Dental Implant

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).

Dr Per-Ingvar Branemark, Sweden Professor developed the concept of osseointegration and coined the term. In his study, microcirculation, he surgically inserted the titanium chamber into the tibia of a rabbit. The initial concept of Osseointegration stemmed from vital microscopic studies. The studies followed involved titanium implants placed into jaw of dog.

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) to support a dental prosthesis. It is the ‘tooth root’ analogue and is often referred to as fixture (Richard Palmer).

Implant classification

1. Classification of endosseous implants according to placement within tissue:

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

b. Transmandibular (transosseous) dental implants "staple boneplates":

- The staple bone plate is used to rehabilitate the atrophic edentulous mandible.

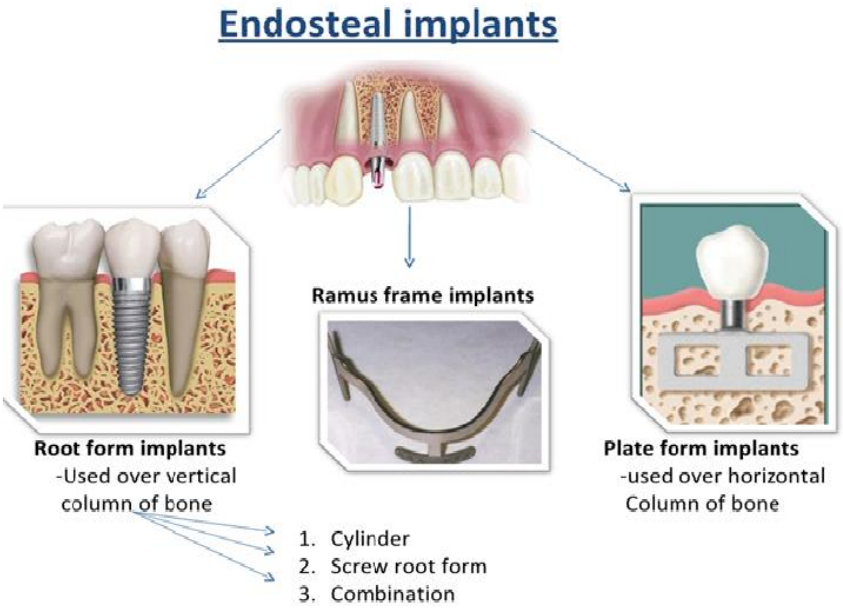
- It is a transosteal threaded posts which penetrate the full thickness of the mandible and pass into the oral cavity in the parasymphysial area.

c. Submucosal implants: A small "pressstud- like" device within the soft tissue helping to retain a denture, usually maxillary

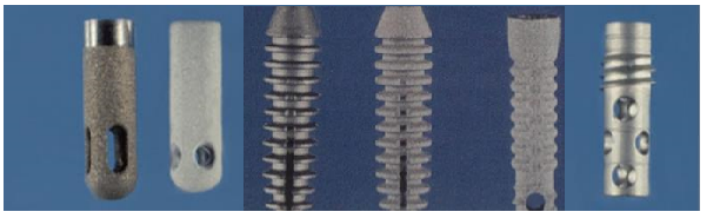
d. Transdental fixation: A metal implant placed through a tooth and extended through the root canal into the periapical bone to stabilize the mobile tooth sometimes referred to as endodontic implants. This was first used by Cuswell and Senia in 1983.

e. Endosseous dental implant: These implants are anchored in bone and penetrate the oral mucosa to provide prosthetic anchorage.

- ✓ Ramus frame
- ✓ Blade (plate)
  - -conventional blade design
  - -vented blade design
- ✓ Root form, or cylindrical
  - -pin type
  - -screw type
  - -basket type
  - -hollow cylinder



2. Classification of endosseous implants according to their design:



a- Cylinders endosseous implants.

b- Screws or spiral post endosseous implants.

c- Combination endosseous implants.

3. 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.

c- Non- metallic (ceramics, Carbon): Instead of metal, zirconia offers a ceramic choice that is more natural-looking and just as strong and durable as conventional implants.

4. 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.

5. 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.

6. 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 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.

7. 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.

8. 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.

Factors affecting healing

1- Surgical technique: All surgical procedures are traumatic. The level of trauma is a critical factor that determines whether healing will progress toward fibrous or osseous integration. Surgical preparation on hard tissue causes a necrotic zone of bone (interface) due to cutting of blood vessels, frictional heat, and vibrational trauma.

Excessive trauma leads to fibrous encapsulation of the implant. Surgical trauma must be minimized during all aspects of implant surgery to optimize success rates. The temperature for impaired bone regeneration has shown to be as low as 44 C^{o} to 47 C^{o} for one minute.

2- Premature loading: Time should be allowed for healing of necrotic bone, formed due to surgery. Movement of the implant during this healing phase will result in fibrous encapsulation. For this reason it is recommended by many operators to keep the recently placed implants unloaded for a period of two to eight months depending on the clinical situation, implant coating, location of the implant, and whether the implant is placed into bone grafts.

3- Surgical fit: Even with the best technical precautions, bone contacts only portions of the implant and a perfect microscopic contact is not possible. A longer healing period will be required before loading implants then surgical fit less then optimal.

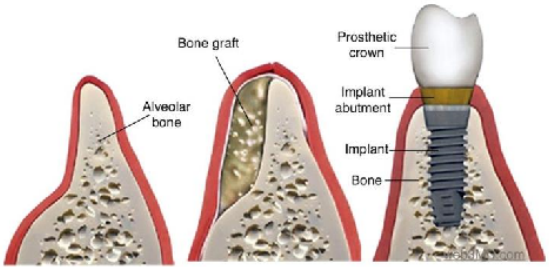
4- Bone quality and quantity: The mandible has a denser cortex and a coarser thicker cancelli than the maxilla. When we go posterior, jaws tend to have a thinner, more porous cortex, and a finer cancelli. Bone regeneration is more likely to progress at a faster rate if the surrounding is denser. It is very frequent to find that bone amount is not enough for implant placement. The following measures can be done to overcome this problem:

- The use of short implants.

- Changing the implant angulations.

- Ridge augmentation.

- Subantral augmentation (sinus lift) in the maxilla.



- Trans positioning of the neurovascular bundle in the mandible.

- Bone synthesis (ossified tissue can be created in predetermined shapes and dimensions).

5- Physical condition of the patient: Nutritional status, aging, diabetes mellitus, blood diseases, corticosteroids therapy and radiation treatment are among many factors which can affect healing.

Team approach

- Some authors believe that the same operator should place and restore the implants. The rationale is that it is more efficient form a patient's point of view. It also allows the practitioner more freedom in changing the predetermined position of the implants at the time of surgery. Because the same individual is responsible for the prosthetic treatment, these changes can be incorporated into the treatment plan more readily.

- Others believe that a team approach is more appropriate to follow. A surgeon should place the implants, and a prosthetic dentist should complete the restoration. Because it allows for the utilization of expertise of the two individuals, there is a built- in second opinion in the approach. Additionally, there is shared responsibility and shared liability. Regardless of the philosophy followed, it is well to delineate the responsibilities at each stage of implant therapy, and it should be clear that **dental implant is a prosthetic technique with a surgical step.**

The prosthodontic should:

1- Perform the initial clinical evaluation.

2- Perform the initial radiographic evaluation.

3- Obtain the diagnostic casts.

4- Obtain the diagnostic wax- up.

5- Determine the location and number of implants and fabricate a surgical template.

6- Select the proper abutment following the implant exposure.

7- Design and fabricate the prosthesis.

8- Provide oral hygiene care and instructions.

9- Ensure recall of the patient to evaluate maintenance and provide care as required.

The oral surgeon responsibilities include:

1- Confirmation of the radiographic evaluation.

2- Confirmation of the physical evaluation.

3- Determination of the location and number of implants within limits set by the prosthetic dentist.

4- Placement of the implants (first stage surgery).

5- Uncovering of the implants (second stage surgery).

6- Confirmation of osseo-integration of the implants.

Components of branemark implant system

I. Implant Fixture/Implant Body: The portion of a dental implant that provides support for the abutment(s) through adaptation upon (eposteal), within (endosteal) or through (transosteal) the bone. The body is that portion of the implant designed to be surgically placed into the bone. It may extend slightly above the crest of the ridge.

II. Healing/Cover Screw: The component of an endosteal dental implant system used to seal, usually on an interim basis, the dental implant body during the healing phase after surgical placement. The purpose of the healing screw is to maintain patency of the internal threaded section for subsequent attachment of the abutment during the second stage surgery.

III. Healing Abutment/Interim Endosteal Dental Implant Abutment: Any dental implant abutment used for a limited time to assist in healing or modification of the adjacent tissues.

After a prescribed healing period that allows a supporting interface to develop, second stage surgery is performed to uncover or expose the implant and attach the transepithelial portion or abutment. This transepithelial portion is termed a second stage permucosal extension, because it extends the implant above the soft tissue and results in the development of a permucosal seal around the implant.

IV. Implant Abutment: The portion of a dental implant that serves to support and/or retain any prosthesis. Three main categories of implant abutments are described according to the method by which the prosthesis or superstructure is retained to the abutment:

i. Abutment for screw uses a screw to retain the prosthesis or superstructure;
ii. Abutment for cement uses dental cement to retain the prosthesis or superstructure;
iii. Abutment for attachment uses an attachment device to retain the removable prosthesis.

Many manufacturers classify abutments as fixed whenever cement retains the prosthesis and removable when they are screw retained. Each of the three types of abutments is further classified into straight and angled abutments, describing the axial relationship between the implant body and abutment.

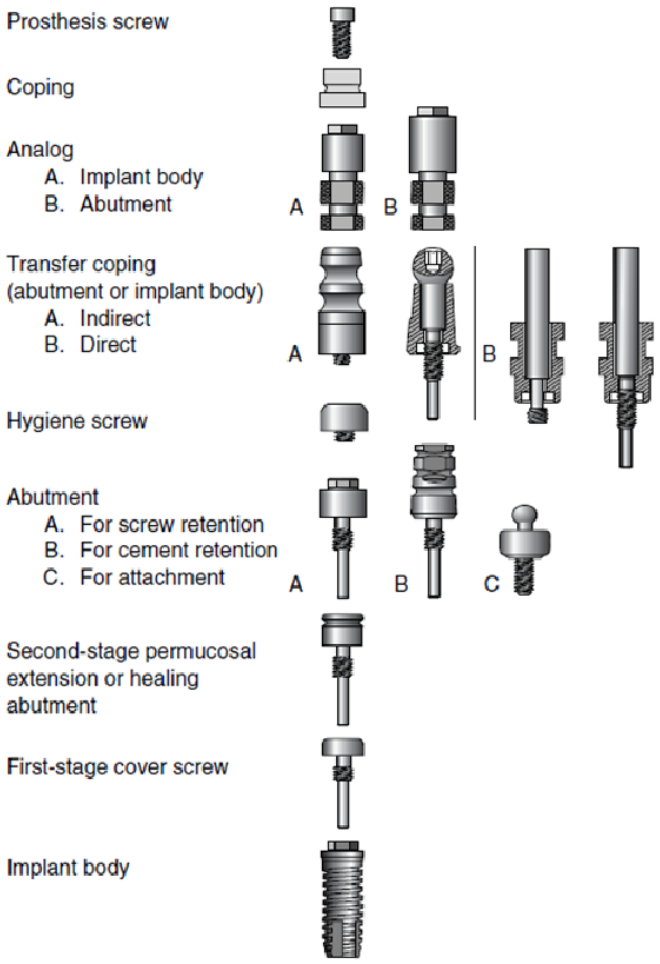
V. Hygiene Screw: It is placed over the abutment between prosthetic appointments to prevent debris and calculus from entering the internally threaded portion of the implant.

VI. Transfer Coping/Impression Coping: Any device that registers the position of the dental implant body or dental implant abutment relative to adjacent structures.

VII. Implant Analog: An analog is something that is analogous or similar to something else. Implant analog is used in the fabrication of the master cast to replicate the retentive portion of the implant body or abutment. After the master impression is secured the corresponding analog (implant body, abutment for screw or other portion) is attached to the transfer coping and the assembly is poured in stone to fabricate the master cast.

VIII. Coping/Gold Cylinder: It is a thin covering usually designed to fit the implant abutment and serve as the connection between the abutment and the prosthesis or superstructure. A prefabricated coping usually is a plastic pattern cast into the metal superstructure or prosthesis.

IX. Coping Screw: The screw retained prosthesis or superstructure is secured to the implant body or abutment with a coping screw.



Indications of dental implant

1. The single edentulous area with healthy adjacent teeth.
2. Partial edentulism with the posterior edentulous tooth region.
3. Complete edentulous patients.
4. Patients who cannot tolerate a removable partial or complete denture.
5. Patients who had high aesthetic demands.
6. Age above 18 years that is after growth is completed.

Contraindication of dental implant

General contraindications Absolute contraindication:

1. Heart diseases (Patient with history of less than 6 months).
2. Active cancer, some bone diseases such as osteomalacia, Paget's disease, osteoporosis.
3. Certain immunologic diseases, patient on immunosuppressive drug, AIDS.
4. Patient who had undergone a recent radiotherapy treatment.
5. Patient on bisphosphonates medication.

Relative contraindications: Diabetes Patients, Pregnancy and Smoking.

Local contraindications:

1. There is insufficient bone to support the implants or bone structure is Inadequate.
2. Important anatomical structures such as the maxillary sinus, the inferior alveolar nerve have an abnormal position that can interfere with the dental implants.
3. Some local diseases of the oral mucosa or alveolar bone can temporarily prevent the placement of dental implants until the conditions are treated.
4. Hypersensitivity or other allergic reactions; rarely occurs.
5. Poor oral hygiene
6. Bruxism or involuntary grinding of the teeth.

Prosthetic options in implant dentistry

In 1989, Misch, proposed have prosthetic options for implant dentistry. There are three options are FPs (FP-1, FP-2, and FP3). These three options may replace partial (one tooth or several) or total dentitions and may be cemented or screw retained.

Two types of final removable implant restorations are RPs (RP-4 and RP-5); they depend on the amount of bone and soft tissue support, not the appearance of the prosthesis.

FP-1: is replaces only the clinical crown; looks like a natural tooth.

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 hyper contoured in the gingival half

FP-3: Replaces missing crowns and gingival color and portion of edentulous site; prosthesis most often uses denture teeth and acrylic gingiva, but may be porcelain to metal, or zirconia.

RP-4: Removable prosthesis; over denture that is completely implant supported, no soft tissue support.

RP-5: Removable prosthesis; over denture supported by both soft tissue (primary) and implant (secondary).

Treatment plans related to key implant positions and implant number

The position of dental implants within the arch is crucial to longterm success. Some implant positions are more critical than others in regard to force reduction. For a fixed prosthesis, four general guidelines have been postulated to assist the clinician in treatment planning:

1. Cantilevers on the prosthesis should be reduced and preferably eliminated (especially in the maxilla); therefore the terminal abutments in the prosthesis are key positions.

2. More than three adjacent pontics should not be designed in the prosthesis.

3. Canine and first molar sites are key positions, especially when adjacent teeth are missing.

4. The arch is divided into five segments. When more than one segment of an arch is being replaced, a key implant position is at least one implant in each segment.

* An arch may be considered as an open pentagon: the two premolar and molar sites, the two canine sites, and the central and lateral incisors represent the five sides.

Implant Number

In the past an edentulous arch used six implants to support a fixed prosthesis in abundant bone situations and four implants to support a complete full arch prosthesis when minimal bone volumes were present.

However, this treatment option does not consider the force magnifiers of crown or height space, or the A-P distance (A-P spread) of the implants in relation to the bilateral posterior cantilevers replacing the posterior teeth.

Usually a completely edentulous arch is supported by a 12-unit fixed prosthesis, extending from first molar to first molar. Rarely are second molars replaced in the prosthesis, unless the opposing arch has a second molar present. In this scenario the position of the implants cannot follow the four key implant position rules, and include either four pontics between the anterior implants or three pontics cantilevered from the most distal implants. In addition, the number of implants in a treatment plan should rarely use a minimum number. There is no safety factor if an implant fails.

The decision on the number of implants in the treatment plan begins with the implants in the ideal key positions. Additional numbers are most often required and are primarily related to the patient force factors and to bone density in the edentulous sites.

As a general observation the number of implants to replace all of the **mandibular** teeth ranges from five to nine, with at least four between the mental foramina. When fewer than six implants are used, a cantilever must be designed in a fixed prosthesis as a result of the mandibular flexure. Cantilevers in the mandible should ideally be projected in only one posterior quadrant to increase the A-P distance and reduce the force to the implant. When seven or more implants are used, two separate restorations may be fabricated with no posterior cantilever to permit mandibular flexure and torsion.

A greater number of implants are generally required in the **maxilla** to compensate for the less-dense bone and more unfavorable biomechanics of the premaxilla, and range from 7 to 10 implants, with at least 3 implants from canine to canine.

In most situations an implant should be positioned at least 1.5 mm from an adjacent natural tooth and 3 mm from an adjacent implant.

As a general rule, it is better to be on the side of safety in numbers than on the side of too few implants. Therefore when in doubt, add an additional implant to the treatment plan.

Basic sequence of procedures in implants treatment

a. Chief Complaint: The practitioner must determine which is most important for patients, aesthetic, mastication or phonation. This requires careful listening and sufficient time.

b. Physical Evaluation: The medical history normally taken in the modern dental office often is enough for implant patient. It must be kept in mind that there are few contraindications to the use of dental implants. Proper evaluation should be made whether the patient can tolerate the planned procedures or not consultation with the surgeon at this point may be necessary to arrive at proper evaluation in- patients with complicated medical history. The physical ability or limitations of the patient also play a part in the design of the prosthesis, the selection of the final restoration.

c. Psychological Evaluation: One must realize that. For many patients, the perception of what constitutes implant therapy has been formed from information provided by friends, publications, and other mass media. This is not necessarily all negative, because it results in the patient seeking implant therapy. Many times, however, the patient cannot properly evaluate the information, and limitations of therapy are not clearly understood therefore, it is necessary to educate the patient concerning the necessity of specific procedures for the case.

d. Dental Evaluation: In addition to the usual dental evaluation,

• The prosthodontist must incorporate into this evaluation the possible effects of the conditions present in the oral cavity on implants placed in this environment.

• A history of bruxism, mal-aligned dentition and extruded teeth, which preclude development of harmonious occlusion and a hygienic restoration should alert operator to problems in this area. Patient's commitment to a lifelong maintenance must be evaluated.

e. Bone: The age of the patient and the amount and type of bone available to support the implants must be determined through the following:

1. Radiographs evaluation, the types of radiographs used depend on the number of implants to be placed, the location in the jaws, and the availability of the equipment.

2. Another method, which can be used in determining the amount of bone available, is palpation. This method is particularly useful in the mandible. It is often possible to encircle the mandible completely with forefinger and thumb and obtain an indication of the size and shape of the arch at a particular point.

f. Soft tissue: The soft tissue through which implants exist in the oral cavity is a critical area in terms of long- term success. This is the area that the patient must maintain to ensure gingival health and therefore must be capable of withstanding the hygiene manipulation (brushing and flossing). Fixed keratinized tissue is the preferred tissue in this area. This is the only type of tissue that has ability to form a tight collar around the implant necks. If soft tissue grafting is anticipated, it is probably best done before implant placement.

h. Ridge relationships: The relationship of the maxilla to the mandible plays an important role in determining the type of prosthesis that can be done and is a deciding factor in the type of occlusion that can often be determined by visual examination, the best observation of this relationship is achieved from mounted diagnostic casts.

i. Radiographic evaluation: radiological evaluation for determination of sufficient bone quantity and quality to support the implants must be done. The choice of radiological technique appropriate for a given patient depends on a number of factors, including the type of restoration and implants to be used, the position of the remaining dentition, the extent to which bone quality or quantity is in question, the availability of the machine needed, and the coast. The following radiological techniques are available:

1- Periapical radiographs.

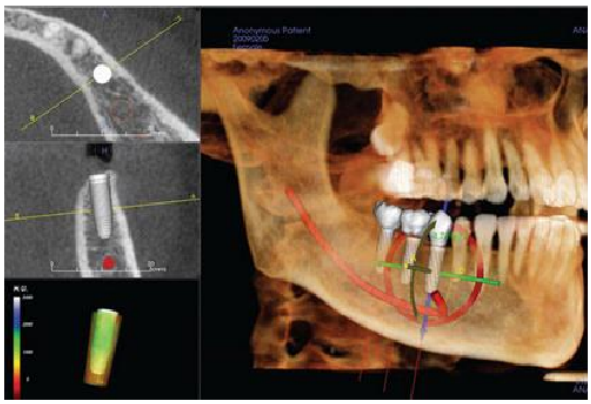
2- Panoramic radiographs.

3- Lateral cephalometric radiographs.

4- Computed Tomography (CT).

5- Cone Beam Computed Tomography CBCT.

6- Magnetic resonance imaging (MRI)



A maker of known size should be placed directly on the mucosa during the exposure, when a periapical or panoramic radiographs was selected as the preferable technique. The aim of placing such marker (metal ball of known diameter) is the determination of actual ridge height because ordinary radiographs do not have one- to one correspondence with regard to size. For example, if the actual diameter of the maker is 5 mm. However, on the panoramic film they measure 6 mm, a 20% magnification occurred. Therefore, if the bone measure above the interior dental canal is measured 22 mm on the film only 18.3 mm is actually available.

Radiographic Stent

A diagnostic template incorporating stainless steel balls is used for treatment planning of the implant position. The actual diameter and position of the stainless steel balls in the template relative to the diameter and the position measured on the radiograph help determine distortion of size and position as seen on the radiographs.

In the maxilla the vertical bone between the floor of maxillary sinus-alveolar crest and nasal floor-alveolar crest is evaluated. In mandible distance from inferior dental canal or mental foramen is evaluated.

Surgical Template

As mentioned in radiographic splint, surgical template can be fabricated by duplicating the existing denture or a newly fabricated prosthesis. Once the position of the implants is determined by palpation clinical, radiographic and diagnostic cast examination, the surgical stent is fabricated.

There are two main functions for the stent,

1) Guide the operator to the selected places for implant placement

2) To direct the operator drill to a proper direction through which he should drill in bone The surgical stent can be fabricated using a clear heat cured or autopolymerized acrylic resin and of approximately 4mm in thickness.

First Stage Surgery: the placement of Branemark implant.

Second Stage Surgery: The uncovering of the implant is carried out after a healing phase of at least 4 months. The gingival former is screwed onto the implant and flap sutured around.

Impression techniques for implant retained prosthesis

Impression is a negative imprint of an oral structure used to produce a positive replica of the structure for use as a permanent record or in production of a dental restoration or prosthesis.

One of the most important factors for the success of implant prosthesis is the accuracy of the impression procedure, proper impression technique helps in:-

1. To obtain the original position of the implants during the processing of the master cast.

2. Allow the passivity of the frame work casting to the prosthesis-implant connections. The development of impression techniques to accurately record implant position has become more complicated &challenging. Several impression techniques have been suggested to obtain a master cast that will ensure passive fit of the prosthesis on implants.

Classification of impression techniques according to the level of impression into:-

a. Prepared abutment impression:

It is the placement of the abutment directly in the mouth of the patient and taking impression on its preparation in situ.

The impression taking and the preparation of the prosthesis follow the same method used for the abutments of natural teeth.

b. Abutment level impression techniques: For abutment that placed into the implant.

c. Implant level impression techniques: The implant location and angle is recorded with the orientation of internal hex.

Implant level and abutment level impression can be made by following techniques:

1-Open tray technique (The pick-up impression technique) (direct impression)

The tray is different from standard edentulous tray that it has opening to allow access to the guide pins and impression copings or screws. That's why this technique may be called open tray technique.

1. Prepare a primary cast, properly extended alginate impression is useful.

2. Use baseplate wax to provide relief buccal, lingual &distal to the abutments, one layer is enough to relief edentulous area.

3. Sufficient wax relief is achieved by a strip of baseplate wax with 8mm width &6mm height over the area of the abutment fixtures &ridge.

4. Use a suitable custom tray material to adapt it over the prosthesis foundation.

5. While the material is still soft, use a wax knife to cut a window over the occlusal surface of the abutment relief area.

6. Wait for complete polymerization, then finish the tray.

7. In some cases; a suitable &well selected plastic tray may be used after cutting the areas opposite to the implant.

Final impression procedure:

1- Remove the healing abutment or screw or gingival former. The healing cap should be placed either into sterile saline or Corsodyl once it has been unscrewed from the implant using a hand screwdriver during the impression procedure.

2-Inspect the implant prosthetic table for tissue invagination. If tissue is covering the prosthetic table, replace the healing abutment lightly &return to the surgeon or contact the surgeon for guidance.

3- Use suitable coping; ex. Square type.

4-An open tray is usually used in this technique, (a tray with an opening), allowing the coronal ends of the impression coping screw to be exposed. The tray must be checked for extension &passive location.

5-the copings are connected to the implants first intra-orally.

6-radiograph of the connected implant is essential to ensure a proper seating of the impression post. This will also ensure that the practitioner has a baseline recording of the bone health &levels in and around their implant.

7-Insert the implant screw analog &screw it well, these screw must be long enough to extend into the implant passing through the impression post &projected outside the impression tray through the prepared whole in the tray, at least 2mm.

8-To prevent impression escape from the whole, sheet wax is adapted over the posts.

9-An impression is made after loading the tray with the suitable impression material.

10-Insert the tray in the patient mouth &wait till the impression material is set. Then the copings are unscrewed (loosen the screw); when you remove the impression the impression posts will be removed along with the impression.

11-Replace the healing abutment or screw in the patient mouth.

12-The implant analog is aligned to the impression post &connected to the impression copings with the screw (tighten the screw); the impression now contain the impression post &implant analogue secured by the screw; it is ready now to be poured to have the definitive cast. Impression components are intended for single use only.

Advantages:

1. Less chance for errors; more precise.

2. The position of the implants can be duplicated, weather these fixtures are close to each other or scattered in different area in the arch.

Disadvantages:

1. Patient must have adequate vertical opening for the tall impression screws.

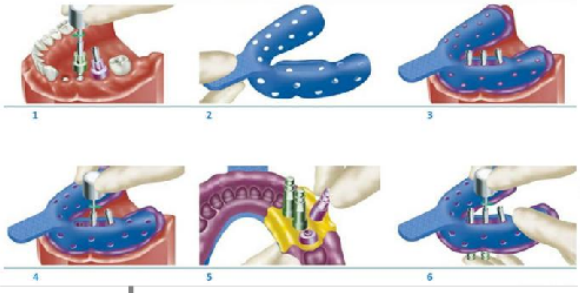
2. It need special preparation &may be adjustment in the tray or using a custom tray; this may add additional time to the impression procedure.

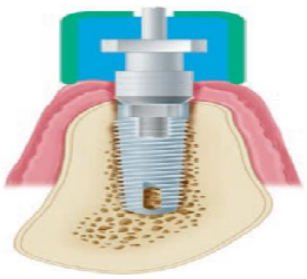
3. Takes time, because the screws must be opened then remove tray with impression posts.

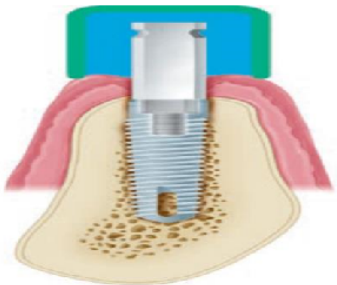
4. Not suitable for uncooperative patient.

5. Once the impression material is "set" it is difficult to quickly remove tray if patient gags.

6. Amount of angulations is critical especially when the implants are of different angulations that may interfere with the seating of the long screws.







2- Closed tray technique (The transfer impression technique) (Indirect impression)

1. A closed tray is used to make the impression, it could be well selected &properly extended stock tray or special one.

2. Remove the healing abutment or gingival former.

3. Inspect the implant prosthetic table for tissue invagination. If tissue is covering the prosthetic table, replace the healing abutment lightly &return to the surgeon or contact the surgeon for guidance.

4. Use tapered copings.

5. The coping is connected to the implants first intra-orally the post must be stable do not rotate or move, secure the components with the screw.

6. Block the screw opening with some wax.

7. Radiograph of connected implant is essential to ensure a proper seating of impression post.

8. An impression is made &separated from the mouth, leaving the copings intra-orally.

9. Loosen the screw &the impression posts are removed &connected to the implant analogs.

10. Replace the healing abutment or screw or the gingival former.

11. Then the impression post analog assemblies are reinserted in the impression before fabricated the definitive cast.

In most cases the copings may not returned to the original position &this was believed to be the primary source of error in the transfer impression technique. This error could be multiplied when the impression is made in situations of multiple implant placement might create some difficulties, or sometimes failure of the prosthesis. To minimize &omit any error in the transfer procedure a snap-on impression cap is used. This cap is plastic seated on the impression post before impression making; upon impression removal the cap will remain attached in impression material. In this way position of posts &analogue will be duplicated.

Advantages:

1. Patient does not need as much of a vertical opening as with an open tray technique.

2. Handing is simple

3. Price: impression tray does not need to be modified.

4. Quick &less time consuming.

Disadvantages:

1. Considered to be less accurate (especially for multiple restorations).

2. With the increased divergent of the posts the impression material might be distorted upon removal.

3. Presence of the wax in the screw head.

Some of modification:

Transferring the implant position from the mouth to the definitive cast is one of the most critical steps in implant prosthodontics.

To achieve passive fit of the prosthesis, some modification occur such as **Splinted technique**

A direct (pick-up) impression technique with splinted copings is the technique of choice, particularly for multiple implants. However, the traditional method of splinting the copings with autopolymerizing acrylic resin is a technique-sensitive and time- consuming procedure.

Transfer coping is splinted using wax or acrylic material with floss or prefabricated metal bars and sticks as framework to support the acrylic.

Splinting of transfer copings prevents rotational movement of impression copings in impression material during analog fastening, which provides better results than not splinting by decrease amount of distortion and to improve impression accuracy and implant stability.

3. **Snap-fit (Press-fit) Plastic Impression Coping**:

- This technique uses press-fit impression coping which is connected to the implant by pressing instead of screwing and the plastic impression copings are picked up in the impression.
- This technique is not a pick-up impression because it does not require an open tray, but instead uses a closed tray.

It is not a transfer impression, either, because the plastic impression copings are picked up in the impressions.

Accuracy of impression

1. Number of implants- impression making for single implants is technically less demanding than multiple implants.

2. Position of implants- parallel implants will limit the distortion in the impression. It was found that direct transfer method provide the most accurate working cast additionally the inaccuracy of the indirect method to nonparallel abutment relationship &deformation of impression material was seen.

3. Impression material- with high accuracy &less dimensional changes, enough working &setting time also good flexure strength are needed. Vinyl polysiloxane is best suited.

4. Type of impression tray- it was found that metal &rigid plastic trays gave greater accuracy of impressions than flexible plastic ones; custom made tray showed good accuracy when it fabricated properly.

5. Clinician training- clinician errors could be attributed to lack of formal training, limited understanding of the techniques involved. ϖ Subsequent technical work may be vary according to the system used, but it is continued by an abutment selection &placement. These abutment is could be adjustable or even preparation can be made to have accurate parallel implants &to manage the angulation &orientation of the occlusal surface.

Transitional prosthesis:

The patient may need transitional prosthesis; this depends on the type of surgical procedure &prosthesis design, this prosthesis may serve to:-

1. Establish phonetic &esthetics at the proper OVD.

2. Help to evaluate the patient's TMJ response to the OVD.

3. May be used as a guide for fabrication of the surgical template.

4. If the existing denture is good, no need for the transitional denture, but it may requires some modifications to ensure the amount of load application.

5. Tissue conditioner may be used in the course of healing with the existing denture.

Even though obtaining absolute fit is practically impossible, minimizing the misfit to prevent possible complications is a generally accepted goal of prosthodontics implant procedures.

Occlusion consideration in dental implant:

In the management of occlusion in dental implant it is essential to consider the adjacent &the opposing dentition. Natural teeth respond to occlusal load in a different way than the implant supported fixed or removable prosthesis. Dental implant differs than the natural tooth by the absence of the periodontal ligament. Naturally this ligament allows for micromovement of the tooth &the tooth can tolerate function load. The osseointegrated implant response to the load depend on the extension &direction of the load.

- Canine guidance, group function used in single tooth implant, fixed PD.
- Lingualized, monoplane occlusion used in denture &overdenture, balanced occlusion is essential to ensure denture stability &preserve supporting structure.

Simple comparison between tooth &implant:

	Healthy tooth	Healthy implant
Gingival sulcus	Shallow in depth	depend on abutment length &restoration
Junctional epithelia	depth On enamel	On titanium
Gingival fiber	Complex array inserted in the cementum above the crestal bone	No organized collagen fibers Attachment
Connective tissue Attachment	Well organized fibers attached to the cementum & alveolar bone	Bone growing in close with the implant surface
Physical Characteristics	Physiological mobility as a Function of the ligament	Rigid connection to the bone as Ankylosis
Adaptive Characteristics	Width of the ligament may alter to allow more mobility with increased functional load	No adaptive capacity
Proprioception	Highly sensitive receptors Present in the ligament	No ligament receptors

Implant protective occlusion

This concept was proposed by Misch and Bidez in 1994 it's also called medial position lingualized occlusion. The feature of this concept are:

1. Usage of implants of greater width whenever possible.
2. Anterior teeth should disclude the posterior teeth.
3. Absence of lateral contacts in excursion.
4. All Occlusal contacts more medial than the natural teeth .
5. A reduced width of the Occlusal table.

Risk factors of Overloading in implant

1. Cantilevers

Cantilevers can increase the possibility of overloading, possibly resulting in peri-implant bone loss and prosthesis failure. In terms of cantilever length, a clinical study demonstrated that long cantilevers (≥ 15 mm) induced more implant-prostheses failures compared to cantilevers < 15 mm long.

2. Parafunctional activity

The etiology of tooth loss is a good way to evaluate the occlusal state of patients. Both the force intensity and parafunctional habits can have a considerable negative effect on the stability of implant components. It has been reported that parafunctional activities and improper occlusal designs are correlated with implant bone loss and failures.

3. Premature contacts

Premature contacts are defined as occlusal contacts that divert the mandible from a normal path of closure, interfere with normal, smooth, gliding mandibular movement, and/or deflect the position of the condyle, teeth, or prosthesis.

Excessive lateral forces from premature occlusal contact can cause excessive marginal bone loss or even osseointegration failure.

4. Bone quality

In human studies, higher rates of implant failure were reported in bone of poor quality Occlusal overload on poor-quality bone can be a crucial factor in implant success and longevity at both the surgical and prosthetic stages.

Consequences of overload in implant

- Early implant failure.
- Early crestal bone loss.
- Intermediate to late implant failure.
- Intermediate to late implant bone loss.
- Screw loosening (abutment and prosthesis coping)
- Uncemented restoration
- Component fracture
- Prosthesis fracture.
- Preiimplant disease (from bone loss).

Occlusion check

1. Maximum intercuspation – contact in the centre Light contact (30 μm)
2. Firm occlusion with shim stock (8-30μm) passing through.
3. Anterior guidance with natural dentition, if possible.
4. No contact on lateral movement – working, non-working.
5. Group function – if no natural tooth for lateral guidance.

* **Occlusal contact positions:-** the ideal primary occlusal contacts must be within the diameter of the implant, within the central fossa. Secondary occlusal contacts should remain within 1mm of the periphery of the implant to decrease moment loads. Marginal ridge contacts should be avoided.

Factors influencing osseous integration:-

1. Biocompatibility of Implant Material

Materials used for fabrication of dental implants can be categorized in two different ways. From a fundamental chemical point of view, dental implants fall into one of the following three primary groups: (a) Metal (b) Ceramics (c) Polymers.

In addition biomaterials can be classified based on the type of biologic response they elicit when implanted and the long-term interaction that develops with the host tissue. Three major types of biodynamic activity are (a) Biotolerant (b) Bioinert (c) Bioactive.

The different levels of biocompatibility emphasize the fact that no material is completely accepted by the biologic environment. To optimize biologic performance, artificial structures should be selected to minimize the negative biologic response while ensuring adequate function.

Metals for implants have been selected based on a number of factors: their biomechanical properties, previous experience with processing, treating, machining, finishing and suitability for common sterilization procedures. Titanium (Ti) and its alloys (mainly Ti6Al- 4V) have become the metals of choice for endosseous parts of currently available implants. Implants made of commercially pure titanium CpTi.

2. Implant Design:

Implant design refers to the 3-dimensional structure of the implant, with all the elements and characteristics that compose it. Endosseous dental implants exist in a wide variety of designs with the main objective in every instance being the long-term success of osseointegrated interface and uncomplicated function of the prosthetic replacement. It has great influence on initial stability and subsequent function.

The main design parameters are:

a. Implant Length: Implants are generally available in lengths from about 6 mm to as much as 20 mm. The most common lengths employed are between 8 and 15 mm, which correspond quite closely to normal root length.

b. Implant Diameter: A minimum diameter of 3.25 mm is required to ensure adequate implant strength. Implant diameter is more important than implant length in the distribution of load to the surrounding bone.

c. Implant Shape: Hollow cylinders, solid cylinders, hollow screws or solid screws are commonly employed shapes, which are designed to maximize the potential area for osseointegration and provide good initial stability. Screw shaped implants also offer good load distribution characteristics in function.

Dental implants are also categorized into

I. Threaded screw implants are threaded into a bone site and have obvious macroscopic retentive elements for initial bone fixation. The fixture with threaded surface has:-

a. Larger surface area and the threads also help to balance the force distribution into the surrounding bone tissue.

b. The threads created in the bone site play an important role in initial implant fixation.

II. Non-threaded, cylindrical or press fit. The press fit implants depend on microscopic retention and or bonding to the bone, and usually are pushed or tapped into a prepared bone site Precision fit of the fixture called primary stability is an essential element for osseointegration, the failure of which leads to soft tissue proliferation between the fixture and bone rather than direct bone interface

3. Implant surface:- The quality of the implant surface influences wound healing at the implantation site and subsequently effect osseointegration.

a. Smooth surface: Wennerberg and Coworkers suggested that smooth be used to describe abutments, whereas the terms minimally rough (0.5 to 1 μm), intermediately rough (1 to 2 μm) and rough (2 to 3 μm) be used for implant surfaces.

b. Rough surface: Plasma spray coating is one of the most common methods for surface modification.

- Plasma spraying.

- Blasting with particles. In this approach, the implant surface is bombarded with particles of aluminium oxide (Al2O3) or titanium oxide (TiO2) and by abrasion; a rough surface is produced with irregular pits and depressions. Roughness depends on particle size, time of blasting, pressure and distance from the source of particles to the implant surface.

- Chemical etching is another process by which surface roughness can be increased. The metallic implant is immersed into an acidic solution, which erodes its surface, creating pits of specific dimensions and shape. Concentration of the acidic solution, time and temperature are factors determining the result of chemical attack and microstructure of the surface.

- Porous sintered surfaces are produced when spherical powders of metallic or ceramic material become a coherent mass with the metallic core of the implant body. Lack of sharp edges is what distinguishes these from rough surfaces. Porous surfaces are characterized by pore size, pore shape, pore volume and pore depth, which is affected by the size of spherical particles, temperature and pressure conditions of the sintering chamber.

4. Prosthetic Interface: It is the level at which the superstructure or the abutment connects to the implant body. It can be either:

♣ **external.** The most common external connection is the hexagonal ("hex") type. The 0.7 mm high, 2.7 mm wide, straight external hex on a 4.1 mm diameter platform is considered the industry's standard. Due to its strength and stability limitations, however, variations in the hex and platform have evolved. The standard external hex allows 4.0° to 6.7° of rotational wobble with 3°-5° of tipping depending on the type of hex. Full seating of abutment over fixture can only be verified by taking additional radiographs. Without intimate contact between the walls of the mating hexes, cyclic loading transmits forces directly to the fixation screw, which may cause it to repeatedly loosen.

♣ **An internal hex** in the implant is designed to prevent rotation of the abutments. Compared to an external hex, an internal hex allows a better protection against rotation of abutments and against gap formation at the implant abutment interface.

♣ **External spline** by Calcitek acknowledges that its 0.4 mm spline connection allows 3° tipping thereby transferring forces to the abutment screw under lateral loading. However the butt joint shoulder of the spline connection can also trap soft tissue during abutment seating. Furthermore the 1.0 mm height of the spline connection can interfere with occlusal clearance and hinder establishment of anatomical contours on angled abutments.

♣ **Non-hexed conical** connection is an ITI implant design which has a conical opening to an internally threaded shaft. Tightening an abutment with a matching conical surface provides lateral stability. It provides no interdigitation to resist rotation, which is of some significance in single tooth restorations. In order to assure contact with the mating conical surface, the abutment cannot be designed to seat on the top surface or 'shoulder' of the implant. This limitation prevents the use of abutments wider than the diameter of the conical opening and leaves the shoulder exposed to support the restoration. Without flush fitting abutments, there is no opportunity to prepare the margins to follow the natural contour of the tissue.

♣ **Non-hexed morse taper** connection.

a. A 1°-2° tapered abutment post frictionally fits into the non-threaded shaft of the implant, which has a matching taper.

b. The body of implant is designed with a series of fins for a press fit insertion procedure.

c. The connection also dictates how abutments are attached and stabilized and the type of emergence profile they can provide. However there are several potential esthetic and hygienic limitations with this connection.

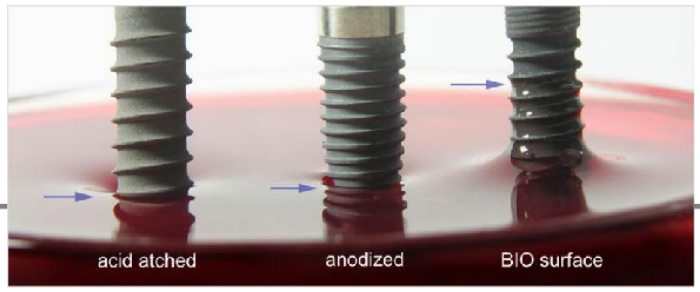
5. Bone Factor: The stability of the implant at the time of placement is very important and is dependent upon bone quantity, quality as well as implants design. Bone is predominantly cortical, may offer good initial stability at implant placement but is more easily damaged by overheating during the drilling process, especially with sites more than 10 mm in depth. Success is highly dependent upon a surgical technique, which avoids heating the bone. Bone should not be heated beyond 43°C, since alkaline phosphate begins to breakdown. Gentle surgical technique with the speed of drilling equipment not to exceed 2000 rpm and copious amount of sterile irrigation with internally irrigated drills should be used.

Factors that compromise bone quality are infection, irradiation and heavy smoking. Their effects results in diminution of the vascular supply to the bone which compromises healing response, a feature that has been well described in the healing of fractures.

6. Loading Conditions: Following installation of an implant it is important that it is not loaded during the early healing phase. Movement of the implant within the bone at this stage results in fibrous tissue encapsulation rather than osseointegration.

This has been compared to the healing of a fracture where stabilization prevents non-union. The Branemark system emphasizes on maintaining the fixtures unloaded for six months in the maxilla and three to four months in the mandible, mainly because of differences in bone quality.

* No loading while healing is the basic guide to osseointegration.



The surgical procedures are divided into two stages:

1) The first stage is the installation of the fixtures into bone, allowing a 3 to 6 month healing period. The mucosa supported interim denture should not be worn for 1 to 2 weeks, which also helps to prevent breakdown of the soft tissue wound. Bone healing begins within first week after insertion of the fixture and reaches a peak at the third or fourth weeks. The initial healing tissues gradually become bony tissue after six to eight weeks. If fixtures are displaced or loaded during this interim healing period, fibrous tissue formation will occur.

2) The second stage is the connection of abutments to fixture. The two stage surgical procedures are very important for successful osseointegration. Following the recommended healing period (3-6 months) abutments are connected to the implant to allow construction of prosthesis.

7. Surgical technique: minimal tissue violence is essential for proper osseointegration. Good cooling, sharp instrument, contamination &gradual implant drilling &surgical skill all affect the success of osseointegration.

8. Initial stability: it is known that where an implant fits tightly into its osteotomy site then osseointegration is more likely to occur. This property is related to the quality of fit of the implant, its shape, & bone morphology &dentistry. Thus screw-shaped implants will be more readily stable than those with little variation in their surface contour. Soft bone with large marrow spaces &sparse cortices provides a less favorable site for primary stability to be achieved.

Criteria for success of implants:

1. Implant remains immobile when tested clinically.

2. No radiolucency in radiograph.

3. Vertical bone loss around implant does not exceed 1.0 mm in the first year of loading, & does not exceed0.2 mm per annum thereafter.

4. No pain or discomfort.

5. No infection or iatrogenic neuropathies.

Causes of failure of implant:

1. Improper force placed on the implant causing damage to the implant &surrounding bone.

2. Bacterial plague due to inadequate hygiene by the patient.

3. Systemic factors e.g. diabetes &smoking.

4. Reduced host resistance.

A failing implant can be defined as one in which the criteria for success are not met. 'Periimplant' inflammation (peri-implantitis) present a similar clinical picture to periodontal inflammation, with bone loss as a key feature. 'perimplantitis' implies accompanying bone loss. The failing implant often presents as a chronic then terminal condition ultimately leading to implant exfoliation.

The stages of implant failure have been suggested to be:

1. Gingival inflammation.

2. Gingival hypertrophy.

3. Progressive deepening of pockets.

4. Progressive attachment loss.

5. Progressive bone loss.

6. Change in microbial microflora.

7. Osseo-integration with mobility &peri- implant radiolucency.

8. Implant exfoliation.

Types of failure of implant:

1. Infection due to improper technique by dentist, &bad oral hygiene by patient.

2. Loose implant due to excessive load.

3. Nerve impairment due to placement of implant upon the nerve resulting in lack of sensation &pain in the area.

4. Poor quality of tooth material using acrylic based teeth is better than porcelain.

Criteria for Success:

The term implant success may be used to describe ideal clinical conditions. It should include a time period of at least 12 months for implant serving an implant as prosthetic abutments. Implant success is suggested for a span of:

- 1-3 years → early implant success
- 3-7 years → intermediate implant success
- More than 7 years → long-term implant success

Implant Quality Scale Group	Clinical Conditions
I. Success (optimum health)	a) No pain or tenderness upon function b) 0 mobility c) <2 mm radiographic bone loss from initial surgery d) No exudates history
II. Satisfactory survival	a) No pain on function b) 0 mobility c) 2–4 mm radiographic bone loss d) No exudates history
III. Compromised survival	a) May have sensitivity on function b) No mobility c) Radiographic bone loss > 4 mm (less than 1/2 of implant body) d) Probing depth > 7 mm e) May have exudates history
IV. Failure (clinical or absolute failure) → any of the following	a) Pain on function b) Mobility c) Radiographic bone loss > 1/2 length of implant d) Uncontrolled exudate e) No longer in mouth