In conventional implant system, we provide delayed loading, which needs prolong time period. Paradigm shift occurs from delayed to immediate loading implant system through cortical implantology. Cortical implant is a science but even more so, it’s an art where technique and procedure with thorough knowledge can be well executed by skilled, educated dentists via multidisciplinary approach. This system is associated with a special occlusal scheme, which demand rigid fixation of screw to the stable cortex

Dr Manoj Kumar Singh is a Professor in the Department of Periodontics. He is a fine teacher with precise knowledge in his field and especially in the subject of cortical implantology. His insights help his colleagues and students to achieve the desired treatment outcome. He teaches both soft skills and patient management.

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A JOURNEY THROUGH BASAL AND CORTICAL IMPLANTOLOGY

Science of Cortical Implantology

LAP LAMBERT Academic Publishing

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A JOURNEY THROUGH BASAL AND CORTICAL IMPLANTOLOGY

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2) Dr. Rupam Kumari
3) Dr. Aastha Todi

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- Dr. Manoj Kumar Singh

CONTENTS

INTRODUCTION

In the present time, to be successful, quality is of prime significance, and this is valid for health care services too. To achieve such a work quality, it is important to keep up an ideal harmony between new innovation and its reasonable use. In dental services, implant dentistry is considered as a piece of giving a superior and stable corrective result to patients. Meeting the patient's expectation of a permanent and immediate prosthetic solution in partial or complete edentulous jaws is quite challenging. Fixed replacement of teeth can be done by various treatment modalities starting from conventional crown and bridge to crestal dental implants. These fixed prostheses require stability, support and it depends on the supporting bone quality and quantity. The conventional dental implant is a successful treatment modality but available bone quality and quantity is an important determinant for successful implantation and moreover the durability of implant.

Conventional dental implant is inserted into residual alveolar bone having sufficient quality and quantity. The long-term predictability is questionable as progressive loss of alveolar bone in long-term occurs due to various metabolic diseases or peri-implantitis. The elderly patients with completely edentulous arches and very poor bone quality/quantity have a hopeless prognosis and may not have a good rehabilitation of conventional denture or conventional dental implants.[1,2]

There are many situations where successfully replaced missing tooth with conventional dental implants, suffers from peri-implantitis clinically and in the long-term may fail. The clinical assessment of Osseo integration is based on mechanical stability, considering primary stability (absence of mobility in bone bed after implant insertion) and secondary stability (bone formation and remodeling at implant bone interface). A thicker cortical layer supports the implant superior to a slenderer cortical layer. Similarly, denser bone offers more prominent protection from movement. These clinical situations may be segmental or complete arch having poor bone quality and quantity and does not have a predictable outcome with conventional dental implants, but in such cases successful treatment with an unconventional Basal and cortical implant can be ideally done. There is a need to know about macro and microscopic anatomy of residual alveolar bone, basal and cortical bone before placement of dental implants for long-term success of conventional as well as basal and the cortical implants. The placement of implant in cortical and basal bone is based on its strategic location in order to get implant stability from the very beginning to bear the immediate load.

These strategic implants require very specific design which can be accommodated into the basal and the cortical bone. As per these strategic sites natural basal bone having some flexibility and elasticity as well as stiffness and toughness, is necessary so that our implant should have a similar property [3,4].

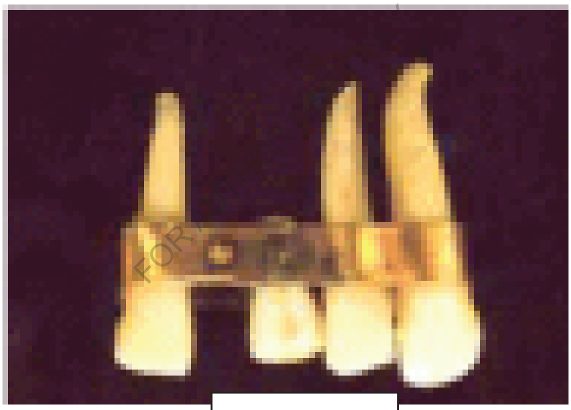
THE HISTORY OF IMPLANTOLOGY:

In spite of recent rise of oral Implantology from a scientific exploration, it must be memorised that the roots of this discipline go back to ancient times. There is well-known narration of archaeological findings from the pre-Columbian era illustrating stone inlays in teeth or even used to replace lost dental elements. Nevertheless, the first successful implant treatment survived to us is symbolised by the well-known mandible fragment with three implanted shell valves. The Peabody Museum of Archaeology and Ethnology at Harvard University had a mandibular fragment of a person who lived between the 7th and 8th centuries AD, with three cuneiform shell pieces in the location of lower three incisors. [5,6,7].

Shell piece

THE CLASSICAL AGE:

There are cases of implant attempts made during the Classical Age that, regrettably, are unsupported by findings or practical acceptance. Hippocrates (5th century BC) wrote about the probability of anchoring artificial teeth to the gums using gold or silk thread in order to restore extracted elements, advising the practitioners to put the discarded mobile elements or teeth back in space that were removed from injured mandibles, and tying them with gold thread to rest of the teeth

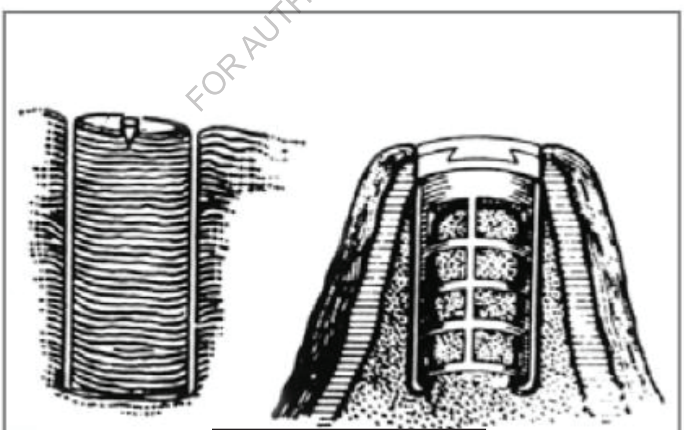


Gold thread

The work of Pierre Fauchard in the middle of the 18th century, made him the founder of modern dentistry and began to make a name for itself. In his seminal work *Le Chirurgien Dentiste, ou traité des dents* he illustrated five replantation cases and one transplant. Regarding these, Fauchard extracted the tooth anyway and readapted it after filing it down.

It was in 1806 that Giuseppange lo Fonzi (1768–1840) made-up the mineral tooth, a discovery that would be of great importance for the future evolution of implant dentistry. His greatest effort was to create a single artificial tooth that could be implanted directly into the socket using platinum hooks. It had fulfilled important aesthetic and functional demands. They were also chemically unalterable.

Attempts were made by Payne to engage his silver vented cylinders in the early 20th century. The first porcelain roots by Sholl's were "roughened" in order to increase retention. It was not as biocompatible, and 70 years later studies demonstrated, porcelain was nevertheless a better material than the ones proposed previously. [8]



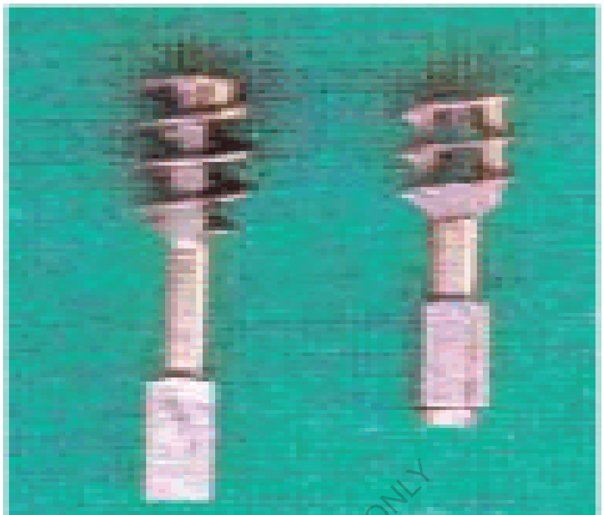
PORCELAIN ROOT

ENDOSSEOUS IMPLANTS DEVELOPMENT IN THE 1960s:

The progress of Endosseous implants can be summarized as follows:

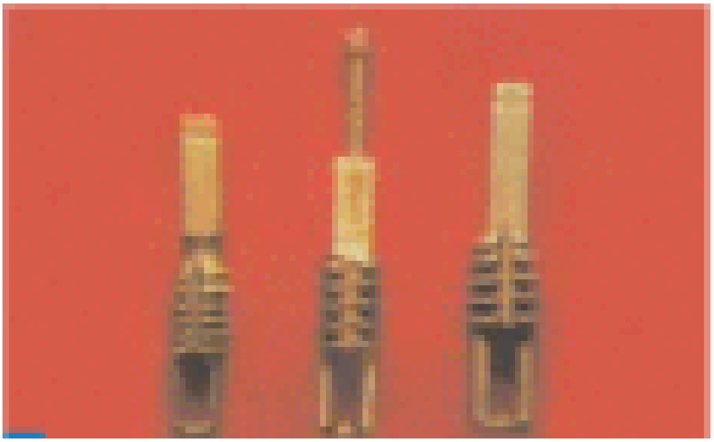
The development of the spiral infibulations took place; which converted into Muratori's hollow-screw implant and Linkow's Vent-Plant followed by Scialom's new tripodial tantalum needle technique, and lastly Tramonte's new self-threading screw technique[23]. A gold cap could be fixed over this section for the prosthetic over structure. In 1967 he used titanium block to create a new screw, a completely biocompatible material that had been popularised recently and was first used in dental surgery by Tramonte.

It was suggested using a 2.25-mm "expanding" cylindrical drill for soft and cancellous bone for inserting a 3-mm screw thread, and a 2.50-mm drill for compact bone. It was recommended using the 2.75-mm expanding drill to insert the 4-mm screws into the cancellous bone, followed by the 3-mm drill if resistance come across the compact bone. When long screws were used, these drills continued to be used, stopping the insertion at the second circumferential notch [9].



Linkow's Vent-Plant

In 1963 Leonard Linkow—unknown in Europe at the time—come up with further alteration of the hollow spiral screws, changes that Cherchève and Muratori had earlier made to Formiggini's spiral. His implant, which he dubbed the Vent-Plant, was originally made of Vitallium and later of titanium [10]



BONE (MACROSCOPIC, MICROSCOPIC, NANO LEVEL AND ATOMIC LEVEL)

Bone biology, it is hierarchically organised material that is constructed as a fibre-reinforced composite material. Bone which is made up of calcium a metal, phosphorus non-metal and Oxygen and hydrogen. They are a primary constituent of a bone mineral fibre reinforced composites are often highly anisotropic means having different mechanical property at a different orientation and can have low transverse strength because of direction of the fibres bone is a densely compact that is cortical bone or more porous that is cancellous or trabecular bone. The tissue that forms these microscopic architectures can be level or completely disorganised. It is nearly devoid of an identifiable structure and microstructure is open layers alternating between region with the highly Orient and Minerals and adjacent interlaminar region. The region with oriented crystals are 20.50 % stiffer than the interlamellar region.

Primary osteon (100-150 micrometre), secondary osteon (200 micrometre), act as a strong fibre embedded in a matrix composed of interstitial lamellae. A cement line is an interface which separates the Osteons from the matrix. It is relative low shear strength, it has ability to control fatigue and fracture as it absorbs energy by stopping crack propagation and to provide viscous damping in compact bone. Bone matrix is composed of cross-linked collagen fibre interspersed with mineral plates with non-collagenous protein that control the assembly and size of these components. These organisational structure produces a composite material with mechanical properties superior to those of any of its constituents which resists structural failure through the fatigue process incurred by a lifetime of repetitive loading. Bone elastic property is due to mineral phase of a tissue, while the inelastic property due to organic phase that is collagen.

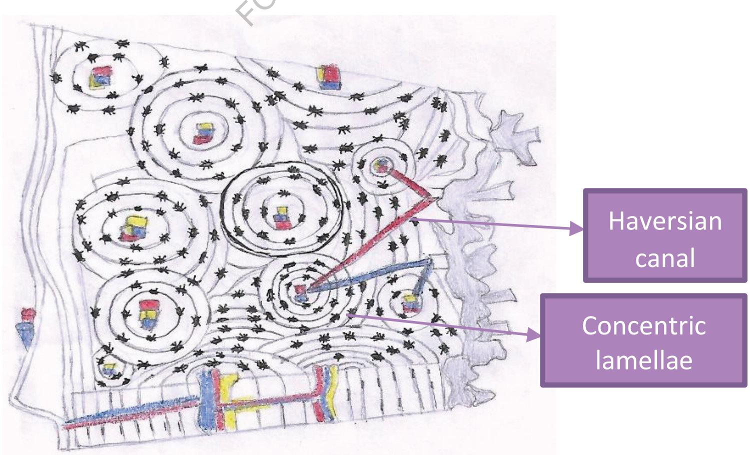
Bone is hierarchically material is descending order anatomically, histologically, molecular and atomic level. quantitative image analysis system in 1980 3D image analysis using a micro-computer tomography reveals full cancellous architecture Spectroscopy techniques molecular under structure used to measure the mass of minerals and many of its characteristic like this two line carbonate substitute hydroxyapatite late is as well as amount of collagen and its maturity through a measurement of young divalent to more mature trivalent collagen cross-linking Fourier transform infrared Spectroscopy FRIT it measures infrared light absorption and emission Raman spectroscopy it measures the energy changes of photo on that are scattered from the polycule both Raman and ftr it depends on the molecular structure and give frequency-dependent peak in a row dating that a characteristic of tissue chemistry and structure useful tools for measuring changes in a bone composition in experimental animal in response to interventional treatment for heart disease. Energy-dispersive x-ray diffraction technique, Gupta et al 2006 small-angle x-ray scattering(SAXS) or wide angle x-ray scattering(WAXS). These can be used to measure mineral crystal thickness and spacing between the mineral plates as well as the lattice strain and elastic modulus of the bone mineral itself. AFM (atomic force microscope) can provide highly resolution 3D image of a surface features and image structure at the level of collagen fibrils and Minerals plates.

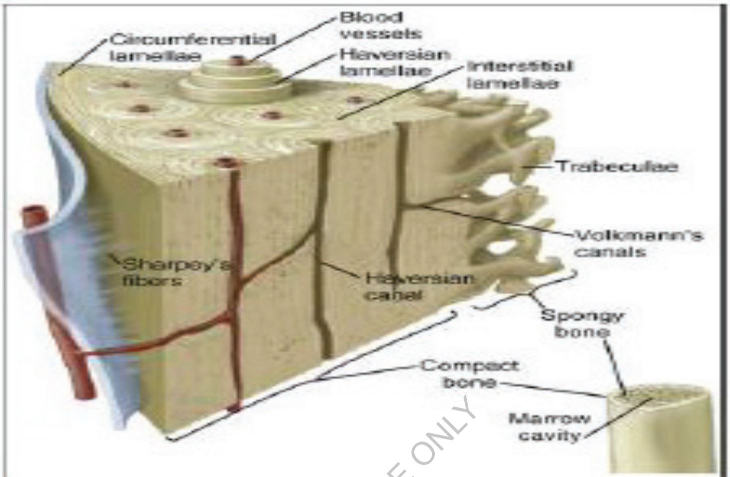
Biomimetics of bone constituents at the ultrastructure, microstructure and macroscopic organisation showed interaction in ways that reduces stress and allowed sustaining the structure over a lifetime. Thus functional improvement for a particular application can be done by using these in manmade materials.

The overall structural mechanical behaviour of whole bone is dependent on the complex interrelationship between the physical properties which is solely determined by the mineral-collagen composite and geometry. Hence the shape of the bone is determined.

Type of Bones and Tissue, the chief function of a marrow is to generate principal cells present in a blood. The internal property of a marrow is a nearly universally feature of a bone except ossicles of inner ear. Cancellous versus compact bone, cancellous is also known as the trabecular bone or spongy bone. Cancellous bone tissue has a much lower density than the cortical bone and allowed the Skeleton to build a large but light weight conical volumes of a bone at the ends of a long bones that carry the larger load of the joint with lower stress at the wide end (metaphysic) and higher stress at a narrow shaft that is a diaphysis.

Haversian Canals are approximately aligned to the long axis of the bone contain capillaries and the nerve fibres, its Canal diameter is 50 micrometre and is same as a human hair. It is important to remember that bone is a dynamic porous structure; its porosity may change as the result of a pathological condition, with age normal adaptive response to mechanical or physiological stimuli, so cancellous bone may become a more compact or compact bone may become more porous over a period.

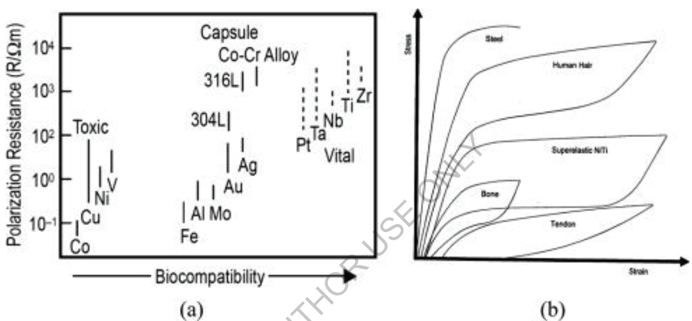



Blood vessels
Circumferential lamellae
Haversian lamellae
Interstitial lamellae
Trabeculae
Volkmann's canals
Sharpey's fibers
Haversian canal
Spongy bone
Compact bone
Marrow cavity

IMPLANT MATERIAL

Rehabilitation of a damaged or missing tooth is a surgical procedure in dentistry called Dental implant surgery wherein the lost teeth is replaced with artificial teeth that resemble and function like real ones. A various types of materials, such as metals alloys, stainless steel, silver, Ti & Cr-Mo-Co alloy, and platinum), ceramics (like zirconia, alumina, glass, and carbon), polymers, poly (methyl methacrylate) (PMMA), and composites (SiC/carbon and CF/carbon) are being used in different types of dental implants (Ratnev et al., 1996). Titanium has a high biocompatibility and its alloys has resulted in their use preferably over most other alloy systems in the medical and dentistry fields (Henriques, 2010). Implants so placed in the jaws must be able to withstand significant and varying amounts of masticatory forces. These composite materials when compared to metals and ceramics, in the desired requirements when used as dental implant materials, offers high, sufficient and superior fatigue properties (Jancar et al., 1993).

Biological and mechanical compatibility are the most important factors which make Metallic implant appropriate for the application: (Bobyn *et al*., 1995; Long and Rack, 1998; Brunette *et al*., 2001; Niinomi, 2008; Geetha *et al*., 2009; Hoh *et al*., 2009; Niinomi, 2010). Whereas the use of a biologically compatible metallic material usually triggers a minimized adverse tissue reaction through the use of inert alloy components, combined with enough potency to form protective passive layers, limiting the release of metal ions into the environment. Elements such as Ni, Co or V, that are toxic or could cause allergic problems are to be avoided, while the alternative favourable subtitutes are Ti, Nb, Zr, and Ta. Hence, a compatible metallic material must offer a favourable combination of low elastic modulus and high mechanical resistance and if these properties are not provided simultaneously, there will be failure of implants due to implant loosening caused by the ‘stress shielding’ phenomenon [31-37].



Biologic safety of metals, polarization resistance versus biocompatibility (Niinomi 1999)

Let us take for example Ni-free Ti-based shape memory alloys , which has a continuous quest for metallic implant materials with enhanced biological and mechanical compatibility which combine the low-stiffness super elastic behaviour of NiTi with the biocompatibility to that of pure titanium. These Ni-free super elastic alloys are a part of the metastable ß-type titanium alloys, having a body-centered cubic phase which closely mimic the plateau-like bone behaviour by triggering, under stress,. This group of alloys are relatively new and form part of materials joining the family of more conventional low-modulus near-ß and ß-type titanium alloys containing non-toxic elements such as Nb, Ta, and Zr, (Mishra *et al*., 1993; Niinomi *et al*., 2012). They have a low superelasticity and owe their low stiffness to the fact that the elastic modulus of the body-centered cubic (bcc) ß phase is lower than that of the hexagonal close-packed (hcp) a phase. [11].

Implant materials which are metallic and are placed in the human body should withstand aggressive environment conditions such as pH 7 and temperature of 37°C. Hence there is a need for high corrosion resistance of these materials. To substantiate this these materials exhibit elevated corrosion resistance in biological environment when compared with other main stream materials like 316L grade stainless steel and cobalt-chromium alloys. The reason behind this performance of titanium is due to the formation of a thin adherent passivating oxide layer formed on the surface of Ti when exposed to body fluid environment. Wear is another phenomenon apart from corrosion where the performance of implant materials seen in cases of titanium implant undergoing accelerated corrosion resulting in the formation of debris, resulting in the blackening of the tissues, and hence a catastrophic failure of the implant. Magnesium implants which was used in vivo in the early 1900s was used to secure the fracture w observed that it undergoes rapid corrosion due to the emission of excessive gas under the tissue. As a continuation of this work, several Mg alloys were developed like Mg-Cd, Mg-Al, and Mg-Al-Mn were developed as an alternative to the pure Mg. It takes 12 weeks for the wound healing to occur which is usually the reason behind the failure of these implants due to rapid corrosion. In the same manner magnesium also undergoes a corrosion reaction in humans which results in magnesium particles formation such as $Mg(OH)_2$ and H_2 gas in presence of water.

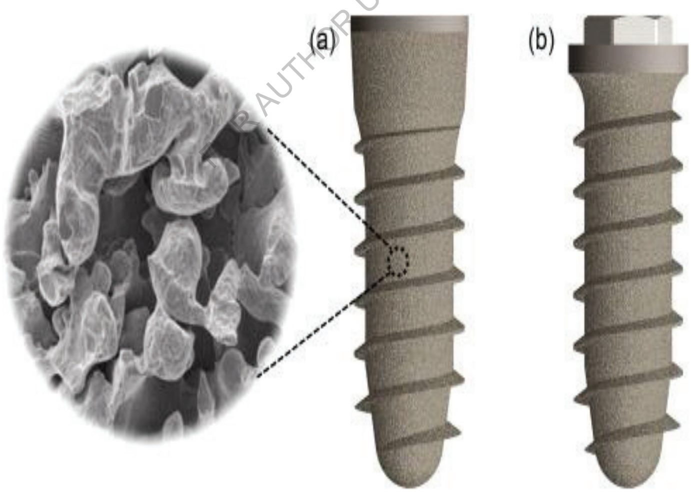
Metallic implant materials have attained immense clinical importance and many metallic materials include stainless steel (316L), titanium and alloys (Cp-Ti, Ti6Al4V), cobalt–chromium alloys (Co–Cr), aluminium alloys, zirconium–niobium, and tungsten heavy alloys. The rapid growth and development in biomaterial field has created scope to develop many medical and dental products such as dental implants, craniofacial plates and screws, pacemakers, valves, balloon catheters, medical devices and equipment's; and bone fixation devices, dental materials, prosthetic and orthodontic devices for biomedical applications. These metal-based alloys for biomedical applications are the materials of choice as they have good biocompatibility & mechanical properties, good corrosion resistance, and feasible. Based on functions of the implant and the biological environment, the type of metal used in biomedical applications is dependent upon.

While designing load-bearing dental the mechanical properties of metals have a great importance. moreover, when the implant requires high wear resistance such as in the case of artificial joints, Co–Cr–Mo alloys are used. As compared to the properties of ceramics and polymers, the properties of high tensile strength and fatigue limit of the metals allows them the possibility to design the implants that can carry good mechanical loads and they also comparatively higher ultimate tensile strength and Young's modulus of elasticity but lower strains at failure.

When placed In the biologic medium, the implanted metal-based biomaterial causes changes on the surface of material and degrades to release some by-products. Owing to these interactions between metallic implant surface and cell or tissues occur [13].

In today's times Implant materials must also be designed such that it has a good longevity. An ideal implant must have a unique and good surface chemistry that causes cell changes to occur at the interface which would happen in a case of osseointegration. There is continuous wear and worn off particles are released when there is infection. These toxic substances or uncontrolled surface degradation isolates the implant from the normal tissues due to formation of a layer of a fibrous capsule around them. In other words, an implant Is said to be idea when it is one which almost behaves identical to the host tissue. When the implant is placed, there is a short-term response of the tissues which determines the eventual long-term response. [12]

The aim of acccerelating and improving bone and integration lies in the modification and coating of surface of dental implants by creating a 3D nano- and microscale porous structures in case of threaded implants the highest concentration of stress lies adjacent to the superior most thread which develops during loading. Conveniently, to achieve efficient force transfer to a greater portion of bone-implant interface, porous surface implants have been developed and attain a lower peak peri-implant bone stresses. In a short implant model, the porous implants produced by various methods to achieve better osseointegration, they exhibit a better and a favourable stress distribution in the cancellous bone as compared to the solid one. The permeable surfaced Ti and Ti-6Al-4V implants are manufactured by either plasma-splashing or sintering powders on a strong substrate. The implants fabricated by method of sintering Ti alloy powders were so called termed as “so-called short (≤7 mm)” implants which had approximately 0.3 mm of thickness and consisted of two or three layers of sintered Ti-6A1-4V alloy powders which were bonded with security to the underlying solid substrate. On the basis of human & animal studies, it was concluded that there was a significant contribution of these characteristics namely reliable osseointegration of “short” implants and rapid bone ingrowth (osteoconductivity). [13]



Under the category of biocompatibility, Modern bone implant materials are as bio-tolerant, bio-inert and bioactive materials. PMMA which is a good example of a Bio-tolerant materials is characterised by a thin fibrous tissue interface, whereas bioinert materials like titanium and aluminium oxide usually embed well into the bone. calcium phosphate,ceramics and glass which are bioactive materials directly have a chemical bonding of the implant with bone. Wilke *et al.* In his studies proved that the marker for osseointegration was highest on the cell proliferation on the hydroxyapatite surfaces followed by titanium and chrome-cobalt-molybdenum alloy. He also proved that when viewed under the TEM the commercially available pure titanium, Ti6Al4V and cobalt-chromium alloy show comparable results at the implant-bone interface.

Over the past few years, a newer implant material has been running in the market which substantially produces higher volume of bone growth within the implants. It also possesses better characteristics in terms of 80% higher porosity without compromising on the structural integrity of the implant. It is composed of pure tantalum which forms after forming a layer of deposit on a vitreous carbon skeleton by chemical vapour deposition/infiltration. This trabecular-like metal can be moulded into variable complex shapes and can utitlized in the form of a bulk implant or a surface coating material. It has excellent biocompatility, high corrosion resistance, it is conducive to biological fixation and has a low modulus of elasticity allowing it have more physiological load, hence giving promising results with this novel material. [14]

CP Titanium – Commercially Pure Titanium - Titanium CP4 – Grade 1:

- Softest Titanium
- Highest ductility
- Good cold forming characteristics
- High corrosion resistance
- Excellent welding properties
- Good impact toughness.

Used in the applications for:

- Architecture,
- Automotive Desalination,
- Medical, Marine, Processing & Chlorate Manufacturing

Titanium CP3 – Grade 2:

- Moderate strength
- Excellent cold forming
- Good welding
- Good corrosion resistance

Used in the applications for:

- Aerospace
- Automobile
- Medical field
- Desalination

Titanium CP1 – Grade 4

- Stronger than Grade 2 & 3,
- Cold formed

- Low ductility
- Good corrosion resistance

Grade 4 titanium is commonly used in:

- Aerospace,
- Industrial and Medical applications where high strength is needed

Titanium Based Alloys

- Most commercially available
- Excellent combination of high strength and toughness
- Good welding and fabrication properties

Commonly used in:

- Aerospace
- Chemical processing
- Marine
- Medical

Titanium Grade 23 – Titanium 6Al-4V ELI

- similar to Grade 5 but has lower oxygen, nitrogen and iron.
- better ductility and fracture toughness
- Similar applications as Grade 5

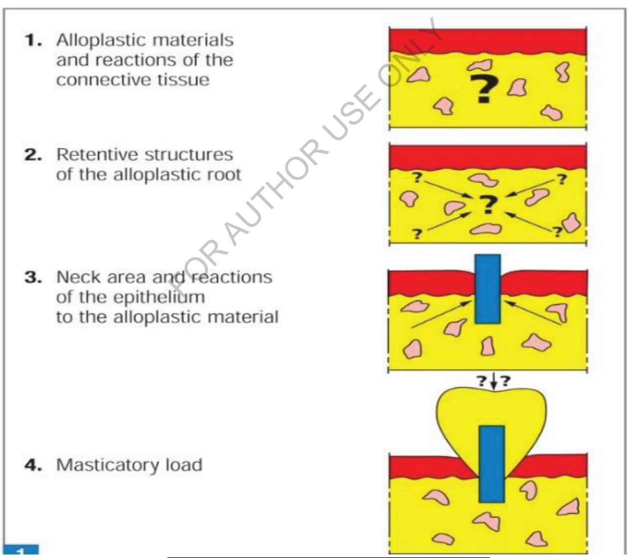
Titanium Beta Alloys

- They can be Fully heat treated and welded
- high strengths

- Possess good creep resistance
- Excellent formability
- Used in Aerospace

Titanium Alpha-Beta Alloys

- Medium to high strength levels;
- Heat treatable and weldable
- High temperature creep strength
- Limited cold forming but hot forming qualities are normally good;



SCHEMATIC DIAGRAM

Choice of materials:

Number of researcher should expect that their research to yield a conclusive answer about the biocompatibility of implant materials with regard to the type of tissue reaction at the insertion sites, which were in a quiescent state for six months before the implant was inserted:

1. Biologically inert for the host tissues.
2. Physically and chemically stable over time, without any alterations.
3. Resist to fracture, wear and deformations.
4. Sterilisable.

The biocompatibility tests were performed with various materials arranged with a shortened cone shape, and embedded underneath the mucosa with a similar careful strategy (U. Pasqualini, 1962). [15]

Venable et al (1937–47) had already demonstrated that implant materials had to be chemically and electrolytically inert, because potential differences can also occur between implant and host tissue due to the presence of organic fluids, which act as electrolytes. The following materials had already been used before this experimentation, with mixed results:

1. gold and gold alloys;
2. platinum and other elements from the group of Mendeleev's periodic table;
3. silver
4. copper, lead and manganese;

5. porcelain and glass;
6. plastics;
7. tantalum;
8. stainless steel and Stellite (chromium-cobalt-molybdenum).

OSSEOINTEGRATION OR "INTEGRATING BONY ANKYLOSIS":

The study of the behaviour at the interface between alloplastic structures and host tissues is not an easy task. The assessment of their immediate associations with both the metal designs and the encompassing tissues would be exceptionally alluring. All things considered, this expected investigation is forestalled by the gigantic specialized challenges associated with getting a part of the metal construction and host tissues adequately slender to permit assessment without changing their in vivo relationship: one could resort to using ground sections, following inclusion in a substance strong enough to hold the metal fragment during mechanical grinding of the section; on the other hand, assessment with mirrored light could be utilized, as per the method utilized for the minuscule investigation of dark articles. In opinion, neither method permits clear differentiation or adequate staining of the different structural elements. If anything, they might represent a complement to the traditional technique, following bone decalcification, metals are removed in order to analyse the appearance of the contact surface without them [16].

Bony ankylosis of emerging needles

Many researchers who employed the tripod with the smooth emerging needle technique (with no surface treatment) had the chance to observe that, in cases of accidental fracture, the fractured needle was sometimes impossible to remove from its bone site.

The study of smooth needle and the block gave us conclusions:

1. It is not true that only buried implants can osseointegrate after months of passive housing below the mucosa.

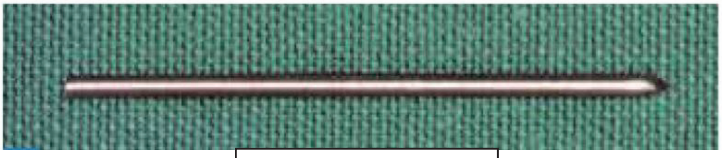
2. Given their mechanical stabilization by means of bicorticalized (or tricorticalized) components, partially buried, immediately loaded implants also undergo successful osseointegration, giving the patient the benefit of wearing temporary and definitive prostheses almost immediately.

   When properly placed in a tripod or bipod fashion, or as support for other types of implant, smooth metal needles can also counteract great stress and traction.

Implant design:

Jacques Scialom's needle implants

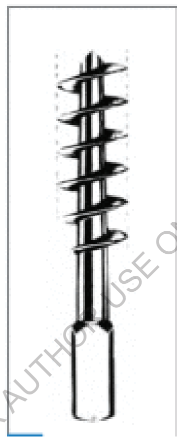
In 1962 an implant with a completely different design compared to the previous ones was presented, and it exploited the immediate stability and resistance of divergent needles, inserted deeply into the compact bone. Each needle, placed directly into the bone through the mucosa, could easily be pulled out but after external blockage the needles became a single unit that could withstand extraction and showed exceptional stability. The two close ends of the needles were bent and were joined closer to each other using pliers and self-curing resin was used to lock it forming a single block to shape it in the form of an abutment. The divergence of the needle also had the advantage of distributing the occlusal load across a very broad support. This technique was designed by the Frenchman Jacques Scialom, who named it "technique des implants aiguilles" (now known as the Scialom needle or pin implant technique) The needles were made of tantalum, a relatively "new" metal that is pure, acid- and base-proof, and totally biocompatible. [17]



SCIALOM NEEDLE

STEFANO TRAMONTE'S DRIVE SCREW:

Just one look at the implant presented by Stefano Tramonte in 1964 and it is immediately clear that it differs enormously from all the previous screws, for with that screw titanium began to be employed in implantology.



THE LONG JOURNEY TOWARD POSTLESS BLADES:

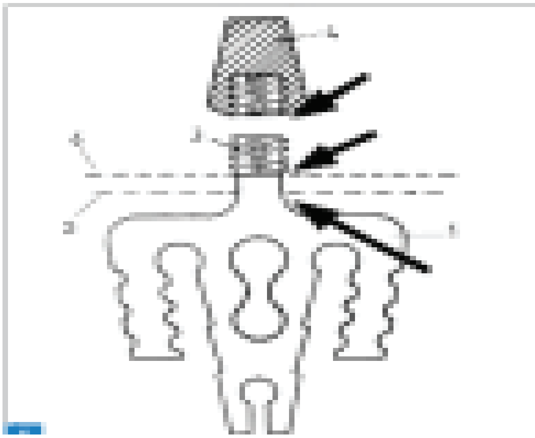
The very intense marketing of the Linkow technique spurred the curiosity of the public and the demand for implant solutions, despite the justified reservations of academia. Their critical attitude toward the new method was based on:

1. the fantastical claims of Linkow's collaborators/demonstrators of a success rate approaching 100%;
2. the consequences of commercial marketing that left novices to practice a method advertised as extremely simple, but that instead required caution, surgical skill, insight and extensive prosthetic experience;
3. the many failures, attributed—without any scientific backing—to alleged organic disorders, the lack of hygiene and/or the contamination of titanium as a result of accidental contact with other metals (chisels, hammers, pliers, etc.)
4. the absolute lack of experimental trials on the causes of the failures "of unknown etiology" and the reasons for the success of analogous implants, seemingly placed in conditions identical to those where failures had occurred.

At the same time, the great advantages of successfully placed Linkow blades, which increased the chance of solving cases of edentulism untreatable with other types of implants, could not be underestimated. [18]

THE POLYMORPHIC TWO-STEP BLADE IMPLANTS:

All the two-step vented basket implants tested on dogs ten years earlier (1962) gave excellent results, because each one kept the baskets in a quiescent state during the critical phase of reparative and integrating osteogenesis. Pasqualini thus decided to fit the blades with very short threaded emerging posts to prevent external mechanical stress on the submerged structures



original drawing of Pasqualini's blade.

Therefore, he removed the posts from the polymorphic blade in order to thread a small portion of the neck to connect the prosthetic abutments at a later date. The smooth portion of the implant neck, which emerged 3 mm from the top of the blade, had to be completely buried within the bone groove; the threaded portion that grazed the external mucosal surface measured an additional 2 mm. Thus modified, the blades would not interfere with the quiescent state of reparative osteogenesis, allowing subsequent risk-free loading. [19]

THE GARBACCIO BICORTICAL SCREWS:

In the early 1970s, Bicortical screw concept was first bought into the picture by Dino Garbaccio which represents another step forward in the evolution of implantology. Garbaccio must also be credited with other concepts, including:

1. the use of Torpan drills to prepare the tunnel, as they:
    a. do not overheat the bone since they act like the blades of a rotating scalpel;
    b. allow the oral surgeon to perceive the different resistance between compact and cancellous bone, making it possible to stop the drilling and then the progression of the screw precisely;
2. screws composed of an initial smooth pointed segment referred to as a nosepiece, which acts as a guide. [20]

Bicortical stabilization

From a biomechanical point of view, the permanent stabilization of the endosseous artefacts should benefit from the compact support structure situated on the external surface of human bones, which includes the mandible and the maxilla. The central spongy bone tissue has less retention and stabilizing capabilities and it is formed by few trabeculae, poorly mineralized, immersed in abundant medullar spaces. In 1972 Pasqualini had already proven that the majority of the implant failures “of unknown aetiology” where surgical error serious general illnesses and occlusal imbalance had been excluded.

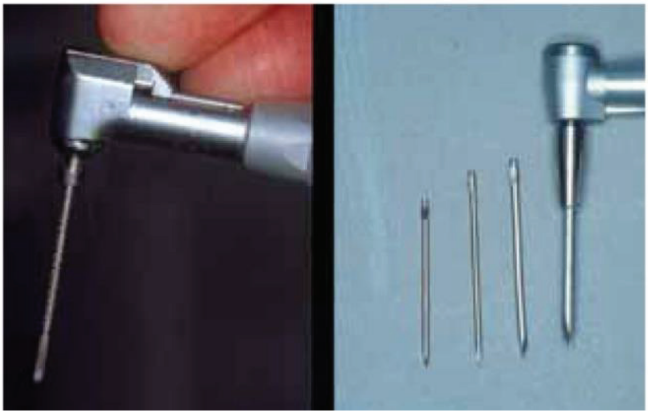
The features of the bicortical self-threading screws that contribute to increasing initial stability:

1. minimal tissue trauma, due to the small and thin smooth apical portion, which guides the threads along the primary tunnel created by the drill accurately, avoiding friction, fractures and the creation of false routes;

2. the shape of the threads with progressive diameters, each of which broken up by two sharp notches, which penetrate the bone tissue without compression, thus creating an incision wound. Healing is fast, with few painful side effects, and no areas of bone resorption. [20]

THE MONDANI INTRAORAL SOLDER:

Scialom’s tantalum tripod implant technique, which was very effective and virtually atraumatic in the first half of 1970s, whereas the screws and blades almost completely overshadowed the reputation of. [21]



PRE-IMPLANT RADIOLOGY:

Today the diagnostic options for a correct approach to implants are virtually infinite. Radiology classically divides pre-implant investigations into first- and second-level examinations. For pre-implant planning, the former include orthopantomography (OPG) and intraoral radiographies, the latter specific tomographic imaging (CT). This section will deal mainly with tomography, although first-level analyses permit a general evaluation of the clinical case. Guidelines have been proposed for the optimal use of technology and as a way to obtain unambiguous answers to the problems faced by dentists and maxillofacial surgeons. Nonetheless, it seems useful to examine the motives behind a reasonable request for additional second-level radiological information, because there is a specific device that is preferable for each examination.

The reasons that seem to contraindicate CT examinations

- longer time frames;
- radiation doses.

Longer time frames:

The wide view afforded by panoramic X-rays is an indispensable complement to CT examination. As paradoxical as it may seem, teeth and voids are better observed through the comprehensive view offered by the orthopanoramic X-ray than in CT imaging. We seek different answers from tomography, which by definition identifies smaller sectors with a view of details as diagnostic elements within the three explorable dimensions. The radiologist must always take the panoramic X-ray with a template to better target the subsequent CT. Just as the radiologist is willing to accept a longer time frame for performing the first-level investigation prior to the CT, so too must the dentist be aware that the preoperative template is a necessary aid for accurate surgery, regardless of its preparation time. Exceptions can be represented by emergencies, e.g. immediate post-extractive implantations.

Radiation doses:

Absorbed radiation varies depending on the equipment that is used. The dentist should be aware that - diagnostic results being equal - some devices have a lower radiation emission and that it is essential to undergo only the prescribed radiographic investigations, explaining this to the patient. Modern CT equipment (such as the volumetric scanners described ahead) emits very low radiation, even if the doses are higher than those emitted during orthopantomography[115-127].

second-level investigations were conducted for the following:

- surgical safety;
- more accurate measurements;
- legal issues.

Surgical safety:

By surgical safety we mean a set of objective and subjective reasons for performing the examinations. They can be identified as follows:

- aesthetic planning, especially for edentulous patients;
- questionable OPG images;
- unforeseen bone mineralization problems;
- patient perception of the dentist's professionalism.

Aesthetic planning:

We must premise this by saying that CT is the only test that can clarify the three fundamental aspects for which it is used. The peri-implant assessment provides information on :

- height;
- thickness;
- degree of mineralization.

If the OPG provides about average information on the height of structures, but it's only the CT scan which can assess the bone thickness. Due to its 3D view, Ct scan provides an exact image for model analysis, laying the groundwork for correct morpho-functional rehabilitation.

Questionable OPG images and unforeseen mineralization problems:

On learning about OPG, we are made aware of its limitations such as a 2D view which provides limitations to the dentist especially the implanotlogist where the thickness is required to be known in a 3D form. Hence this along with the possible mineralization artefact encompasses OPG to not be considered as comprehensive diagnostic examination X-ray for a pre – implant assessment.

More accurate measurements:

The dentist can plan carefully and select the implant with the most suitable size and best material if the investigations provide accurate 1:1 dimensional measurement. without a computed tomography and the accurate measurements along with a well-executed examination, the "ideological" basis for choosing a material cannot be justified. Hence the short implant so selected will have a lesser potential for good primary stability when placed and will be an objectionable choice when the actual dimensions involved effectively require longer and/or larger implants.

OCCLUSION:

"Deep balancing" of the implant

The one-step implants can also exploit the supporting structures that, when joined together, can distribute stress across a broader surface if there is resistance to static and dynamic occlusal stress. In addition to being in a region of compact bone, these teeth also distribute the load across areas that are broader than their occlusal surface. Deep balancing of the implant is achieved by infixing a needle that diverges with respect to the axis of the main implant, which must reach & penetrate the cortical bone deeply & be soldered to the screw at the point where it emerges from the bone.

IMMEDIATE FIXED TEMPORARY PROSTHESES AND DEFINITIVE PROSTHESES ON IMPLANTS:

Constructing fixed temporary prostheses:

Researchers will conclude that the minimum and deciding recommendations for temporary or fixed implant in prosthetic rehabilitation as on natural tooth if they fail to follow the principles of static and dynamic occlusal balance [22]

Front single-tooth implant

Implant rehabilitation in case of a single tooth is the most classic treatment modality. But the replacement of missing single tooth implant by immediate loading requires the knowledge of occlusion, which can be understood on the basis of two indications.

1. No front tooth, including canines, should have static contacts with the opposite teeth. Due to the different loading direction with respect to the root inclination these contacts are pathological

2. Premolars and molars are the only teeth that can safely withstand static occlusal force, since they distribute the load along the main axis of the roots.

A patient appearing with a complaint of missing tooth or is about to lose one due to trauma frequently comes with a desire for a temporary prosthetic rehabilitation. In such a case if the missing tooth is replaced or the one that is about to be expelled in replenished with a single-tooth implant is inserted and the crown is placed without balancing of occlusion, it will be self-suicidal case and the implant is bound to fail. The clinicians who are unaware how important occlusal balance is, will definitely direct the cause of failure to the fact that the implant should have been splinted to the adjacent teeth or more so ever the implants were not submerged properly or there was a microbial attack. The crown which is placed temporarily is thoroughly checked for any immature contacts both in static and dynamic position and the same precautions were duplicated when the permanent porcelain crown was fabricated and was later cemented to the implant abutment.

Also, on many occasions, the cement placed between the implant and the abutment may cause an increase in the height due to the incompressible property of the liquid produced by the cements. This problem was thoroughly checked and eliminated along with the static and dynamic premature contacts. When the molars and premolars are absent or in case of their antagonists being missing in the opposite arch, it is often observed that the front tooth becomes mobile and compromised and are usually kept by the patient due to aesthetic concerns. In such cases, we proceed as follows:

1. we initially place the distal implants without extracting the mobile front teeth;

2. after 2–3 weeks, when the surgical wounds of the mucosae have reached a satisfactory level of initial healing, we extract the front teeth and replace them with at least four implants, which are temporarily splinted using one or more bars soldered to the distal implants. Impressions of the whole arch is taken and later after 2 days, a temporary bridge is fixed carefully with cement keeping the load distribution in check along the whole length, making sure the stress doesn't hamper the implants.

In rare and occasional case, if the patient can endure the placement of multiple implants as that in the distal and frontal regions in one sitting, then the impression is taken. The temporary prosthesis is placed to avoid second stage or three stage surgeries. [23]

Impression taking with implant abutments

The impression-taking technique is the same for both natural tooth and implants since there is no difference between the shape of prostheses on implants and natural tooth (except for the fact that titanium is not caries-susceptible and can thus be undercut). The old strategy - which utilized aluminium moves for characteristic projections and pre-made exchanges for inserts, and was the best accessible when impressions were taken utilizing copper rings and Kerr thermoplastic glue.

We should call attention to that, dissimilar to characteristic projections comprising of dentine, which is more delicate, embed projections can be decreased more in size because of the greater opposition and moral soundness of titanium. N Nevertheless, it isn't generally conceivable to give the embed projections an ideal tendency, since they are embedded according to the incline of the accessible bone peak and not founded on future prosthetic requirements. Abutments are prepared by making sure that the drill tip reaches the subgingival space of the implant abutments. Because of the persistent juxtaposition of the mucosa on the titanium projection surface, a couple of drops of nearby sedative are quite often infused. Following addition of the withdrawal rope to make a gingival sulcus, which is basic for each sort of planning, we take impressions of both the inserts and characteristic projections. The impression of the opposite arch is taken using alginate, it is soaked in a disinfectant and send to laboratory in a tightly sealed packaging. The manual manipulation of the patient’s mandible in centric relation, taken by the wax-bite occlusal registration is extremely important.

Cementation of implant abutments

Embed projections ought to never be fixed with impermanent concrete in view of conceivable unevenness in case of fractional decementation, nor with complete oxyphosphate concrete since the attachment among gold as well as crown metal and titanium isn't steady. Our convention consistently calls for solid tar concrete to fit the titanium projections safely to the crowns, as whenever it is polymerized it will forestall decementation. The utilization of liquid gum concretes is key to keep away from stature expands, which are extremely hard to change. For spans or blended prostheses upheld by inserts or normal projections, we incline toward associative cementation of the crowns on characteristic teeth with oxyphosphate, utilizing glass ionomer concrete for the crown set on titanium projections.

The dental implants (ideally two) ought to be accustomed to cooperating, planning the diverse planning seasons of the two materials (individual strategy). Overabundance gum concrete is consistently fitting to be eliminated before it sets as later it gets hard to eliminate it.

Complete fixed prostheses on implants in place of dentures

Patients who are completely edentulous having a sufficient wide ridges, distally and in front region (at least up to the first molar), it is theoretically possible to go for fixed rehabilitation. In any case, some crucial guidelines should be regarded to keep away from botches that could frustrate recovery endeavors.

1. In each arch, all surgery should be completed in a single session, to immediately provide the patients with a temporary prosthesis (fixed, if possible) in occlusal balance.
2. The bone height should be checked with X-rays and/or CT, followed by assessment of the width by means of occlusal and bucco-palato-lingual probing. Targeted tomographic analysis and callipers are very useful for this, also making it possible to establish implant diameters in advance.

The measurements are very useful both for flapless surgery as well as open surgery. Some areas that are seemingly suited for implant placement may instead be too thin to permit insertion. This unfortunate situation is even more embarrassing when it occurs suddenly, thwarting and/or complicating the work that has already been done.

Another rule is never to attempt total rehabilitation of the upper arch if there are still good front teeth in the mandible. Here, permanent rehabilitation of mandible is required first, in order to avoid imbalance and expulsion of the upper prosthesis due to the presence of the front teeth. If the remaining lower teeth are still anchored to partial removable prostheses, the absence of mucosal resilience should be carefully assessed, as it will force contact with the more stable front teeth, sustaining the aforementioned imbalance.

Implant-anchored removable dentures

So far we have inspected the signs and contraindications for supplanting upper and lower false teeth with embed upheld complete fixed prostheses. Now, we will manage the restoration of edentulous atrophic distal regions, where the fruitful securing of false teeth to a couple of inserts rubbing fitted Dolder and Ackerman bars or adaptive prostheses is as yet conceivable.

OPERATING PROTOCOL FOR THE IMMEDIATE-LOAD IMPLANTOLOGY:

Immediate loading is an indisputable physiological truth that happens beginning with undeveloped turn of events, which continually applies powers and applies capacities on the skeletal device. Prompt stacking actuates two attending exercises in the peri-embed bone: utilitarian movement and tissue cicatrization. The last will develop toward a reparative capacity (osseointegration) when there is a sufficient burden or a protective one (fibrointegration) within the sight of a lacking burden. Fibrointegration is one of the two periods of embed disappointment, the other one being versatility, coming full circle with implant loss. It is obvious that the basic principles & techniques pertaining to immediate loading are quite different and sometimes contrast with those employed for delayed loading, which envisions healing of the peri-implant tissue without any loading. This partially explains why the surgical and prosthetic techniques can be perfectly outlined in a protocol in the case of submerged implants, while they can only partially be specified for emerging implants, whose range of applications is more complex & subjects these implants to a wide range of unplanned & unpredictable situations in delayed-load implantology. [24]

The immediate loading used by the researchers follows a protocol, wherever possible, and suggests the guidelines to preserve the full range of application options of these types of implants and this technique.

A convention is a bunch of guidelines that controls the succession, planning and execution of sequential methodology that can "typically" lead to a specific outcome. To diminish the quantity of factors and monitor all conditions, the methodology viably turns out to be particular, barring countless patients from treatment.

Contrarily, a rule is a "trail" to be followed admirably, one that is brimming with exhortation and ideas. It impacts however isn't totally restricting.

Therefore, based on these considerations, researchers will identify three fundamental steps in immediate-loading rehabilitation.

1. First or preoperative phase.
2. Second or surgical phase.
3. Third or postoperative phase.

Conclusion:

Endosseous implants are among the incredible accomplishments of reconstructive medical procedure, and gratitude to them the miserable circumstances of edentulism that embarrassed such countless patients until a couple of years prior are presently vanishing. Cortical implantology is gaining popularity over conventional endosseous implants as it overcomes the drawback of conventional system. Today implantations are offered by almost all dental practices, but these services are often limited to a conventional method, due to lack of information about the better rehabilitation options offered by cortical implant techniques. A strong evidence proves facts that how much better one could operate if familiar with the great reconstructive possibilities offered by bicorticalized emerging implants, intraoral soldering, emerging implants and blades. These cortical and basal implantology, literature support also gives immense self believe to clinician while choosing or planning patient treatment plan. There is no point of entering into debates that have been avoided so far about conventional or cortical, but we could enlighten our self or provide right information to “latest generation” and help them to adopt, this new emerging implantology method along with conventional system. This book tries to include to all those who contributed to the evolution of cortical and basal implant dentistry, from its origins to the present day. I have tried to begin with the history of the first implant attempts, reporting it - where possible till current status of cortical and basal implantology. This method underscores that the individuals who are going to restore an edentulous area ought to have a full comprehension of the hidden makes that drove the condition in any case, since this is the best way to try not to rehash similar mix-ups, which will imperil a definitive achievement of the techniques. It is very important to related static or dynamic occlusion while rehabilitating different condition. Indeed, cortical and basal implantology is only the first stage of rehabilitation, which will be completed by prosthetic functionalization of the implants.

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