved minimally expensive treatment emphasizing on non-surgical procedure which included removable or fixed dentures, which has its own drawbacks. So, the increase in the demand for function, esthetics, psychological benefit and the occurrence of complex surgical conditions has led to the development of newer advancements.[1-3]

Implantology is a distinct branch of dentistry that deals with the rehabilitation of the edentulous ridges with Osseo integrated implants that support the prosthetic teeth. It involves a surgical procedure in which an alloplastic material, dental implant, is surgically inserted into a residual bony ridge primarily to serve as a prosthodontic foundation. The basis of implantology is osseointegration of the implant into the bone. Endosseous dental implants are of two types based on the method of insertion into the bone: a) Axially inserted crestal implants b) Laterally inserted basal implants.[2-5]

The conventional crestal implants are inserted into the jaw bone from the crestal alveoli axially. They may be placed perpendicular or tilted in the form of cover screws, cylinders and blade implants. Crestal implants are used for single or multiple unit restoration in adequate bone tissue. The load transmitting surface is vertical and it provides good support for prosthesis when adequate bone height and width are present. A successful implant therapy requires a minimum bone support of 13-15mm in length and 5-7mm in width. The drawbacks of crestal implants are, it is expensive, requires complex surgical procedure spread over 2-3 appointments over a period of 3-6 months, limited range of implant size and design, can be placed only when adequate amount and good quality of bone height is available for support. Screw slackening and fracture at the interface are other complications of these implants and also roughened surface of crestal implants leads to infection and bone loss.[6-8]

This design of implants cannot be given to patients with systemic complications like diabetes mellitus, smokers, chronic periodontitis and in atrophied ridges. Ridge augmentation procedures like inlay or onlay alveolar grafts, nerve repositioning, sinus lift and nasal lift has to been done in order to achieve adequate bone height. Despite good success rates of these procedures, there is donor and recipient site morbidity, poor prognosis, increased cost and treatment time and less degree of agreement by the patient for the treatment, has led to the development of newer techniques in implantology. The two most frequently used techniques for atrophied ridges are Mini dental implants and Basal implants.[6-10]

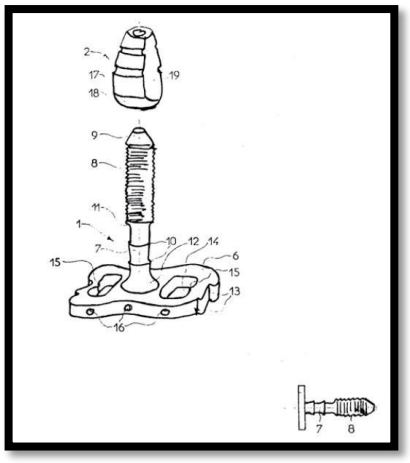
Basal implantology is a modern implantology system that engages the basal cortical bone of both the jaws for achieving retention of the implant. It is the fixed unalterable framework of maxilla and mandibular bone and provides excellent bicortical anchorage, hence basal implantology is also referred to as bicortical implantology. They are used for multiple unit restoration. The advantages of basal implants over conventional implants are that, it is done in a single appointment using a flapless procedure, simple, cost-effective procedure which utilizes minimum armamentarium. It provides an infection free zone of bone for implants, greater stress bearing area, lesser resorption rate and a possibility to provide immediate prosthesis, which cannot be achieved with the conventional crestal implants. Moreover, Basal implantology does not require ridge augmentation procedures and they are single piece implants that can be loaded immediately so, the strength provided by the implant is excellent.[7, 8, 11, 12]

The aim of this library dissertation is to throw light on the newly developing branch of implantology, called the basal implants, which is a revolution in the treatment of edentulous space with atrophied ridges.

HISTORY

The German and the French dentists were the pioneers in the development of basal implants. The first endosteal implant design that had a lateral insertion path was devised in Italy by Lobello. It had a disk and threaded pin that were inserted separately by lateral insertion path, gaining its stability from the inner and outer cortical bone. It is connected with the help of a screw. The development and the use of single unit implant was done first by Jean-Marc Julliet in 1972. The pin was threaded completely providing no resilience. It was available in only one standard length, with no homogeneous cutting tools available were limited to areas where the base plate anchors both cortical structures. [13]

Later in 1975 Dr. Clunet-Coste manufactured the technique of T-shaped single unit implant. The Eugen Kuhlman company and their subsidiary Zerca had marketed these implants. After the death of Julliet, Zerca had discontinued the production of these implants.



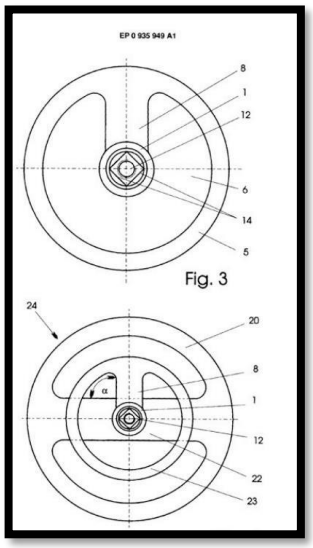
Implant design by Dr. Clunet Coste, France

Scortecci developed cutters and rotationally symmetrical design implants called disk implants. This design included the cutter flutes and a turbine of diameter 1.6mm. Scortecci's company Victory produce 2 implant systems.

• ED SERIES- with external thread and delicate ribs along shaft. It is available in diameter 5-15mm. All the implant features round disks with single-, double-, triple- and quadruple disk design with a inter disk distance of 3mm.

• In 1990 Spatin- implants with multiple disk design EDD 12/8 G4 and EDD 15/9 G4. They were most commonly used in maxillary restorations.

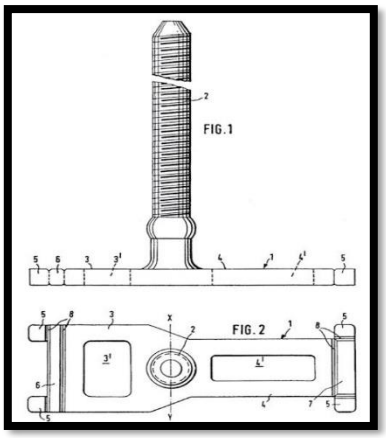
A major void in Scortecci concept was of compromised blood supply above the implant, therefore causing inflammatory osteolysis.



Idhe and Stefan developed implants that behaved elastically inside the bone, allowing resilience of the threaded pin.

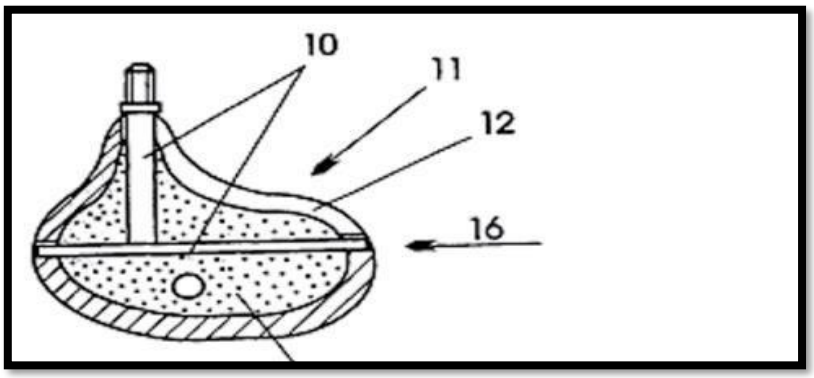
Dr.Stefan Idhe in 1977, improved the basal implants into a Basal Osseo integrated systems also called lateral basal implants. These implants had a round shape with roughened surfaces and transmit the masticatory forces both in the vertical and basal part. As there were limited range of sizes and shapes of implants along with the added advantage of roughened surfaces.

Soon, Dr.Stefan Idhe further modified these implants by replacing the round base plate with edges, that prevented the early rotation before osseointegration. In 1999, the vertical shaft of the implant was polished to reduce mucositis and peri-implantitis. Shortly in 2002, Robert Streel the fracture proof implants were introduced with bending areas in the vertical shaft.



Perfectly balanced disk implants with bendable lateral stubs that are intended to ensure primary stability to lateral forces.

Over the years, the basal implants were improved into a single piece implant with a polished surface which helped reduce peri-implantitis and reintegration of implants was possible in case of loosening which could not be done in roughened implant surfaces. This design has an advantage of providing enough elasticity for the development and functional stimulation of the bone. The lateral implants were further modified in 2005, from cemented constructions to screw designs, which are important for maxillofacial fixation of epitheses.[8, 10, 14, 15]



This is an asymmetrical BOI implant design, first described in 2000, was capable of compensating for the centrifugal resorption pattern of the mandible, while the bone cavities for insertion could still be prepared with rotationally symmetrical instruments. Arrow 16 indicates the insertion path. The threaded pin is located away from the central position on the implant base, but offset. This design allows coping with the centripetal resorption of the maxilla and centrifugal resorption of the distal lower jaw.

DEFINATION OF BASAL IMPLANTS

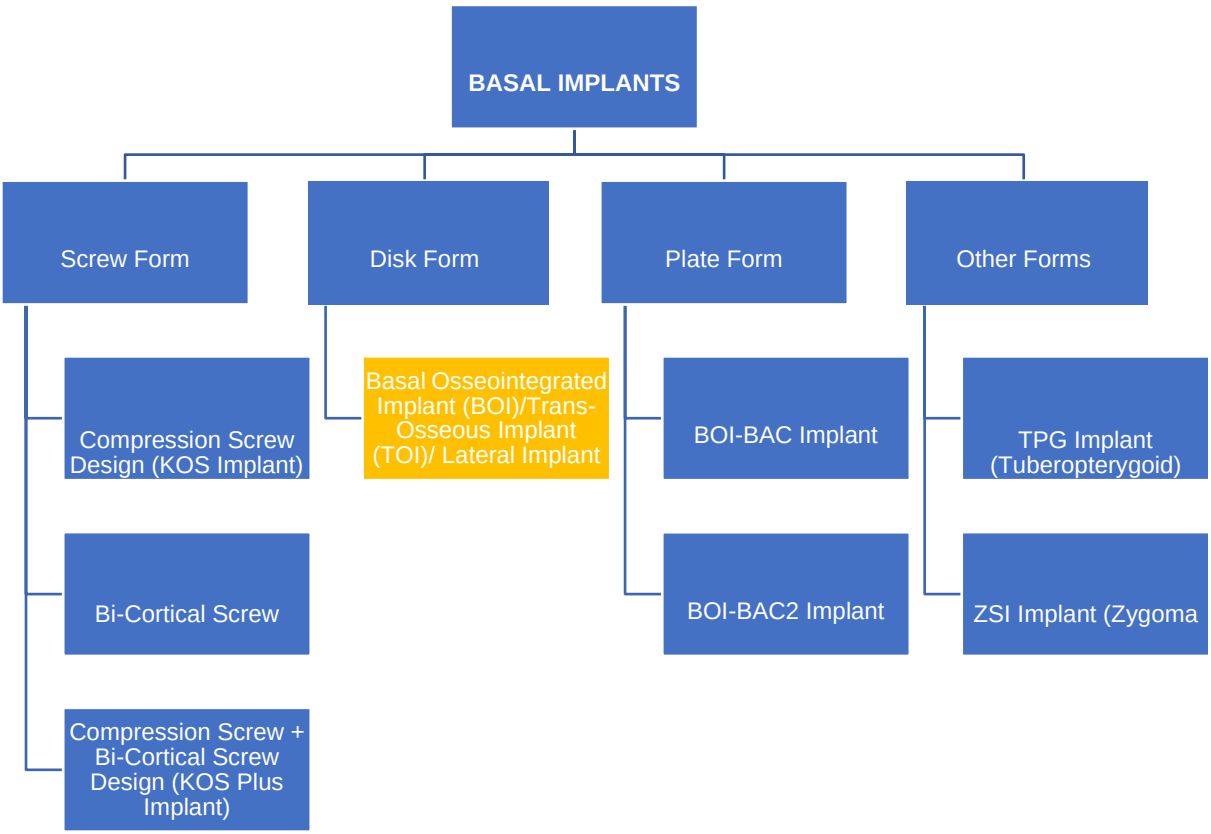
Yadav et al., (2015) defined Basal implantology also known as bicortical implantology just cortical implantology is a modern implantology system which utilizes the basal cortical portion of the jaw bones for retention of the dental implants which are uniquely designed to be accommodated in the basal cortical bone areas. [8]

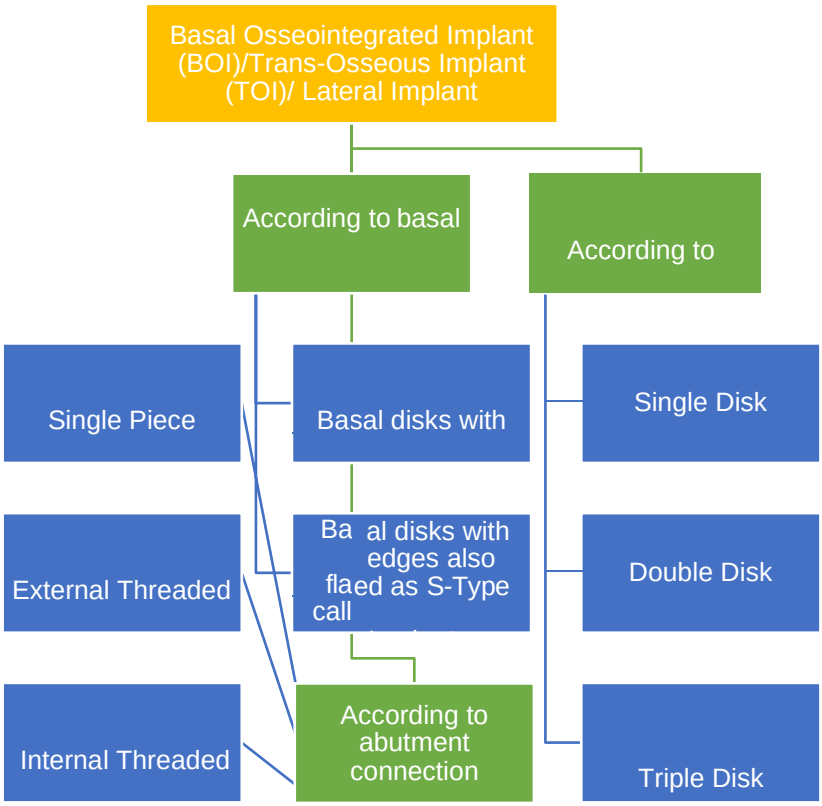
Basal Implantology: Basal Implantology refers to the lateral insertion of disk-form implants into basal bone and, more generally to the anchorage of implants in basal bone.[16]

CLASSIFICATION

There are four basic types of basal implants available.

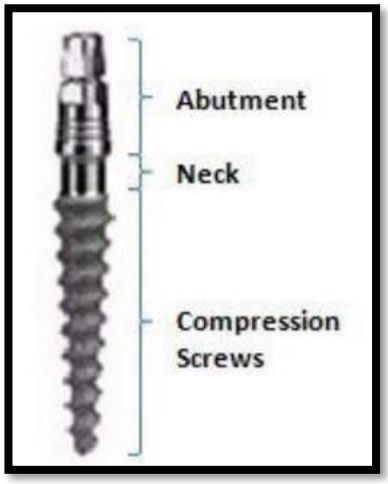
1. Screw Form.
2. Disk Form.
3. Plate Form.
4. Other Forms.





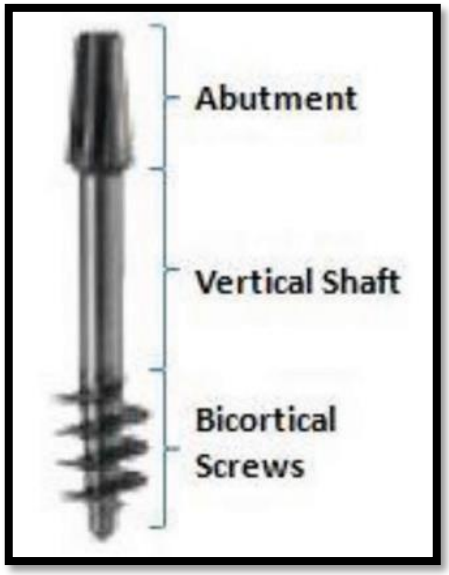
Screw Form

a. Compression Screw Design (KOS Implant)



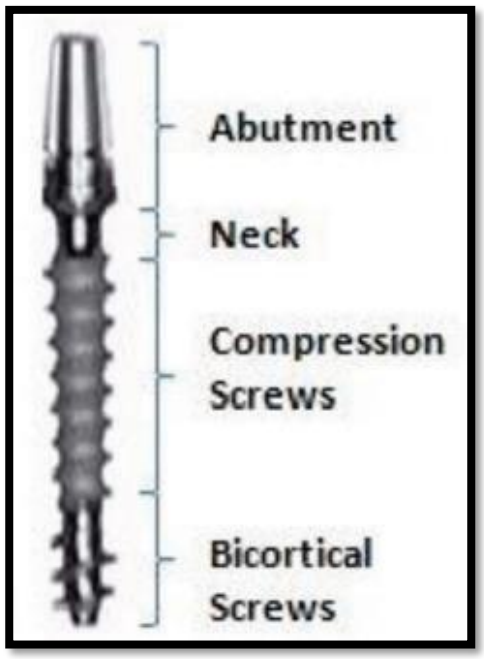
Compression Screw Design (Kos Implant)

b. Bi-Cortical Screw Design (BCS Implant)



BI-CORTICAL SCREW DESIGN

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



Combination Of Compression Screw And Bi-Cortical Screw Design

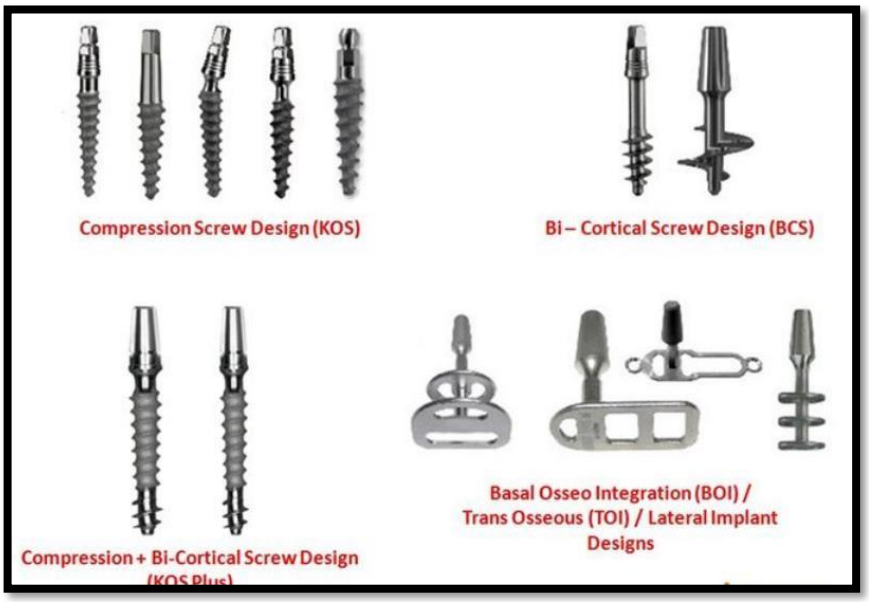
Disk Form

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

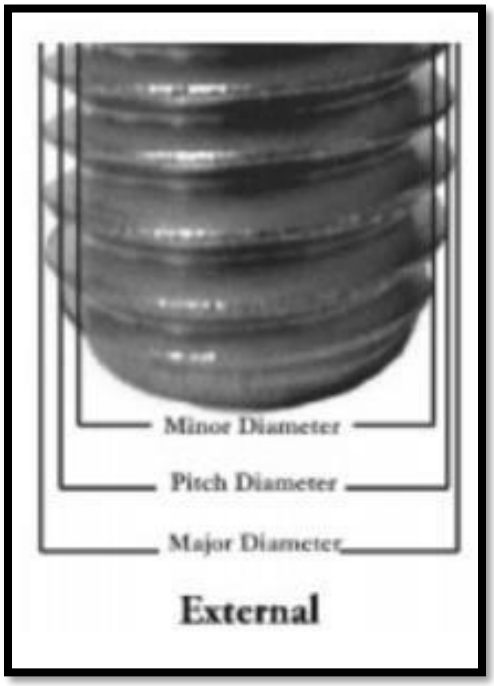
SINGLE, DOUBLE AND TRIPLE DISK FORM IMPLANTS

1) According to abutment connection

i. Single Piece Implant.



ii. External Threaded Connection



External Threaded Connection

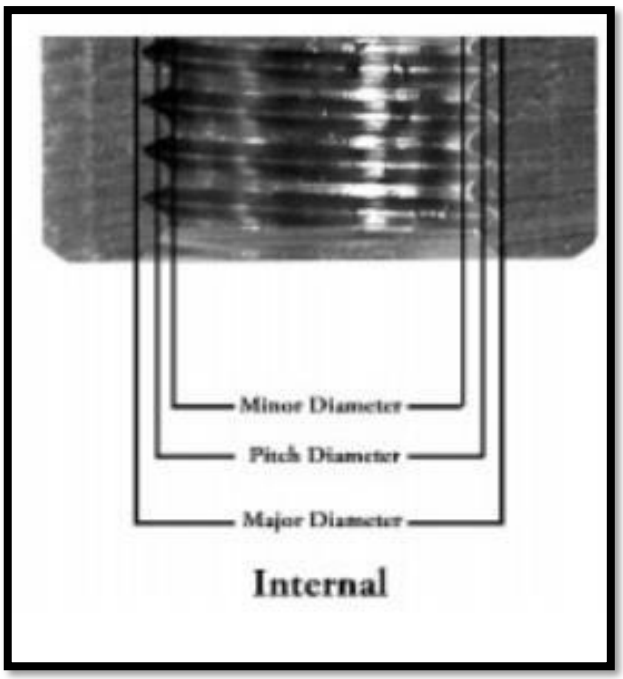
Types:

- External Hexagon.
- External Octagon.

A. External hexagon abutment connection

B. External octagon abutment

iii. Internal Threaded Connection.



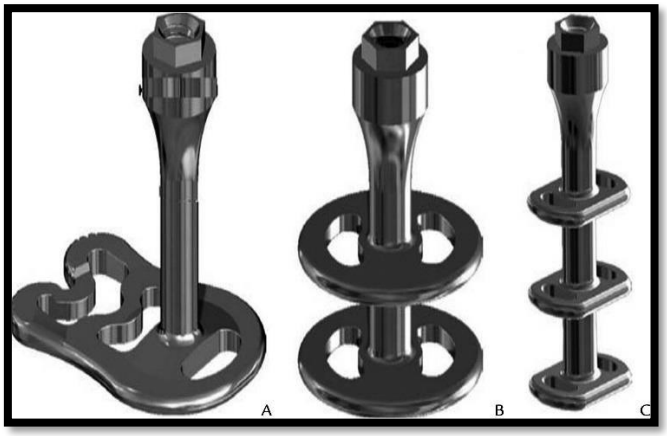
INTERNAL THREADED CONNECTION

2) According to basal plate design

i. Basal disks with angled edges.
ii. Basal disks with flat edges also called as S-Type Implant.

3) According to number of disks

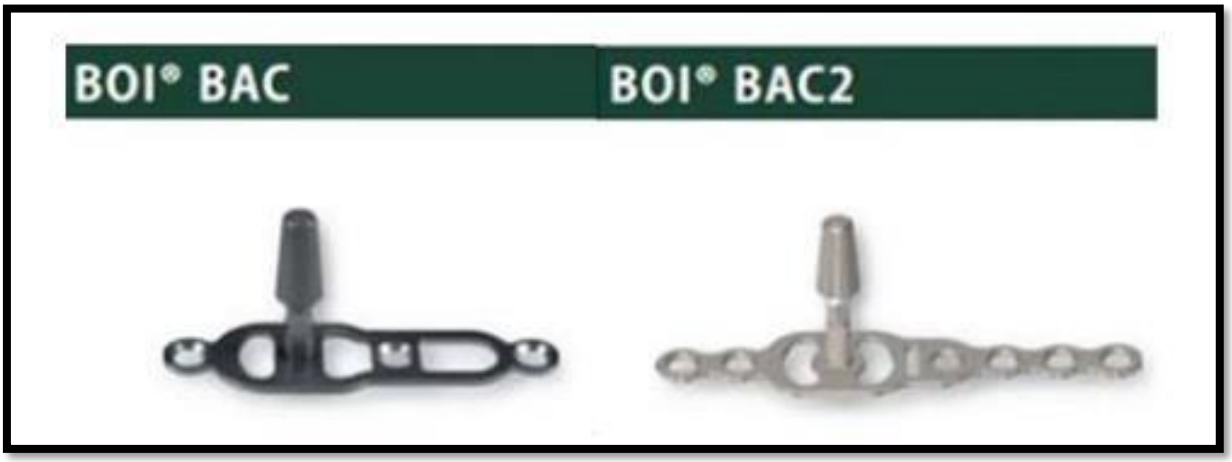
i. Single Disk.
ii. Double Disk.
iii. Triple Disk



A. Single disk implants B. Double disk implants C. Triple disk implants

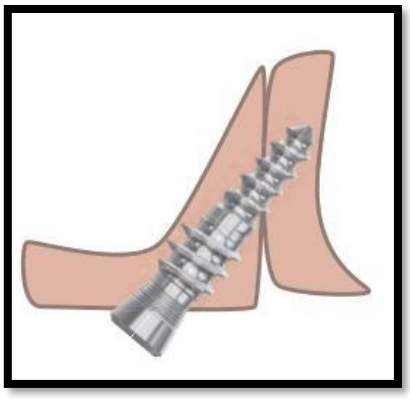
Plate Form

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

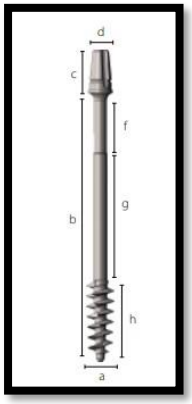


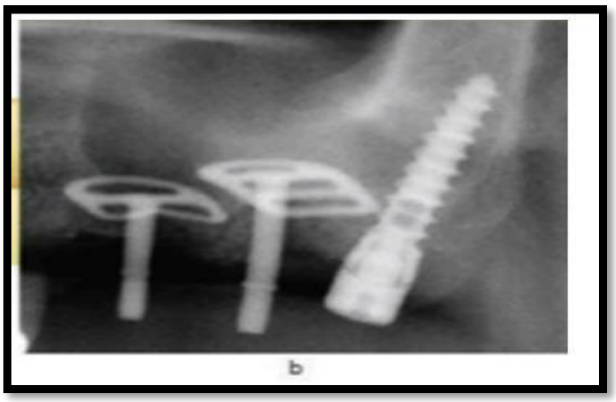
Other Forms

a. TPG Implant (Tubero-pterygoid).



b. ZSI Implant (Zygoma Screw) [10]





RATIONALE OF BASAL IMPLANTS

The concept of basal implantology originates from the presence of two distinct parts of jaw bone-

a) The tooth bearing alveolus also called the crestal bone.

b) Basal bone

The crestal bone that bears the tooth is less dense in nature and hence, it is exposed to infection from the pathologies of tooth/injuries/iatrogenic factors and has less load bearing capacity. Basal bone is defined as the osseous tissue of maxilla and mandible except alveolar process. The basal bone is densely corticated with less susceptibility to infections and resorption, it offers excellent support for the anchorage of implants. Thus, the rationale of using basal implants is that the cortical bone is more resistant to resorption, which originated from the orthopaedic, hence basal implants are also called orthopaedic implants.[8, 13]

OBJECTIVES OF BASAL IMPLANTS

The objective of basal implantology is to restore vital function, hygiene and aesthetics in difficult anatomic situations using minimally invasive procedures. Basal implants have been an effective technique for atrophied ridges rather than the use of root form implants which require prior modifications of bone morphology using grafting procedures. However, in complex conditions, bone grafting and GBR is also used along with basal implants to increase the bone volume.[4]

TYPES OF BASAL IMPLANTS

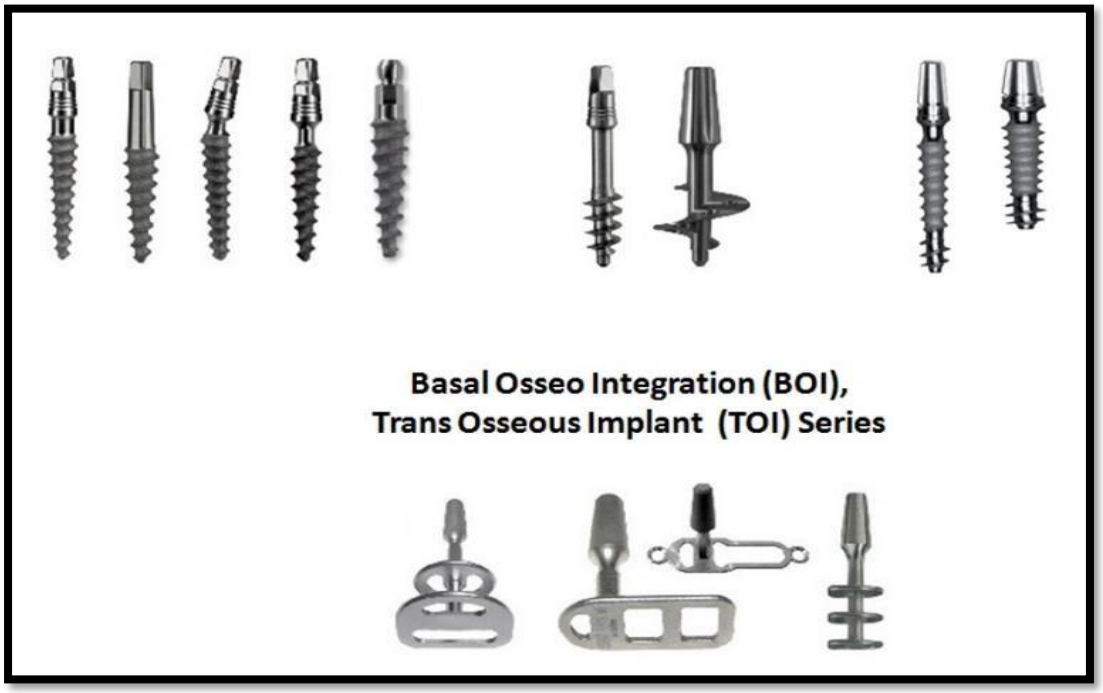
There are two types of basal implants-

A) Basal Osseo integrated implants (BOI)

B) Basal cortical screw implants (BCS)

Basal osseo integrated implants:

These are also called as lateral implants as they are placed laterally into the jaw bone, confined to the cortical bone. These implants are area specific and the load is mainly transmitted to the horizontal segments. They are of two types based on the area in which they are used.



Anterior implants:

In the anterior edentulous area with ample of vertical space, two disk implants with crestal and basal disks are used. The crestal and basal disks have a diameter of 7mm and 9-10mm respectively. The purpose of crestal implants is to provide stability until the basal disks are completely ossified to its load bearing capacity. When there is lack of vertical space, then a single disk basal Osseo integrated implant is placed with 7-9mm diameter and shaft length between 8-13.5mm.

Posterior implants:

In the posterior segments, square shaped implants are used as the threaded pins inserted from the side have better medial position and this placement helps to compensate the absorption of distal mandible. The desired vertical dimension of disk 9-12mm or 10-14mm diameter and shaft length of 10-13.5mm can be used according to the availability of horizontal bone. An inferior nerve insertion is done when the vertical bone height above nerve is just 2mm. the disk is introduced below the nerve with the thread carrier located at the side of the nerve.

Basal cortical screw implants:

The Bi-cortical screw implants are flapless implants that are placed directly through the gingiva, like a conventional implant. These implants transmit the load of the masticatory forces deep into the cortical bone of the opposite side. They provide initial elasticity and show less susceptibility to peri-implantitis as there is thin mucosal penetration diameter and highly polished surface.[14, 15, 17]

PARTS OF BASAL IMPLANTS

The basal implants are single piece implants in which the implant and the abutment are fused which minimizes the problems that occur due to interface. The basal implants have 3 main parts:

Implant body:

The implant body is thin with wide threads which helps in the increase of implant bone contact area and increases the vascularity around the implant.

Implant neck:

The part that connects the implant and its abutment is called the neck of the implant.

The abutment can be bent to an angle of 15-25 degree depending on the length of the implant.

Implant surface:

The surface of the basal implant is polished with less amount of accumulation of plaque and bacteria.

MORPHOLOGY OF BASAL IMPLANTS

The BOI and BCS implants are produced with a smooth and polished surface because, polished surfaces are less prone to inflammation (mucositis, peri-implantitis). As the KOS and KOS Plus implants are surface treated (sand and grit blasting with subsequent acid etching), the implant neck in KOS implant and in the basal cortical screw part of the KOS Plus implant are highly polished.[13]

Basal osseo integrated implants:

The BOI implants are manufactured either from titanium or titanium molybdenum alloy, to enhance the strength of the implant. The various parts are-

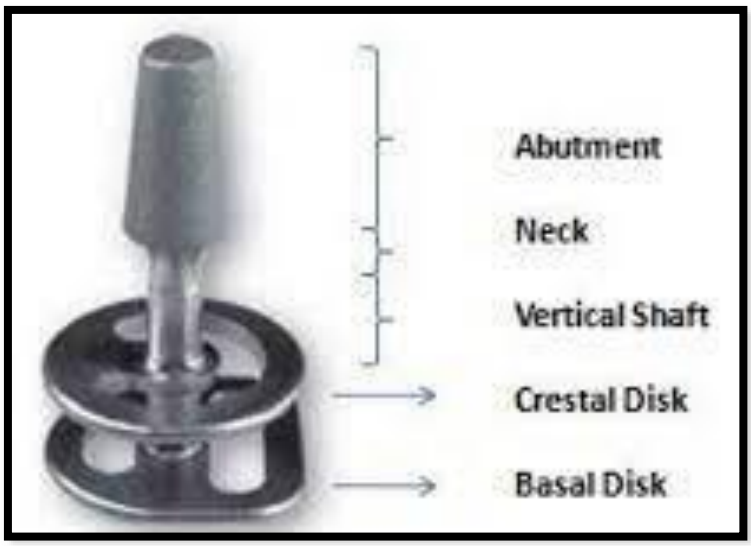
a) Abutment – In single piece implants the abutment is conical, whereas in two-piece implants are externally threaded with hexagonal or octagonal platform or internally threaded.

b) Neck- Neck is the portion lying directly below the abutment portion. The neck is constricted to provide better gingival adaptation post healing, reduce rigidity and allow bending of 15-25 degree.

c) Vertical shaft: It is the part of the implant that connects all the components. It is polished to prevent accumulation of plaque leading to inflammation. It is 10-13.5mm long and either rigid or elastic based on the type of titanium used.

d) Crestal disk: It is the first disk that engages into the crestal bone serving a dual purpose of primary stability initially and as a load bearing component after osseointegration.

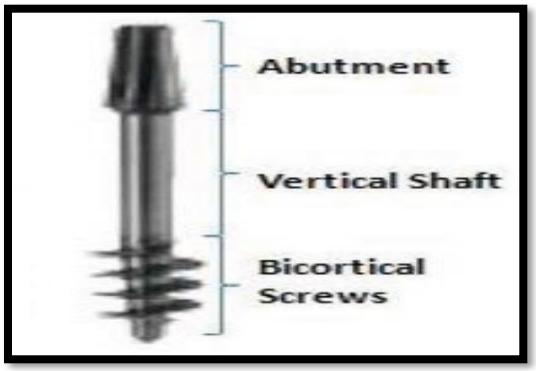
e) Basal disk: It is the second disk present at the base of the implant. The distance between crestal and basal disks should be 5mm. It has a polished surface with an elastic shaft bent at 15-25 degree connecting it to other components.



Parts of BOI implants

Basal cortical screw implants:

The BCS implants are single piece implant design with modification in abutment design and implant portion. The abutment can be Conical straight, Conical angled and multi -unit abutments. They have wide screws that help in engaging the buccal and lingual/ palatal cortical plates to provide primary stability to the implants and later serve as load bearing and distributing components.



Parts of Basal cortical screw implants

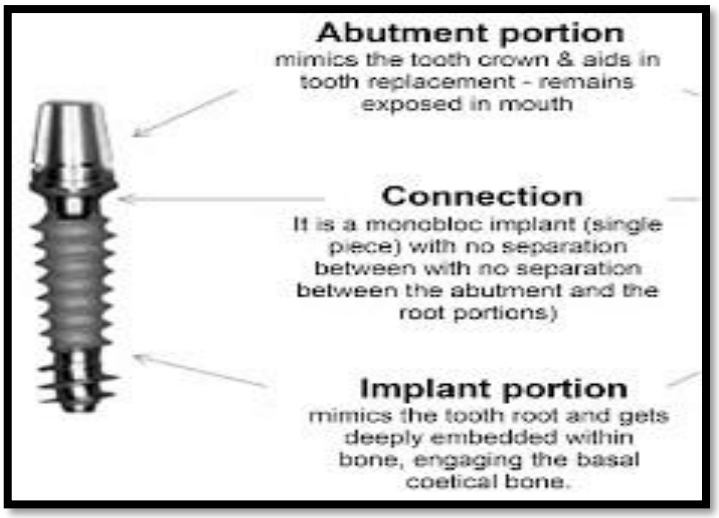
KOS and KOS PLUS IMPLANTS:

These are compressed screw (KOS) and compressed screw with bi-cortical screw design (KOS PLUS). The principle of these implants is that when the implants are placed into the bone it compresses the surrounding cancellous bone to form more compact dense bone.

a) Abutment: The restorative platform is exposed to the oral cavity. The different kinds of abutment available are: conical straight, conical angled, locator abutments, ball abutments, multi-unit abutments.

b) Neck: Neck is polished and bent at 15-25 degrees.

c) Implant portion: The implant has a highly polished surface with several threads, wide structure and turns that enables it to apply compressive forces on the cancellous bone to convert it into dense cortical bone.[13, 14, 16, 18]



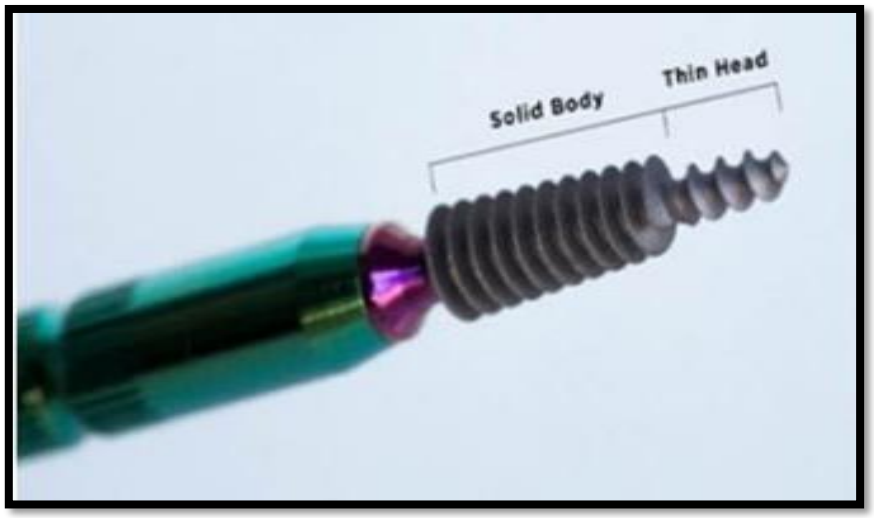
BOI-BAC implant, BOI-BAC2 implant

This is onlay miniplate integrated implant marketed as BAC and BAC2 that are used in severely atrophied areas as a subperiosteal implant retained by screws.

BOI-BAC implant, BOI-BAC2 implant

Tuberopterygoid (TPG) Implant

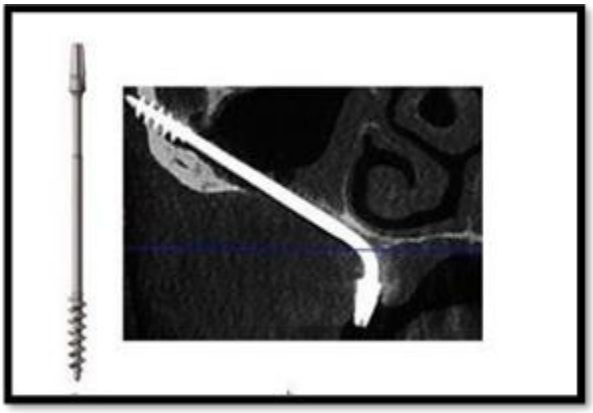
These implants are placed in the pterygoid bone and aid in providing additional support to the prosthesis. These are used in conjunct with Sinus Section technique and are placed at 20o-45o in the bone and the angulation between BOI implant and TPG screw should not exceed 90^{o} otherwise prosthesis placement becomes difficult.



Pterygoid implant

Zygomatic Screw Implant (ZSI)

These are zygomatic implants that are placed in the zygomatic bone and like the BCS implant these also have sharp edge cortical screws that gain bicortical support.



Zygomatic screw implants

Threaded pins:

It denotes the part of the implant that connects the disk to the element that hold the prosthetic superstructure. In the Scortecci's design ED implant series with rib style depth markers along the shaft, offered assistance to assess the length of implant required. The length of the threaded pin is measured in G units. 1G unit= 1.5mm. The threaded pin can be smoothly polished or roughened surfaces. The roughened surface brings better osseointegration but, may colonize several microorganisms on the macro mechanical spaces which was not seen on the smooth threaded pins. In order to get the best of both kinds, a hybrid design was introduced in which the shaft near the mucosa was smooth and basal segments were enlarged for surface enlargements.[13]

Disks/Rings:

The BOI implants have a multi-disk elastic system that consists of crestal and base plate. The purpose of the crestal plate is to provide additional stabilization until the base plate is completely ossified. Both the plates are equally resilient hence there is a risk of transmission of infection from crestal plates. The newer developed BOI have web bar of crestal plate located perpendicular to that of base plate. This part of crestal plate is inserted directly into palatal bone, well protected from resorption. The distance between the disks in initial BOI implants was 3mm.This made it difficult to manoeuvre the surgery for the removal of crestal plate. Hence the distance between the disks has increased to 5mm.

Implant featuring wiser disk- to- disk interval of 5mm

These rotationally symmetrical disks showed integration with the bone on the inner aspect of osteotomy, where there was a gap present on the vestibular side. This has led to the change in design of disks that had a flattened rectangular design on one side and rounded on the other side, they were called the “S” implants, a characteristic features of BOI implants.

The diameter of the basal disk should be as large as possible as they show more elasticity and also increases the distance between the load transmitting surfaces and the site of bacterial attack. The disks contain the web bass that connect it to the threaded pin. The conversion of the functional loads to isoelastic vibration that the bone can tolerate depends on the shape and size of these bars. The more the number of web bars, more is the distribution of forces. These were known as ADS implants. The BOI implants are elastically suspended between the cortical bone. The elasticity is

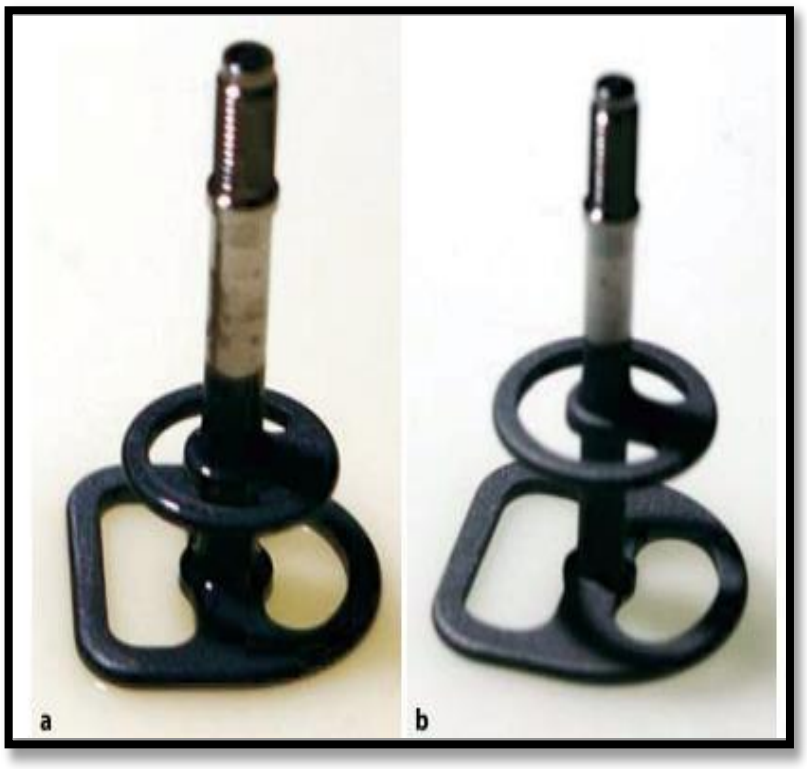
reduced with the number of implants supporting the restoration increases. The rigidity increases with more number and larger base plates.[13]

External implant:

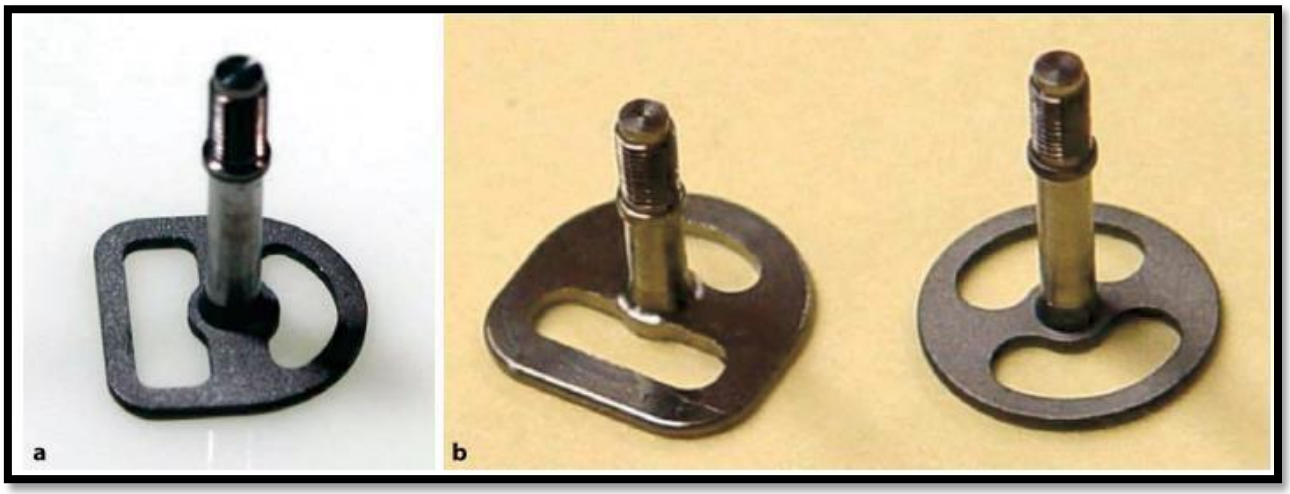
The distance between the cortical bone structures in maxilla and mandible are located 12-14mm apart, the various lengths of implants available are EDAS implant (9×12mm, 9×14mm, 10×14mm), EDADS implant (12/17mm) EDAAS implant (10×20mm)

EDAAS implants features one sounded and one flat side but also available as two rounded sides. The threaded pin is located centrally during manufacture. One material used is titanium or Ti-15Mo. In order to economize the amount of titanium used, the threaded pin was shifted 2mm to the medial direction. The available lengths are from G5 to G9. To attain optimum fracture resistance, the radius in the transitional zone between the threaded pin and web bar is reinforced and the web bar is made thicker.

Double -disk implants 9/7 G5. The G5, G7 and G8 versions of these double - disk implants (9 or 10mm diameter at the base disk) are commonly used to replace canines in both jaws.



EDDS implants (right) are well suited for insertion into stable bone structures. If the vertical bone volume is greater, it is recommended to use EXDDS implants(left), as the greater distance between the load-transmitting surfaces (5mm) will prevent BMUs from interfering with each other during bone repair process.



EDS implants feature a basal plate that is basically circular but with a longer radius towards the angled ends. The implant is this protected against rotation in the bone cavity. Furthermore, it's lateral segments stabilize the implant against removing forces by increasing the friction.

EDS 9G6 are used most commonly in the area of second molars in the mandible. A design with two additional edges offers much greater primary stability (and an intrabony anti-rotation feature) than a circular design with the same base diameter. Designs with edges and flat base- plates are called "S-Type-implants".

EDAS 9/12 G5. This implant design is predominantly used in distal jaw segments. EDAS implants are also available with three web bars radiating from the threaded pin. EDAS implants are also available with three web bars.

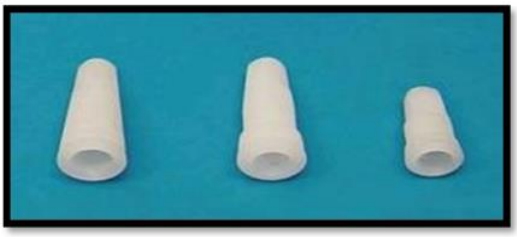
Abutment for external thread design:

There are 3 types of abutments available TSD4, TDS5 and TSD99. The height of implant is 6.5mm for TSD4, 10.5mm for TDS5and TSD99.The TSD99 abutment have a more internal/superior position of threading among longer implant shaft to be placed more in a mucosal direction. So that they also provide a longer surface for cementing.

These abutments are also available in white Delrin, that are more elastic in nature. DA abutments can be bound with GIC cement for temporary connection that is stable yet de-bonding is relatively simple. If the BOI implants are to be angulated, DA implants are unsuitable, in such cases titanium or TAP-D tool (that is screwed onto thread) are used.

If the transitional zones of implants lie in a submucosal position, the abutment with an apically polished neels are of 4mm length can be used. One disadvantage with the ED implants is that they need to be shortened before placement as there are not sufficient lengths available.

Standard abutment design TSD4, TDS5 and TSD99.



Abutment designs DA99, DA5, and DA4. Note that these abutments are not visible on X-rays. For this reason and also because they are quite elastic, one can get the wrong impression that the bridge is not connected by an abutment at all.

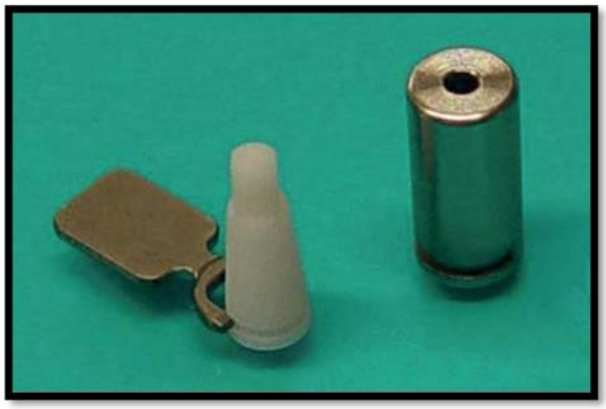
Abutment designs TSD44 and TSD55(with elongated polished necks) compared to the shorter TSD4 TDS5 designs.

Semi-permanent bonding on ed implants:

• Cements based on methacrylate compounds can be used that allow for de-bonding by thermal action by application of heat using rotary instruments.

• Circlip systems:

These systems must be equipped with special grooves and the degree of precision is substantially higher. In case of lack of precision, the restoration can be removed and the circlips can be replaced.



Another option of connecting superstructures in a semi-permanent manner is by the use of circlips. The circlip shown on the left is inserted through the slot shown on the right until it engages the groove of the abutment. Then the handle is broken off the ring. For removal at a later time, the ring has to be destroyed.

Double threaded screws:

They are used in situations where the abutments show different axial inclination. In case of mandibular ridge resorption, permanent cement is used in anterior abutments and double threaded screws are used for distal abutments that can be removed conveniently. These are made of CrCoMo, therefore can be connected directly to the bridge by plasma/laser welding.

Internal Designs With External Hexagon Id System:

The ID system was developed by Scortecci in combination with structural screw implants. The M 1.4 internal thread is combined with an external hexagon surrounding by a ring-shaped enclosure. The advantage is this is that the external octagon does not protrude form restoration surface of implant.

The IDO system is a rigid design with the threaded pins of diameter 2.3mm and the prosthesis is mounted with the help of a screwed connection.

External v/s Internal designs:

The advantage of ID implants is that there is adequate vertical dimension for the prosthesis, as the screw connection extend deep into these internal threads. The screw connections should be placed at the level of gingiva and of a smaller diameter to present access for cleansing. ID implants cannot be used in elastic implant restoration system due to rigid design and wide cups. As the prosthetic screws are thinner than ED implants, there are more susceptible to breakage and loosening. The screwed structures can be removed more easily than cemented structures.

The ED implants are always placed in a lingual/ palatal direction to create space for prosthetic consideration. The restoration of aesthetics is more complex with ID implants and since they cannot be reduced in height, these must be proper stock keeping. The prosthetic screws of ID implants are made of pure gold which undergoes plastic deformation during screwing. Therefore, maximizing reinforcing the extension of the prosthesis.

AVAILABLE SIZES IN BASAL IMPLANTS

Root implants:

Basal implants sizes available: Diameter: 3.5 mm, 4.5 mm, 5.5 mm, 6.5 mm, 8.5 mm, 10.5 mm.

Length: 6 mm, 8 mm, 10 mm, 12 mm, 14 mm, 16 mm, 18 mm, 20 mm, 22 mm, 24 mm, 26 mm.

“Basal SS” implants (sandblasting with HA/TCP) sizes available:

Diameter: 3.5 mm, 4.5 mm.

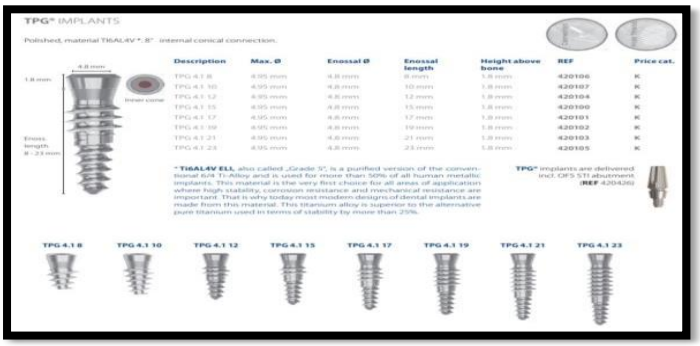
Length: 6 mm, 8 mm, 10 mm, 12 mm, 14 mm, 16 mm, 18 mm, 20 mm.

IDHE IMPLANTS:

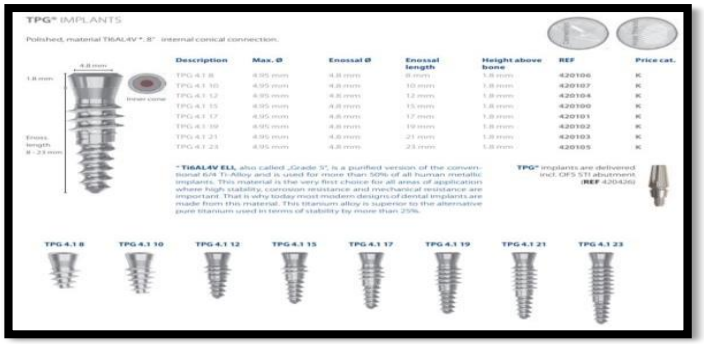
Enossal Ø	Enossal length	Neck Ø	Note	REF
3.0 mm	6 mm	2 mm	bendable	458100
	8 mm			458101
	10 mm			458102
	12 mm			458103
	14 mm			458104
	16 mm			458105
	18 mm			458106
	20 mm			458107
3.5 mm	6 mm	2 mm	bendable	458110
	8 mm			458111
	10 mm			458112
	12 mm			458113
	14 mm			458114
	16 mm			458115
	18 mm			458116
	20 mm			458117
4.0 mm	6 mm	2 mm	bendable	458120
	8 mm			458121
	10 mm			458122
	12 mm			458123
	14 mm			458124
	16 mm			458125
	18 mm			458126
	20 mm			458127

4.5 mm	6 mm	2.35 mm	458130
	8 mm		458131
	10 mm		458132
	12 mm		458133
	14 mm		458134
	16 mm		458135
	18 mm		458136
	20 mm		458137
5.0 mm	6 mm	2.35 mm	458140
	8 mm		458141
	10 mm		458142
	12 mm		458143
	14 mm		458144
5.5 mm	6 mm	2.55 mm	458150
	8 mm		458151
	10 mm		458152
	12 mm		458153
	14 mm		458154

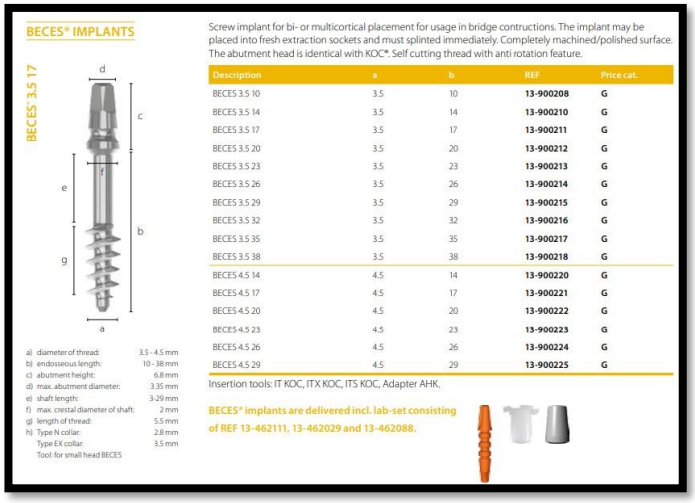
Tubero-pterygoid implants:



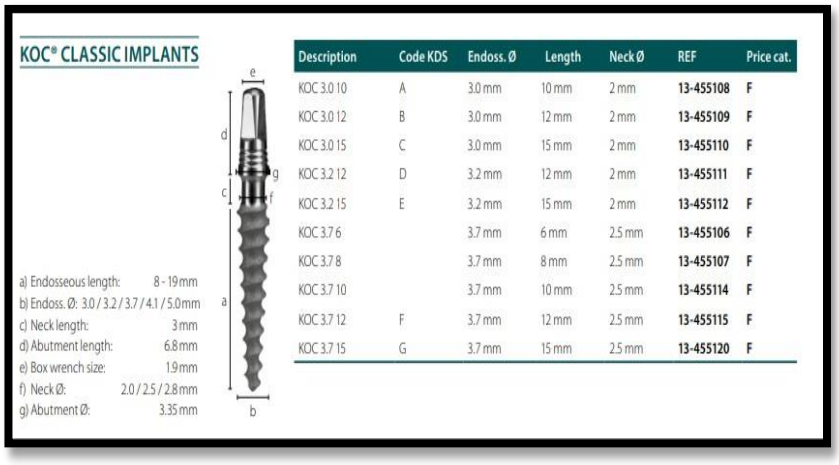
KOC Root Implants



BCS Implants:



KOC Implants:



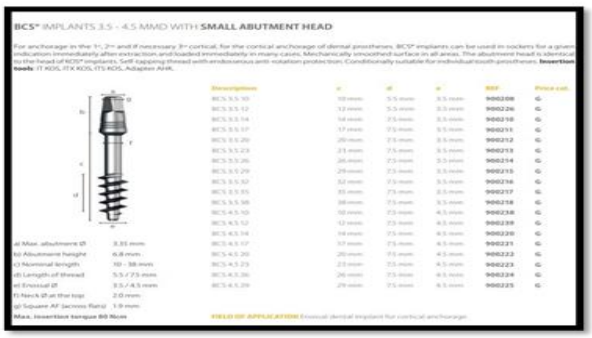
KOC® PLUS - IMPLANTS

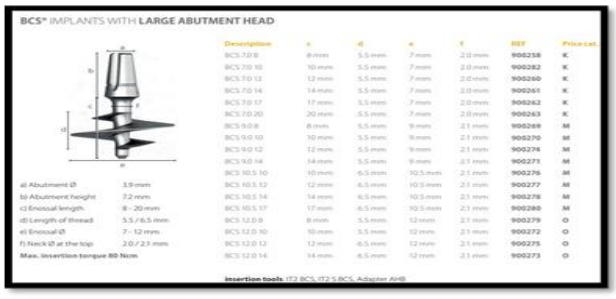
KOC® PLUS are single piece implants with polished sharp apical threads and roughened compression threads for placement in the spongious bone. **KOC® PLUS** combines the advantages of a compression screw implant with the unexpected stability of anchorage in the 2nd cortical. For use in the upper and the lower jaw. Made from highly compatible and proven titanium alloy (Ti6Al4V ELI according to ASFT M 136-13 and ISO 5832-3). Screw in with IT2 BCS or handgrip & adapter.

a) endosseous length	9, 12, 14, 16, 19 mm
b) max. endosseous Ø	
(= nominal Ø of rough implant part)	3.7 / 4.1 / 5.0mm
c) height of cutting thread	3.0 mm
d) height of compression thread	6, 9, 11, 13 mm
e) neck length (for mucosa)	3 mm
f) head height	7.2 mm
g) max. diameter of the head	3.9 mm
h) diameter of apical thread	
nominal diameter 3.7:	4.5 mmd
nominal diameter 4.1:	4.5 mmd
nominal diameter 5.0:	4.5 mmd

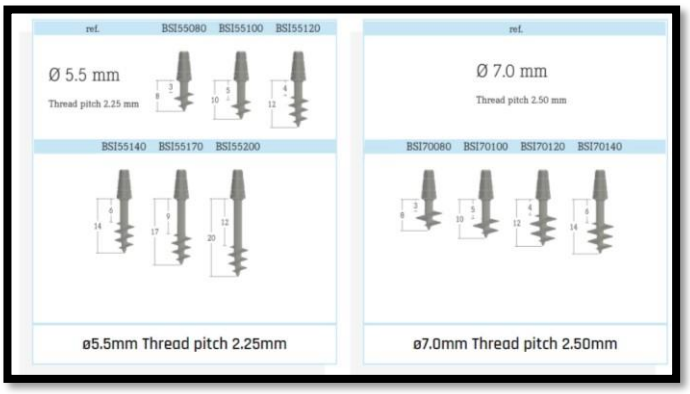
Description	Compression thread	Endosseous length	Neck length	REF	Price cat.
KOC 3.7 9+3	9 mm	12 mm	3 mm	**13-455800**	**G**
KOC 3.7 11+3	11 mm	14 mm	3 mm	**13-455801**	**G**
KOC 3.7 13+3	13 mm	16 mm	3 mm	**13-455802**	**G**
KOC 3.7 16+3	16 mm	19 mm	3 mm	**13-455803**	**G**
KOC 3.7 20+3	20 mm	23 mm	3 mm	**13-455804**	**G**
KOC 3.7 23+3	23 mm	26 mm	3 mm	**13-455805**	**G**
KOC 4.1 6+3	6 mm	9 mm	3 mm	**13-455810**	**G**
KOC 4.1 9+3	9 mm	12 mm	3 mm	**13-455811**	**G**
KOC 4.1 11+3	11 mm	14 mm	3 mm	**13-455812**	**G**
KOC 4.1 13+3	13 mm	16 mm	3 mm	**13-455813**	**G**
KOC 4.1 16+3	16 mm	19 mm	3 mm	**13-455815**	**G**
KOC 4.1 20+3	20 mm	23 mm	3 mm	**13-455814**	**G**
KOC 5.0 6+3	6 mm	9 mm	3 mm	**13-455820**	**G**
KOC 5.0 9+3	8 mm	12 mm	3 mm	**13-455821**	**G**
KOC 5.0 11+3	11 mm	14 mm	3 mm	**13-455822**	**G**
KOC 5.0 13+3	13 mm	16 mm	3 mm	**13-455823**	**G**
KOC 5.0 16+3	16 mm	19 mm	3 mm	**13-455824**	**G**

KOC® Plus implants are delivered incl. lab-set consisting of **REF**13-462111, 13-462030 and 13-462086.

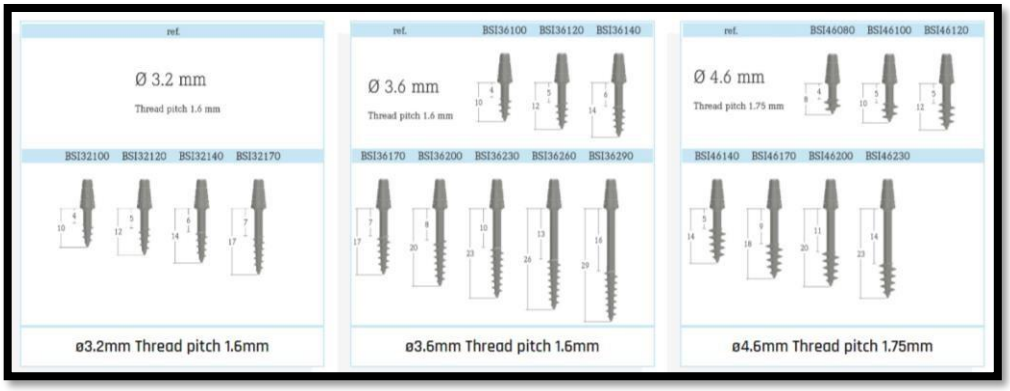




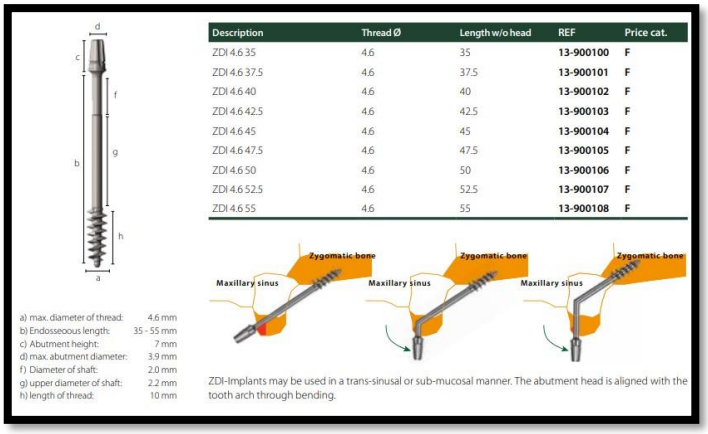
Simpladent implants:



BECES Implants



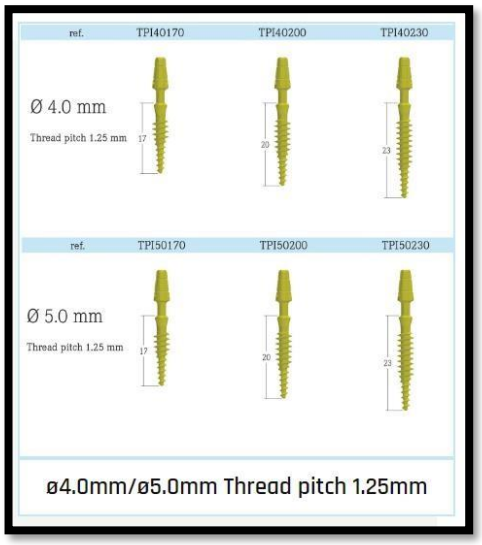
Zygomatic screw implants:



Basalfix implants:

Length	Dia 3.0	3.3	3.75
10	BDI-P3010	BDI-P3310	BDI-P3710
11.5	BDI-P3011	BDI-P3311	BDI-P3711
13	BDI-P3013	BDI-P3313	BDI-P3713
16	BDI-P3016	BDI-P3316	BDI-P3716

Bioline Implants



INDICATIONS AND CONTRAINDICATIONS

Indications:

1. Several missing teeth or indicated for extraction.
2. Failure of Bone augmentation or 2- stage implant placement.
3. Bone atrophies like very thin ridge with crestal Bucco-palatal thickness is less than 2mm and insufficient bone height. [19]

Contraindications:

Absolute Contraindications:

1. Patients on drugs like high dose of IV bisphosphonates for osteoporosis / cancer, anti-coagulants, etc.
2. Epileptic patients
3. Patients undergoing radiotherapy for cancer.
4. Severe heart disease or stroke within 6 months.
5. Allergy or hypersensitivity reaction to titanium alloy.
6. Acquired immunosuppressive syndrome (AIDS)
7. Age < 15 years. [19]

Relative contraindications:

1. Bruxism, clenching, malocclusion, history of fracture of tooth associated with psychological problems.
2. Facial or Trigeminal neuropathy.
3. Uncontrolled diabetes.
4. Lesion of the oral mucous 3membrane.
5. Smoking
6. Poor oral hygiene
7. Infection of the surrounding teeth (Periodontal pockets, Cysts, Granuloma, etc)[19]

ADVANTAGES AND DISADVANTAGES

Advantages:

1. One-piece implants: This concept of one-piece implants has led to reduction in the failure of implants due to interface problems between the connection between different parts of the implant.
2. Basal- cortical support: these implants take support from the basal bone which has stable and fast repair capacity along with increased resistance to resorption.
3. Compromised ridges: Basal implants are the best treatment modality for atrophied ridges, as the augmentation procedures can be avoided, the outcome of which is unpredictable.
4. Distribution of masticatory forces: The masticatory forces are directly transmitted to the cortical bone, which is the load bearing and distributing area.
5. Peri-implantitis incidence: Peri-implantitis is often seen as a complication of conventional implants due to the roughened surface and multiple parts of the implants. The incidence of peri- implantitis is reduced to 98% in case of basal implants due to the polished surface that decreases the accumulation of plaque and bacteria onto the implant surface.
6. Medically compromised individuals: Basal implants have shown great results in patients with diabetes, chronic smokers and chronic periodontitis.
7. Immediate loading: The advantage of basal implants is that the prosthesis can be given immediately within 72 hours of surgery.
8. Minimally invasive: The surgery is minimally invasive with fast healing and less post-operative complications.[14, 15]

Disadvantages:

1. Compromised aesthetics in case of single tooth replacement.
2. Technique sensitive: A skilled surgeon with good knowledge of the anatomy is required to perform the surgery successfully.
3. May lead to excess bone loss in case of good bone support.[19]

DIAGNOSIS

The diagnosis and treatment objective will depend on the complexity of the case and the experience of the surgeon. The BOI can be used in areas with sparse bone volume and the emergence points of these implants need not coincide with the location of the restored crown, hence no major concessions need to be made for the prosthetic requirements.

The major considerations during diagnosis are:

- Prognosis of the remaining teeth and the decision whether to include them in the prosthesis. If not included then other treatment measures like Eg: occlusion, splinting, etc. need to be considered to ensure stability.
- The areas of placement of BOI: the canine and the second molar region are found to be the most suitable followed by the anterior region with a drawback of restricted freedom for prosthetic design. The premolar and the first molar areas are found to be most unstable in both the jaws.
- The fundamental state of the masticatory system.[13]

TREATMENT PLANNING

The treatment plan must consider both clinical and economic factors. Currently two distinct philosophies of Basal Osseointegrated Implants can be applied. Treatment philosophy advocated by Idhe, Haas, and Spahn explains that only four implants should be inserted at strategic positions per jaw. This philosophy does not impede any flexion of the bone that is present in between the implants. Other philosophy by Scortecci, Heuckmann and Maier, aimed to create a rigid implant-restoration system by placing maximum number of implants. Both are clinically successful with specific advantages and disadvantages.

Maxillary Restorations:

The position of canines and second molars are the strategic areas for implant placement in maxilla. An additional implant can be placed in the nasal spine for anchorage. In the canine position single disk implants with high value, of 9mm disk diameter are placed or triple disk implants of 7mm diameter or larger can be placed EDAS implants of dimension 9×12, 9×14 and 10×14mm are generally used at second molar. Additional support can be gained from pterygoid implants.

Mandibular Restorations:

Mandible in general under heavy torsion, a multi-implant strategy would reduce the elasticity of bone. Hence, 4 to 6 implants with one digital implant on either side is preferred.

Mandible should be treated first since:

- Retention of complete denture is better in maxilla than mandible
- Implant treatment in maxilla is redundant once mandible is restored.
- Morphological changes in the mandible are substantial due to several adjustments that used to be made.

If both the jaws are inserted with implant, then there is a risk of overloading. Considering the several reasons, the mandible should be restored first.

The prosthetic loading should be done within 8-12days but an attachment is to load the implant after 6-8 weeks of bone healing and repair is completed. A temporary restoration can be placed in the maxilla whereas, the mandible can be restored immediately.[4, 10]

ASPECTS OF BOI IN PERIODONTALLY INVOLVED CASES

The characteristics to be considered for the placement of implants in periodontally compromised teeth is the changes in the direction and pressure of the blood flow. This is the aspect that affects the successful outcome of the BOI rather than the bacteriological aspects. Bone should always be highly mineralized, therefore, adequate capillary blood perfusion without high flow rate should be present. The changes in the mineralization of the bone are appreciated when internal perfusion is lower than extraosseous vascular pressure. [13]

- Excessive mineralization of linea oblique puts the alveolar bone in a precarious nutrimental position.
- In cases of anterior chewing pattern, the occurrence of periodontitis is functional in origin along with slight amount of bacterial involvement for the progression of disease. There is a hige degree of mineralization seen in the distal aspect of mandible.

CHARACTRISTIC	**CRESTAL IMPLANTS**	**BOI IMPLANTS**	**CLINICAL ADVANTAGE**
THREADED PIN/ VERTICAL ASPECT OF THE IMPLANT	Surface enlarged: Macro-design: thread Etching/sandblasting	Machined surface	BOI implants have less chances of infection.
LOAD TRANSMISSION	Vertical	Basal, far from the mouth	Load transmission area in infection protected zone.
STRUCTURE OF LOAD BEARING AREAS	Pole near the core	Broad lateral support	
NUTRIENTS AND OXYGEN SUPPLY	Endosteal supply of nutrients and transport speed are limited.	Periosteal supply of nutrients.	Overload situations can be detected easily and repaired by increasing the nutrient supply.
RECALL REQUIREMENTS	Frequent	Less frequent	Low cost of maintenance for the patient.

Though there are certain differences in the general principles of basal and crestal implants. Certain modulation has been made in crestal implants such as:

- Bi-cortical screw (Oraltronics) – it consists of wide threads with smooth surfaces which is strictly basally Osseointegrated even though placed crestal.
- Porous coated implants (Osseopore) – It consists of large perfusion areas that provide 3D nutrient matrix to the cortical bone.
- Crestal implants with conical design – It transmits less load to the basal bone than conventional crestal implants

Since the BOI implants allow immediate insertion of a fixed prosthesis, periodontal therapy is not necessary. In crestal implants, the implant itself blocks the path of removal for intraoperatively

introduced inflammation process, whereas the BOI allow efficient suppuration through the insertion slots.

	ADVANTAGES	**DISADVANTAGES**
SOFT TISSUE INFECTION BEFORE OPERATION	Good intra-bony blood supply and good soft tissue blood supply.	No sterility at the implant site.
TISSUE HEALING	Fast and efficient bony and soft tissue healing is expected.	Large remodelling area is expected due to which primary stability can be lost.
MASTICATORY FUNCTION		New/ altered chewing function needs to be developed.
MASTICATORY FORCES	Low forces in initial healing phase.	Stronger after reconstruction: endangered equilibrium and shortening of muscles.
OSSEOINTEGRATION	Fast remodelling and modelling.	Initial porous bone with little strength.

ASPECTS OF BOI IMPLANTS PLACEMENT IN THE MAXILLARY SINUS REGION

One of the greatest difficulties for the restoration of posterior maxilla is the inadequacy of available bone height and close approximation of the floor of the maxillary sinus. There are 2 basic concepts for the placement of BOI implants in the sinus region. **[13]**

- An implantation technique of basal disk implants in the area of maxillary sinus was introduced in 1980's. an incision was made in the upper mesial area of the anterior vestibular sinus wall and the membrane is elevated dorsal, caudal and in cranial direction. After the osteotomy is prepared, the implant is inserted and the cavity prepared in the sinus is filled with a grafting material either inorganic material or a combination with autologous cancellous bone. One of the complications of this technique is that the membrane is too thin in some patients and can tear very easily. Another technique was described by Donsimoni in 2003, in which the membrane was elevated without any disruption. The suction is applied through the nose which will gradually elevate the membrane without direct manipulation.
- Trans-sinus installation of the BOI implants was described by Konstantinovic in 2003. A major requirement for this process is the presence of palatal ridge or lateral nasal wall for primary stability. According to the anatomy of the maxillary sinus, the results of trans-sinus placement can be the following:

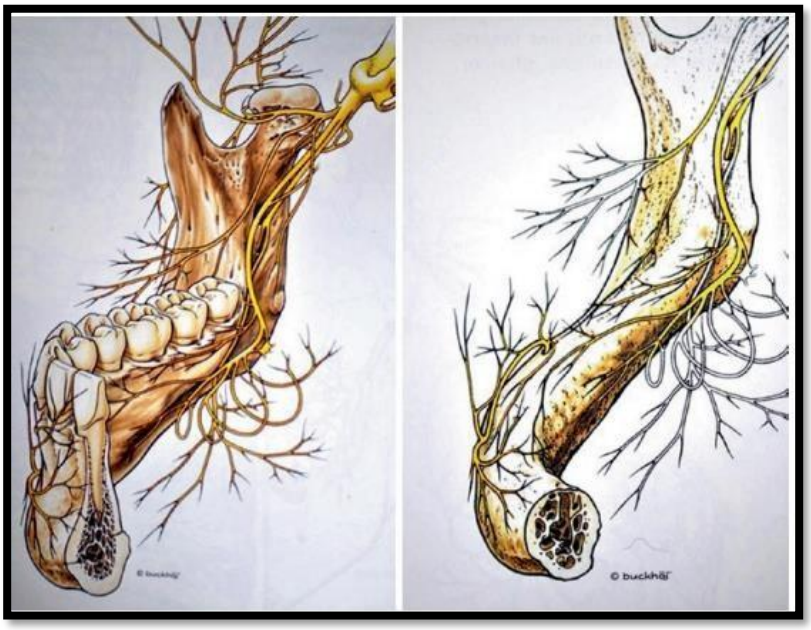
SCENARIO	**OUTCOME**	**COMPLICATIONS**
The implant traverses the sinus with/ without damage to the Schneiderian membrane.	The membrane heals around the entire area of the implant	Mild sinusitis that resolves spontaneously.
The implant traverses the sinus with/ without damage to the Schneiderian membrane and in the end position, part of the load transmitting area is in the sinus but not the threaded pin.	The membrane heals around the implant and covers the bone and the implant.	Mild sinusitis that resolves spontaneously.
The implant traverses the sinus with/ without damage to the Schneiderian membrane with the load transmitting leg and the threaded pin is in the sinus.	The membrane heals around the implant as a loose, well vascularized soft tissue network inside the sinus.	Presence of loosely arranged soft tissue around the implant.
The implant traverses with/without damage to the membrane with load transmitting area and the threaded pin inside the sinus without bone support.	The membrane undergoes compartmentilization.	This leads to compartmentilization, with the over compartment connected to the oral cavity through the threaded pin causing spread of infection.

ANATOMY OF ALVEOLAR BONE AND BASAL BONE

The alveolar process is the portion of the maxilla and mandible that forms and supports the tooth sockets (alveoli). It forms when the tooth erupts to provide the osseous attachment to the forming periodontal ligament and disappears gradually after the tooth is lost.

The skeletal bone that remains after tooth loss and complete resorption of the alveolar crest is termed basal bone. This bone structure has a very low turnover (ten times less than alveolar bone) and is highly sensitive to thermal injury and infection. The basal bone has limited blood supply only from the inner lining of the periosteum, hence a strict aseptic protocol for surgery, careful handling of the periosteum and proper irrigation during lateral osteotomy is necessary for the healing to occur.

The success of the implant mainly depends on the availability of bone described in terms of bone quality and density. As stated by Wolff: “Every change in the form and function of bone or of its function alone is followed by certain definite changes in the internal architecture, and equally definite alteration in its external conformation, in accordance with mathematical laws.”Bone density can be determined by various methods: By tactile sense using a manual Osseo tensor, by tactile determination during osteotomy, and more accurately using CT scans.



Comparison of alveolar bone and basal bone

In 1988, Misch defined four bone density groups independent of the regions of the jaws, based upon macroscopic cortical and trabecular bone characteristics.

The four macroscopic types of bone are:

1. Dense cortical
2. Porous cortical
3. Coarse trabecular
4. Fine trabecular.

Bone density classification given by Misch/Scortecci - 1988

D1 bone: Dense cortical bone with very little spongiosa within

D2 bone: Thick dense cortical bone plate and coarse trabecular bone within

D3 bone: Thin cortical bone plate and fine trabecular bone within

D4 bone: Fatty trabecular bone with no cortex

D5 bone: Immature, non-mineralized bone

The anterior mandibular region has greater bone density than maxilla whereas mandibular posterior region has less bone density compared to anterior region. The least bone density is seen in the maxillary posterior region.[4, 5]

Bone density determined by tactile sense:

The density of bone is described by comparing with materials of varying density.

D1 bone is similar to drilling into oak or maple wood.

D2 bone is similar to the tactile sensation of drilling into white pine or spruce.

D3 is similar to drilling into balsa wood.

D4 bone is similar to drilling into Styrofoam.[4, 5]

Bone density by location:

Bone density D1 may be encountered in the anterior Division A mandible of a Kennedy Class IV partially edentulous patient with a history of parafunction and recent extractions.

Bone density D2 is the most common bone density observed in the mandible anterior region. More than 2/3rd of individual's have this kind of bone density.

Bone density D3 is very common in the maxilla. More than one-half of patients have D3 bone in the upper arch. The softest bone, D4, is most often found in posterior maxillae (approximately 60%), especially in the molar regions or after a sinus graft augmentation (where almost two-thirds of patients have D4 bone, whereas, in the anterior maxilla D4 bone is seen less than 10% of the time.[4, 5]

Radiographic Bone Density and 3D Anatomic Shape:

Periapical or panoramic radiographs are not helpful for determining bone density because the lateral cortical plates often obscure trabecular bone density and bone shape. Bone density and bone anatomy can be determined more precisely using tomographic radiographs, especially computerized tomograms (CT) and cone beam CT. Computed tomography produces axial images of the patient's anatomy, perpendicular to the long axis of the body. The higher the CT number, the denser the tissue present. The Misch bone density classification may be evaluated on CT images by correlation to a range of Hounsfield units.

D1: >1250 Hounsfield units D2: 850–1250 Hounsfield units

D3: 350–850 Hounsfield units

D4:<350 Hounsfield units.[4, 5]

Evaluation of bone density during lifetime:

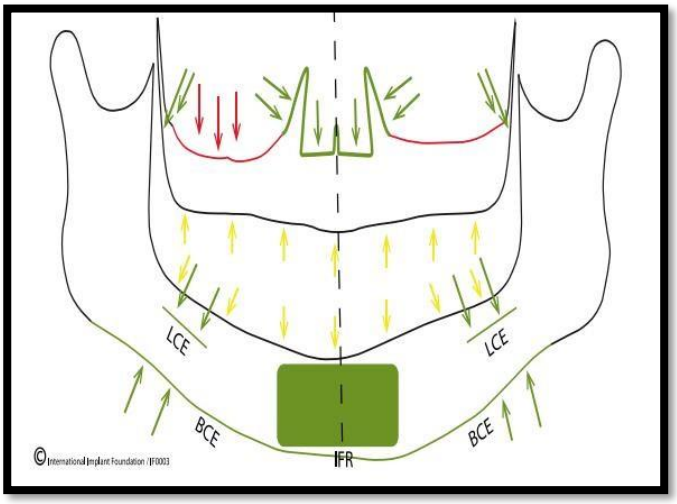
Bone density and bone anatomy modifies the implant treatment plan in several ways: they influence pre-surgery bone management, selection of root-form and/or basal implants, implant dimensions, design, surface condition, number, the implant loading protocol, and prosthetic choices.

A decrease in bone density is accompanied by a decrease in the strength of the bone. Reduction of the incidence of microfractures requires reduction of the strain applied to the bone. As strain is directly related to stress, the stress placed on the implant system should also be reduced as the bone density decreases. Stress may also be reduced by increasing the functional area with increasing the number of basal implants over which the force is applied.[4, 5]

Osseo-Fixation in Basal Implants:[20]

The conventional implants usually have a single cortical anchorage with the anatomical limitations such as the floor of the nose cavity, the sinus in the maxilla or the mandibular canal in the distal mandible. In basal implantology such a demand does not exist, because only the presence of the 2nd cortical bone is required for implant anchorage and because vertical parts of the implants may run outside of the alveolar bone for almost all of the implant length, as long as the thread is anchored in the 1st and 2nd cortical.

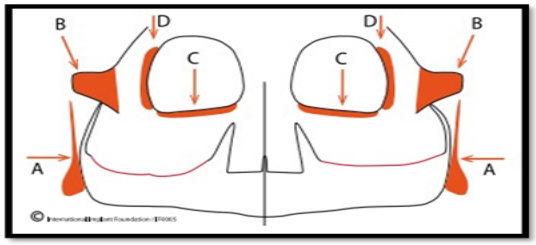
The Strategic Implant® is anchored cortically by the surgeon, and the process of creating this anchorage has been denominated as “osseo-fixation”. Secondary osseo-integration into spongious



bone areas through which endosseous parts of the implants are projecting is expected to happen in any case later. However, for primary stability, i.e., for the success of the treatment, the macro-mechanic anchorage (osseo-fixation) in the 2nd or 3rd cortical is a pre- requisite.

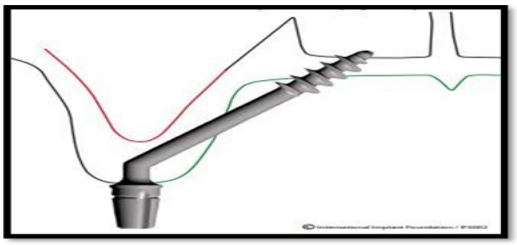
Schematic overview on the corticals in connection to the maxilla and the mandible. Yellow: 1st corticals. Green arrows in mandible mark 2nd corticals. In the distal mandible both lingual cortical engagement (LCE; cross cuts are shown in Figures 9 and 10) and basal cortical engagement (BCE) are possible for screw-like strategic implants. Most patients provide a highly mineralized inter-foraminal region (IFR) which provides in most cases enough stability from inside the mandible for the implant anchorage without additional 2nd cortical engagement. Green 2nd corticals in the maxilla: the floor of the nose, parts of the basal sinus corticals, bone of the outer distal maxilla. Red lines: Resorption prone cortical areas of the sinus floor, having a tendency to allow "sinusal expansion".

"1-2-3" Denomination of Corticals: In this proposal for denomination all crestal corticals are denominated "1st cortical", as pointed out through the yellow arrows in figure. If this next cortical belongs to the same bone (i.e. the maxilla), we denominate it as "2nd" cortical. If cases when the load transmitting threads are projecting out of the maxillary bone and are anchoring into an adjacent bone, we denominate this cortical as "3rd" cortical. Examples for true 3rd corticals are the zygomatic bone, the pterygoid plate of the sphenoid bone as well as the infra-orbital rim. "3rd cortical" engagement is not possible for mandibular implants because there is no other bone available which would move synchrone to the functioning mandible. In the distal mandible suitable 2nd cortical can be found on the lingual and on the vestibular aspect. In the inter-foraminal region the base of the mandible (being a 2nd cortical) is accessible with long implants.



Overview on 3rd cortical in the midface available for oral implant anchorage. A: Pterygoid plate of the sphenoid bone. B: Body of the zygomatic bone. C: Infra-orbital rim. This region may be used for anchorage in cases with defects in the midface. D: Lateral vestibular rim of the orbit

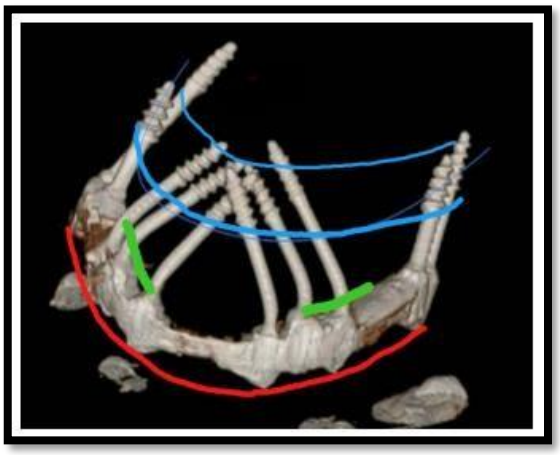
These areas are used for epithesis anchorage, especially for eye replacement.



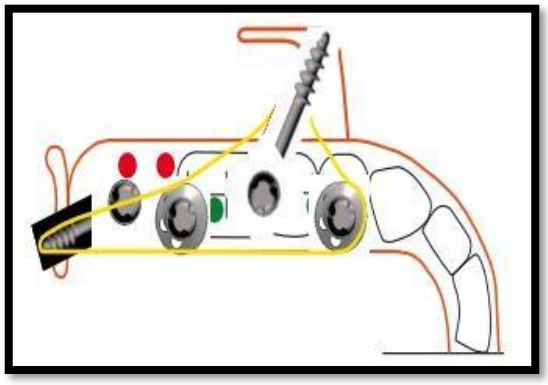
In cases where the implant exits the alveolar bone of the maxilla and reaches through the soft tissue of the palate to the palate process of the maxilla (opposing cortical), the resulting engagement of the threads will be in the "2nd cortical"

The “Supporting Polygon”:

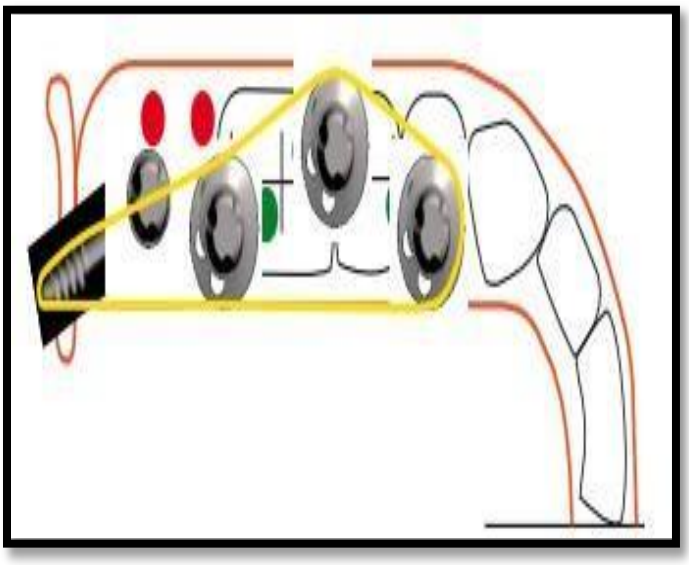
In crestal implantology the penetration areas through the 1st cortical form a supporting polygon and the load transmission areas of all implants form another polygon. It is easy to overview the load situation when considering the polygon. In this concept it becomes clear that the regions of the canines and the 2nd molars are important strategic positions of the polygon. Almost all other implants are positioned inside this polygon and they increase the cortical support but not the size of the polygon. It should be noted that after healing, a long Strategic Implant® provides a short cantilever on the tooth side of the 1st cortical, while the intra-bony side– towards the 2nd cortical– provides a long lever. Hence, large occlusal and masticatory forces are minimized for the 2nd cortical through a long lever.



2-dimensional display of the 3-dimensional spatial situation of a circular bridge in the upper jaw on 10 Strategic Implants. All threads of the implants are cortically anchored somewhere between the upper and the lower blue line, i.e., in the 2nd cortical. Green lines mark anchorage borders in the 1st cortical.



If zygomatic implants are included into the treatment, they increase the size of the supporting polygon in the area of the 1st and 2nd premolar, but not in the area of the 2nd molar.



A typical supporting polygon (yellow line) drawn up for a segment bridge in the upper jaw. The tubero-pterygoid region is equipped with a BCS 3.6 17mm implant, and anterior to this implant three BCS 5.5mmd implant are anchored. The surgeon has tried to place all imlants not in a line to broaden the polygon. Green occlusal contact points on the 1st and 2nd premolar and the 1st molar are visible. From this projection it becomes clear, that contact points and masticatory slopes in 2nd molars (red points) are in most cases located outside of the supporting polygon. Therefore, in Strategic Implantology 2nd molars are not used.

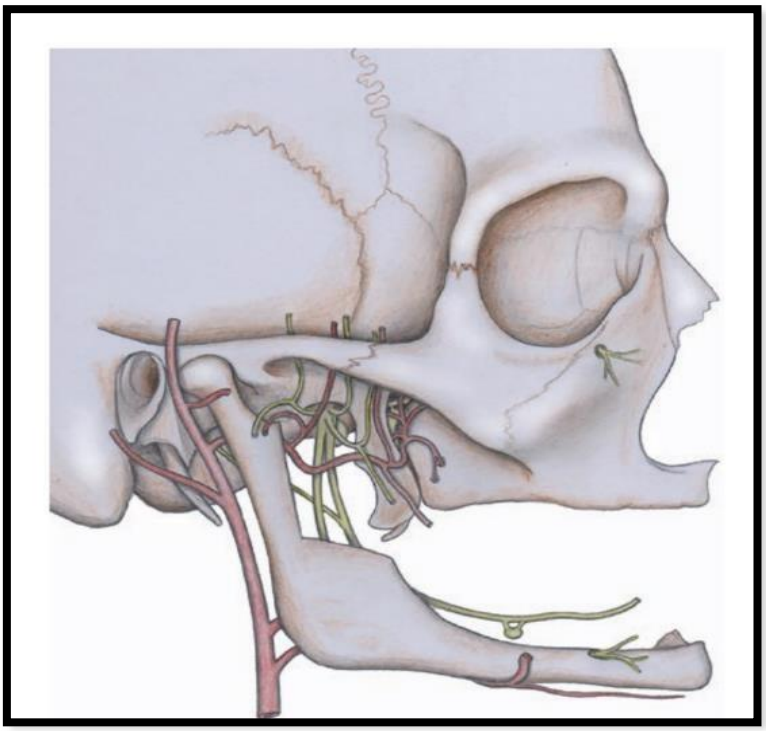
When combined, the “1-2-3” system and the concept of the “supporting polygon” allows setting up a 3-D-treatment plan and getting control over the positions of the 2nd and 3rd cortex and their relationship to the occlusal points and to the masticatory slopes in each jaw. This approach is necessary for cortically anchored, osseofixated implants in immediate loading protocols, for the survival of the implants for the first 3-6 months, until more endosseous parts of the implants become integrated through the process of “biologic osseointegration”.

SURGICAL CONSIDERATIONS OF ATROPHIED MAXILLA AND MANDIBLE

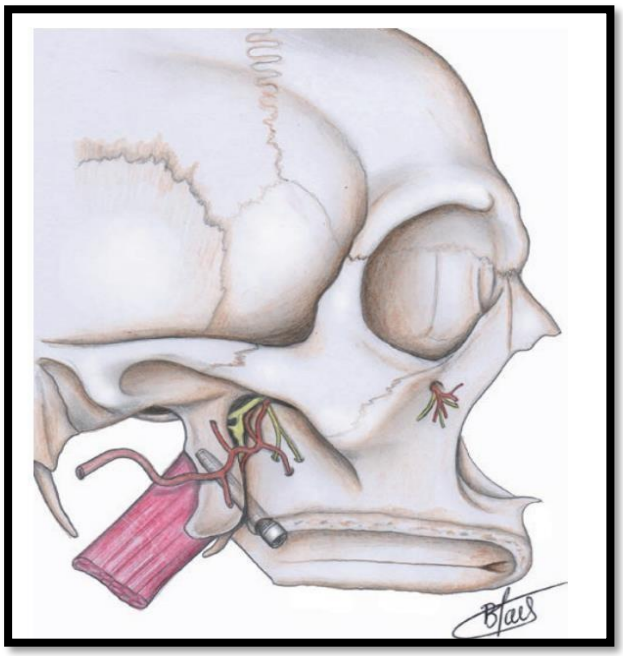
Atrophied maxilla:

As basal implantology is a full-flap procedure, the maxillary sinus landmarks can be easily identified. Atraumatic elevation of the periosteum by separating the tissues by gauze pad avoids injury to the inner layer of periosteum and inadvertent penetration of the sinus. The entire bony structure must be visualized before starting osteotomy. Sharp crestal incisions should be given until the scalpel reaches the bony crest and during osteotomy, the soft tissues and nerves should be protected by holding them with a suction tube against the buccal bony plate.[13] [4]

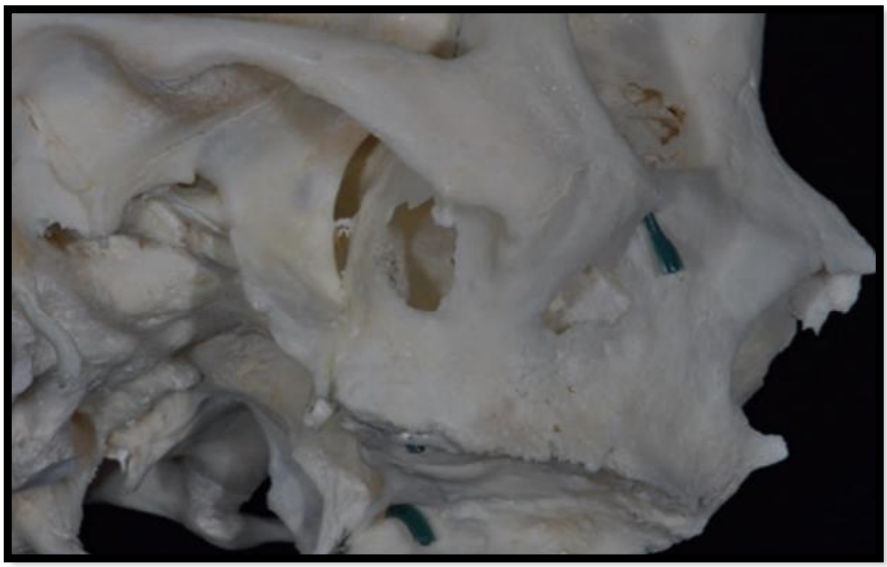
Anatomic Landmarks



Mandible: lingual and mandibular nerves and the submental artery. Maxilla and tuberopterygoid area: maxillary artery and infraorbital nerve.



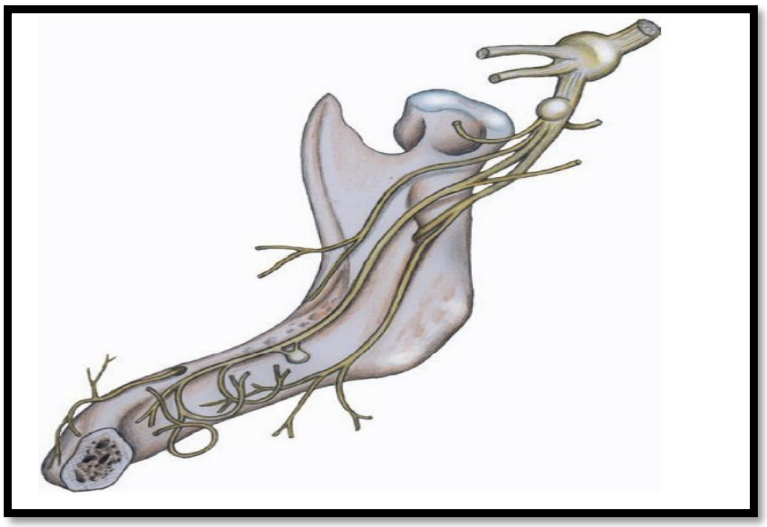
Maxilla: the dense bones of the nasal floor, zygoma, and canine pillar area are suitable for basal implants screw secured with osteosynthesis screws (length 4, 5 or 6 mm). Lateral view of the tuberopterygoid area: this long root-form implant engages the dense bone of the pterygoid process



Maxillary sinus area: very soft bone, if any (“eggshell-thin” bone). Use of a bone matrix osseotensor is mandatory

Atrophied mandible:

The lingual nerve and mandibular nerve are the two critical anatomic areas in the mandible. After a sharp crestal incision in the middle of remaining attached gingiva, a full-thickness flap must be elevated first on the lingual side. The gauze separation technique is important to avoid damage to the periosteum or mandibular nerve and also eliminates the risk of injuring the lingual nerve. Same procedure is repeated on buccal aspect to identify the mental foramen.[13]



Atrophic mandible: dense D1 bone in the mental area. The mandibular nerve foramen opens out on the crest. Lingual and mandibular nerves are critical structures that must be protected during surgery.

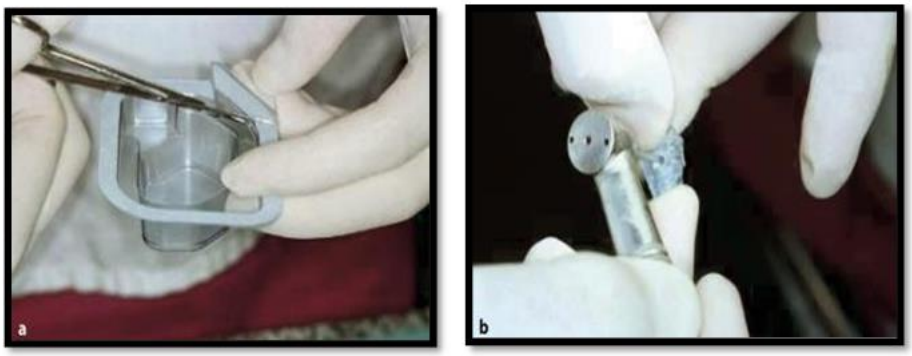
Surgical aspects and their management:

Intraoperative bleeding mainly occurs due to:

1. Palatal artery: The risk of injury to the palatal artery is high in cases of reduced vertical bone. Management:

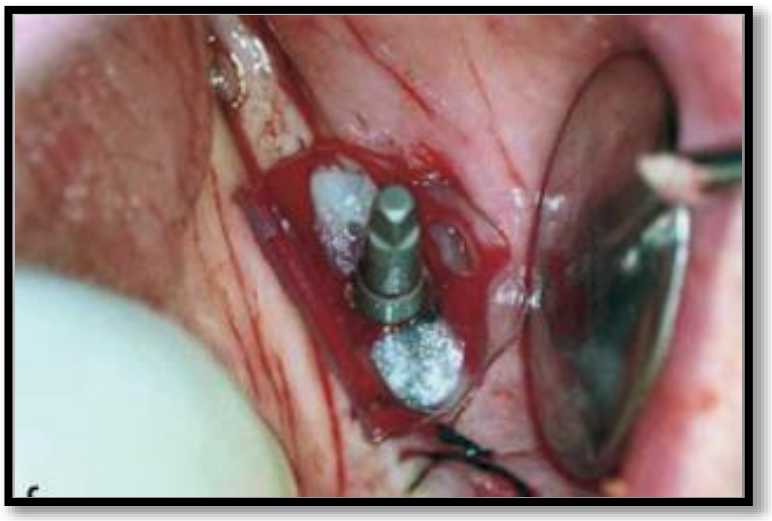
- Do not raise the palatal flap
- Immediate placement of implant in order to arrest the bleeding.

- Take an alginate impression and fabricate a dressing plate screwed to the implant with an abutment and lined with tampon swabs.
- For an individual bleeding site- fabricate a plastic foil screwed to implant with an abutment.
- Deflect the palatal flap and mobilize the vessels.



A local dressing plate is fabrictaed by taking an appropiriate piece of plastic and folding it once, then a hole is cut both layers to slip it over the threaded pions and asecured withan

2. Incisive artery: In BOI implants, bicortical anchorage is assured only when the cortical bone structure is reached beyond the artery in the palatal aspect. The vessel is small with low pressure; hence bleeding is managed using simple sutures.



3. Mandibular artery: when the implants are placed close to the mandibular canal, there are chances of injury to the artery during instrumentation. The mandibular nerve protects itself as long as it is not anesthetized. When the artery is injured, another osteotomy needs to be prepared mesial or distal to the previous site, as placement of the implant over an injured vessel leads to thermal sensitivity.

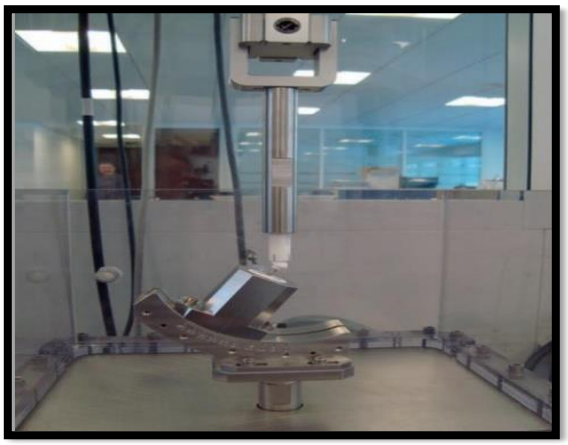
4. Facial artery: it usually gets injured due to extensive flap reflection in heavily resorbed mandible, when the assistant or operator loses control over the instrument. It is managed by applying pressure against the mandible for about 20 minutes or place sutures to arrest bleeding.

5.Submandibular plexus: bleeding from this region is considered dangerous as there is no bony structure against which pressure can be applied. The vessel can be identified and ligated but internal bleeding may still occur in the region. In case of lingual artery injury, pressure can be applied from the lingual side onto the vessel against the mandible.[13]

BIOMECHANICS

Early mechanical tests:

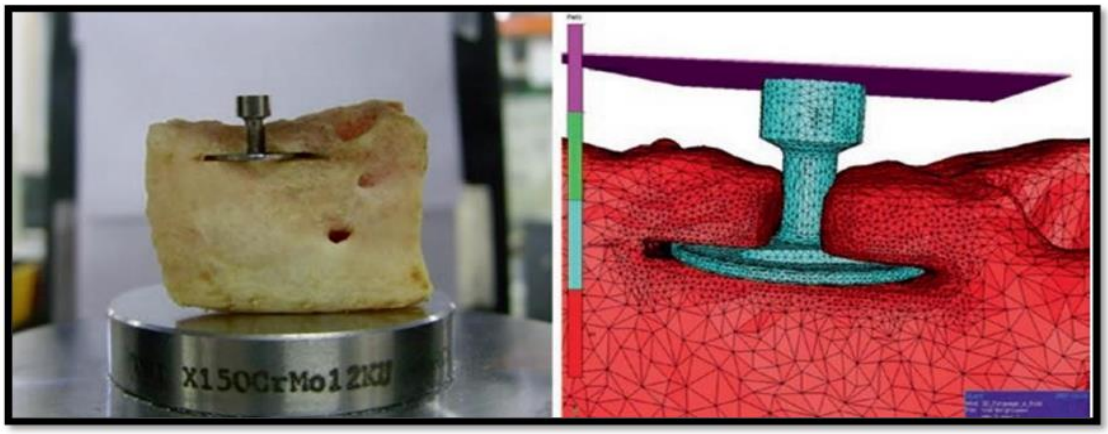
As early as 1996, Victory from France, introduced a test machine for investigating the mechanical properties of dental implants, called the fatigue testing machine. It reproduced critical clinical situations in the premolar and the molar regions and mechanically difficult D1 type bone, the results of which could be applied immediately. In this method, two forces F1 and F2 of 100-400N are applied in various angles (0-35 degree) at a distance of 12mm from the bone level (4mm of transgingival abutment and 8mm of bone height). Titanium root form implants of 3.75mm which is most commonly used are laterally inserted into D1 type bone, mimicking the worst-case scenario of mechanical support. A stainless-steel cap is placed to reach a height of 4mm above the top of the flat monobloc emergence profile. The cap had two inclined surfaces so that the load applied is perpendicular to the surface. The load was applied at 35 degrees to the long axis of implant with two jacks functioning alternative at a distance of 6mm from each other. The forces had an initial frequency of 0.5 Hz, for which displacement is measured at 100, 200, 300, 400N and a total of 100 cycles were done before the forces were modified. This was repeated using frequencies 1Hz, 1.5Hz, 2Hz, 2.5Hz. It was concluded that the implant/abutment/the gold screw did not loosen till a frequency of 1.5Hz. a frequency above 1.5 Hz there was no correlation with the natural model which had a lower frequency.[4]

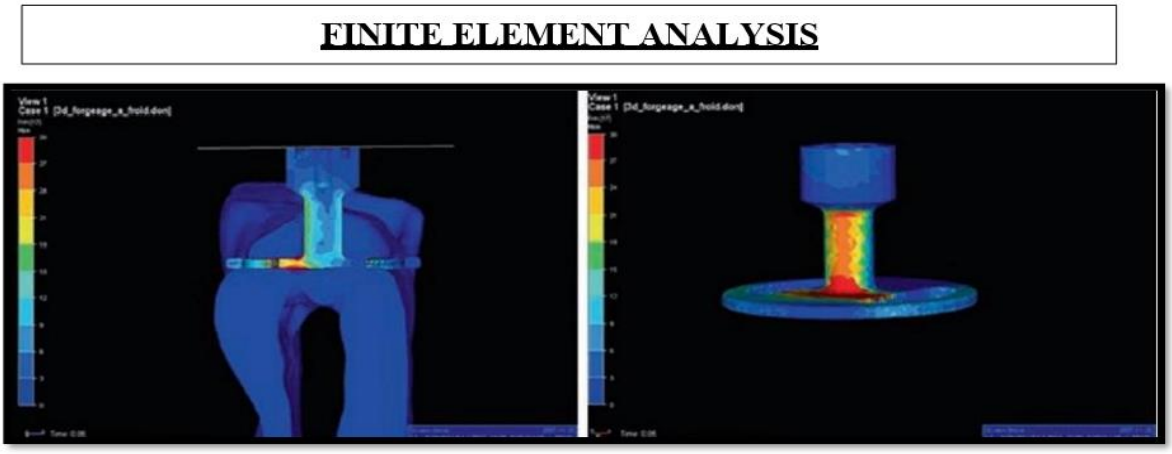


Fatigue testing machine for the dental implants

Finite element analysis:

The success of basal implants depends on its longevity, which in turn depends on risk of infection, acceptance of the implant material, distribution of occlusal forces and the quality of bone available. The risk of infection and the material of the implant have been analysed previously by microbiologic and histological studies. The occlusal stress estimation was previously done by Photo elastic stress analysis. It has been established that the mechanical stress distribution during the function of Disk implants differs from that of root form implants, which is measured along the long axis of the implant. The stress is distributed more evenly in basal implants due to the large horizontal base of Disk implants, which helps to achieve largest region of bone anchored by implant and causes compression. Due to its peculiar design, it undergoes less changes during stress along long axis of the implant. Therefore, it provides structures stability and distributes forces to the surrounding bone.[4]





Stability Principle

Primary stability, defined as the biometric stability immediately after implant insertion, is a critical factor that determines the long-term success of dental implants.[21] Implant designs that provide greater primary stability reduce micromotion and provide a suitable environment for bone regeneration. As the basal implants are indicated for patients with reduce bone volume, height and density, intracortical stability is a major determinant factor for the quality of bone healing. Excessive bone loss in cases of menopausal women, osteoporotic patient and other systemic conditions leads to the loss of cancellous bone but does not affect the basal bone. This loss of bone in the peri-implant region leads to late loss of osseointegration over time. Hence these conditions should be previewed before the implant surgery.[4]

Distal Intracortical Anchorage in Atrophic Jaws

The base of disc implants engages into both the cortical plates (buccolingual primary palate) in areas with atrophied ridges. Other methods to increase primary stability are use of orthopaedic screws, double disc distal implants, screw secured plate form distal implants to obtain distal cortical anchorage in atrophied maxilla. Disc implants/ pterygoid implants can be used in the posterior region of the maxilla. In atrophied mandible, single/double disk implants, wide screw-screwed implants or plate form disk implants can be used.[4]

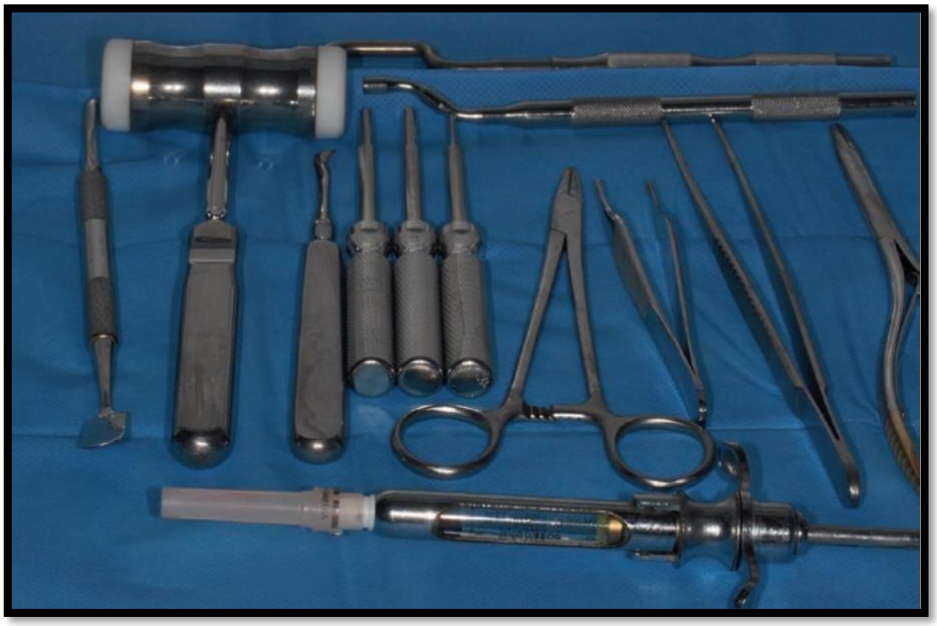
Number of Basal Implants Required

In edentulous patient due to unfavourable bone density and geometry in the posterior areas of the jaw, results in a compromise of the treatment plan, such as placement of minimal number of root form implants in the premaxilla/mental area and fabrication of a bridge with a distal cantilever or bone grafting or GBR in areas of bone resorption. For completely edentulous maxilla 6-10 implants are required, whereas, for mandible 5-9 implants are required for immediate.[4]

ARMAMENTARIUM

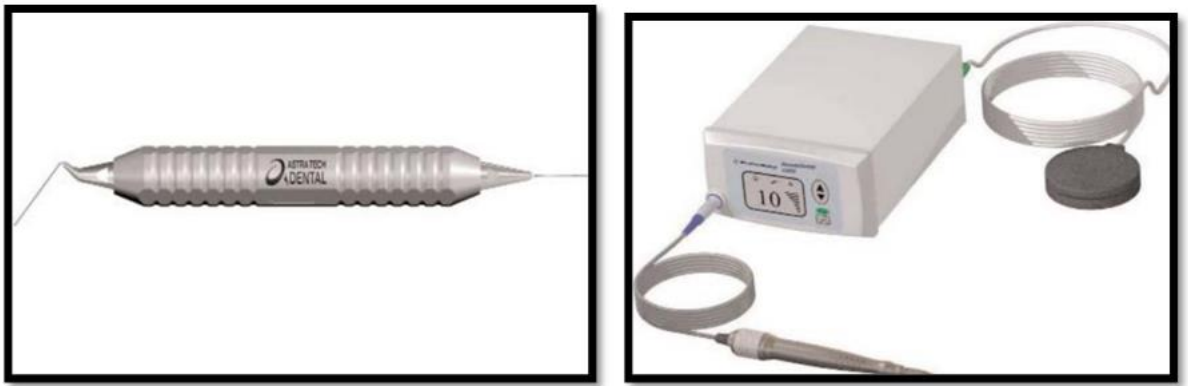
The armamentarium for the placement of the basal implants are as follows:

1. Scalpels (Bard-Parker no.15)
2. High- speed handpiece
3. Periosteal elevators
4. Bone and gum scissors
5. Manual gum retractor, automatic retractor
6. Titanium cutters of different lengths
7. Seating instruments (straight, curved, bayonet)
8. Surgical mallet
9. Needle holder
10. Resorbable or non-resorbable suture material
11. Suture scissors
12. Self-tapping osteosynthesis screws for plate-form Disk implants



Armamentarium for the basal implant surgical procedure

Periotome: It is a slender tip instrument that is used for atraumatic extraction of the teeth to reduce the amount of post operative bone loss. Periotomes are used to sever the attachment of the periodontal ligament to the teeth. Excessive application of forces may cause the fracture of the buccal cortical plate, the occurrence of which makes the region unsuitable for immediate implant placement. The introduction of the powered periotome helps in the application of controlled forces.

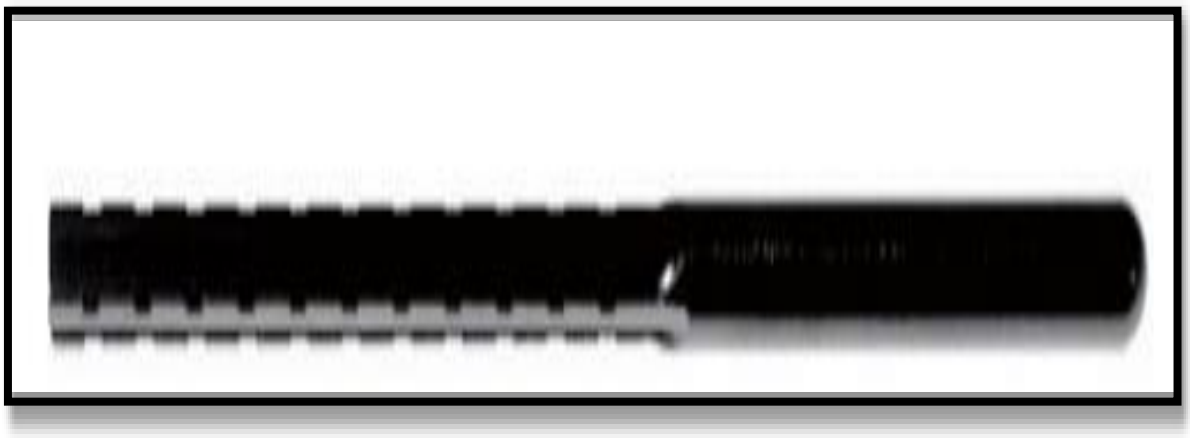


Periotome used for the atraumatic extraction of teeth

GDC PERIOTOME

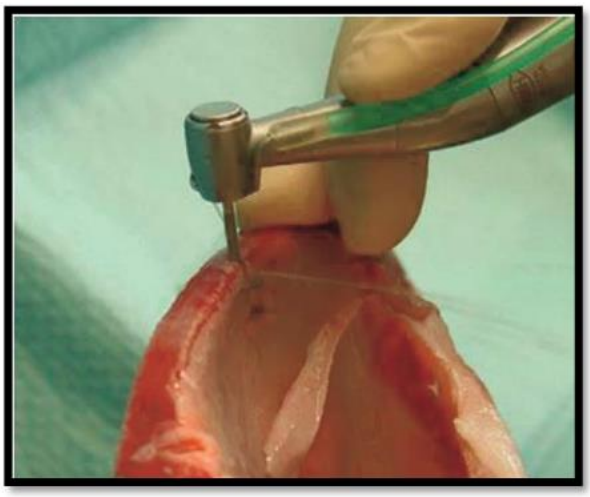
The basal implants can be placed in two approaches, one is by making a direct flapless osteotomy and the other is by raising the flap and preparing a T-shaped osteotomy, with a vertical and horizontal cut. A Pathfinder drill is used to create a single pilot osteotomy. The other approach is by raising the flap and create a T-shaped osteotomy using lateral cutters. This approach is usually not indicated, as raising the flap reduces the blood supply and does not allow immediate loading of the implants, as a sutured site is not favourable for immediate prosthesis.

A vertical cutter is used to prepare a channel for threaded pin. It prepares the osteotomy for further lateral cutters. The width of the working surface is also 1.6mm, which is smaller than the threaded pin. A normal tungsten carbide cutting bur to penetrate the cortical bone and then the vertical cutting burs are used.



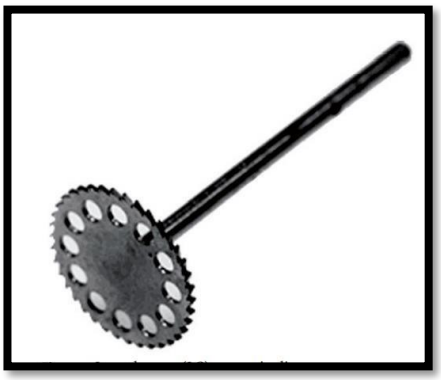
Vertical cutter- prepares a channel for the threaded pin

When lateral cutters are used, enough irrigation is provided even when the cutter is completely inserted into the osteotomy site. The picture illustrates a test osteotomy performed on a pig scapula.



When the twin cutters are used, the irrigation does not reach beyond the crestal disk, hence the basal disk should be irrigated separately.

Lateral cutters are used to create the horizontal component of the osteotomy. It should be started with a 7mm diameter bur followed by the use of successful increment diameter burs.

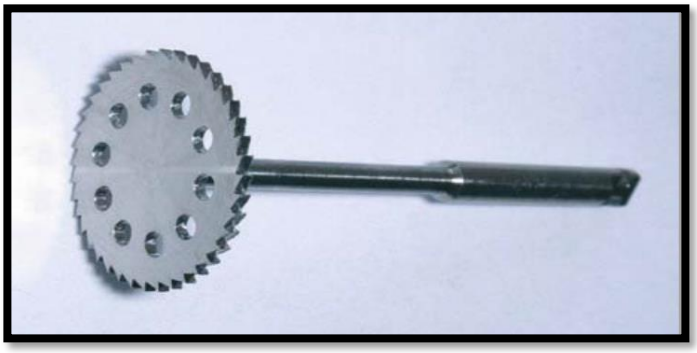


Lateral Cutter

Twin cutter burs are used for double disc implants which ensures the parallelism between the cuts and the distance between the discs. They are available in two diameters: 9mm and 7mm, with a disc-disc distance of 5mm and 3mm respectively.

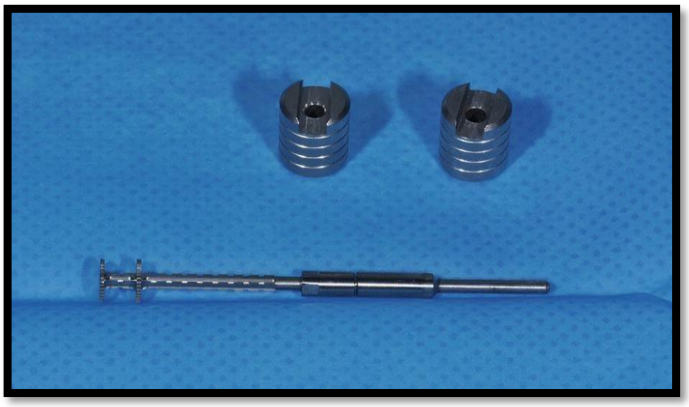
Twin Cutter

A combo cutter bur can be used to create the required right angle between the vertical and the horizontal component.



Combo Cutter

Periotest: It is an instrument used to measure the amount of primary stability attained after implant placement.[4, 22]



Cutter extenders for lateral osteotomies in narrow spaces

INITIAL BONE BED ACTIVATION USING BONE MATRIX OSSEOTENSORS

The aim of this technique of bone bed activation was to use dental instruments like drills/burs/needles to decorticalize the jaw bone surface after full flap exposure and make it bleed. The results were painful due to excessive heating of drills, metals and bacterial pollutions, non-calibrated trauma and improper instrument surface characteristics. Hereby Goldman in 1970, put forward the technique to use an anaesthesia needle to mechanically stimulate the periosteum to treat periodontal disease. Despite its initial benefits this procedure had its drawback of soft tissue contamination due to the hollow cylinder of the anaesthesia needle, bacteria and metal contamination and hence was discontinued.[4]

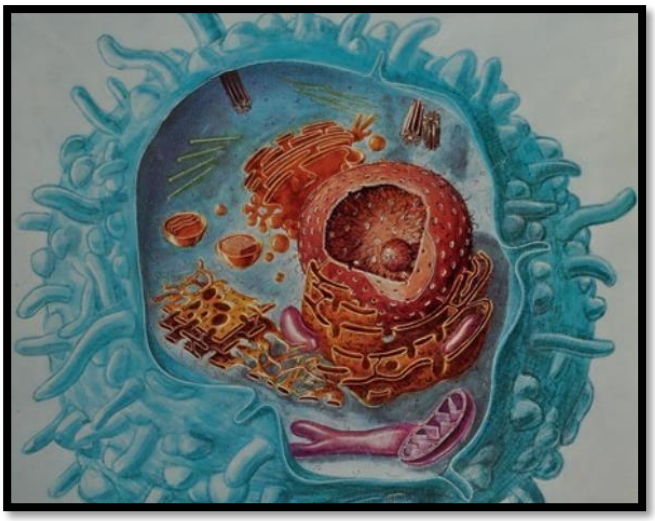
Osseotensors

The Osseo tensors is a specially calibrated manual/ rotary surgical steel instrument with a diamond like carbon coated tip. The mechanism includes osteo-regulation based on mechanical transduction together with stimulating repair to regulate bone regeneration. The concept behind minimally invasive mechanotherapy using a autologous, flapless procedure is to produce subperiosteal bleeding, avoid bacterial contamination, promote angiogenesis and osteogenesis by activation of local stem cells with minimal trauma.

Recent advances in mechanotherapy, discovered “gene activation effect” of distraction osteogenesis. It shows that when the capacities of human bioreactor (HBR) activated with Osseo tensors are used to stimulate the cascade of molecular events, bring about mechanical signal into the nuclei and activates the appropriate gene for tissue engineering. The mechanical stress is delivered to the bone in the form of compression, distraction, trauma, microtrauma, which activates the repair mechanism signalling molecules. Just as the surgical trauma of the bone results in remodelling of the bone via callus formation, the mechanical micro trauma of the periosteum also induces repair. The localised microcracks caused by penetration of the Osseo tensors into the bone induces the release of growth factors like BMP, IGF – I&II, IGF-B and Osseo inductive proteins from the matrix which recruit stem cell and cause regeneration of bone. The size of the impact region is no larger than the tip of a transfusion needle.[4, 13]

The observation and research findings in various fields led to the development of a specific instrument capable of producing calibrated microcracks without bacterial contamination, metal debris or thermal damage to tissues. Bone matrix Osseo tensors were presented for the first time in 2005 at oral implant form organised by the medical school of the university of Nice- Sophia Antipolis, France. The goal of this technique is to minimize the inflammatory response, to activate the stem cells for angiogenesis, stimulate progenitor cell, stimulate osteogenesis in order to improve bone quality and quantity. [4]

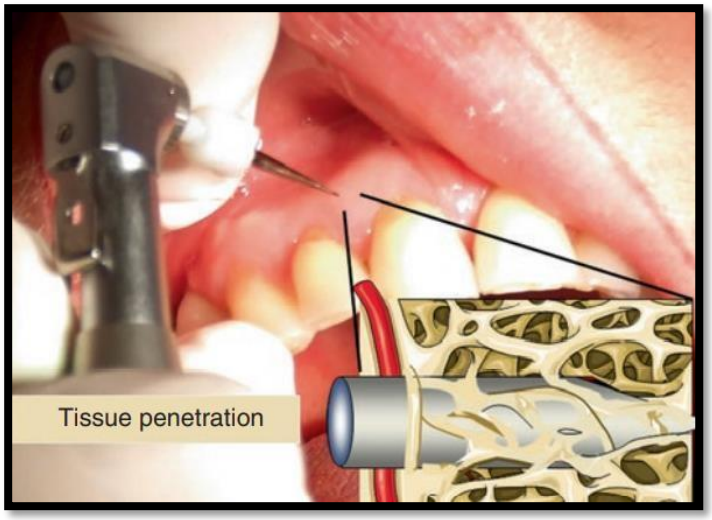
When used in sinus region, the blood extravasates from the strongly irrigated connective tissue under the respiratory epithelial lining of the sinus cavities. In certain conditions both the surgical site and the donor bone graft site are activated. Since 2005, Osseo tensors have been used in presurgical management to improve the bone quality before the installation of implants.[4]



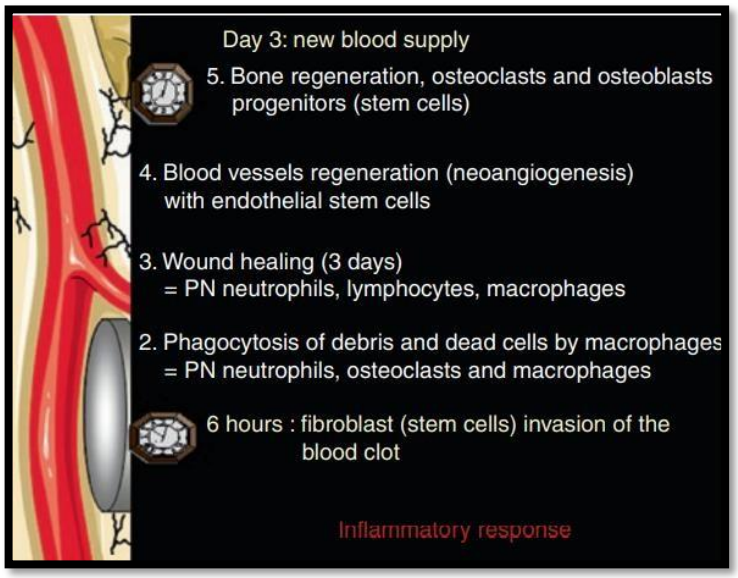
After bone matrix osseotensor application, signalling molecules target specific receptors in the extracellular matrix, bone cells, and cell nuclei (DNA and gene activation)

Diphasic Effect of Bone Matrix Osseotensors

Trans parietal migration of the diamond like carbon coated tip of the instrument through the osteogenic compartments which include the periosteum, bone matrix, endosteum, vascular walls, bone marrow, modifies bone matrix tensions resulting in bone homeostasis.



Transparietal tissue penetration under local anaesthesia



The Cascade of Events That Occur After Tissue Penetration

The resultant osteogenesis occurs in 2phases:

1. Catabolic Phase: (From t=0 to t =21days)

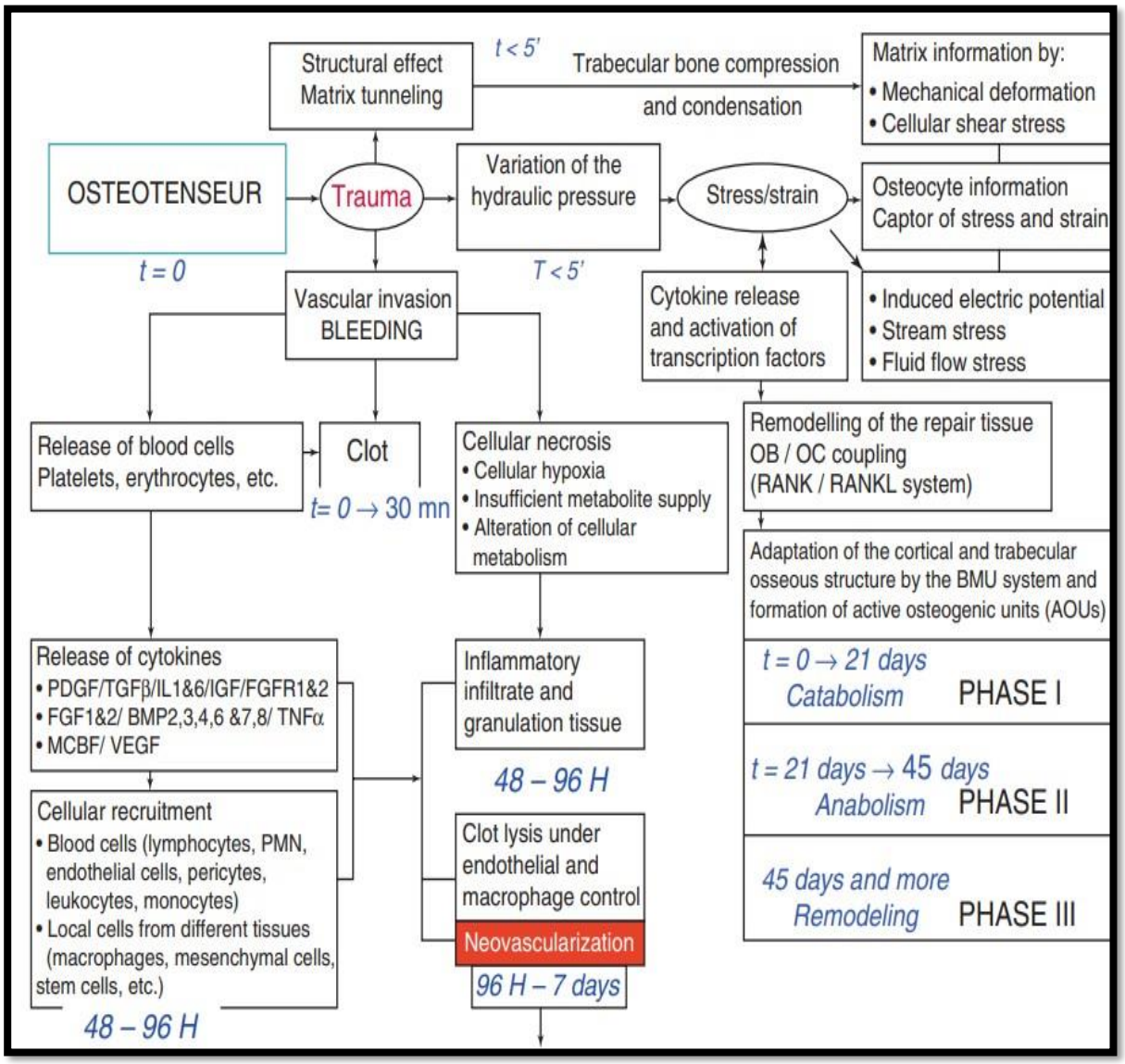
The initial catabolic phase, begins 3minutes after trauma with an inflammatory response, in which the bone softens due to macrophage type 1 phagocytosis and osteoclastic activity for the first 3days, progressively the activity of macrophages reduces. The activity of macrophages to start

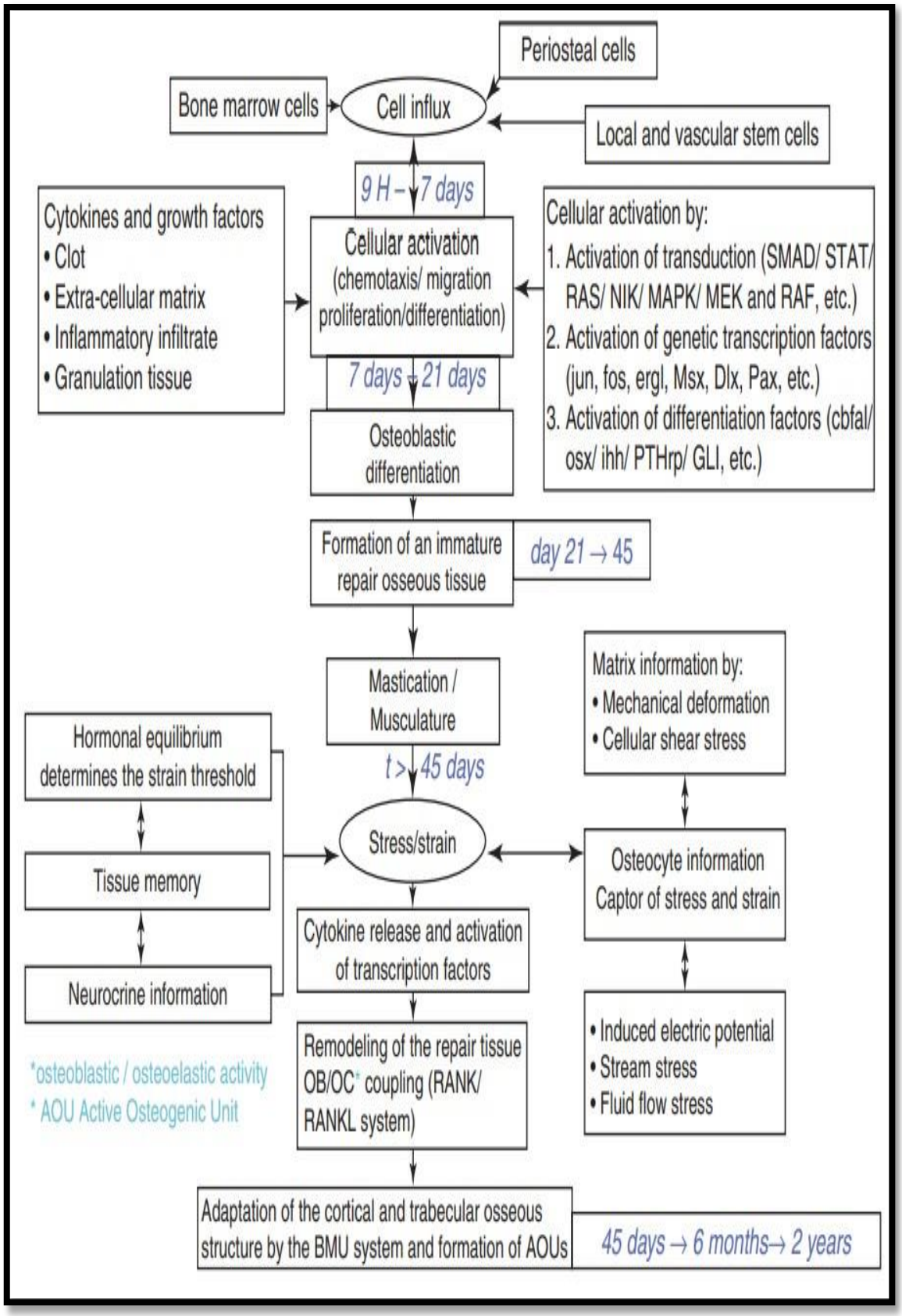
after 3days which promotes neo-angiogenesis. This process of stem cell differentiation for tissue repair occurs for 3 weeks.

2. Anabolic Phase: (From t=21 days to t-45 days)

The anabolic phase follows the catabolic response characterised by osteoblastic activity with reconstruction and improving the bone quality and quantity due to formation of callus. The appropriate waiting period for implant installation or bone grafts in type III & IV is 45-90days depending patient age and bone characteristics.[4]

Cascade of events in the use of osseotensor:

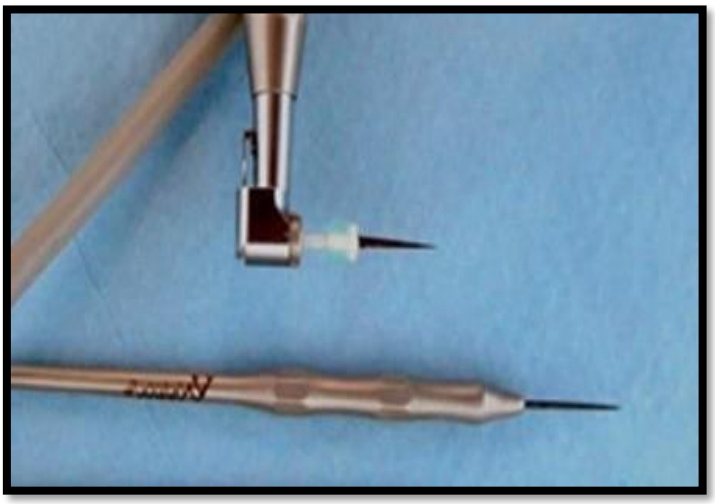



Periosteal cells
Bone marrow cells
Cell influx
Local and vascular stem cells
9 H – 7 days
Cytokines and growth factors
• Clot
• Extra-cellular matrix
• Inflammatory infiltrate
• Granulation tissue
Cellular activation (chemotaxis/ migration proliferation/differentiation)
Cellular activation by:
1. Activation of transduction (SMAD/ STAT/ RAS/ NIK/ MAPK/ MEK and RAF, etc.)
2. Activation of genetic transcription factors (jun, fos, ergl, Msx, Dlx, Pax, etc.)
3. Activation of differentiation factors (cbfal/ osx/ ihh/ PTHrp/ GLI, etc.)
7 days → 21 days
Osteoblastic differentiation
Formation of an immature repair osseous tissue
day 21 → 45
Mastication / Musculature
Matrix information by:
• Mechanical deformation
• Cellular shear stress
t > 45 days
Hormonal equilibrium determines the strain threshold
Tissue memory
Neurocrine information
Stress/strain
Osteocyte information Captor of stress and strain
Cytokine release and activation of transcription factors
• Induced electric potential
• Stream stress
• Fluid flow stress
Remodeling of the repair tissue OB/OC* coupling (RANK/ RANKL system)
*osteoblastic / osteoelastic activity
* AOU Active Osteogenic Unit
Adaptation of the cortical and trabecular osseous structure by the BMU system and formation of AOUs
45 days → 6 months→ 2 years

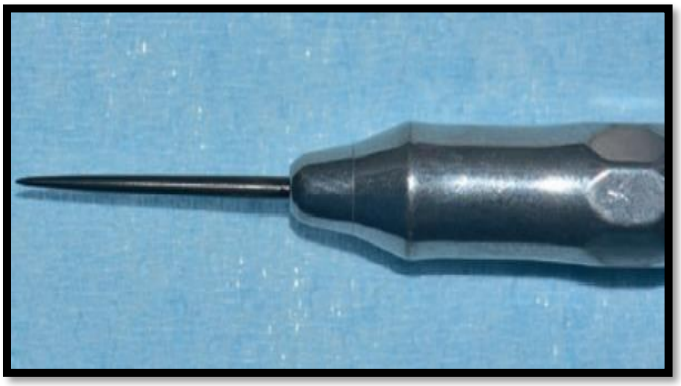
Manual Osseotensors for D3 and D4 Densities [4]

The manual Osseo tensor is designed to condense and expand type III and type IV soft bone without any drilling effect. After anaesthetising the gingival tissues, a manual Osseo tensor is press fit through the gingiva into the periosteum and bone in a flapless procedure with slight rotation. The operator must check the bone surface for the weakest area for the ease of penetration and also the density of bone to decide upon the area of penetration. The area of penetration can be decided using a stereolithic model. The manual Osseo tensor should not be forced into dense bone, it may cause damage to the tip. The number of manual impacts differs based on the type of bone.

For soft /egg shell thin D4/D5 bone the number of impacts is not limited whereas for D1/D2 type of bone, a single impact with a rotating Osseo tensor would suffice. The tip of the Osseo tensor is smaller than transfusion needle and the solid design avoids the various complications which ultimately leads to fracture of the implant. The number of manual impacts differs based on the type of bone, for soft/egg shell thin D4/D5 bone the number of impacts is not limited whereas for D1/D2 type of bone, a single impact with a rotary Osseo tensor suffices. The tip of the Osseo tensor is smaller than transfusion needle and the solid design avoids the various complications which ultimately leads to fracture of the implant. In the sinus region it traverses the eggshell thin bony sinus wall and pass through Schneiderian membrane. Blood extravasates under the respiratory lining of the sinus cavities which acts a balloon that atraumatically elevates the membrane. This occurs without haemorrhagic bleeding as the membrane closes up immediately as the needle is removed, due to gravity, atmospheric pressure and cell-cell adhesion of the respiratory sinus epithelium. Any blood in the respiratory epithelium causes ball on effect to raise the Schneiderian membrane which creates a space for formation of callus on the sinus floor. The resultant bone height was seen to be from 1.3-6 mm, measured by 3D cone beam imaging.



Manual Osseotensors and Rotaty Osseotensors



Manual Bone Matrix Osseotensor: The Instrument Of Choice For Bone Stimulation In Patients With Atrophic Maxillae

Regional Accelerated Phenomenon (RAP)[4]

Every impact site is a point of departure of accelerated reparative osteogenesis. Bone callus is formed by the mineralisation of the subperiosteal blood clot after 45-90 days which corresponds with the bone formation after closed fractures without displacement.

For type 3 and 4 soft bone, the microcracks created at impact sites induce local condensation and expansion without damage to outer architecture. Thereby, converting type 3 and 4 into type 2 bone. The number of impact sites and the repetition of the mechanotherapy depends on the bone

quality, quantity of the bone and age of the patients. The best method to appreciate the results is by manually probing the area with a manual Osseo tensor.

Rotary Osseotensor for D1 And D2 for Bone Densities:[4]

Rotary Osseo tensors are mounted on to a handpiece that rotates at 23000 rpm under copious irrigation. Rotary Osseo tensors are used for D1 and D2 dense cortical bone usually seen at mental region of mandible and in pterygoid and zygomatic process nasal floor and vertical nasal wall in maxilla. It is used in a flapless procedure with a single axial impact site of depth 3-11 mm into the bone. The region outside of the cortex is activated by manual Osseo tensor by tunnelling of the periosteum that causes bleeding which promotes blood supply. Totally, Osseo tensors are different from conventional drills as they condensed the bone rather than removing it. The mechanism is by perforating the outer cortex and pushing the endosteal trabeculae against the remaining buccal, lingual/palatal bone wall. The drilling effect is minimum as the tip has a cutting function. D1 type of bone shows little bleeding with manual Osseo tensor. Hence the implant fail as there are 1% lining cells and the proper blood supply for osseointegration. Hence, rotary Osseo tensors are used in cases of hypertense and sclerotic bone and D2 bone for softening and it is applied for bone splinting where it is helpful for removal of fractured Osseo integrated implant or impacted canine or 3rd molar, one where after the use of rotary Osseo tensors.

Indication- manual osseotensor:

Manual Osseo tensors are used in 3 different ways mainly in maxilla- Trans parietal penetration, Tunnelling of periosteum and Manual probing.

- Flapless application 45-60 days before implant installation/ sinus elevation at sites with less bone volume for easy penetration. Re-evaluation is done after 45 days, if the bone volume is satisfactory. Then the implant placement is done.
- Flapless tunnelling of the periostieum is done to increase the initial blood supply and activate the periosteal stem cells.
- 1 week before Guided Bone Regeneration
- 1 week before autologous free or pedicle bone graft.[4]

Indications for Rotary Osseotensors

Rotary Osseo tensors should penetrate to a depth of 10mm under copious irrigation, mainly used in mandible.

- Flapless application 1 week before implant placement (One site).
- Flapless application 1 week before extraction of an impacted tooth / mobilization of an impacted canine (4-5 sites).
- Flapless application 1 week before retrieval of a fractured Osseo integrated implants. (3-4 impact sites)
- Flapless application 1 week before distraction or crestal expansion (single site).[4]

Contraindications:

- Physically and mentally challenged patients.
- Patients using high dose bisphosphonates
- Sinusitis
- Oral infection
- Poor oral hygiene and dental condition[4]

Applications:

- **Minimally invasive sinus lift procedure:**

The use of Osseo tensor 45-60 days prior to the implant placement has shown a bone gain from 1.2- 6mm and better osseointegration with better acceptance of graft with neo angiogenesis.

- **Tissue engineering and prf:**

The use of Osseo tensors at the target sites for tissue engineering is seen to be helpful by initial blood supply and simultaneous recruitment of bone progenitor cells.[4]

SURGICAL PROTOCOL

Patient Preparation:

Initially intraoral preparation is done using 2% CHX. Cleansing can be done using spray/jet lavage with Ringer's solution and hydrogen peroxide serving as the primary media. A prophylactic antibiotic dosage should be given, 2gm of amoxicillin 20 minutes pre-operation.

Osteotomy Preparation:[13]

The implant bed is created using vertical, horizontal and combination cutters using a lateral access. Initially vertical bone is cut using a tungsten carbide cutter using a turbine with profuse irrigation. The advantage of using turbines is that it stops when excessive forces are applied by surgeon. The other tools used are high speed contra-angle handpiece and ELCO system with torque control adjusted to 30%. The cutters may bend sometimes, as even minor rotational imbalances may cause deformation. Once the osteotomy has been prepared, implant is inserted using a lateral access and hammer style strokes. Case should be taken, not to apply forceful strokes at the threaded pin as it may undergo plastic deformation and become harder than other areas. These areas are seen at peak stress concentration areas which are at high risk to fracture on cyclic loads.

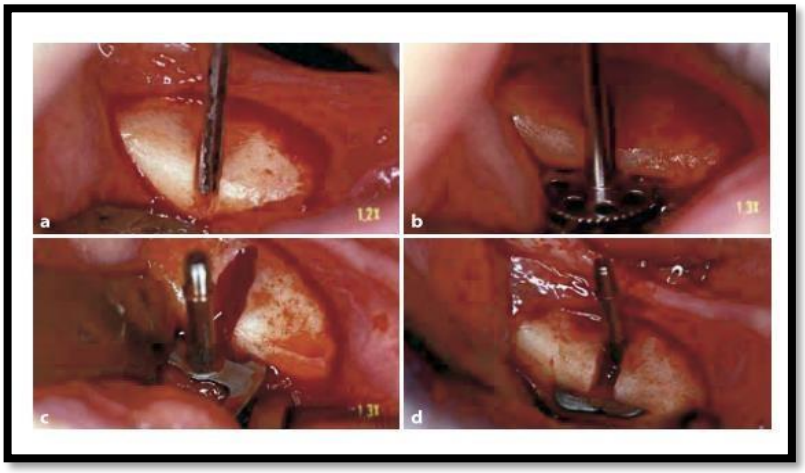
In the posterior maxilla, an undersized implant bed is created, for example, if a10mm implant is to be inserted then as 9mm cutter osteotomy preparation is done. Where as in the mandible, a reverse approach is applied, for example, to invest a 9mm implant, a 10mm osteotomy needs to be prepared.

The cutter gets jammed inside the bone and resist to removal. It usually happens while horizontal expansion in the distal mandible which by plastic deformation of jaw due to strong flexion during mouth opening. This plastic deformation occurs due to microcracks. Bone tissue permits crack formation while resisting crack propagation.

The BOI implants can also be inserted lingually in left mandible if there is accessibility and adequate bone volume. Slot guages are used to ascertain that the implant is smoothly glided into

the osteotomy. The osteotomy spontaneously heals by native bone growth or blood derived autologous membranes with calcium phosphate or calcium sulphate additives can be used.

Non- resorbable grafts are contraindicated in mandible as it may migrate and cause chronic irritation to the mental nerve. In the maxilla, bone defects may be grafted using TCP, HA, autograft, allograft, xenograft or PRF.

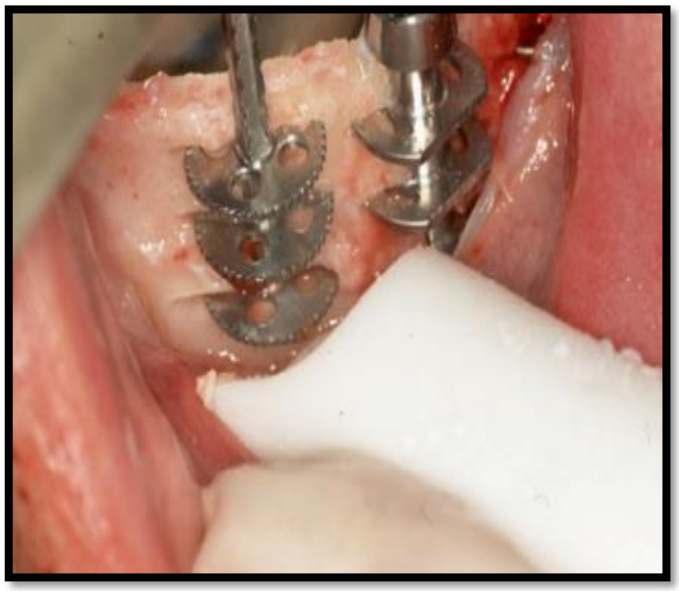


The vertical osteotomy slot is cut first. It defines the direction, the departure points and the endpoint of insertion. Subsequently, a number of horizontal cutters with incremental diameters (starting with a 7-mm cutter) are applied. In maxillary structures and on the non-working side of the mandible, it is frequently possible to establish both the vertical and the horizontal slot at once by using a combination cutter (e.g.,10mm). Once the slots have been completed, the implant can be inserted. It is recommended to use implants that are somewhat "oversized" in relation to the bone structure.

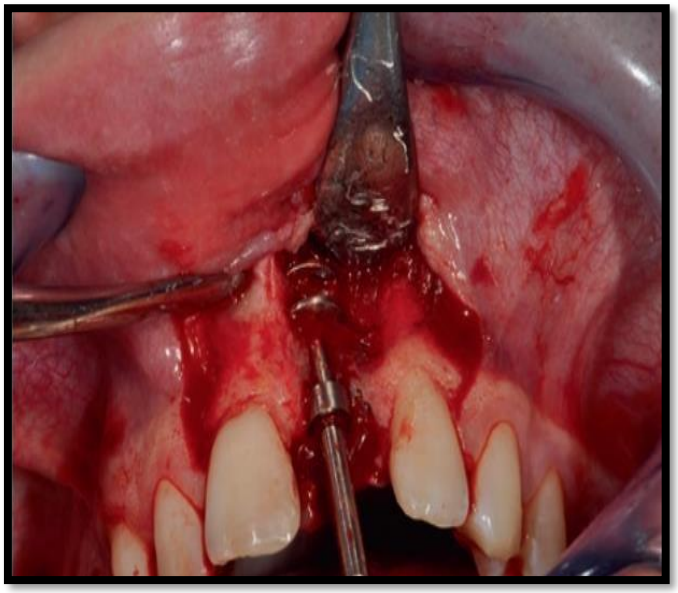
Irrigation:

It is generally used to protect bone from overheating. In a study done by Albrektsson(1985) and Eriksson et al. (1982) demonstrated that a temperature of 47°C maintained over 1 min significantly reduces bone growth near roughened implant surface, whereas a temperature of 44°C does not impact bone formation. The temperature deep inside the osteotomy cavity according to in-vivo studies was found to be 26-28°C when 18°C irrigation is provided. The solution most commonly used is Ringer lactate rather than saline, due to its composition, it is more benign to

bone. As bone harbours more salts and proterium and are quickly drained when a solution of lower osmolarity is used.[13]



The picture illustrates the osteotomy site for the placement of a triple disk basal implant.



The picture illustrates the osteotomy site for the placement of a double disk basal implant.

Alteration in Approach in Clinically Different Situation:[13]

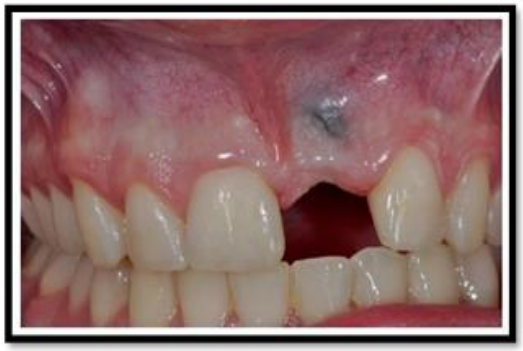
- BOI implants are usually placed in optimal bone volume but, in case of placement in prosthetically pleasing manner then the threaded pins are parallelized by bending after insertion and before flap closure.
- If adequate bone volume is not present above the mandibular nerve, then the disks may be placed under the nerve.
- In the maxilla, implants can be placed either through augmented sinus floor or by intra sinus approach.

Special precautions during lateral osteotomy

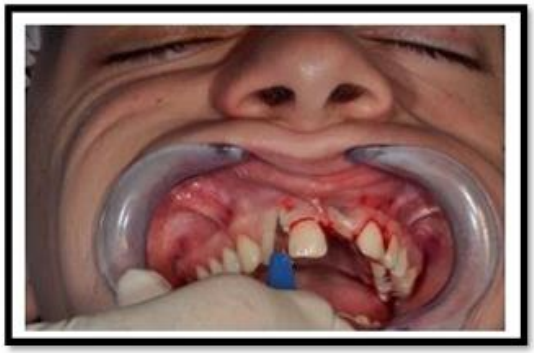
- For Disk implants, a small lateral cut is made with a 5mm diameter cutter. This can be left in place and verified radiographically for correct position before continuing with larger diameter.
- The soft tissues, periosteum, and mandibular nerve must be protected For mandible, start with a 5mm diameter cutter and then use the final cutter (7or 9 mm).

Cylindrical Monobloc Disk implants:

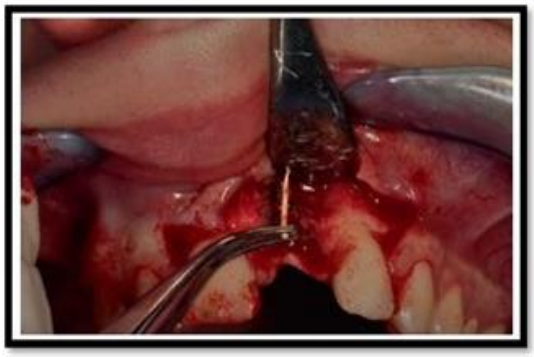
Elevation of both lingual (or palatal) and buccal full-thickness flaps permits visualization of the moment when the cutter reaches and starts to enter the opposite cortical plate. This allows avoidance of injury to the periosteum. If part of the implant protrudes outside of the bone after Disk implant® installation, it can be left as a graft holder for autogenous bone chips that have been collected in situ or for placement of a non-resorbable biomaterial such as autologous dentin, BioOss®, CoreBone®, Ivory®, Interpore®, and/or a PRF membrane. The full-thickness flaps are then sutured passively. For single-tooth replacements in the aesthetic zone, an Invisalign®-like removable temporary should be used during a waiting period of 6 months.



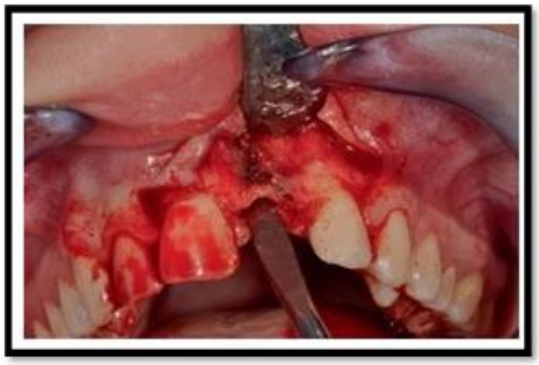
Typical situation for single-tooth replacement using either root-form dental implants with prior bone grafting or immediate placement of basal implants (double Disk implants).



Angulated soft tissue incision including the two adjacent teeth.

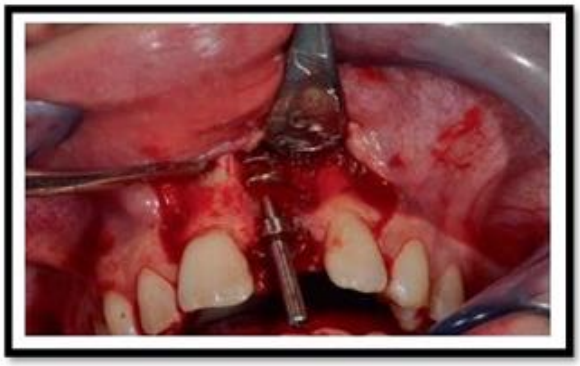


A full thickness flap is elevated: a gutta percha root canal filling trapped in the bony defect caused the recurrent fistula.

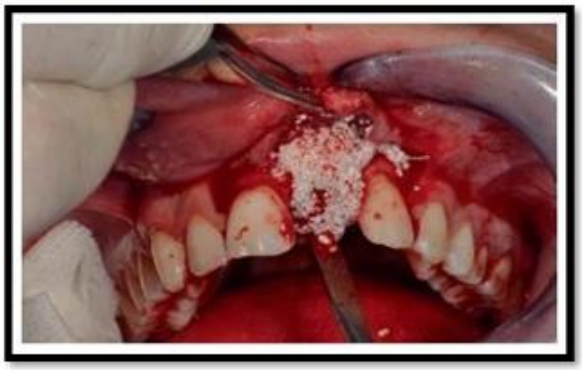


A very little bone remained after removal of the foreign body and only the palatal plate remains intact.

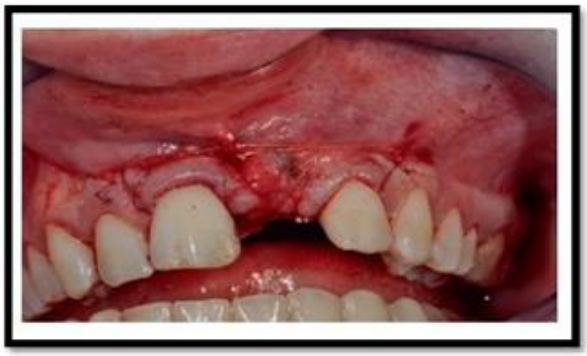
The patient refused a bone graft but accepted a basal implant treatment, lateral osteotomy was performed under copious irrigation.



A double Disk implant was inserted laterally and absolute primary stability was checked.

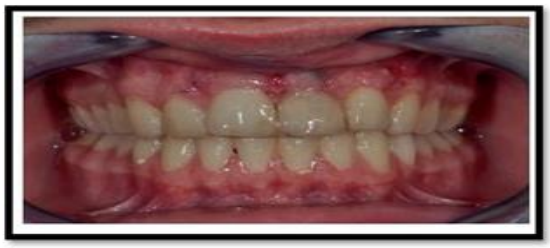


Full coverage with bone substitute and PRF.



After a high horizontal internal periosteal incision, the full thickness flap was sutured with 4-0 Glycolon suture material.

An Invisalign like temporary template was made with commercial teeth and left in place for 6 months.

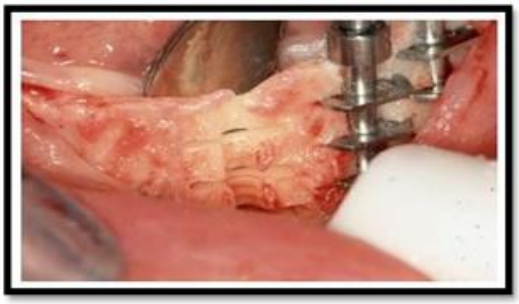


The temporary appliance must not injure the implants area. At 6 months post-op, a titanium/composite tooth was screw-secured onto the double Disk implant. Healing at 1 week. Second surgery at implant exposure 6-7 months later.

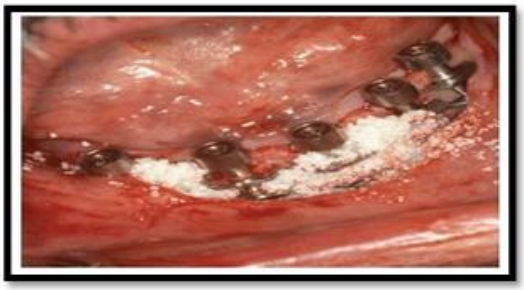
Asymmetrical Monobloc Disk implants:

Depending on the planned direction of insertion, a cutter corresponding to the larger or the smaller diameter is used (e.g., a 7 mm or 5 mm cutter for a Disk-implant with a 7 × 5 mm rectangular base). Mesio-distal preparation of the osteotomy is achieved using a discrete back-and-forth movement of the corresponding cutter (single-, double-, or triple-disk cutter corresponding to the future implant). This slightly enlarges the vertical shaft cut, permitting a gentle press fit of the Disk-implant using a surgical mallet and an appropriate implant-seating instrument. The Monobloc emergence profile can be installed at bone level or just above. A small diamond-coated wheel bur can be used to create an appropriate crestal bone housing if needed. Protruding disks should be covered with a bone substitute material (BioOss®, Ivory®, CoreBone®, Dentin Grinder® graft, etc.) and PRF. The full-thickness flaps (lingual/palatal and buccal) must then be sutured passively.

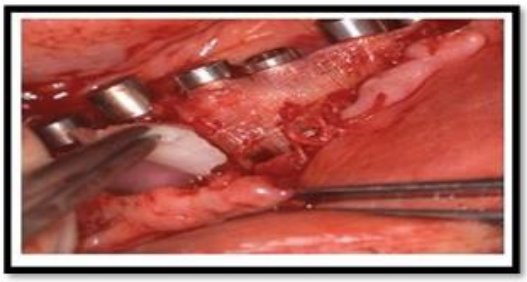
Knife ridge in the mental area: lateral osteotomy for installation of a triple Disk implant that must engage the lingual plate.



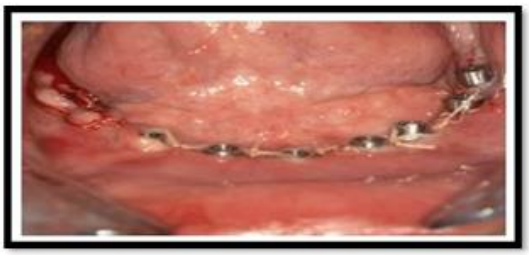
The vertical cortical bone wall of the lingual plate must be preserved, otherwise the entire bone height and the Disk implant can be lost.



The protruding portion of the triple Disk implant must be completely covered by bone substitute material. Adding an orthopedic screw (diameter 2mm length 5mm) after Disk implant installation is sometimes useful because absolute primary stability is mandatory



PRF membranes are placed over the bone substitute material to hold it in place.



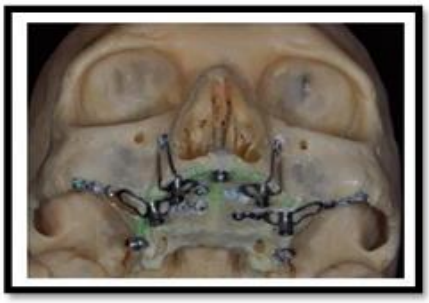
Release of the periosteum using a horizontal incision allows passive suturing of the full thickness flap. An immediate loading procedure with a fixed screw- secured bridge is mandatory.

Plate-Form Disk implants with Osteosynthesis Screws:

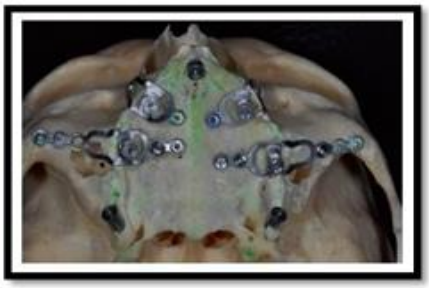
Plate-form Disk implants® must always be rendered endosseous; they must not remain subperiosteal. This can be achieved by inserting the plate in a lateral bone cut and covering it with a bone substitute material and PRF, or, when preparation of a bone notch is not feasible, by simply covering it with a non-resorbable bone substitute material (BioOss®, Interpore®, CoreBone®, Synthograph®, or equivalent) plus autologous PRF membranes using GBR technology. The periosteum and/or Schneiderian membrane (for plate-form Disk implants® secured on the zygomatic process) should always be kept at a distance from the plate to avoid future exposure with time due to the pull of masticatory muscles. The plate portion of the basal Disk implant® must always remain in intimate contact with the bone bed. A round tipped seating instrument and a surgical mallet should be used to gently shape the titanium plate to the bone crest.

Mandible: The recipient bone bed is first flattened with a 7 or 9mm diameter cutter. Whenever possible, a notch should be prepared in the bone to anchor the plate on the lingual or buccal aspect of the recipient bone site.

Maxilla: Use a 7 or 9mm diameter cutter, depending on the dimensions of the basal implant selected. In the zygomatic area, prepare a cut passing completely through the crest or simply flatten the surface for placement directly on the crest. If the sinus is effracted, push the membrane away with PRF membranes and bone substitute material, then install the wide plate-form Diskimplant®. Firmly secure the implant to the zygomatic process and the palatal maxillary bone with 2 to 5 mini orthopaedic screws (5 or 6 mm in length, diameter 2 mm). In the canine pillar area, the plate must always be bent at a 90° angle. A lateral osteotomy is prepared at the crestal level.



Atrophied dry maxilla with basal implants inserted on the major maxillary buttresses.



Occlusal view of basal implants firmly screw-secured in the remaining dense bone. The wide base of the plate-form Disk implant (43 * 9mm) provides reliable support for a fixed, screw-secured prosthetic appliance.

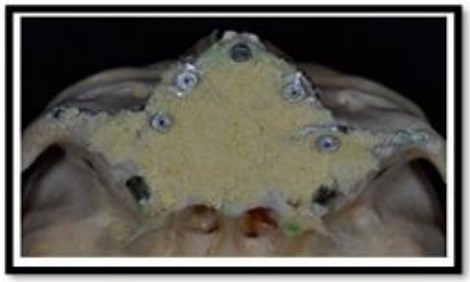
Close up view of basal implants in close contact with the recipient bone site.

The zygomatic Disk implant spans an Oro-antral communication.

The sinus membrane must be elevated using PRF membranes.

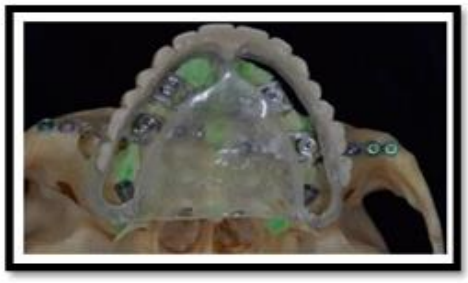
Bone substitute material is used to cover the entire area

Bone substitute material is placed over the PRF membrane in order to close the lateral opening in the sinus wall.

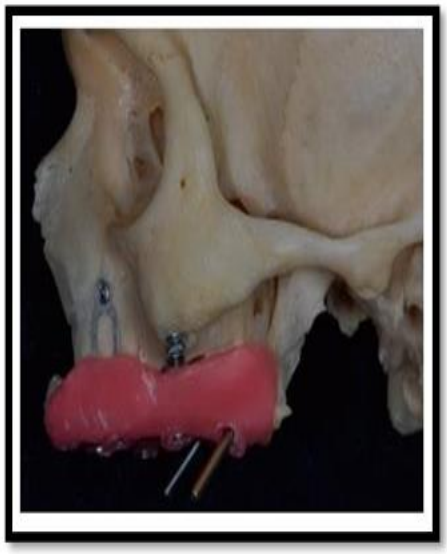


Bone substitute material must cover the entire area; no portion of the basal plate should remain exposed.

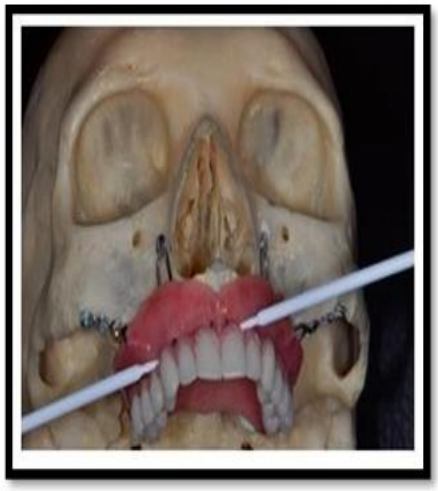
Fratex implant firmly anchored in the pterygoid bone.



A transparent surgical guide made with the full upper denture can be helpful for basal implant installation.



In atrophic jaws, distal anchorage in the major skeletal buttresses is mandatory. A tubero-pterygoid root- form implant can be angled at 45 degrees without problem because its flat emergence profile makes it easy to screw-secure the fixed prosthesis.



Screw- secured prosthesis in place with space for maintenance and easy cleaning.

RESTORATION OF ATROPHIED MANDIBLE AND MAXILLA

Mandible

There are two thoughts that were developed are:

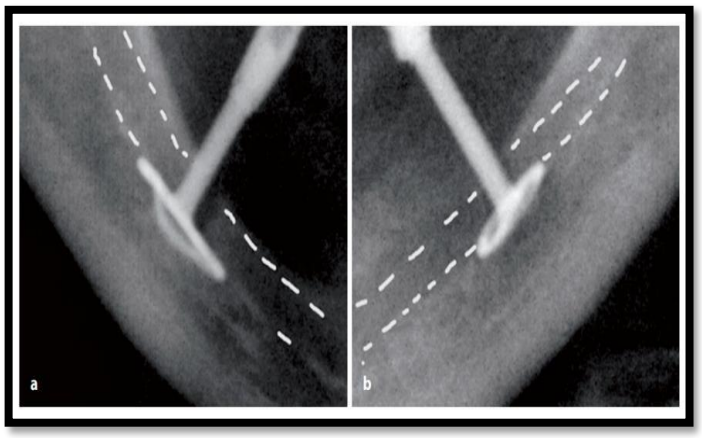
1. Multi implant concept of French school It was given by Scortecci and according to this concept the basal and crestal implants are combined to form a rigid restoration that does not permit torsion across the mandible and reorient forces.

2. Strategic implant positioning concept of German school -It was given by Dr. Ihde. in this concept four implants are placed in the mandible in the canine and second molar region allowing torsion and reorientation of forces compensated by the flexibility of the prosthesis and avoids osteolysis and implant fracture.

3. Infranerval Implantation Technique If vertical bone supply above mandibular nerve is <2mm, then Infra nerve insertion is indicated EDAS implants are generally used.

Procedure:

A sharp bone cutting bur or round bur are used to open the nerve canal and expose the nerve. The caudal extension of the nerve should be explored. If the nerve is not bound by bone caudally then there is a high risk of damage. If the nerve is located for lingually then the vertical osteotomy is



prepared vestibularly followed by second infra-nerval horizontal implant slot. This procedure is known to produce certain amount of paraesthesia that persists for 3 months.

Two examples of Infranerve implantation in BOI technique. The nerve route is indicated by the white dotted lines. In the case, one would have been able, if only barely, to insert a double -disk BOI implant below the nerve. However, this would have additionally weakened the mandibular structures and increase the risk of fracture. The implant was additionally moved distally, which is why the vertical insertion slot is clearly visible. This allowed the medial edge to be adapted more closely. The caudal and vestibular limits of the cortical bone of the nerve canal did not suffer any damage.

Maxilla

The atrophied maxilla is challenging to restore due to the presence of pneumatized sinus and porous bone. The porous bone is compensated by compression screw implants and the sinus is taken care of by 2techniques.

1. Sinus section techniques-

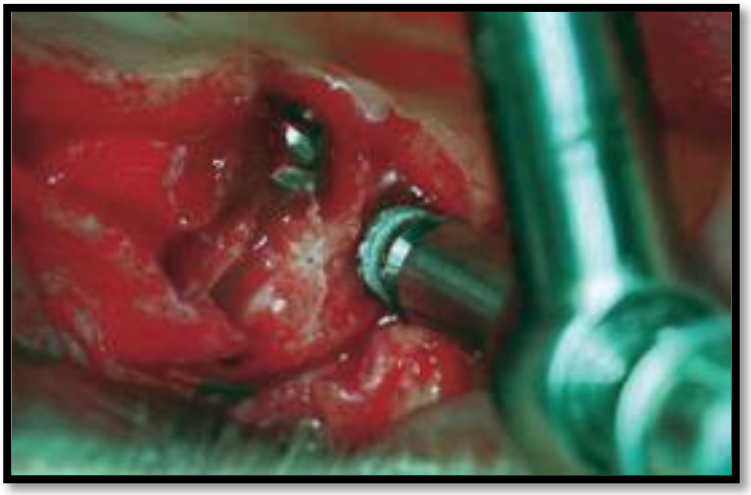
In this method two/ three walls of the sinus are sectioned to facilitate placement of the basal disk in the sinus. The purpose of this technique is to gain bi-cortical support but restricted to the placement of single implant in each sinus. The placement of graft and lifting of membrane is done based on the requirement.

2. Tubero-Pterygoid screws (TPG):[13]

The distal maxilla is stable to resorption as the mandibular anterior segment as it harbours attachments of powerful chewing muscles. The bone in this region adapts to the functional change the tuberosity region is highly vascularized. The full thickness flap is elevated sufficiently on the palatal aspect to have a rear view of the disto-medial anatomy of maxilla. The tubero-pterygoid implant is to be inserted obliquely in a medial and distal direction. The angles with sagittal and vertical planes are around 20-45 degrees.

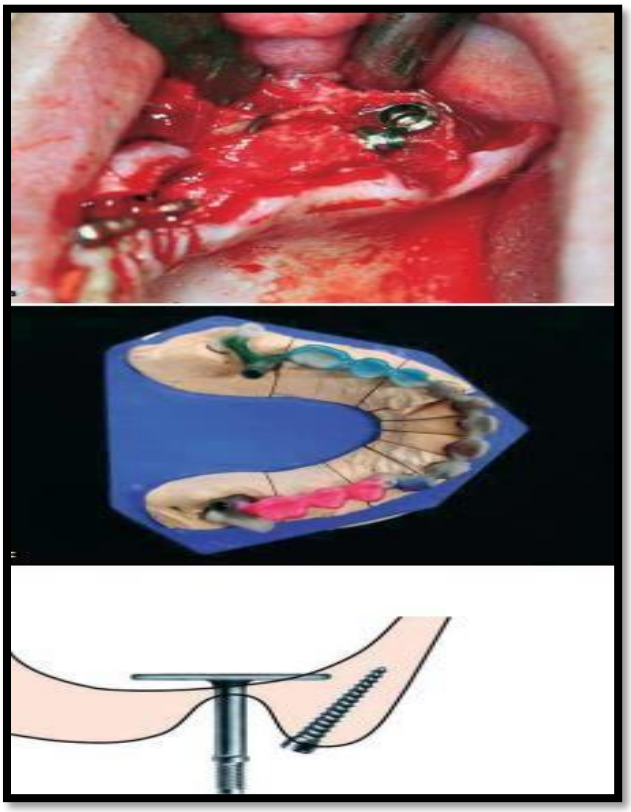
After ridge exposure, drilling is started at low speed with low pressure intermittent drilling technique. The goal is to anchor the cortical tip in the area of sinus wall or at lateral pterygoid muscle attachment. The pterygoid implant should be placed first when a distal BOI is also planned, to have better accessibility. If the sinus floor is hit easier then, the osteotomy is reoriented more distally. The length of pterygoid implants used is 40cm and cone shaped STC or STO type compression screws are used since they have shown better osseointegration.

STO Tubero-pterygoid screw 31mm in length and 4.1mm in diameter.



The disk of an IDO 9/12 G6 implant was inserted basally to the root area of the extracted second molar. The inclination of the BOI implant faces towards the palatal aspect. The tubero-pterygoid screw, by contrast, is oriented in a distomedial and cranial direction. The screw implant is still connected to the insertion tooth with the ratchet connected.

The basal plate of the most distal BOI is very often positioned below the crestal aspects of the pterygoid screw. This procedure required well-trained three- dimensional imagination and deep knowledge of the anatomy.



The angle between the tubero-pterygoid screw and the BOI at 17 should not exceed 90 degrees because that would make it difficult or impossible to insert the bridge.

3. Zygomatic screw implant:[23]

These implants are placed in the zygomatic bone and helps in bicortical support. The original Branemark customized zygoma fixture was designed to be inserted from the palatal aspect of the resorbed maxilla in the region of the second premolar, through the maxillary sinus into the compact bone of the zygoma. Initially it had the characteristics of a conventional implant but with increased length and diameter. It was a self-tapping titanium implant with a machined surface and available in lengths of 30–52.5 mm. The threaded apical part had a diameter of 4 mm and the crestal part had a diameter of 4.5 mm. The implant head was provided with an inner thread for connection of standard abutments. Later on, the implant head was angulated to 45°. In today's fixture the surface has evolved to a moderately rough oxidized threaded surface and the head includes an implant driver screw that remains inside the implant, offering an inner thread for the connection of special 'zygomatic' abutments.

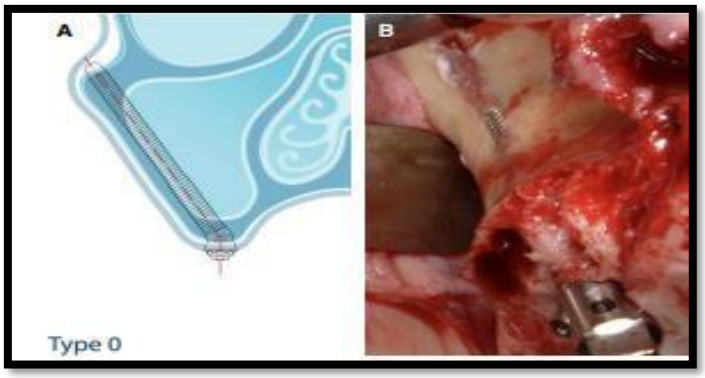
The two landmarks to be identified are vertical ridge / anterior border of zygomatic arch and lateral border of the orbit. The local anaesthesia is administered and then a mucoperiosteal flap is elevated exposing the posterior/ central part of the zygomatic complexes the lateral wall of maxillary sinus and the alveolar rest. A retractor is used for visibility and for protection of soft tissue while drilling.

Original Technique:

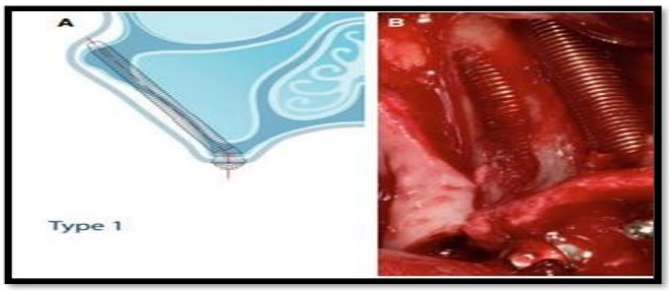
The indicator is used to determine the path of drilling starting at the crest usually at the second premolar or first molar. A bone window of 10mm wide is created at the lateral aspect of maxillary sinus, the sinus membrane is from the wall and placed in the sinus cavity. A series of drill are used to penetrate the alveolar process and zygomatic bone. The length of the implant estimated by a depth gauge. The self -tapping zygomatic implants are placed with the aid of motor or manually. If needed the bone particles harvested locally can be placed in the region. The cover screw is placed and the flap is closed. Straight/ multiunit brane-mark abutments are used after a healing period of 6 months.

Modified Approach: ZAGA (Zygomatic Anatomy Guided Approach):

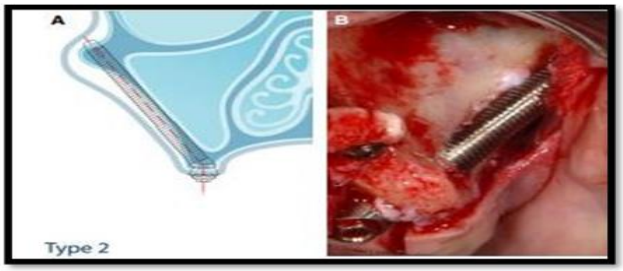
In patients with pronounced buccal concavity on the lateral aspect of maxillary sinus. When zygomatic implants are placed there is excessive palatal emergence of the implant head leading to bulkier bridge at the palatal aspect, patient discomfort with oral hygiene, patient discomfort with oral hygiene and speech hindrances. The new approach is according to the anatomy of the maxillary sinus. There are five basic skeletal forms of the zygomatic buttress-alveolar crest complex was identified.



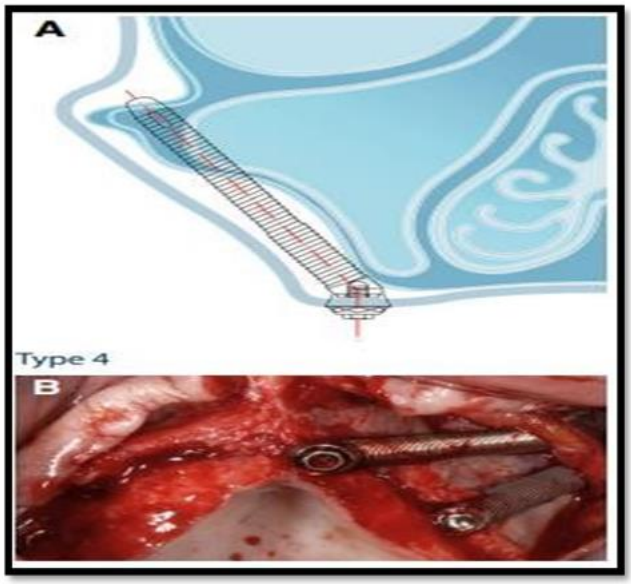
TYPE 0: Schematic (A) and clinical (B) examples of a zygomatic anatomy-guided approach (ZAGA) type-0 path. The anterior maxillary wall is very flat. The first osteotomy is placed on the residual alveolar crest. The implant body reaches the zygoma bone following an intrasinusal path.



TYPE 1: Schematic (A) and clinical (B) examples of a zygomatic anatomy-guided approach (ZAGA) type-1 path (posterior implant). The desire to place the implant head in the correct prosthetic site, together with the presence of a slightly concave anterior maxillary wall, caused the implant osteotomy to perforate the maxillary wall. Regardless, most of the implant body remained inside the maxillary boundaries.



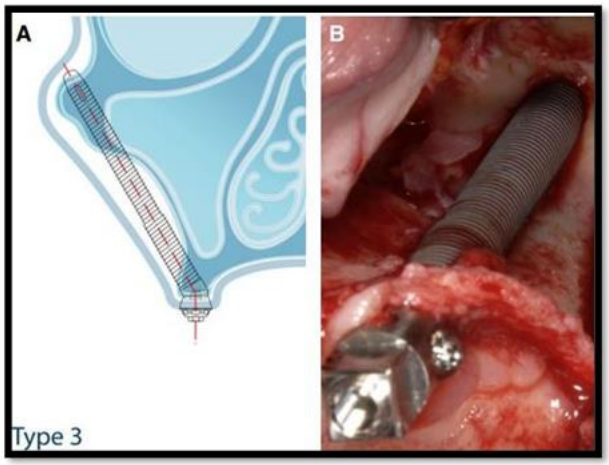
TYPE 2: Schematic (A) and clinical (B) examples of a zygomatic anatomy-guided approach (ZAGA) type-2 path. In the presence of a more concave maxillary wall, ideal placement of the implant head forced most of the implant body to be placed extra-sinusally. However, no space was left between the implant surface and the anterior maxillary bone.



TYPE 4: Schematic (A) and clinical (B) examples of a zygomatic anatomy-guided approach (ZAGA) type-4 path. The atrophied maxilla presented both vertical and horizontal resorption. To place the implant head in an optimal location, while avoiding perforation of a very thin palate, the surgeon had to choose an extra-maxillary path.

Prosthetic procedure:

The zygomatic implants have a great tendency to bend under horizontal loads. This is due to the length of the implant and the poor availability of bone support. In order to gain more stability in full arch restoration of maxilla, two stable conventional implants should be placed at the anterior region. The original protocol was delayed loading of the implant but, immediate/ early loading has also given good clinical outcomes (Ostman et al, Bedrossian et al and Davo et al).



TYPE 3: Schematic (A) and clinical (B) examples of a zygomatic anatomy-guided approach (ZAGA) type-3 path. As a result of a very concave maxilla, the first osteotomy performed from the palatal side of the alveolar crest went out buccally to the maxillary bone until it reached the zygoma in a more cranial position. The middle part of the implant does not touch the bone.

4. Glabellar implants:[24]

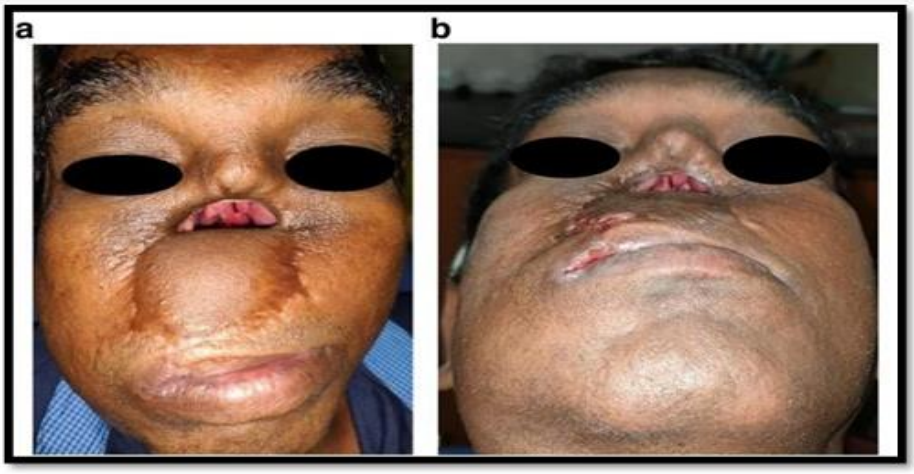
In case of malignancy of the maxilla, the best treatment protocol is surgical resection. The loss of structure causes difficulty in phonetics, deglutition and masticatory function. When there is a loss of structure like nose/ ear or orbit then it needs to be rehabilitated using a craniofacial prosthesis/ epithesis.

Case Presentation:

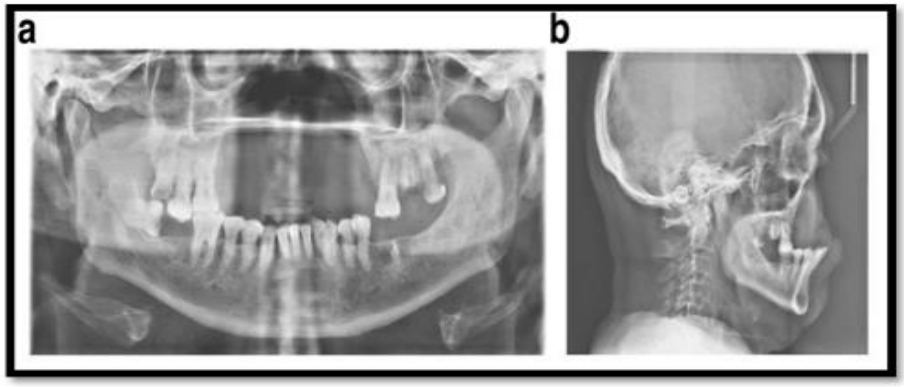
1. A 48year old man presented with a difficulty on chewing with restricted mouth opening. The patient underwent anterior segmental maxillectomy along with right antrostomy and complete rhinectomy 4year ago as a treatment for squamous cell carcinoma. According to Brown's classification, the defect is assessed as 2b, with a vertical and bone horizontal components. Intraorally, all the upper incisors up to premolars with missing bilaterally and 3rd molar were missing on the mandibular arch.

Due to the poor periodontal prognosis of the remaining teeth, they were extracted. After cephalometric and CT analysis, 2 zygomatic implants, 2 pterygoid implants and one glabellar implant for the nasal epithesis. The mandible was rehabilitated with 3 implants.

For the reconstruction of maxilla defect, a metal to acrylic hybrid prosthesis was used and for nasal epithesis, silicone material was used.



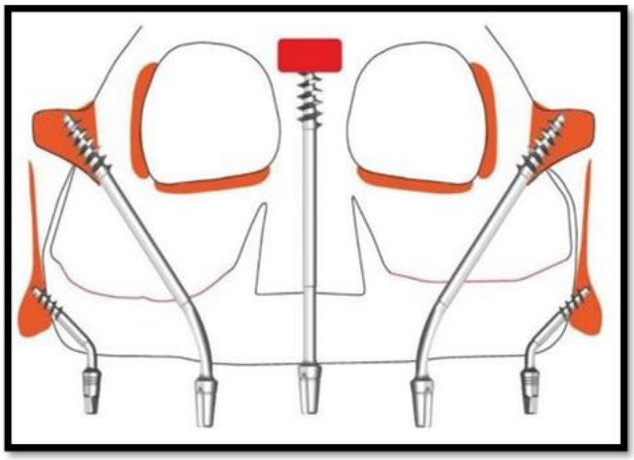
A, B: Pre-operative facial view—a broad nasal opening is visible, which led to anterior facial deformity



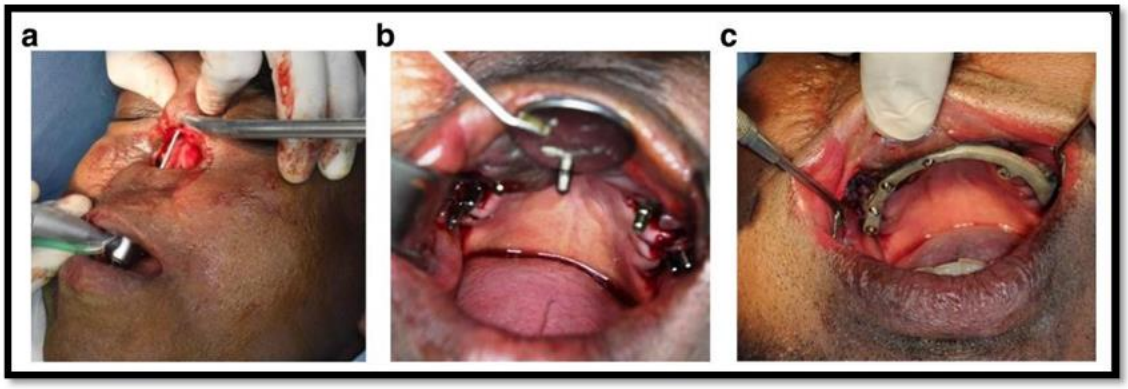
a. Pre-operative OPG. All the upper incisors up to premolars missing bilaterally, as well as lower left molars.
b. Pre-operative laterocephalogram

Table 1 Types of implants inserted

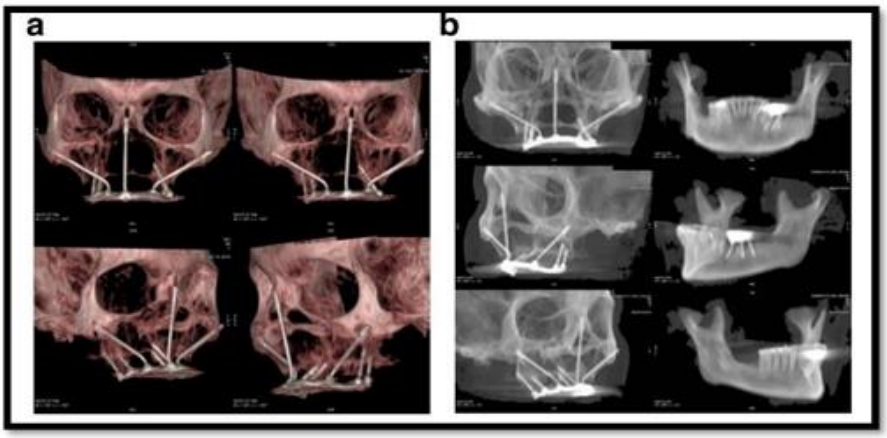
Type of implant	Location	Length	Diameter	Number of implants
BECES (Simpladent, Switzerland)	Pterygoid	26 mm	3.6 mm	1
BECES (Simpladent, Switzerland)	The pterygomaxillary buttress on the right side	17 mm	3.6 mm	1
BECES (Simpladent, Switzerland)	Pterygoid (distal)	17 mm	3.6 mm	1
BECES (Simpladent, Switzerland)	Pterygoid of the left maxilla	23mm	3.6 mm	1
ZDI (Simpladent, Switzerland)	Zygomatic bone on the right side	50 mm	4.6mm	1
ZDI (Simpladent, Switzerland)	Zygomatic bone on the right side	52.5 mm	4.6 mm	1
ZDI (Simpladent, Switzerland)	Glabella region engaging floor of frontal sinus/nasion; the fusion of middle and superior transverse facial buttress	55 mm	4.6 mm	1



Schematic planning of the implant placement

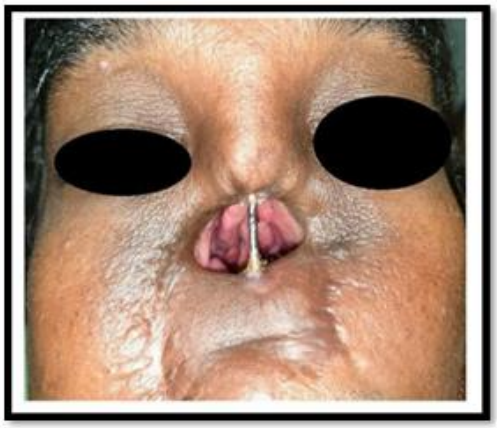


a Glabella implant osteotomy. b Implant placement procedure. c Metal try-in

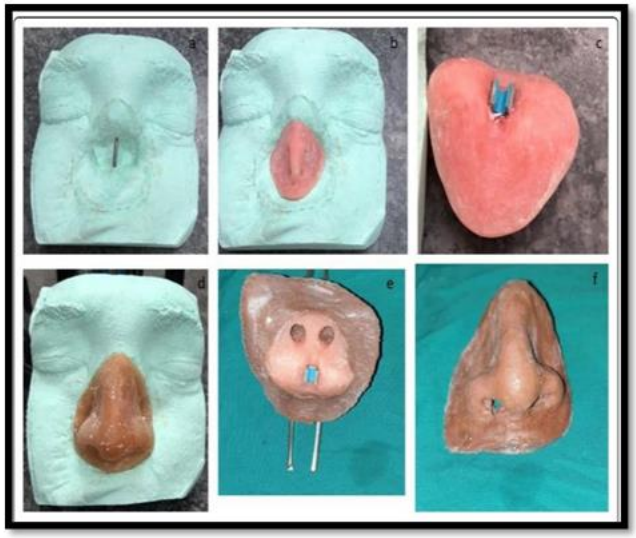


Post-operative CT coronal view: one zygomatic implant was used for the glabella region anchorage, engaging the floor of the frontal sinus, and in the mandible, three implants were placed in order to replace the left molar. b Post-operative CT sagittal view.

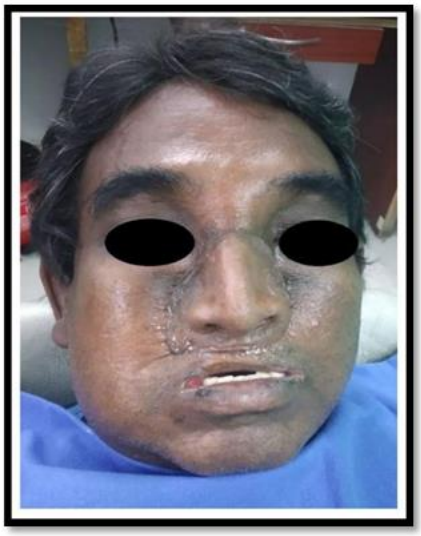
a-c Metal to acrylic hybrid prosthesis. The anterior were set up in a crossbite and the posterior teeth accordingly to the concept of strategic occlusion.



A post-surgery view of the zygomatic implant placed for the glabella region anchorage after the intraoral prosthesis fixation



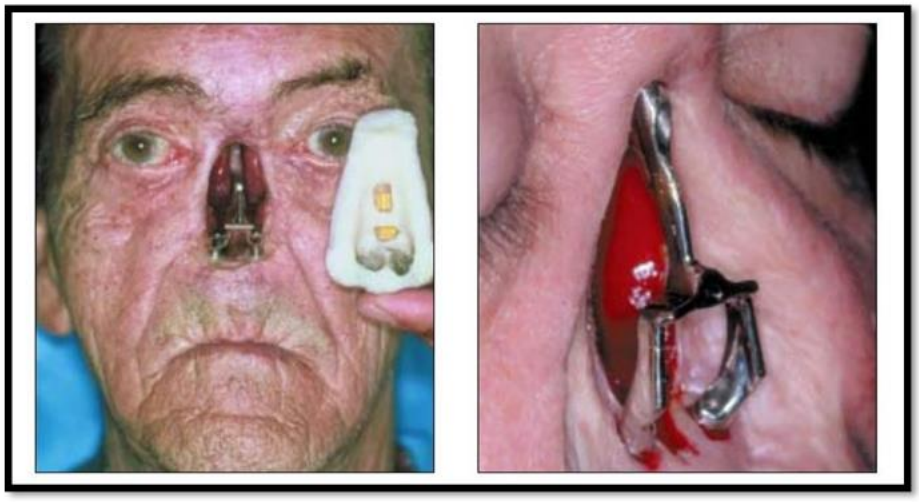
A removable nasal epithesis with a custom-made bar clip. a-f Steps of making the nasal epithesis. The clip was fabricated by doing casting of wax pattern over the body of the zygoma implant; then, it was cut in half. Retentive wings were also fabricated along the clip. The half-cut clip was fixed to the tissue surface of the nasal epithesis to be used as a clip over the body of zygoma as a bar.



Final look with an intraoral hybrid and extra oral-nasal epithesis.

2. In another study done for the facial rehabilitation stated that the primary implant site for the nasal defects was piriform ridge at the base of the nose with a cumulative survival rate of 87%. The secondary site was the glabellar with the primary consideration of pneumatization of frontal sinus and quality of bone.

The placement of 7mm long implants were more flavour able at the glabellar region.



A. Horizontal and vertical Hader bar design used in nasal defects.
B. Glabella implant splinted to the piriform implants via segmented tissue bar and set screw.

The placement of 7mm long implants were more flavour able at the glabellar region.

5. Cortically fixed at once concept

This protocol was introduced by Dr. Henri Diedrich in 2013. These are plate form implant which look like miniplates (used for fracture reduction) with an abutment platform. The unique design allows them to be bent and adapt to any surface and is anchored into the bone using expanding mini- screws. The advantage of this technique is iso-elasticity enabling them to mimic bone.

PERI- IMPLANT HEALING

The conventional concept of osseointegration is called as ‘Osseo-adaptation’ in case of basal implants as the remodelling of bone occurs under continuous functional load. The Osseo-adaptation occurs by the ‘Bone Multicellular Unit (BMU). It is like a cutting cone with a tail, the cutting cone comprises of osteoclastic cells that destroy the bone near the peri-implant region. The tail consists of osteoblastic cells that lay down new bone. As the unit moves in the bone osteoclastic activity precedes osteoblastic activity. The formation of BMU occur during immediate loading remodelling of bone under functional stress which initiates healing and finally results in dense, peri-implant bone.

The different phases involved are

1. Activation phase- the precursor human mesenchymal cells develop osteoblast and osteoclasts in 3days.

2. Resorption phase- osteoclastic activity occurs measuring the bone soft and porous at the rate of 40nm/day.

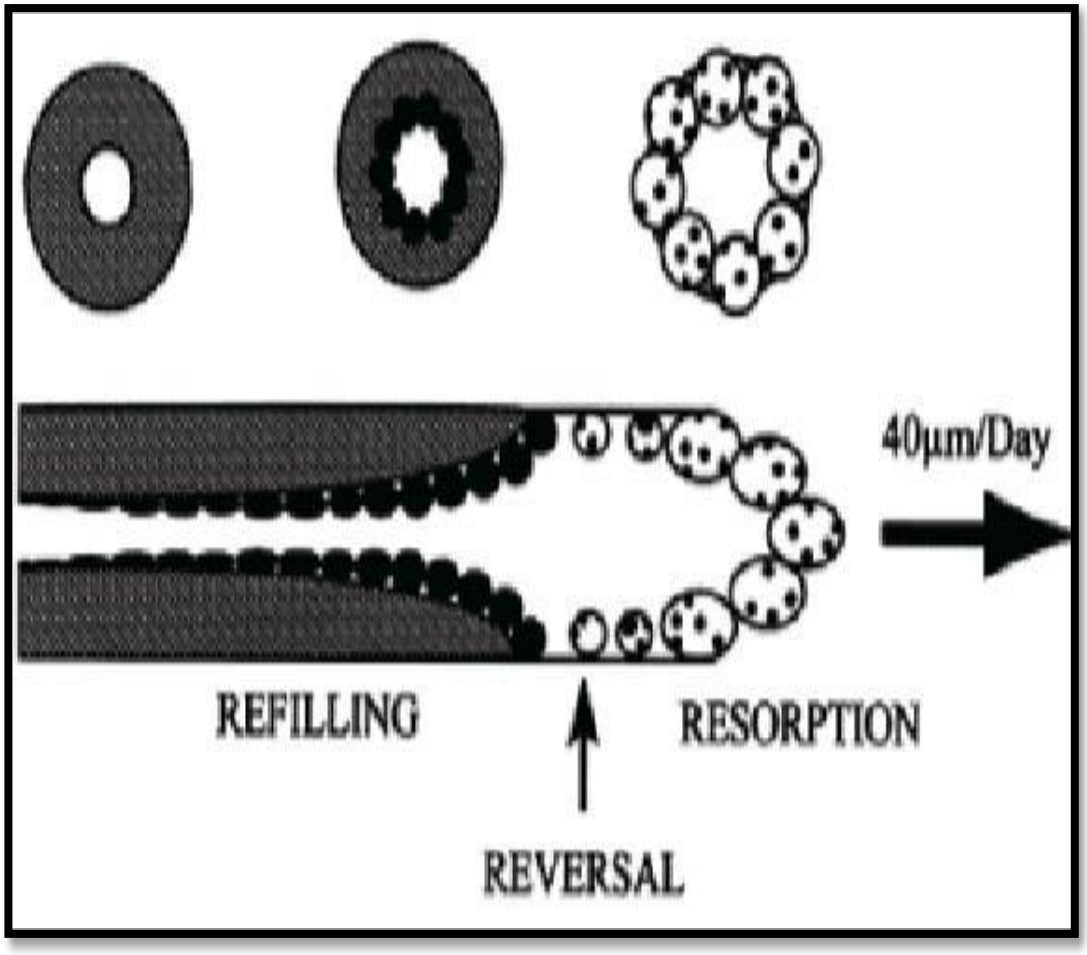
3. Reversal phase- osteoblastic activity takes place in this phase, which lays down new bone in haversian canals at a rate of 1-2nm/day

4. Progressive phase- the osteoblasts forming concentric lamella in haversian canals, leads to reduction of diameter of the canal and increase in bone density. The diameter of haversian canal is 40-50nm and the bone formed is a non- mineralized matrix osteoid. This phase lasts for 3months.

5. Mineralised phase- after 10days of osteoid formation, mineralisation phase begins.

   a. Primary stage – this stage provides hardness to the osteoid and accounts for 6090 mineralisation
   b. Secondary stage – this stage impacts final hardness and final morphology of bone. This phase lasts for 6-12months.

6. Dormant phase- The osteoblasts develop into osteocytes and line the haversian canals and take up mechanical, metabolic and homeostatic functions.[13]

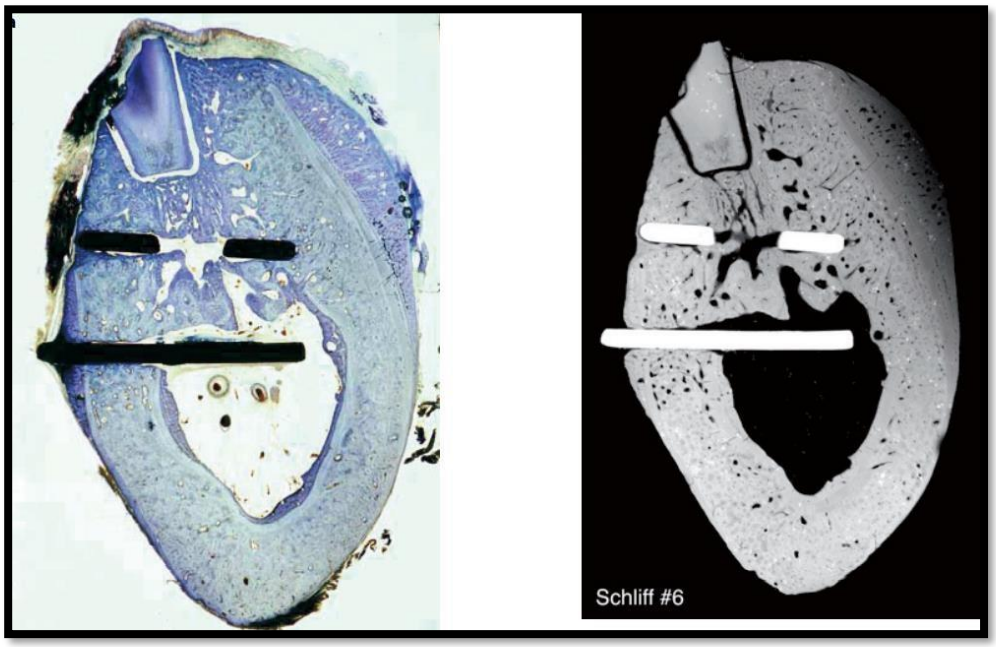


Bone multicellular unit consists of osteoclasts and osteoblasts which are combining their activities to a cutting cone that eats bone ahead of the osteon and depositions bone inside the newly formed cavity. The zone between the cutting and deposition is called the reversal zone. The tunneling takes place at 40 micrometer per day.

HISTOLOGY OF BASAL OSSEOINTEGRATED IMPLANTS

Bone tissue resembles the properties of composite material by permitting crack formation and resisting crack propagation to prevent failure. In the initial phase, the density decreases due to the tunnelling of the BMU, that increase the porosity of the jaw. The secondary osteons induce weakening of the bone structures located away from the alveolus. The extent to which the bone structure reacts to the implant depends on the size of the implant relative to the size of the jaw. It was finally concluded that the functionally loaded implants induced propagation of cracks and microcracks gave rise to subperiosteal remodelling. In the absence of functional load, there is no propagation of cracks seen. In young individuals, woven bone is formed in periosteal area by periosteal apposition and in older patients by endosteal apposition.

The basal Osseo integrated implants inserted in non-sterile conditions showed remodelling crestal to the implant disk. In crestal implants, immediately loaded screw implants showed lingual and vestibular modelling with pronounced vestibular modelling, due to osteomyelitis repaired by woven bone formation. Osseo integration was not observed with the crestal implants placed under non-sterile conditions.[13]



Histological and radiographic depiction of Osseo adaptation of the basal implants

COMPARISON OF ENDOSTEAL VS BASAL IMPLANTS

	BASAL IMPLANTS	**ENDOSSEOUS IMPLANTS**
INDICATIONS	Reduced bone height and width.	Requires adequate bone height and width for placement
STRUCTURE AND SHAPE	Inverted T- shaped	Mimics root morphology
MECHANISM OF INTEGRATION TO BONE	Osseoadaptation	Osseointegration
ARMAMENTARIUM	Simple	Complex
COST	Cost effective	Expensive
COMPLICATIONS	Less frequent	More common
MAINTENANCE	Requires less effort from patient for maintenance.	Requires more effort by the patient for maintenance.
SIZE AND DESIGN	Wide range of sizes and designs.	Limited range of sizes and designs.
ANCHORAGE	Anchored into the basal bone which is dense, mineralized and less prone to resorption.	Anchored into crestal alveolar bone which is of less quality and more prone to infection.
TECHNIQUE	Bi-cortical anchorage	Engages to a single cortex.
ELIGIBILITY OF PATIENT	Compatible for all patients.	Smokers and diabetic patients are contraindicated.
PROSTHETICS	Very simple prosthesis which can be immediately loaded, with less chair side time.	Complex prosthesis which can be loaded only after a period of time and more chair side time.
ENDOSSEOUS SECTION	Flat or blade like surfaces with spaces to permit	Screw shaped with machine or HA coated surfaces.

BONE DISPLACEMENT	Displaces 60% less bone substance. More resistant to resorption.	Considerable bone displacement and loss occur that vary with size and length of the implant.
MUCOSAL PENETRATION	1.9 to 2.3 mm only the vertical implant body is smooth and polished reducing chances of post operative problems.	Larger than basal implants and higher chances of peri- implantitis, vertical bone loss, crater like bone loss and other infections.
MASTICATORY FORCES	They are transferred to the basal plates in the cortical bone that can bear huge load and greater capacity for regeneration.	Forces act in the vertical direction along the sides of the screw structure.
SURVIVAL RATE	96% for BOI Implants The survival rate in multiple disk implants (96.6%) is 1.7% higher than in those with single disk (94.9%).	Survival rates in both the maxilla between 93% and 99.2% and mandible between 93.2% and 100%.[25]

ADVANTAGE OF BASAL IMPLANTS COMPARED OVER ENDO-OSSEOUS IMPLANTS

1. Achieving primary stability is easy in basal implant compared to endo-osseous implant as basal implant is cortical engagement implant, but only in mandible whereas in maxilla, both exhibit similar results

2. Basal implant placement is less technique sensitive

3. No minimal bone width or length required.

Drawback of basal implants over endo-osseous implants:

1. As basal implant is a single unit prosthesis in the entire arch, it is difficult to replace a basal implant, whereas in delayed implants, it can be done

2. Basal implant placement requires more time than endo-osseous implant placement.

PROSTHESIS

When BOI implants are used in aesthetic anterior regions, a long-term temporary bridge should be used to avoid interference with patients eating habits, before definitive restoration. **[4]**

If a full arch implant treatment is planned in a previous complete denture patient, then the denture can be redesigned into a temporary fixed bridge. The temporary bridge can be reversed with ceramic/ resin.

The most common impression material used as are conventional silicones, polyester or alginate materials.

In case of a situation where is an impression needs to be taken after implantation procedure, then case should be taken that fresh sutures are not penetrated. The process of impression taking and bite registration are performed simultaneously with occlusal rim trays. The advantage is that the presence of slight malpositioning of anterior implants or abutments can be detected and connected.

Types of Overloads

BOI implants are susceptible to overloading due to heavy load transmitting surfaces. There are four types of overloads.

1. Primary Overload:

When the prosthesis shows one or more early contacts at implant sites, then it is defined as primary Overload.It is corrected by reducing the affected segments with abrasive instruments.

2. Secondary Overload:

When the spatial position of the mandible changes due to muscle alteration, it is defined as secondary Overload. It develops naturally as a adaptive force caused by short-term interaction between chewing muscles.It is connected same as primary overload.

3. Tertiary Overload:

The overload that occurs due to bimaxillary positional relations may undergo substantial changes is called tertiary overload.

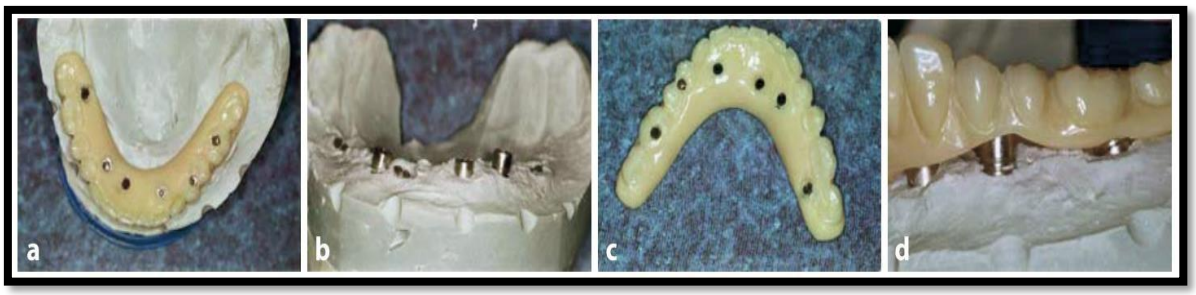
It is corrected by reducing the affected areas or replacing the restoration.

4. Iatrogenic Tertiary Overload:

It occurs due to ill-advised occlusal adjustments done by the dentist without awareness of the problem. It occurs abruptly and has higher risk implant fracture.

Treatment objectives for the prosthesis:

- The curve inclination should result in a normal occlusal curve.
- The bridge should be evaluated relative to soft tissue.
- Check contact should be evaluated. Since, long term denture wearer have increase in soft tissue volume in the checks.



Screw retained temporary bridge in the mandible supported by ID implants. Good accessibility for oral hygiene instruments and the massive design of the structure.

Flat Emergence Connection

All disk implants, mono block fractal implant and mono block transgingival abutment have the same flat emergence profile (mono block concept) as proposed in 2020 by G. M. Scortecci.

There is a combination of three elements, a flat joint and an external hexagon protected by a cylindroconical set (horse cone), this emergence ensures a passive fit even in angulated/ divergent position.

Prosthetic options for monoblock implants include:

- Prolongation with mono block transgingival abutment in case of gingival thickness over 3.5mm
- Direct screw retained prosthesis
- Hex abutment posts for cement retained prosthesis
- Ball attachments
- Telescope
- Castable plastic coping for single tooth replacements and multi-unit bridges.

When the disk implant is installed into thick gingiva of 3.5mm, the placement of mono block transgingival abutments help in bone augmentation & soft tissue management. The abutment and the implant should fit properly, any gap between them does not provide an accurate impression which leads to improper prosthesis, uneven distribution of forces and loosening / fracture of the abutment screw/ implant body.

These units are detected using IOPA with the X-ray directed to right angles to the long axis of the implant and it should be parallel to the upper surface of the implant. Panoramic radiographs are advised when IOPA are not clear and to access extensive rehabilitation and full arch restoration.

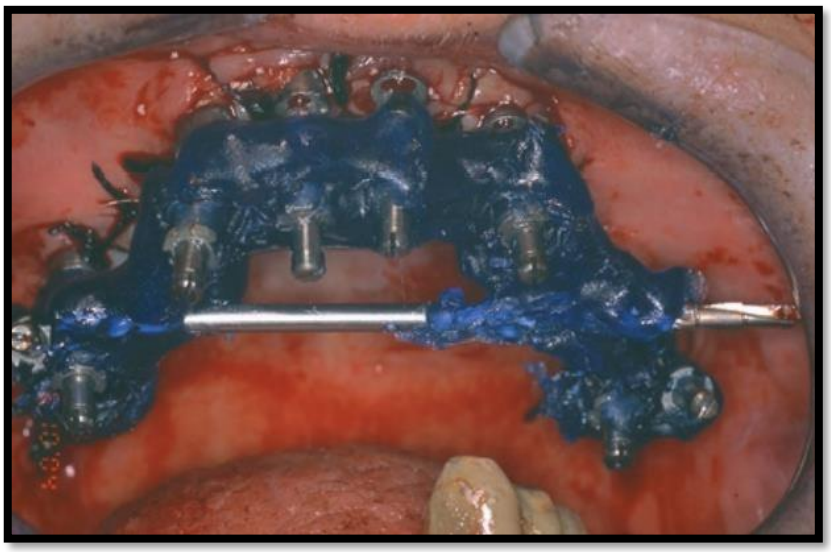
Disk implant with a Monobloc flat emergence profile and a transgingival Monobloc abutment (same profile).

Impression Techniques

Disk implants use the same prosthetic components as mono block fractal root form implants that have flat emergence profile.

Impression tray and pick up type titanium impression coping are recommended.

- For partial restoration(bridge) pick up titanium impression copings connected together with Luxabite resin are used with an open impression tray.
- For completely edentulous patients, a pick-up impression is taken, with all the titanium impression copings connected with Luxabite.



Impression copings connected with Luxabite. A transpalatal bar is used to prevent distortion of the impression.

Transfer of Interarch Relationship And Recording Of Occlusion-

- For fully edentulous patient's, the first inter arch relationship is recorded using a direct hard tissue silicone bite or existing denture relieved with silicone. This provides the technician rigid screwed to implant occlusal rim with posterior wax block.

- For partially edentulous patients

a. Silicone rubber bite or hard wax if natural teeth are present in occlusion.

b. Screw secured occlusal rim is formed if no reliable dentition is present.

Fabrication of transitional / final prosthesis [4]

Screw – secured fixed restoration:

After pick up impression with titanium impression coping

- For delayed loading, impression is taken after 4-6months of implant placement.
- For immediate loading, the impression is taken immediately and a fixed screw secured titanium restoration is installed 24-72hrs post operative.

Occlusion, phonation, and aesthetics are checked and another impression is taken for final prosthesis. Final prosthesis consists of full zirconia machined titanium bonding cylinder glued to full zirconia prosthesis and screwed securely to the implant.

- Follow up and maintenance done at 1,3 and 6 months.

a. Severe dysgnathia with retruded maxilla. A total of four BOI implants and one STC implant were strategically inserted.
b. Framework model revealing the dimensional relations.
c. The bridge is cemented to the BOI implants and screwed to the STC implant.
d. Bridge after the try-in. The bridge components were pre-mounted on the model. During the try-in, the bite was registered with silicone.
e. The individual components of the CoCrMo bridge are immobilized and connected by plasma welding.
f. The original material can be used to fill the gaps. The same material can also be used for any build-up that may be required.
g. A second metal try-in is performed to verify the welding result and for bite registration.
h. Dentin build-up.
i. Finished bridge featuring optimally designed masticatory surfaces and a gingival mask made of pink ceramics.
j. Successful illusion of natural oral relations.

CEMENT RETAINED PROSTHESIS

-Pick up impression is taken using titanium impression copings.

-Silicon bite or hard wax is used to take the inter arch relationship

-If the implants are not perfectly placed a customised angulated abutment with a positioning stent and a rigid plastic bite should be made for new occlusal record.

•A classical impression of the customised abutment is taken to fabricate the final cement retained fixed bridge. A transitional cemented acrylic fixed bridge is given temporarily. A reimpression is taken to access the fit of the prosthesis. Then a final prosthesis is fabricated.

COMPLICATIONS

Preoperative precautions:

1. Allergy to titanium:

Titanium is widely used as a material for implants as it has been biologically accepted. But, in certain patients it may cause certain allergy reactions. Therefore, a dermal test should be done by placing a titanium disk over the skin for pre-operative diagnosis. [4]

2. Anticipation of mechanical and biological problems:

Poor management of temporary prosthesis in heavy smokers leads to loss of implants.

3. Peri-implantitis:

Rough surfaces on the implants should be avoided even though the provide an immediate advantage in terms of primary stability, due to the release of metal release during function and difficulty in cleaning on exposure.

4. Risk Of Bacterial Endocarditis:

Any invasive procedure poses a risk of bacterial endocarditis. The American Heart Association has recommended a prophylactic antibiotic regimen prior to any surgical procedure.

REGIMEN
1. Tab. AMOXICILLIN 3gm per os before surgery
2. Tab. CLINDAMYCIN 600mg per os 1hour before surgery
3. Tab. CLINDAMYCIN 500mg per os 1 hour before surgery
4. Tab. AZITHROMYCIN 500mg per os 1 hour before surgery

5. Bisphosphonates:

Patients who used to be treated with bisphosphonates are at high risk for implant failure s IV bisphosphonates can induce osteonecrosis.

6. Anesthesia:

An IV sedation is administered by a well-trained professional and patient should refrain from liquids and solids for 6 hours prior to administration of the drug. Oral sedation could also be given using Benzodiazepines or Antihistamines. The most effective method of anaesthesia in dental office is local- regional anaesthesia using 2% lignocaine with 1:1,00,000 epinephrine, 4% lignocaine with 1:2,00,000 epinephrine, 0.5%Bupivacaine with 1:2,00,000 epinephrine or 3% Mepivacaine without vasoconstrictor.

During Surgery

1. Intraoperative bleeding:

Intraoperative bleeding during the procedure is managed by suturing the flap and giving a surgical pack to the patient and ask to bite on it for 20 minutes. Other methods to prevent bleeding is by making a mid-crestal full flap incision and avoid straight vertical incision instead of which horizontal/ angulated posterior or anterior releasing incision should be given.

2. Mandibular nerve injury:

The most common complication is mandibular nerve injury. The injury can occur due to stretching, compression, partial resection, during flap elevation or drilling procedure. For basal implant installation, the incision should be a crestal incision in the middle of attached gingiva. The surgery should be terminated if patient complains of pain. In case of persistent pain as paraesthesia even after uneventful implant placement, the implant should be removed before integration occurs.

3. Lingual nerve injury:

Injury to the lingual nerve can be identified radiographically and may last for years with minimum recovery, occurring during extraction of mandibular 3rd molar or placement of implants in the molar region using the lingual plates. The patient usually reports paraesthesia and burning sensation in the lateral part of the tongue. This complication can be avoided by not using releasing incision in the lingual direction and the incision should always be crestal with a vestibular releasing incision.

4. Injury to the infraorbital nerve:

Injury to this nerve cases partial anaesthesia or dysesthesia of the upper lip. This can be avoided by raising a full thickness flap and using a large, rigid plastic suction tube against buccal bone plate under the infraorbital foramen.

Management of neuralgia:

1. Minor injury heals in a few months (generally 3 months). The recovery depends on the extent and type of injury.

2. Clorazepam, carbamazepine, pregabalin or pyridoxine is given as medications.

3. Micro-suturing with 9/0 or 11/0 sutures can be done using the microscope.

4. For acute mandibular nerve neuralgia, injury of specific drugs around the stellate ganglion in the cervical area to provide relief.

5. Fracture of atrophied mandible:

Mandibular bone is prone to the risk of fracture as the mechanical strength is reduced by multiple implant site preparation, this causes spontaneous fatigue fracture. This occurring owing to the dense cortical nature and extremely poor intra-bony blood supply.

Prevention:

1. Bilateral Botox injection into the temporalis and masseter one week pre- operative.

2. Patient should be cautioned to apply minimum stress (soft diet) at least for 45-60 days.

3. Use of disk implants or self-tapping micro threaded, small diameter root form implants should be used that uses only single drill.

Management:

1. Immediate implant retrieval from the fracture region.

2. Placement of plate from Disk Implants on both sides, with rigid intraoral connection followed by screw retained prosthesis with a rigid external fixator is given for immediate stability.

3. Stabilization of fractured zone with mini-plates followed by prosthesis after few months.

4. Maxilla-Mandibular immobilization with intraoral/ extraoral appliance.

6. Penetration Of Nasal/ Sinus Floor:

In situations when there is reduced bone height and density, the implant can be anchored onto the nasal floor by nasal membrane/ sinus membrane lift. Small oro-antral communication can be treated with palatal pedicle grafts.

7. Improper placement:

The implants may be placed too far buccally or lingually. It initiates the thin, mobile and vulnerable floor of the mouth and cause difficulty in speech. When placed buccally it leads to exposure of implants are required to engage both the cortical plates to achieve good Osseo adaptation.

Post-Operative

1. Management Of Swelling/Hematoma/Pain:

- Use of ice pack after surgery.
- Administration of corticoid regimen, 60mg Solupred per os post-operative plus 60mg per os the day after and 60mg after second day of surgery.
- Extensive hematoma is treated by antibiotic therapy- Amoxillin 2gm/day
- Analgesics and NSAIDS: Paracetamol 1000mg.

2. Incision Line Opening: It occurs due to suturing with tension after surgery. To prevent incision line from opening, a internal releasing incision should be made in the periosteum with scalpel. If the sutures open, then it should be left to heal by secondary intension.

3. Subgingival Plaque Associated With Peri-Implant Complication: The microbiota is found to be similar in peri-implantitis and in periodontal health and disease. Use of plastic scalers and rubber cups are recommended in the implant region but should be avoided as this cleaning technique opens the hemi- desmosome biologic seal between the disk implants and the surrounding structures. Patients with increased saliva are recommended with screw retained zirconia prosthesis as calculus does not adhere to the highly polished zirconia surface.

4. Exposure Of The Disk Implants: In a few complications, there may be exposure of the implant from the alveolar mucosa. Even though there is no pain for the patient, it may lead to peri-implantitis. Hence the exposure portion should be removed surgically in a flapless procedure under local anaesthesia using high speed diamond or carbide burs. In a double disk implant, the exposed disk can be removed leaving behind the other if it is well Osseo integrated.

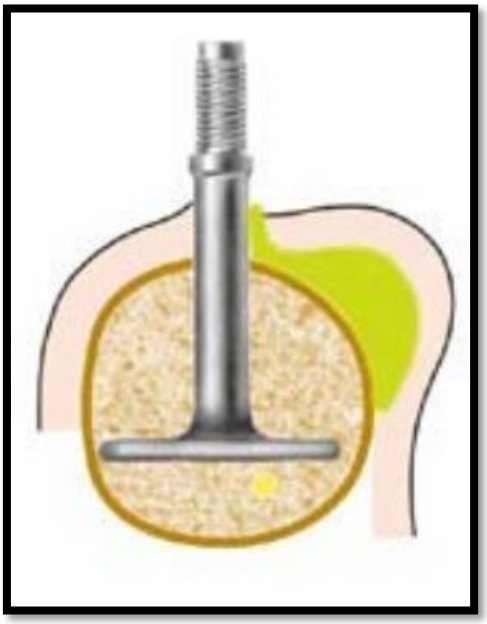
5. Peri-imlantitis:

The occurrence of periimplantitis is rare in disk implants due to machines narrow vertical shaft. The implant should be removed only when the prosthesis is problematic.

6. Functional Overload Osteolysis: The masticatory forces transmitted through the cortical bone causes microcracks. These are repaired by the formation of secondary osteon by the process of

remodelling. This temporarily increases the porosity and decreases the degree of mineralization. These microcracks can be detected in the radiograph due to reduced mineralization. If the loads are reduced to an adequate amount, the basal implants have the ability to reintegrate.

7. Infection: Infection may occur when an infected part is submerged below the mucosa over time and the gateway of suppuration is closed with the scar tissue. These infections are just as the submucosal abscess and are treated by making an incision to open the abscess. The surface adjacent to the threaded pin is excised by electrosurgery.[9]



Submucosal spread of infection in basal implants.

MAINTENANCE AND FOLLOW UP

In the immediate post operative period, the patient is refrained from brushing and the use of any aids for 48 hours. Later the patient is asked to maintain the implant region with proper brushing, Waterpik®-type appliance, super floss and/or special peri-implant care using 3% hydrogen peroxide and disposable cotton swabs, depending on the patient's individual situation. Follow up inspection should be done professionally for once a year initially. [4]

Successful basal implant maintenance

Oral hygiene instructions and recall

- Mechanical maintenance of prosthetic components (screw retightening, recementing, closure of screw access holes)
- Occlusion/night guard

Reversible problems

- Minor mechanical problems (screw loosening, fracture of resin or ceramics, screw fracture)
- Peri-implant mucositis, calculus removal
- Laser therapies
- Traumatic occlusion—correction
- Replacement of a fractured element (ceramic, resin, prosthetic retaining screw, titanium abutment screw, etc.)

Compromised Osseo integrated basal dental implants

- Oral hygiene instructions/reinforcement
- Stop smoking
- Check the occlusion
- night guard
- Shorter maintenance intervals

- Antimicrobial mouthwash and/or irrigation
- Laser therapies
- Change the transgingival abutment (in case of a fistula or fracture)
- Systemic antibiotics selected according to susceptibility test
- Nonsteroidal anti-inflammatory drugs
- Tetracycline
- Drugs to enhance bone reconstruction and mineralization
- Minor surgical treatment
- New prosthesis when prosthetic misfit is identified at implant interface
- Removal of the protruding metallic portion (disk) of an Osseo integrated basal implant with a diamond or carbide bur under copious irrigation
- Placement of an additional trans parietal orthopaedic screw (5–6 mm) against the base of the compromised Disk implant® with the screw-retained bridge in place.

Irreversible problems

- Major aesthetic, speech, or functional problems
- Major biological or mechanical problems (implant or jaw fracture
- Peri-implantitis associated with pain and implant mobility
- Acute neuralgia/severe psychological problems
- Complete bone breakdown and basal implant mobility/pain/infection

Failed basal implant

- Implant removal—correction of the bone defect with biomaterials and membranes
- Bone grafting (1 or 2 sessions; bone matrix cell activation with an osseotensor mandatory 60 to 90 days before surgery)
- Major surgical treatment, including closure of any oro-antral communication; return to a conventional partial or complete denture
- New implant placed after a waiting period (at least 1 year for extremely atrophic edentulous jaws)
- New basal implant-supported prosthesis[4]

SUMMARY

The demand for the restoration of function and aesthetics of the edentulous patients has kept the branch of implantology in the spotlight in the recent past. Modern dentistry has adapted to restore the various characteristics necessary for masticatory function and proper nutrition intake. The shift in the use of crestal implants to basal implants for the rehabilitation of the edentulous patients was necessary, as there were complex restorative conditions in the geriatric patients. The several drawbacks of crestal implants and the need for ridge augmentation procedures in the areas with a deficit in bone height has convinced the implantologists for the development of new implants that can be placed using the available bone height, called the basal implants.

Dr. Stefan Idhe in 1997 first developed the lateral basal implants and further made modification to it as it was not completely successful. Basal implants gained excellent bi cortical anchorage from the cortical bone. The various forms of basal implants available are: screw form, disk form, plate form and others like the Tuberopterygoid and the zygoma screw implants. There are two types of known basal implants called the Basal Osseo integrated implants and the Basal cortical screw implants.

The edge of basal implants over the crestal implants is that they are one- piece implants, provide bi cortical anchorage in compromised ridges, effective resistance to the masticatory load, reduced incidence of peri-implantitis, a minimally invasive procedure with an immediately loaded prosthesis within 72 hours. One of the major applications of basal implants is in medically compromised conditions like diabetes, chronic periodontitis and also in patients with a history of habits such as smoking and consumption of alcohol, wherein the conventional implants are contraindicated. During the placement of these implants, the analysis of the stress distribution is necessary in order to have a thorough knowledge about the amount of load the region can withstand. This is carried out using a finite element analysis.

The armamentarium used are the Periotome (for the uneventful extraction of the teeth), vertical cutters, lateral cutters, twin cutters, combo cutters, Periotest (to access the amount of primary stability achieved) and Osseotensors for the initial bone activation with a diphasic osteogenic effect prior to the implant placement.

The basal implants pose an array of complications like allergic reaction, periimplantitis, risk of infection, intraoperative bleeding, injury to the vital anatomical structures, fracture of bone, swelling, post operative pain, exposure of the disk of the implants, accumulation of the subgingival plaque and calculus due to improper prosthesis and functional overload osteolysis.

Despite the several advantages of the basal implants, the complications overshadow their use in the field of implantology. Hence further research is necessary to overcome these complications and to provide a better and efficient treatment for the rehabilitation of edentulous ridges.

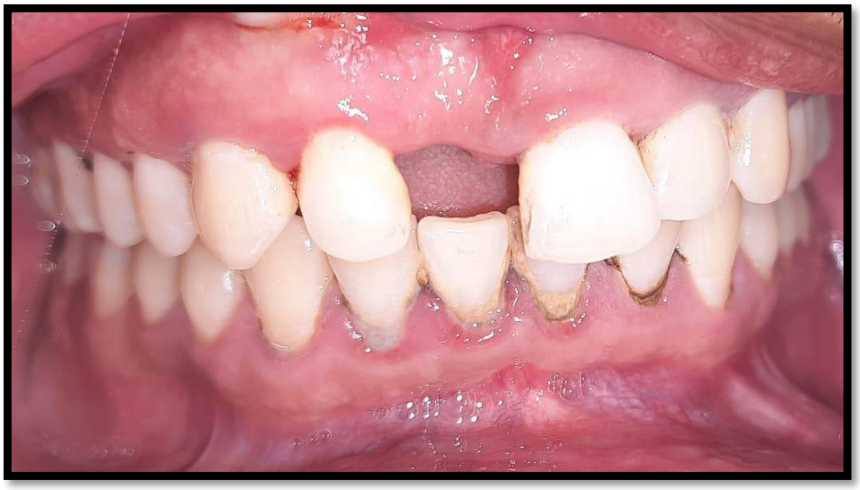
CONCLUSION

Basal implantology has been known to fit into the guidelines “PRIMUM NIHIL NOCERE”, which means “First Do No Harm” as it has evolved to be the alternative treatment of choice when augmentation procedures are necessary for severely atrophied ridges. The recent advances in research have led to the replacement of conventional implants in complex situations where in there is inadequate bone height, width, volume and presence of crucial anatomical structures. Basal implants can be placed avoiding critical structures like the inferior alveolar nerve in the mandible and also gain anchorage by utilizing the pterygoid plates in the maxilla to achieve excellent primary stability.

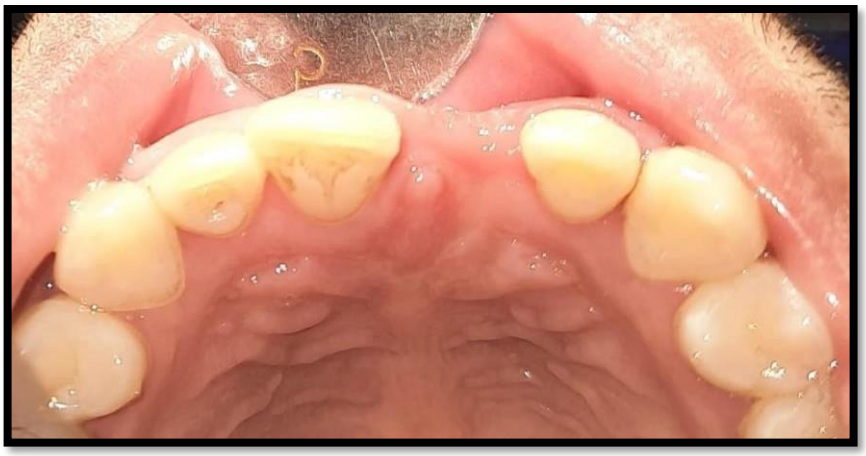
The additional superiority of basal implants over the conventional implants is that it is done in a flapless approach with minimal surgical effort, reduced post-operative pain, swelling and discomfort. After the placement of the implants with a cortical anchorage, the abutments can be adjusted at 15-degree angulation relative to the implant axis with immediate loading of the prosthesis. The success of the basal implants is also attributed to the reduced risk of infection post-operatively.

With the wide range of designs of basal implants, it has been an excellent mode of rehabilitation for atrophied ridges which pose a plethora of complications. Despite the several benefits and noted success, basal implants have gained little trust amongst the conventional implantologists. Hence further research and development needs to be done in this field to prove its efficacy as a complete replacement for conventional implants.

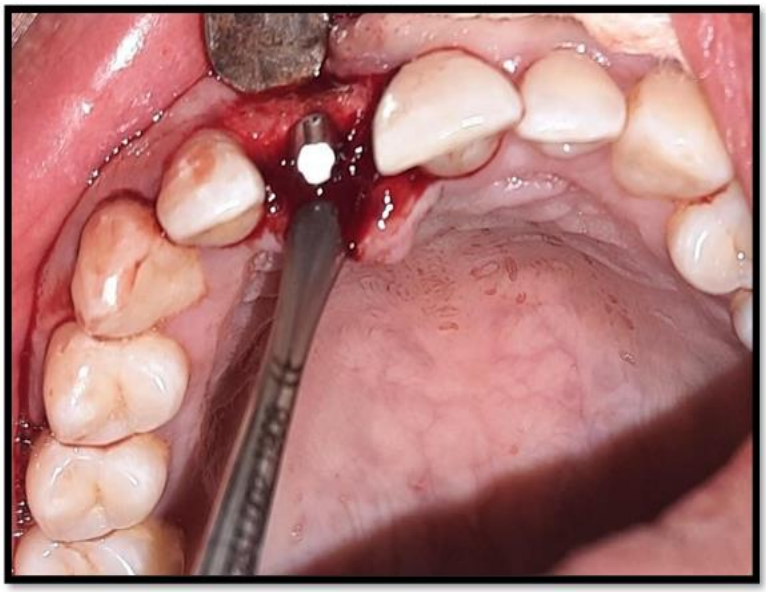
CASE REPORT



REDUCED BONE HEIGHT AND RIDGE WIDTH

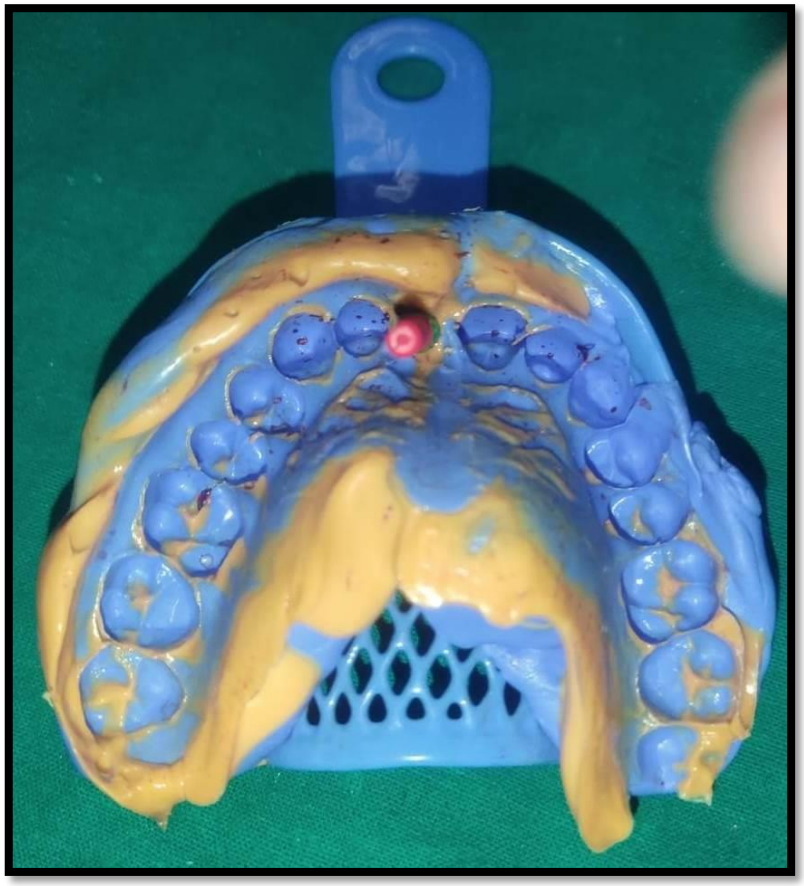


INCISIONS PLACED ON THE RIDGE.

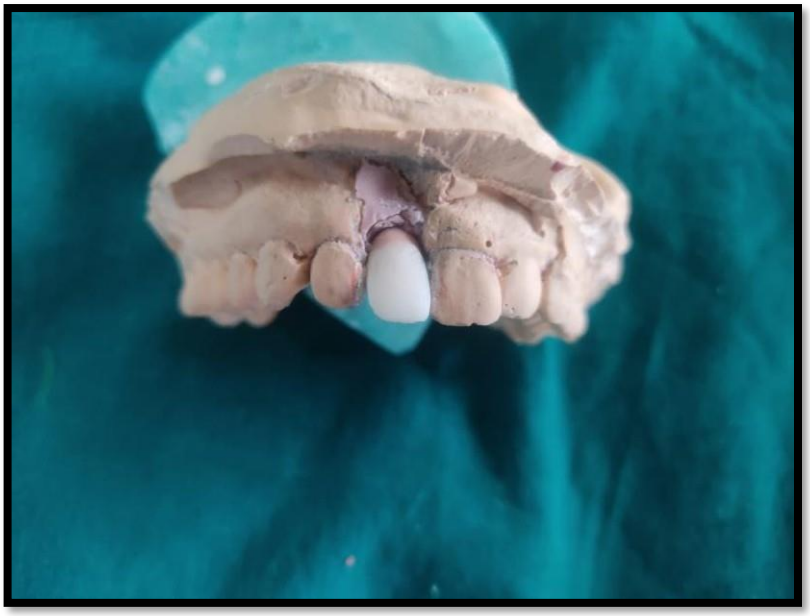


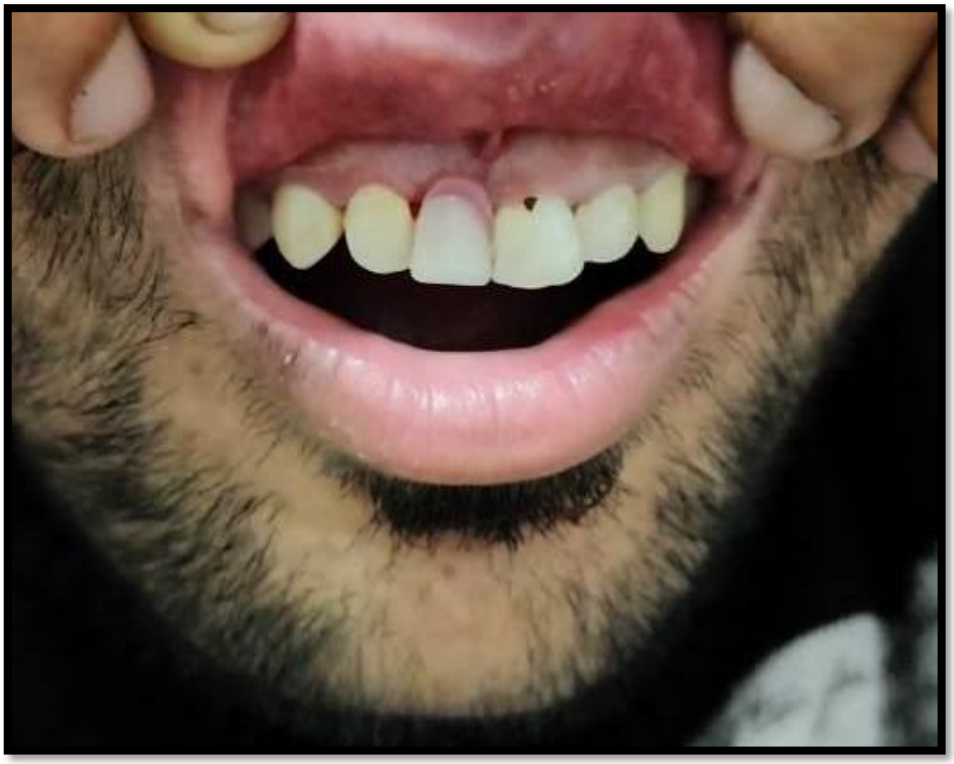
MINIMAL FLAP ELEVATION AND PLACEMENT OF THE BASAL IMPLANT

THE ANGULATION OF THE ANTERIOR BASAL IMPLANT



IMPRESSION MADE AND THE PROSTHESIS IS FABRICATED.





THE FINAL PERMANENT RESTORATION DELIVERED TO THE PATIENT.

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