

Implant Prostheses

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Introduction

Osseointegration is a direct bone anchorage of an implant body, which can provide a foundation to support prosthesis. Dr Per-Ingvar Branemark, Sweden Professor developed the concept of osseointegration and coined the term. In his study, microcirculation, Prof. Branemark surgically inserted the titanium chamber into the tibia of a rabbit. The initial concept of Osseointegration stemmed from vital microscopic studies. Then studies that followed involved titanium implants placed into jaws of dogs.

Oral Implantology (Implant Dentistry):It is the science and discipline concerned with the diagnosis, design, insertion, restoration and/or management of alloplastic or autogenous oral structures to restore the loss of contour, comfort, function, esthetics, speech and/ or health of the partially or completely edentulous patient

Implant Prosthodontics: It is the branch of implant dentistry concerning the restorative phase following implant placement and the overall treatment plan component before the placement of dental implants.

It is the phase of prosthodontics concerning the replacement of missing teeth and/or associated structures by restorations that are attached to Dental Implants .

Implant:-Any object or material, such as an alloplastic substance or other tissue, which is partially or completely inserted or grafted into the body for therapeutic, diagnostic, prosthetic or experimental purposes .

Implant Prosthesis: Any prosthesis (fixed, removable or maxillofacial) that utilizes dental implants in part or whole for retention, support and stability.

Implant System: Dental implant components that are designed to mate together. An implant system can represent a specific concept, inventor, or patent.

It consists of the necessary parts and instruments to complete the implant body placement and abutment components.

Osseointegration: The apparent direct attachment or connection of osseous tissue to an inert, alloplastic material without intervening connective tissue

Direct bone anchorage to an implant body, which can provide a foundation to support prosthesis (Branemark, 1983).

A direct structural and functional connection between ordered living bone and the surface of a load carrying implant (Albrektsson et al., 1981). Endosseous Implant/Endosteal Implant:

A device placed into the alveolar and/basal bone of the mandibleor maxilla and transacting only on cortical plate .

A device inserted into the jawbone (endosseous) tosupport a dental prosthesis. It is the ‘tooth root’ analogue and is often referred to as fixture (Richard Palmer).

Implant classification

Dental implant can be classified depending on placement within tissue

o Subperiosteal: A CoCr casting custom made for an edentulous bony ridge and placed subperiosteally with integral trans-mucosal posts for denture retention.

o Transmandibular (transosseous) dental implants “staple boneplates”:

- The staple bone plate is used to rehabilitate the atrophic edentulous mandible.
- It is a transosteal threaded posts which penetrate the full thickness of the mandible and pass into the oral cavity in the parasymphysial area

o Submucosal implants: A small “pressstud- like” device within the soft tissue helping to retain a denture, usually maxillary

o Transdental fixation: A metal implant placed through a tooth and extended through the root canal into the periapical bone to stabilize the mobileTooth sometimes referred to as endodontic implants This was first used by Cuswell and Senia in 1983

• Endosseous—blade (plate), ramus frame, transosteal or staple, root form, or cylindrical: These implants are anchored in bone and penetrate the oral mucosa to provide prosthetic anchorage.

1- Classification of endosseous implants according to their design:

a- Cylinders endosseous implants.

b- Screws or spiral post endosseous implants.

c- Blade form endosseous implants.

d- Root form endosseous implants

2- Classification of endosseous implants according to their material:

a- Pure titanium: the titanium oxide surface was responsible for the formation of the direct bone- implant interface.

b- Titanium alloy: the titanium alloys exist in three forms: alpha, beta and alpha beta phases and they all originate when pure titanium is heated and mixed with aluminium and vanadium.

3- Classification of endosseous implants according to surface characteristics:

a- Sand blasted surface.

b- Titanium Plasma Sprayed surface (TPS), it has satisfactory results regarding the osseointegration and the clinical prognosis.

c- Titanium oxide surface coating the implants to make the inert metal a bioactive one.
d- Hydroxyapetite coating
4- Classification of endosseous implants according to the insertion technique:
The insertion techniques of endosseous implants have been classified into either:
a- Press fit technique, in this type of unthreaded implants, the implant site is drilled slightly smaller than the actual implant size, where the implant is pressed into the recipient site with slight friction.
b- Self tapping technique, in this type of threaded implants, the implant threads are used to tap its site during insertion.
c- Pre-tapping technique, in case of very dense bone, the implant sites are better to be previously tapped using the bone tap instrument before insertion of the threaded implant
5- Classification of endosseous implants according to surgical stages:
a- Single stage design (none submerged – transgingival): the body of the implant is inserted into the bone with its abutment portion penetrating through the mucoperiosteum during the healing period. Surgical placement of a dental implant, which is left, exposed to the oral cavity following insertion. This is the protocol used in non-submerged implant systems
b- Two stage design: in this design the implant body is completely embedded in bone for complete osseointegration. The implant body is then exposed and the healing abutment is placed for soft tissue healing before the impression is made for prosthesis fabrication
6.Classification of endosseous implants according to the time of installation:
a- Immediate implants, they are placed into a prepared extraction socket following tooth extraction.
b- Immediate delayed implants, they are placed within 6-12 weeks after the tooth loss.
c- Delayed implants, they are placed within 6-12 months after tooth extraction, when complete healing and bone remodeling occur
7.Classification of endosseous implants according to time of prosthetic loading:
a- Immediately loaded implants, an acrylic resin prosthesis which is designed to be out of occlusion is placed immediately after implant placement, specially in anterior region for esthetic purposes.

b- Delayed loading implant, delayed loading is done in maxillary implants after 4-6 months and in mandibular implants after 3-4 months to allow for better osseointegration due to the difference of the investing bone composition

Implantology Biomechanics

The initial treatment plan for implant dentistry should include the ideal implant size based primarily on biomechanic and esthetic considerations. In traditional prosthetics, when a tooth is replaced, the abutment teeth are already provided by nature with wide posterior abutments for posterior teeth. When teeth are replaced with dental implants, the implant team should preselect the ideal implant size based on the ideal esthetic restoration within biomechanical guidelines.

Historically, the size of an implant was determined primarily by the existing bone volume in height, width, and length. The surgeon would select longer implants in the anterior regions of the mouth and shorter ones in the posterior areas (or use cantilevered prostheses) because of the limits of the mandibular canal and maxillary sinus. The width of the implant, also determined during surgery, would relate to the existing width of available bone, and one diameter implant (4 mm) would be used in most all situations.

Over the years, dental implant treatment plans incorporating biomechanics have been advocated by the author to decrease the most common complications those related to biomechanical stress. The prosthesis first is planned, including whether the restoration is fixed or removable, how many teeth are replaced, and the esthetic demands. The patient force factors are then considered to evaluate the magnitude and type of force applied to the restoration. The bone density is evaluated in the regions of the potential implant placement. The key implant positions are determined followed by the additional implant number based on the patient force factors and the bone density in the implant sites. The key implant positions are important regardless of the patient force factors and bone density. The total implant number, on the other hand, is directly related to these force factors and bone density. For example, more implants should be used when the patient has parafunction or the bone is less dense because the greater force exerted on the implant abutments will transmit greater stresses to the implant bone interface. In fact, implant number may also be a factor when the ideal size of the implant is inadequate for the biomechanical load. The next consideration in this ideal treatment plan sequence is the implant size.

Treatment Plan Sequence:

1. **Prosthesis**
2. **Key implant position**
3. **Patient force factors**
4. **Bone density**
5. **Implant size**
6. **Implant number**

Prosthesis

Prosthodontic Classification (Misch Classification)

FP-1 Fixed prosthesis: *replaces only the crown; looks like a natural tooth.*
An FP-1 is a fixed restoration and appears to the patient to replace only the anatomical crowns of the missing natural teeth. To fabricate this restoration type, there must be minimal loss of hard and soft tissues. The volume and position of the residual bone must permit ideal placement of the implant in a location similar to the root of a natural tooth. The final restoration appears very similar in size and contour to most traditional fixed prostheses used to restore or replace natural crowns of teeth.

FP-2 Fixed prosthesis: *replaces the crown and a portion of the root; crown contour appears normal in the occlusal half but is elongated or hypercontoured in the gingival half.*
An FP-2 fixed prosthesis appears to restore the anatomical crown and a portion of the root of the natural tooth. The volume and topography of the available bone are more apical compared with the ideal bone position of a natural root (1–2 mm below the cement–enamel junction) and dictate a more apical implant placement compared with the FP-1 prosthesis. As a result, the incisal edge of the restoration is in the correct position, but the gingival third of the crown is overextended, usually apical and lingual to the position of the original tooth. These restorations are similar to teeth exhibiting periodontal bone loss and gingival recession.

FP-3 Fixed prosthesis: *replaces missing crowns and gingival color and a portion of the edentulous site; prosthesis most often uses denture teeth and acrylic gingiva but may be porcelain to metal.*

The FP-3 fixed restoration appears to replace the natural teeth crowns and has pink-colored restorative materials to replace a portion of the soft tissue, especially the interdental papillae. As with the FP-2 prosthesis, the original available bone height has decreased by natural resorption or osteoplasty at the time of implant placement. To place the incisal edge of the teeth in proper position for esthetics, function, lip support, and speech, the excessive vertical dimension to be restored requires teeth that are unnatural in length. However, unlike the patient requirements for an FP-2 prosthesis, the patient may have a normal to high maxillary lip line during smiling or a low mandibular lip line during speech. As a consequence, the soft tissue drape should also be replaced. Prosthetic replacement of the soft tissue drape (FP-3 prosthesis) is most often desirable when multiple adjacent teeth are missing.

RP-4 Removable prosthesis: *overdenture supported completely by implants (usually with a superstructure bar).*

RP-4 is a removable prosthesis completely supported by the implants, teeth, or both. The restoration is rigid when inserted: overdenture attachments usually connect the removable prosthesis to a low-profile tissue bar or superstructure that splints the implant abutments. Usually, five to seven implants in the mandible and six to eight implants in the maxilla are required to fabricate completely implant supported RP-4 prostheses in patients with favorable dental criteria.

RP-5 Removable prosthesis: *overdenture supported by both soft tissue and implants (may or may not have a superstructure bar.*

RP-5 is a removable prosthesis combining implant and soft tissue support. The amount of implant support is variable. A completely edentulous mandibular overdenture may have (1) two of three anterior implants independent of each other primarily for retention; (2) splinted implants in the canine regions to enhance retention and stability, (3) three splinted implants in the premolar and central incisor areas to provide improved retention and lateral stability; or (4) four or five implants splinted with a cantilevered bar to improve retention, stability, and support which reduces soft tissue abrasions and limits the amount of soft tissue coverage needed for prosthesis support. The primary advantage of an RP-5 restoration is the reduced cost because fewer implants may be inserted compared with a fixed restoration and there is less demand for bone augmentation, often required for additional implants. The prosthesis is very similar to traditional overdentures supported by natural teeth.

Key implant position

The key implant positions are determined with no limitations. In other words, the radiograph is used for diagnosis to determine the prosthesis and pathology but not the available bone and implant position. Rather, the dentist "pretends" the patient has all the available bone necessary to place the implant in the key sites, the patient has no financial limitations to do the ideal treatment, time is not an issue related to treatment, and the skill necessary to place (or augment and place) an implant in the key sites is present by the dentist or the referring team.

There are four general guidelines to determine key implant positions for a fixed prosthesis in the edentulous site with multiple adjacent teeth missing:

1. Cantilevers on prostheses designed for partially edentulous patients or complete edentulous maxillae should preferably be eliminated; therefore, the terminal abutments in the restoration are key positions.
2. Three adjacent pontics should not be designed in the prosthesis, especially in the posterior regions of the mouth.
3. When the canine is missing, the canine site is a key position, especially when other adjacent teeth are missing.
4. When the first molar is missing, the first molar site is a key implant position for all partially edentulous patients and completely edentulous maxillae.

Character of Forces Applied to Dental Implants

Stress and Strain

The presence of fibrous tissue has long been known to decrease the long-term survival of a root form implant. Excessive loads on an osseointegrated implant may result in mobility of the supporting device even after a favorable bone–implant interface has been obtained. Excessive loads on the bone result in increased strain conditions in the bone. These microstrains in the bone may affect the bone remodeling rate and cause pathologic overload, which results in the loss of bone. The amount of bone strain is directly related to the amount of stress applied to the implant–bone interface. The stress may cause complete implant failure, porcelain fracture, uncemented restorations, abutment screw loosening, implant and component fracture, and crestal bone loss. Although several conditions may cause

crestal bone loss, one of these may be prosthetic overload. The greater the stresses throughout the implant–bone interface, the greater the risk factor for any biomechanical complication, including crestal bone loss and implant failure. Therefore, the stress and strain relationship has been shown to be an important parameter to decrease any biomechanical complication.

Force Magnitude

The physiology of the stomatognathic system imposes a range on the magnitude of forces that may be applied to an implant in the oral environment. The magnitude of bite force varies as a function of anatomical region and state of the dentition. Average bite forces can range from 10 to 350 lb. The magnitude of force is greater in the molar region (200 lb), less in the canine area (100 lb), and least in the anterior incisor region (25–35 lb). These average maximum bite forces increase with parafunction to magnitudes that may approach 1000 lb in the posterior regions.

Force Duration

The duration of bite forces on the dentition has a wide range. Under ideal conditions, the teeth come together during swallowing and eating for only brief contacts. The total time of these brief episodes is less than 30 minutes per day. Patients who exhibit bruxism, clenching, or other parafunctional habits, however, may have their teeth in contact for several hours each day. Fatigue fractures increase in direct relationship to the amount of the force and the number of cycles of load. Therefore, an increase in force duration directly increases the risk of fatigue load to the implant body when the force is higher than the endurance limit of these entities.

Force Type

Three types of forces may be imposed on dental implants within the oral environment: compression, tension, and shear. Bone is strongest when loaded in compression, 30% weaker when subjected to tensile forces, and 65% weaker when loaded in shear. Therefore, an attempt should be made to limit shear forces on bone because it is least resistant to fracture under these loading conditions. This is most important in regions of decreased bone density because the strength of bone is also directly related to its density. An increased width of an implant may decrease offset loads and increase the amount of the implant–bone interface placed under

compressive loads. Hence, when forces are more tensile or shear in nature (as with cantilevers or angled loads), the implant diameter or implant number should be increased to compensate for the weakened bone state.

Force Direction

The direction of the load has a significant effect on the magnitude of compressive and lateral load components (tension and shear forces). Angled loads increase the amount of shear loads transmitted from the implant body to the bone, and the bone is weakest to shear-type loads. By increasing the angle of the load by only 15 degrees, the lateral component of that load (shear and tensile forces) is increased by 25.9%. Every degree of angled load increases the shear load component to the implants, which is the most damaging component of the load because the bone is weakest to shear. The forces to an implant body are typically greatest at the crestal bone interface. Angled loads to the implant prosthesis produce angled loads to the crest module of the implant and hence the marginal bone; therefore, the implant angulation is important to consider.

Under ideal conditions, the implant body should be oriented to provide long-axis compressive loads to the implant and to decrease shear loads to the crestal bone region.

Force Magnification

Force magnification further increases the stress beyond the usual conditions of load (e.g., a cantilevered prosthesis with a crown height greater than normal, an angled load, or parafunction). Multiple force magnifiers, such as a patient with parafunctional habits and an excessive crown height, may exceed the capability of any dental implant to withstand occlusal loads. Careful treatment planning with special attention to the implant position, implant number, occlusal loading, and an increase in implant size to increase functional surface area is indicated when a clinical case presents the challenge of force magnifiers.

Surface Area

The surface area over which the occlusal forces are applied to the implant system is very relevant and is inversely proportional to the stress observed within the implant system (Stress = Force/ Surface area). It can be clearly seen from this basic engineering equation, to reduce stress, the force must decrease or the surface area

must increase. Therefore, an increase in implant size is beneficial to decrease the stress applied to the system. The size of an implant may be modified in either length or diameter.

Implants Number

One Missing Tooth

When one tooth is replaced with an implant, the implant should be inserted into the mesiodistal center of the site.

Two Missing Teeth

When two adjacent teeth are missing, two implants should support the implant restoration.

Three Missing Teeth

When three adjacent teeth are missing, the key implant positions include the two terminal abutments, one on each end of the prosthesis. A three-unit prosthesis may be fabricated with only these abutments when most of the force factors are low to moderate and the bone density is favorable.

Four or More Adjacent Teeth Missing

When four adjacent teeth are missing, the terminal abutments are the key implant positions. Most often, an additional implant is required, especially when the missing teeth include a canine or posterior teeth or when the bone density is poor. Restorations of five to 14 units require the key terminal positions plus additional abutments regardless of force factors or bone density. The other guidelines to the key implant positions determine the most important additional sites for the implant placement.

Abutment Types

One-Piece Implant System

In this type, the implant and the abutment are formed as a single solid unit. In this case, there is no screw-joint between the implant and the abutment.
The lack of a screw-joint is considered an advantage as there is no screw-loosening, dangerous fracturing or micro-motions between the abutment and the implant.
The one-piece implants may be used when narrow implants are indicated, such as in the replacement of the maxillary lateral incisors and lower incisors, or when bone volume is limited and the use of standard implants is not suitable. These types of implants are installed only with the one-stage implant placement method. Examples of a one-piece implant are the one-piece conical titanium implant and Y-TZP Ceramic Implant.

Two piece implant system

The two-piece implant type consists of an implant to which an abutment or a restoration/attachment is connected, usually with a screw. It is more commonly used than the one-piece implant type. With this implant type, both the one- and the two-stage implant surgery protocol can be implemented.

Abutment implant interface:

The implant / abutment interface connection, is generally described as an internal or external connection. The distinctive factor that separates the two groups is the presence or absence of a geometric feature that extends above the coronal surface of the implant.

External connection

Historically, the first implants were designed with a flat butt-joint interface and an external hexagon to allow for the recording of the implant location, and to avoid rotation for single-unit restorations.
This very well-documented connection allows some micromotion of the interface, and less rigidity during occlusal load transmission.
The connection can be further characterized as a slip fit joint, where a slight space exists between the mating parts and the connection is passive or, as a friction fit joint, where no space exists between the mating components and the parts are literally forced together.
The joined surfaces may also incorporate a rotational resistance and indexing feature and / or lateral stabilizing geometry. This geometry is further described as octagonal,

hexagonal, cone screw, cone hex, cylinder hex, 13 spline, cam, cam tube and pin / slot.

The internal connection implants can be divided into the following groups:

1. Passive fit/slip fit joint (space exists between mating components):

1) 6-Point Internal Hexagon Design
This is the most common type of internal implant-abutment connection. It has a six-sided geometric figure, that is, a hexagon recessed into the body of the implant. As the internal geometry is a hexagon, the abutment can fit over the implant at every 60 degree rotation of the implant over the abutment, but not at any other intermediate angle. Thus, abutment positioning is possible at six different positions of the implant over the abutment.

2) 12-Point Internal Hexagon
The 12-point internal hexagon design, is the offset hexagon design that allows for greatest freedom of placement of the abutment over the implant.
The 12-point double internal hex provides an opportunity to place the abutment on the implant for every 30 degree rotation, thus useful when we use angled abutments. It provides us with a greater opportunity to correct the off-axis angulation of the abutment with respect to the implant.
Though the 12-point internal hexagon design offers greater flexibility in the positioning of the abutment over the implant, the design should not compromise the mechanical properties of the implant–abutment interface.

3) 3-Point Internal Tripod
This type of implant to abutment connection represents a triangular internal geometry. A major disadvantage of this system is that it allows for positioning of the abutment over the implant at only 120 degree of rotation.
It represents the trichannel implant system. It is available in four diameters: 3.5, 4.3, 5 and 6 mm and is color-coded for ease of identification. As the replace select 3-point internal tripod system offers limited options for positioning of the implant over the abutment, it is not a very clinically preferred design.

4) Internal Octagon Implant
The internal octagonal implant represents an 8-sided internal geometry connecting the implant and the abutment allowing for positioning of the implant over the abutment at every 45 degree rotation.

2. Friction Fit (no space between mating components)
Locking taper/morse taper:
The concept of morse taper implant-abutment connection design includes a tapered projection from the implant abutment, which fits into a tapered recess in the implant.
There is a friction fit and cold welding at the implant–abutment interface. This implant-abutment connection depends on this friction fit for elimination for rotation at the implant-abutment interface and subsequent abutment screw loosening.

1) 8-Degree Morse Taper Implants
In dentistry, the concept of this morse taper or cone screw tapered connection was rationale in that a tapered connection would yield a mechanically stable, sound and self-locking interface. It basically creates a friction lock similar to the morse taper used in mechanical engineering and related industries.

2) 11.5-Degree Morse Taper Implant
In this implant the fixture and abutment are strongly connected at an 11.5 degree angle by the conical seal design. The conical design seals off the connection and decreases micromovement and microleakage. This thread has a micro-threaded conical neck and TiO blast surface. Microthreads on the fixture top prevent concentration of the stress around the alveolar ridge crest and decrease marginal bone loss.

3) 1.5-Degree Morse Taper Implants
This is a true morse taper implant with an angle of taper: 1.5 degree is available from Bicon implants. The Bicon locking taper abutment has no screw, but like a screw-retained abutment, it relies on friction to keep it intact.
Assembly is achieved by driving the 1.5 degree morse taper into the matching socket in the implant. A high clamping force between abutment and implant is generated by this action.

Prosthetic Attachments

A prosthetic or "superstructure" is retained to the abutment by:
(1) An abutment for screw retention uses a screw to retain the prosthesis or superstructure.
(2) An abutment for cement retention uses dental cement to retain the prosthesis or superstructure.
(3) An abutment for attachment uses an attachment device to retain a removable prosthesis
Each of the three abutment types may be further classified as straight or angled abutments, describing the axial relationship between the implant body and the abutment.

Screw-retained versus cemented fixed implant prostheses

Both types of prosthesis retention can give excellent long-term results, although the retrievability afforded by screw-retained prostheses clearly offers the safer and most versatile option.
Nonetheless some dentists prefer the cementation protocol since this approach precludes visibility of access openings in the occlusal or facial surfaces of the artificial teeth. It should however be emphasized that any sub-mucosal extension of a prosthesis could predispose to an iatrogenic peri-implant inflammation with attendant marginal bone loss if all cement remnants are not removed.
For full-arch prostheses a screw-retained design is recommended as any maintenance procedure or subsequent treatment can be performed more efficiently by removing the prosthesis; for example, in the case of technical problems such as fracture of the veneering material or of abutment screws or treatment of mucositis and peri-implantitis. The problem of screw access openings being located in esthetically relevant areas can be solved by using angulated abutments (i.e. Multi-unit abutments) or angulated screws channels.

Impression Techniques in Implantology

Impression Techniques

1- Implant level impressions
- ❖ Transfer type (close tray).
- ❖ Pick up (open tray).

2- Abutment level impressions
- ❖ Direct Techniques.
- ❖ Indirect Techniques.

Implant level impressions

Traditionally, there are 2 different implant impression techniques for transferring the impression copings from the implant to the impression.

Transfer (closed tray) Technique

The transfer technique uses tapered copings and a closed tray to make an impression. The copings are connected to the implants, and an impression is made and removed from the mouth, leaving the copings intraorally. Subsequently the copings are removed and connected to the implant analogs, and then the coping- analog assemblies are inserted in the impression before pouring the definitive cast.

The clinical situations which indicate the use of the closed tray technique are:

when the patient has limited interarch space, tendency to gag, or if it is too difficult to access an implant in the posterior region of the mouth.

Pick-Up (Opened tray) Technique

Conversely, the pick-up impression uses square copings and an open tray (a tray with an opening), allowing the coronal ends of the impression coping screw to be exposed. Before separating the implants, the copings screws are unscrewed to be removed along with the impression. The implant analogs in the impression are connected to the copings to fabricate the definitive cast. Pick-Up Technique takes advantage of impression materials having rigid properties and eliminate the error of permanent deformation of impression materials because the transfer coping remains within the impression until the master model is poured and separated.

Advantages:
- ❖ Reduce the effect of implant angulation.
- ❖ Reduce the deformation of the impression material.

Disadvantages:

There may be some rotational movement of the impression transfer when securing the implant analog.

Abutment level impression.

1. Direct Techniques Option

The implant abutment may be restored as a natural tooth restoration. The abutment (usually prefabricated) is inserted into the implant body (usually screw retained rather than cemented as with a post in an endodontic-treated tooth).

After preparation of the abutment in the mouth, an impression is made of the abutment. A stone cast is poured, and an individual die of the abutment is trimmed. The restoration is fabricated very similar to a tooth. This prosthetic approach may be called a direct prosthetic option.

Advantages:

(1) familiar to restoring dentists.

(2) no laboratory analog components are required.

(3) splinting crowns together is less complicated, because manufacturer precision for analogs is not required and transfer of components is not required.

(4) reduced cost because analogs and laboratory fees for abutments are eliminated.

Disadvantages:

(1) the abutments are prepared in the mouth.

(2) retraction cord placement is required in esthetic zones or when additional abutment height is required for prosthesis retention.

(3) a different transitional restoration is often fabricated than the option during implant body healing because the abutment is inserted.

2. Indirect technique Option

The indirect technique uses a closed tray to make an impression.. The clinical situations which indicate the use of the closed tray technique are when the patient has limited interarch space, tendency to gag, or if it is too difficult to access an implant in the posterior region of the mouth. An indirect- uses an impression material requiring elastic properties. The abutment is screwed into the implant body and remains in place when a traditional “closed-tray” impression is set and removed from the mouth. The abutment is removed from the implant body in the mouth, connected to an implant body analog, and then reinserted into the closed-tray impression before pouring the definitive cast; hence, the transfer is “indirect.”

Occlusal Considerations in Implantology

Occlusion:

1: The act or process of closure or of being closed or shut off.
2: The static relationship between the incising or masticating surfaces of the maxillary or mandibular teeth or tooth analogues.

Balanced articulation:

The bilateral, simultaneous, anterior and posterior occlusal contact of teeth in centric and eccentric positions.

Lingualized occlusion:

This form of denture occlusion articulates the maxillary lingual cusps with the mandibular occlusal surfaces in centric working and nonworking mandibular positions.

Mutually protected articulation:

An occlusal scheme in which the posterior teeth prevent excessive contact of the anterior teeth in maximum intercuspation, and the anterior teeth disengage the posterior teeth in all mandibular excursive movements.

Group function occlusion:

An occlusal scheme in which lateral pressure are distributed to all working side teeth in contrast MPO where lateral pressure is directed only to the working side canine.

Significance of Occlusion on Osseointegrated Implants

- There are no specific defense mechanisms against occlusal forces in implants: poorly restored occlusion ➡ deleterious effect.
- Prosthesis must be fabricated as accurately as possible in order to achieve long standing success and occlusion should be key factor in overall success rate.
- An impact force can have destructive effects on prosthesis and implants and supporting bone.
- Teeth should contact simutaneously when mandible closes into maximum intercuspal position.

Occlusal Goals for Implant Prosthodontics:

- Bilateral simultaneous contact.
- No prematurities in retruded contact position. (RCP)
- Smooth, even, lateral, excursive movement with no nonworking interferences.
- Equal distribution of occlusal forces.
- Freedom from deflective contacts in intercuspal position (IP).
- Anterior guidance whenever possible

Implant Protective Occlusion (IPO)

IPO was previously known as medial positioned-lingualized occlusion. This occlusal concept refers to an occlusal plane that is often unique and specifically designed for the restoration of endosteal implant.

A primary goal of IPO is to maintain the occlusal load that has to be transferred to the implant body within the physiologic limits of each patient.

IPO addresses several conditions to decrease stress to implant interface

- No premature occlusal contacts or interferences.
- Influence of surface area.
- Mutually protected articulation.
- Cusp angle of crowns (cusps inclination).
- Occlusal contact positions.
- Implant crown contour.

No premature occlusal contacts or interferences:

The implant has no periodontal membrane, concerns center around the potential for the "nonmobile" implant to bear the total load of the prosthesis when joined to the "mobile" natural tooth.

Four important components may contribute movement to the system: implant, bone, tooth, and prosthesis.

The initial difference in vertical movement of teeth and implants in the same arch 28μ.

Initial occlusal contacts should account for this difference or implants will sustain greater loads.

Occlusal prematurities are ideally eliminated on teeth before implant reconstruction. Thin articulating paper (less than 25μ thickness) is then used for the initial implant occlusal adjustment in centric relation occlusion under a light tapping force.

The implant prosthesis should barely contact, and the adjacent teeth should exhibit greater initial contacts. Only axial occlusal contacts should be present on the implant crown.
Once the equilibration with a light bite force is completed, a heavier centric occlusal force is applied.
The contacts should remain axial over the implant body and may be of similar intensity on the implant crown and the adjacent teeth under greater bite force to allow all elements to react similar to the occlusal load.
Hence to harmonize the occlusal forces between implants and teeth, a heavy bite force occlusal adjustment is used because it depresses the natural teeth, positioning them closer to the depressed implant position and equally sharing the load.
The initial lateral movement of healthy anterior teeth ranges from 68 to 108 μ before secondary tooth movement.
Anterior implant movements are not immediate and range from 10 to 50 μ.
Because of the greater discrepancies in lateral movement, the occlusal adjustment in this direction is more critical to implant success and survival.
A similar scenario is used for the occlusal equilibration - implants joined to natural teeth. A light force and thin articulating paper are used, and the implant crown exhibits minimum contact compared with the natural abutment crown.
A heavy bite force is then used to establish equal occlusal contacts for all abutments and the entire prosthesis, whether implant or natural.

Influence of surface area:

An important part of IPO is the adequate surface area to sustain load transmission to the prosthesis.
Wider diameter root form implants have a greater area of contact at the crest than narrow implants which reduces the mechanical stress at the crest.
When narrow diameter implants are used in regions that receive greater loads, additional splinted implants are indicated to compensate for the design.
Placement of implants in posterior jaws to be staggered to improve biomechanical loads.

Crown cusp angle:

Occlusal contact along an angled cusp result in an angled load to the crestal bone.
Post implant crown should have wider central fossa perpendicular to implant body.
Opposing cusp should be modified to occlude in fossa.

Occlusal contact positions:

Determines the direction of force.
The marginal ridge contact is also a cantilever load because the implant is not under the marginal ridge.
The ideal implant body position is usually under the central fossa and maybe 1-2mm to the facial aspect (when bone is abundant) to be under the buccal cusp of the mandible and to improve the esthetic emergence of maxillary implant crowns.
The ideal primary contact should reside within the diameter of an implant.
Secondary occlusal contact should remain within 1 mm of the periphery of implant.
Marginal ridge and buccal cusp contacts should be avoided.

Implant crown contour:

A wide occlusal table favors offset contacts during mastication or parafunction.
Narrower implant bodies are even more vulnerable to occlusal table width and offset loads.
Wider root form implants can accept a broader range of vertical occlusal contacts while still transmitting lesser forces at the permucosal site under offset loads.
Therefore in IPO the width of the occlusal table is directly related to the width of the implant body.
Restorations mimicking the occlusal anatomy of natural teeth often result in offset loads (increased stress), complicated home care and increased risk of porcelain fracture.
In nonesthetic regions of the mouth, the occlusal table should be reduced in width compared with natural teeth.