Dental Implants

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- Osseointegration
- Classification of dental implants
- Implant components
- Treatment planning
- Surgical procedure
- Impression techniques
- Complications

Definition

- 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.
  - Glossary of Prosthodontic Terms-9

OSSEOINTEGRATION

- A Swedish orthopedic surgeon, Prof Branemark, in 1952 accidentally discovered **osseointegration.**
- When pure Ti comes in contact with the living bone tissue the two literally grow together to form a permanent biological adhesion.
- Functional ankylosis- also called

Factors for successful osseointegration.

- Biocompatible material- Ti, either commercially pure or in certain alloys.
- Prrimary implant stability- it should be precisely adapted to the prepared bony site
- Atraumatic surgery to minimize tissue damage
- An immobile, undisturbed healing phase.

Titanium

- Biocompatibility is due to its surface oxide
- When exposed to air it forms a dense 4-nm layer of Titanium dioxide TiO_2 - chemically stable and very corrosion-resistant.
- 4 grades of commercially pure titanium-differing with percentage of trace impurities in the metal.The greater the contaminants the harder the metal.
- Grade 4 cpTi - commonly used for dental implants.

- Grade 5 -Titanium alloy- Ti6Al4V.Offers equal biocompatibility but better tensile strength and fracture resistance than cpTi.

- **Zirconia-** similar in biocompatibility, improved cosmetics, fracture resistance lower,can be used as only one piece.

Steps of osseointegration

- Woven bone is quickly formed in the gap between the implant and the bone.It has low biomechanical capacity,- the occlusal load should be controlled

- After 1 to 2 months, under the effect of load, the woven bone will slowly transform into lamellar bone

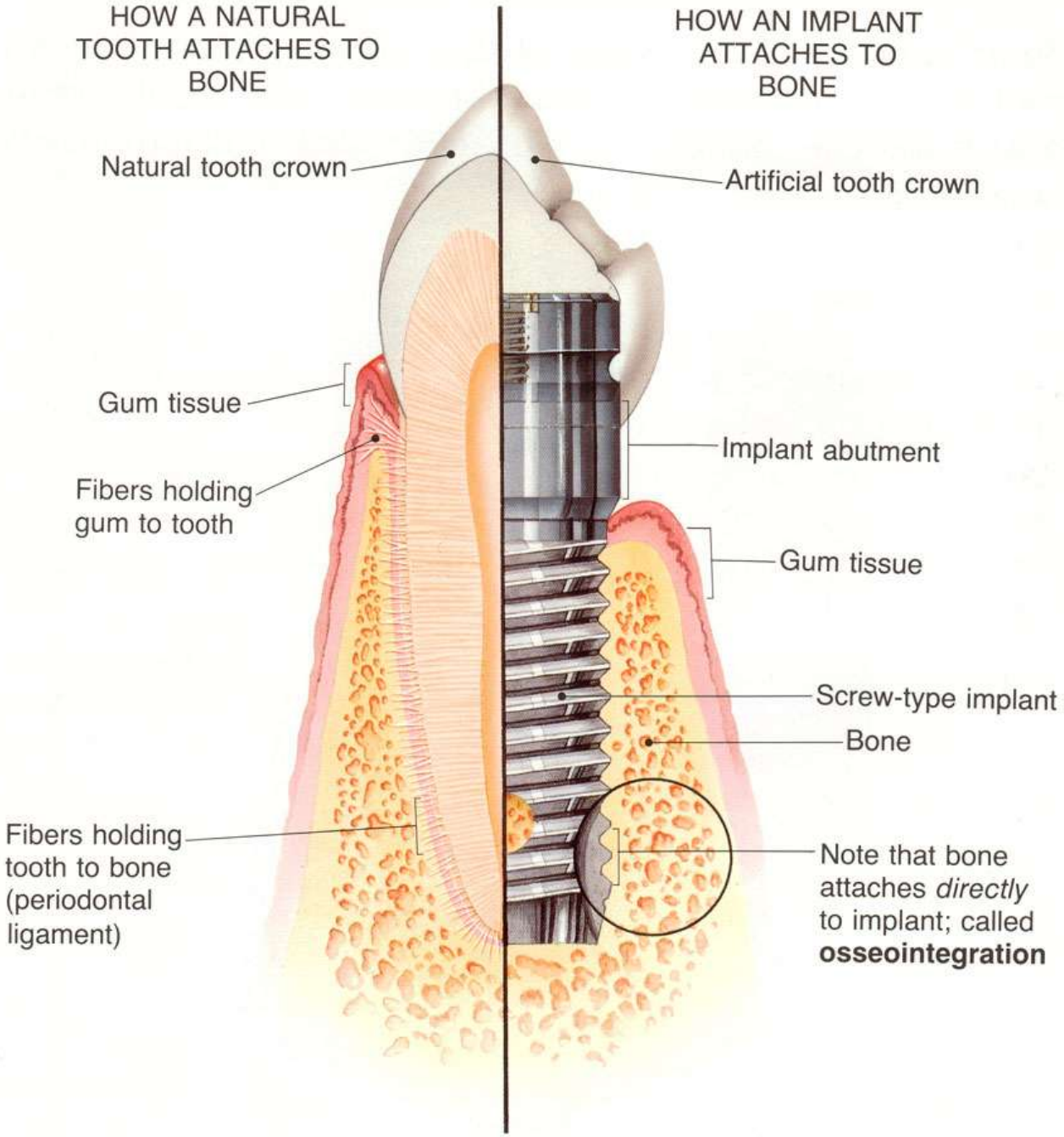
IMPLANT TISSUE INTERFACE

- **Implant and bone interface**- The glycoprotein layer on the bone is adsorbed on the implant surface with the help of adhesive macromolecules like Fibronectin, Laminin.

- They are bonded to the metallic oxide layer on the Ti by covalent bonds, ionic bonds or van-der-walls bonding.

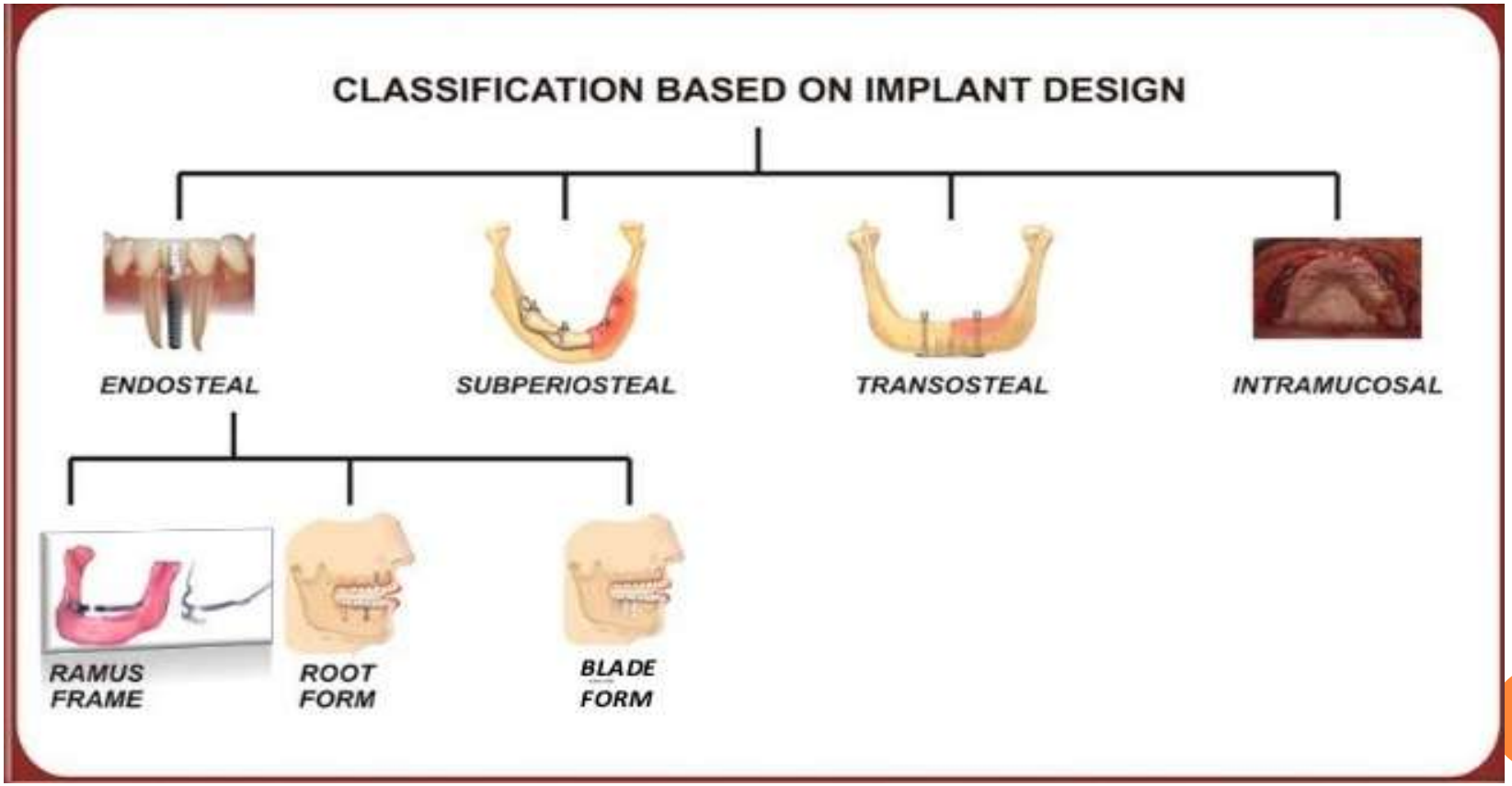
- **Implant connective tissue interface**- gingival fibers forms the attachement , is strong enough to withstand the occlusal forces and microbial invasions.

- **Implant epithelial interface-**Epithelium is attached to implant surface through hemidesomosomes and glycoproteins and considered as Biologic seal.
- It forms a sulcus depth of 3 to 4 mm.


HOW A NATURAL TOOTH ATTACHES TO BONE
HOW AN IMPLANT ATTACHES TO BONE
Natural tooth crown
Artificial tooth crown
Gum tissue
Implant abutment
Fibers holding gum to tooth
Gum tissue
Screw-type implant
Bone
Fibers holding tooth to bone (periodontal ligament)
Note that bone attaches *directly* to implant; called **osseointegration**

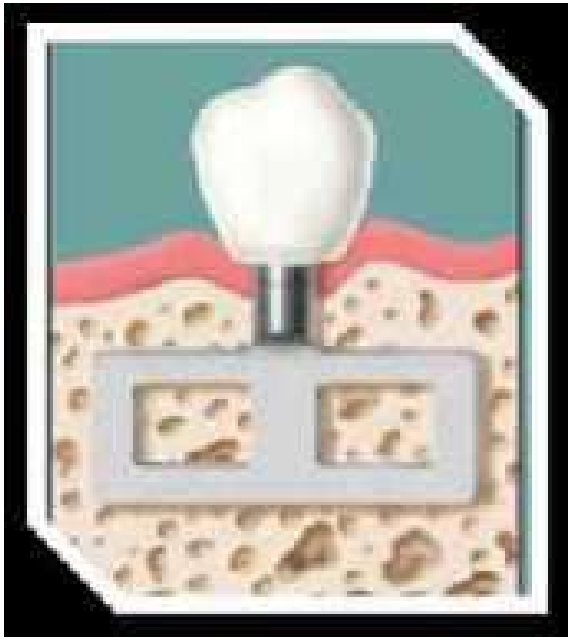
Classification of dental implants

- Based on implant design



Endosteal implants - A device which is placed into the alveolar bone Transect only one cortical plate

- Blade/plate implant-thin plates in the form of blade embedded into the bone



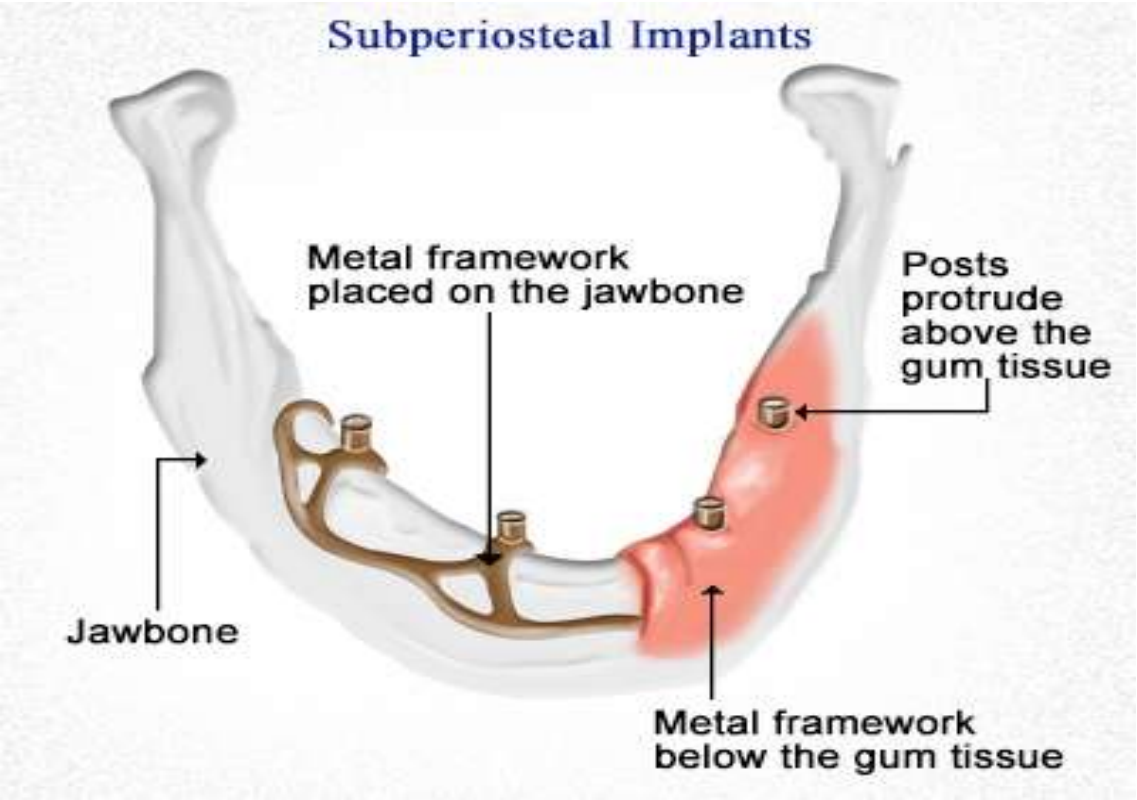
- Ramus frame implant-Horse shoe shaped stainless steel device. Inserted into the mandible from one retromolar pad to the other and passes through the anterior symphysis area

- Root form implant - Designed to mimic the shape of the tooth and for directional load distribution

- Forms:
  - Cylinder
  - Screw root form
  - Combination

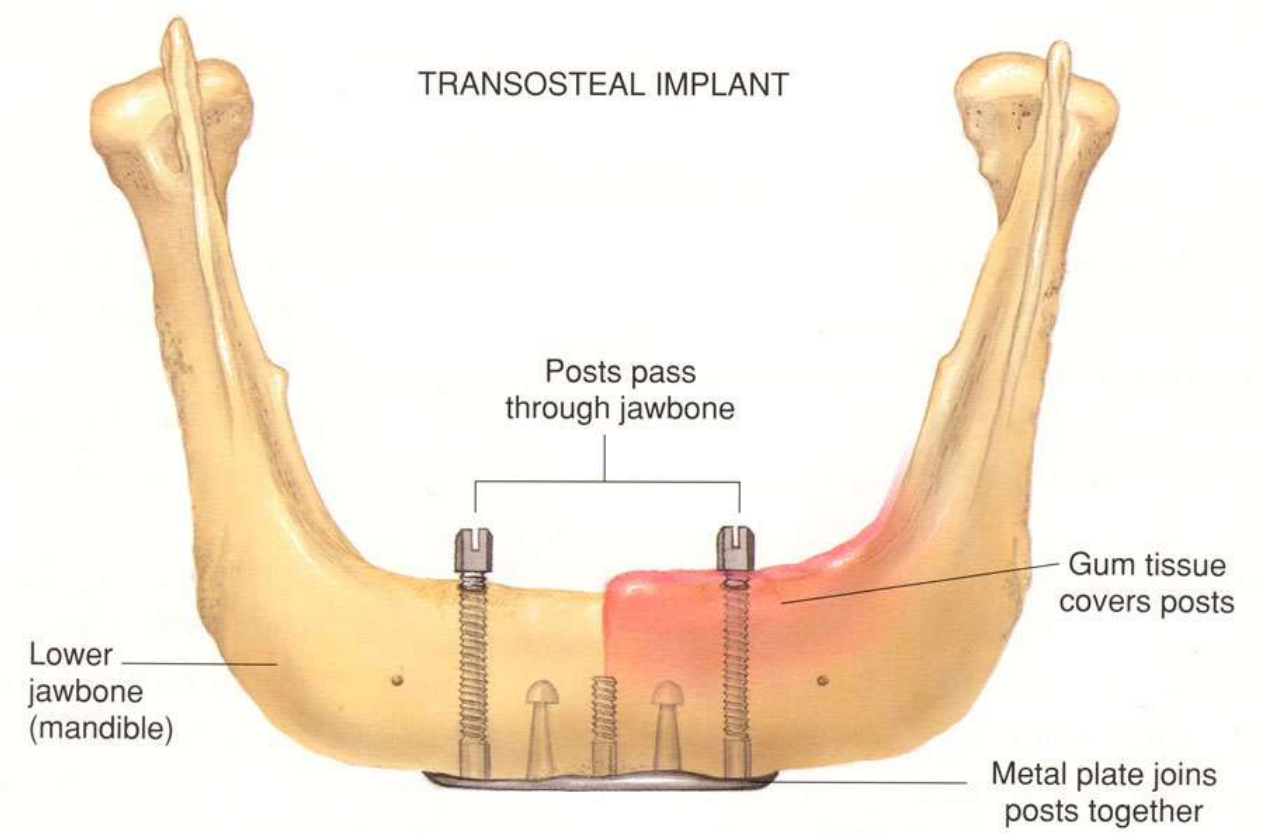
SUBPERIOSTEAL (EPIOSTEAL) IMPLANT

- Placed directly beneath the periosteum overlying the bony cortex,indicated in cases with inadequate bone height for endosteal implants.



- TRANSOSTEAL IMPLANT (Mandibular staple implant)

- Penetrates both cortical plates
- It has subperiosteal and endosteal components.

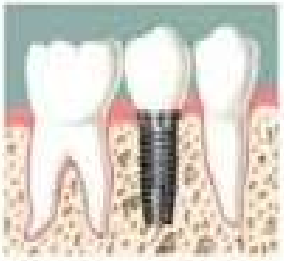


INTRAMUCOSAL IMPLANTS

- Inserted into the oral mucosa. Mucosa is used as attachment site for the metal inserts of removable dentures

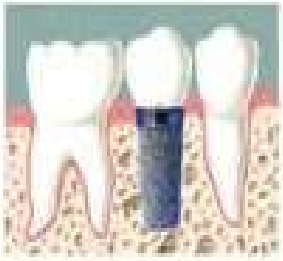
CLASSIFICATION BASED ON MACROSCOPIC BODY DESIGN OF IMPLANT

CYLINDER



THREAD

PLATEAU

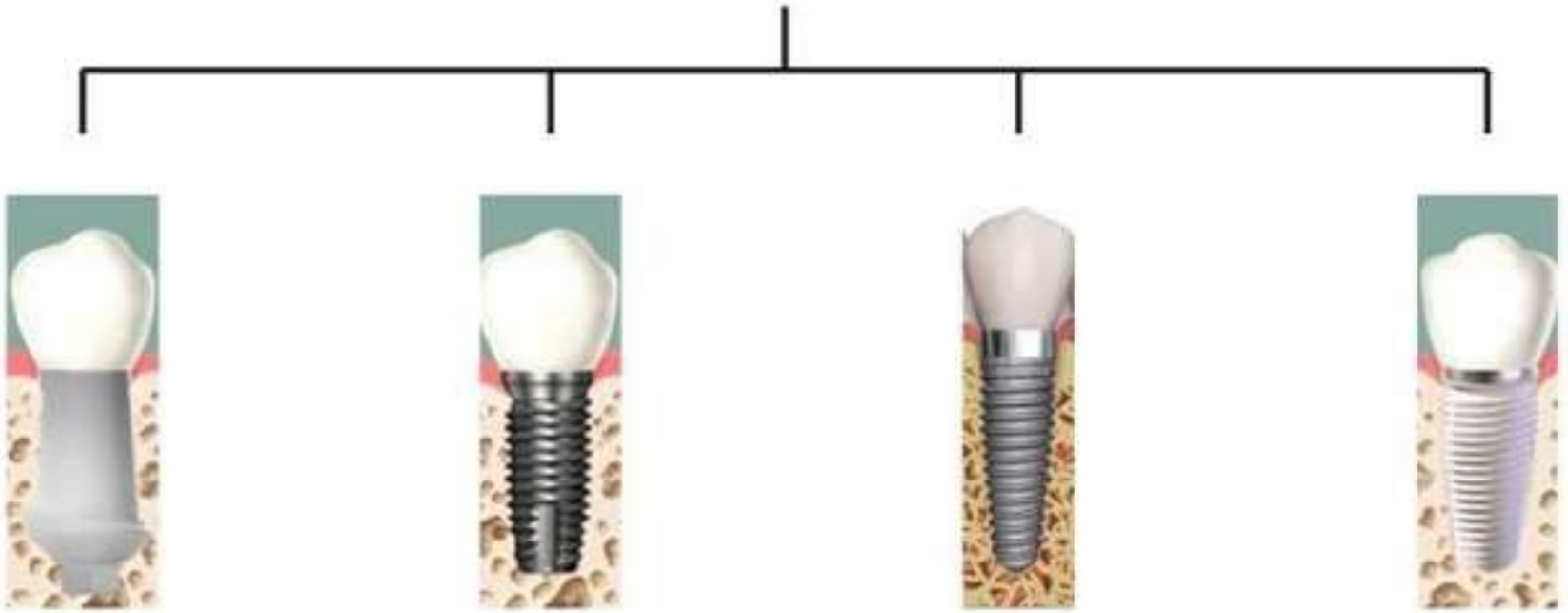


PERFORATED

SOLID

HOLLOW
(or)
VENTED

CLASSIFICATION BASED ON SURFACE OF THE IMPLANT



- **Based on surgical timing**

1. Immediate post-extraction implant.
2. Delayed immediate post-extraction implant. (2 weeks to 3 months after extraction).
3. Late implantation (3 months or more after tooth extraction).

- According to the timing of loading of dental implants

1. Immediate loading procedure.
2. Early loading (1 week to 12 weeks).
3. Delayed loading (over 3 months)

IMPLANT COMPONENTS

1. Implant body
2. Healing screw
3. Healing abutment
4. Impression coping
5. Analogue or Implant Replica
6. Abutment
7. Prosthetic crown

Healing abutment

- It is a temporary part placed on the implant body to create a channel through the mucosa while the adjacent soft tissues heal and results in a perimucosal seal around the implant.

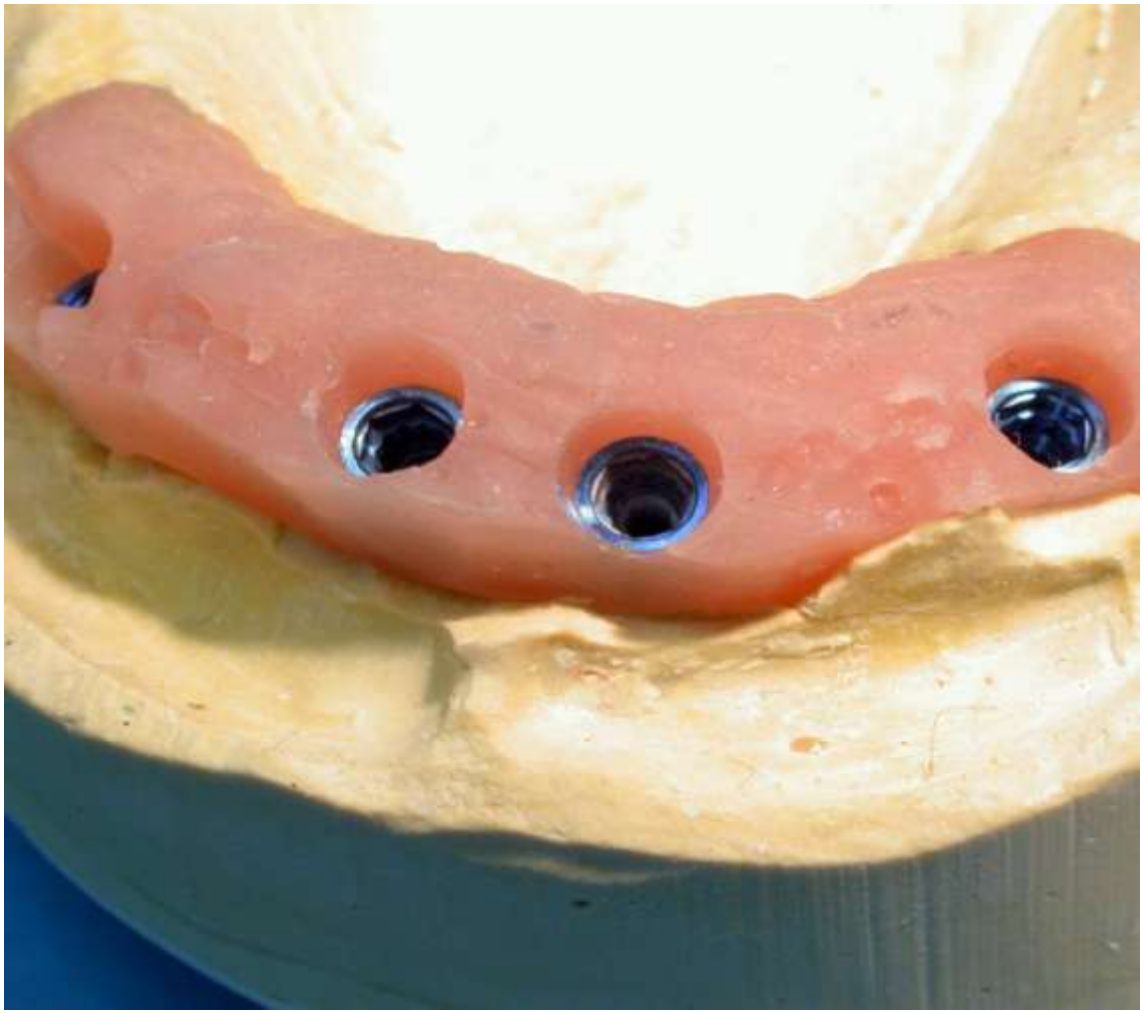
- Also called as permucosal extension or gingival former.

Impression coping (impression cap)

- It is used to transfer the position of the implant body or the abutment to the working cast.
- The dentist screws the impression coping to the real implant body and then takes an impression.
- The impression coping remain fixed in the impression material and lab analogue is added prior to dispatching to the lab.

Analogue or Implant Replica

- Analogues are used by lab technicians to replicate implants and their position in a patient's mouth.
- A model of the patient's dentition is made using an impression.



Analogue provides a replica of the position of the implant from which the technician can place and shape the abutment and build the crown.

Implant abutment

- Intermediate connector between the implant and the restoration, it may extend above the tissue.
- Supports or retains a prosthesis.

- 4 types: cylindrical, shouldered, angled and customizable
- Shouldered designs provide natural-appearing emergence profile

TREATMENT PLANNING

Clinical evaluation

- Medical history
- Current dentoalveolar condition
- Local evaluation of site for implant placement -Alveolar bone height, width, and jaw relationship and prosthetic restorability.
- Intraoral bone mapping - probe through the soft tissue to assess the thickness of the soft tissues and measure the bone dimensions at the proposed surgical site.
- Patient's expectations – Reasonable or not
- Oral hygiene status

Radiographic evaluation

- 2D- periapical, occlusal, panoramic, lateral cephalometric radiographs.
- 3D- CT,Tuned aperture computed tomography, cone-beam CT, MRI

Study model analysis

- To determine

  - Clinical length of the prosthetic crown that will be supported by the implant. (Crown-implant ratio).
  - Inter arch distance.
  - The implant axis- it should be parallel to the axis of adjacent natural teeth.
  - Number and size of implants.

Surgical guides

- Helps to position the implants appropriately from the prosthetic point of view.
- Holes are drilled into the acrylic at appropriate locations with proper axis orientation.

Surgical guided stent

Stereolithography

- From the available CT data a model can be created from a solid block of material by means of a computer guided milling device.
- Advantages:
  - Precise evaluation of the actual osseous condition.
  - Surgical therapy can be precisely planned preoperatively for determination of the most favorable implant axis orientation.
  - Helpful for evaluating the relationship of mandible to maxilla.

FACTORS AFFECTING TREATMENT

Implant position,Number,Size and design depends on

- Implant Prosthesis design- Implant supported denture, over denture or FPD.
- Patient force factors- Para functional habits, masticatory forces, Crown height,Occlusion.
- Bone density

BONE EVALUATION

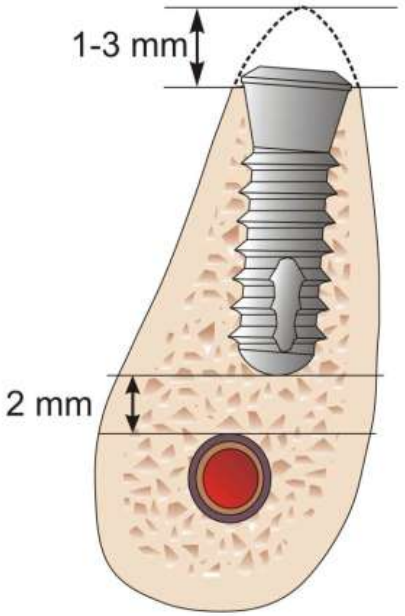
- Bone height - Minimum for long term survival is 10 mm It is 12 mm in the posterior mandible because of nerve proximity.
- Bone width - The minimal width should be 6 to 7 mm.
- Bone length -
  - length refers to mesio distal distance
  - 1.5 mm from adjacent tooth & 3 mm from adjacent implant, Should be 2 mm from adjacent anatomical barrier.
  - So a 5 mm implant requires atleast 8 mm length of the bone

Bone angulation

- Ideally it is aligned with the forces of occlusion & is parallel to the long axis of prosthodontic restoration.
- Premolar region-10°
- 1 st Molar -15°
- 2 nd Molar-20-25°
- For Wider ridge 30° is acceptable

- **Implant size**

- Mand. Incisors and Max. LI=3-3.5mm
- Max. anterior,PM of both arch and Mand.Canine =4 mm.
- For all Molars =5-6mm
- The minimum amount of interocclusal space required for the restorative “stack” of implant is 7 mm.



Crown : Implant

- Most ideal – 1 : 2
- More common – 1 : 1.5
- Minimum requirement – 1 : 1

- As the Crown : Implant increases the number of implants & / or wider implants should be inserted to counteract the increase in stress.

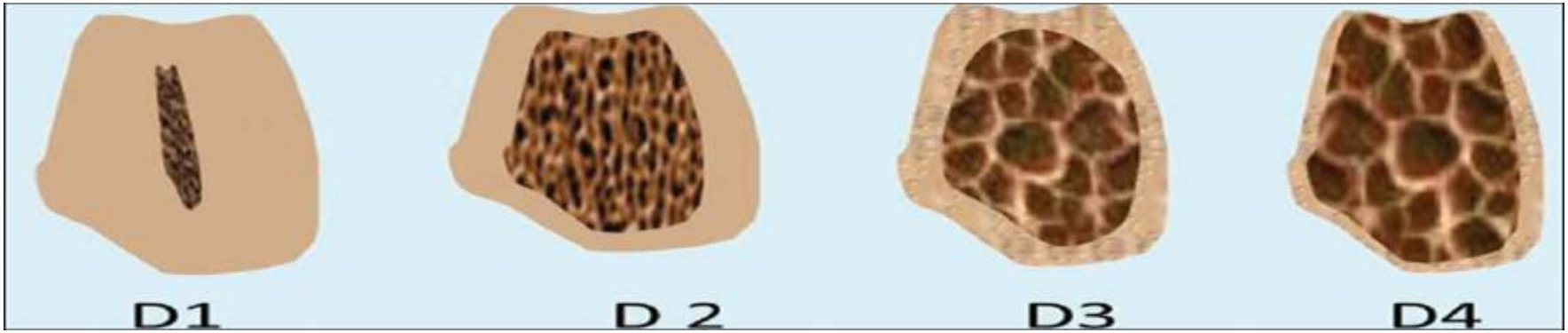
Bone density

- For softer bone, number and diameter of implant must be increased with more and deeper threads.
- Bone density can be assesed by Misch classification on bone density (1988) from C.T using Hounsfield Units or C.T number.
- He classified it in to 4 groups D1 to D4. and D5 is immature bone.
- Higher the CT number, denser is the tissue.
- D1: > 1250 HU; D2: 850 to 1250 HU; D3: 350 to 850 HU; D4: 150 to 350 HU; and D5: < 150 HU.

Misch classification on bone density(1988)

D1	Dense cortical bone	Anterior mandible Posterior mandible
D2	Dense to porous cortical bone surrounding dense trabecular bone	Anterior mandible Posterior mandible Anterior maxilla
D3	Thin porous cortical bone surrounding fine trabecular bone	Anterior maxilla Posterior maxilla
D4	Fine trabecular bone	Posterior maxilla

D5 Immature, nonmineralized bone



Surgical procedure

- Surgery can be done in one stage or in two stage.
- 2 stage surgery-In first stage implants are surgically placed under the gum and the patient is made to wait for 6 months for osseointegration
- 2nd stage surgery is then performed where the healing gingival former is placed and after a week of satisfactory formation of a gingival collar for emergence profile is achieved, impressions are made for implant prosthesis, which may be cemented or screw retained
- one-stage surgery –Implant is placed and left exposed through the gum. In this case, a second stage surgery in not needed

Preoperative care

- Surgical site preparation and isolation
- Preoperative antibiotic prophylaxis - oral dose of 2 g penicillin V 1 hour before
- Local anesthesia

- Incision- Mid crestal incision with a margin of 1.5mm keratinized tissue buccally extending to the sulcus of adjacent teeth
- Flap should be reflected and elevated.

Implant osteotomy

- After the bone is exposed the surgical guide template is positioned.It directs the angulation of the implant.

- A low-speed (1500-2000[rpm]),high-torque handpiece and copious irrigation are necessary to prevent excess thermal injury to the bone

Irrigation :

- keeps the local bone temperature at normal body temperature and also to flush out the bone debris from drill hole.
- NS at room temperature is ideal.

- Various types of physiodispensers are available which can controll speed,torque,and irrigation.

Bone Drilling

- The manufacturers give a guide to the sequence of drill(Sizes) to be used in order to make proper sized drill hole for a particular implant
- The drills are marked for depth to guide the surgeon.

- Drills are used in ascending order of diameter.
- Recommended drilling speed- < 800 rpm

- With the initial drill, the center of the implant recipient site is marked and the initial pilot hole is prepared
- A paralleling pin is placed in the initial preparation to check alignment and angulation .

- If it is appropriate,drill hole is sequentially enlarged to dimensions of the implant.

- After the desired depth and diameter of the recipient site is accomplished, the implant can be placed.

Implant placement

- After final osteotomy, the site is lavaged and aspirated to remove debris and blood.
- For Ti implants, an uncontaminated surface oxide layer is necessary to obtain osseointegration.So touching with gloves, soft tissue or a dissimilar metal should be avoided.

- The implant is rotated with 30 rpm by low speed high torque hand piece /hand ratchet.
- It should be rigid with no mobility on slight compression

- Post insertion radiograph- to evaluate the position , adjacent vital structure.
- Cover screw is inserted. Flaps are sutured.
- If implant position is not correct,it may be removed and reinserted after several months later.

- **Second stage surgery**

  - In second stage surgery in prefferably a '+' shaped incision is made in the overlying mucosa and the cover screw is exposed and removed with a Hex Driver, and is replaced with a gingival former and is left for 7 to 17 days

  - The gingival former helps in formation of a gingival collar around the future abutment which helps in giving the final prosthesis a more natural appearance.

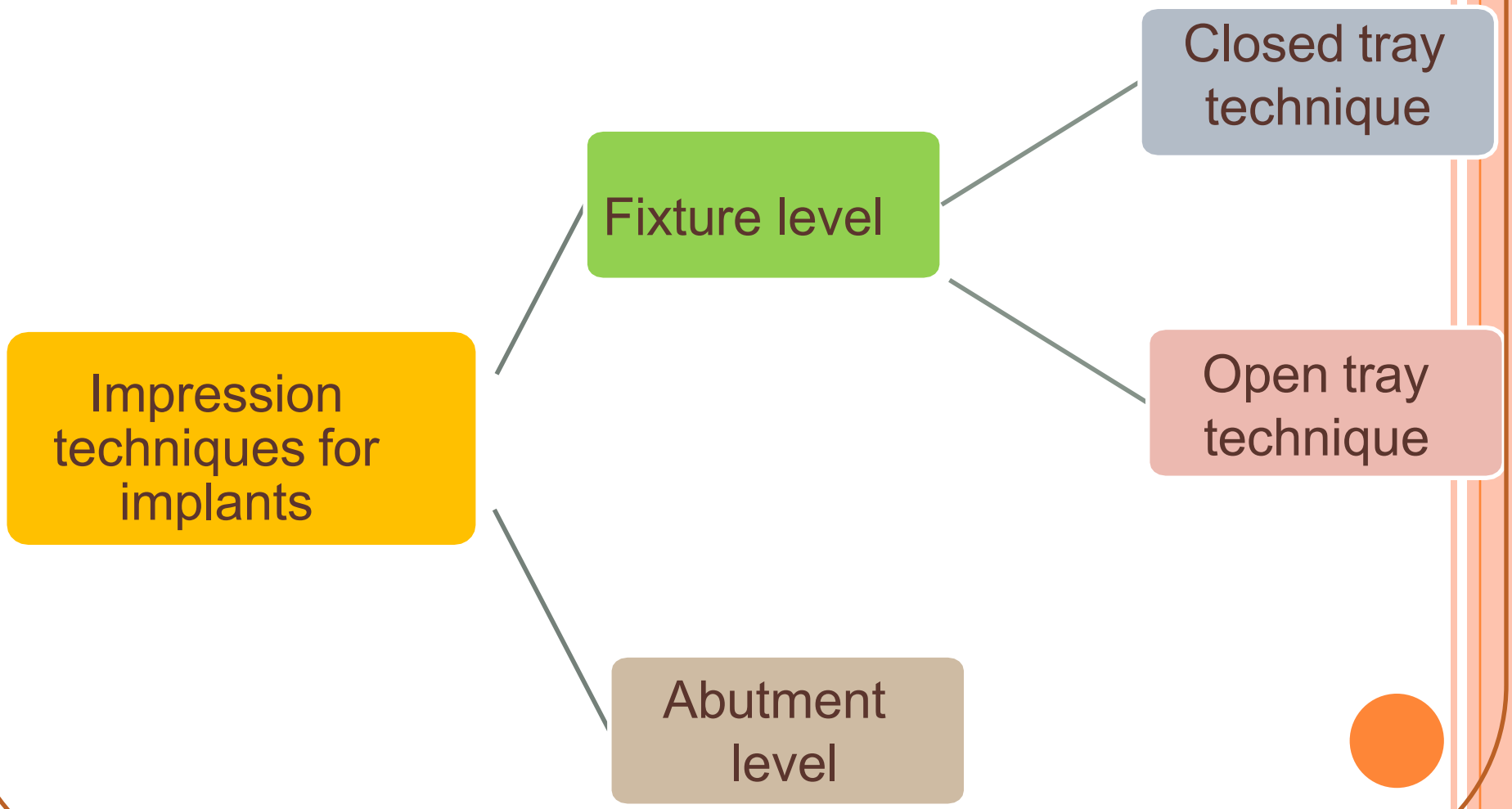
Prosthetic phase

Impression :

- After the healing period,gingival former is removed,impression copings are put onto the implant and impression is taken by open/closed technique.
- The implant analogue is fixed on the impression coping and the impression is poured in die stone.
- Now the analogue is seated in die with same angulation as in bone.
- Once the plaster is set the the coping is removed and abutments are placed over the lab analogue.
- Then the crown is fabricated over the abutment.

- After the fabrication of prosthesis, the abutment is taken off the cast leaving the implant analogue in the cast.
- This abutment can now be transferred and screwed onto the implant and prosthesis affixed to it (either screwed or cemented to the abutment)
- Occlusal adjustments are undertaken if required

Classification of implant impression techniques



ABUTMENT LEVEL IMPRESSION

- Prepared abutment

Fixture / Implant Level Impression

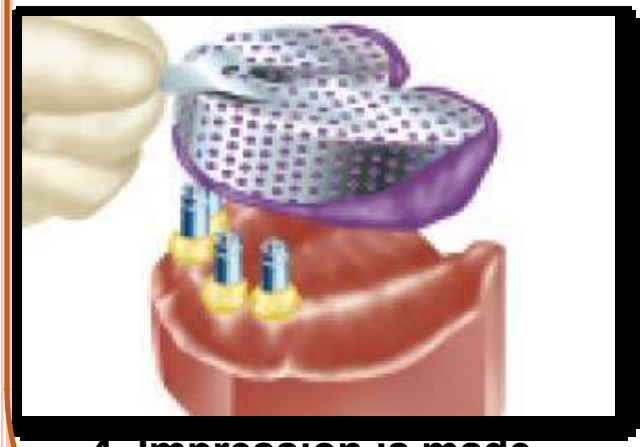
- Impressions are made of an implant using implant level impression copings.
- To create a restoration for an implant, the laboratory model needs to include an implant replica seated in the model replicating the exact implant position in the patient's mouth.
- Such impressions can be made using an open tray or a closed tray technique.

CLOSED TRAY TECHNIQUE

1. Implant fixture

2.Copings attached to the implant body

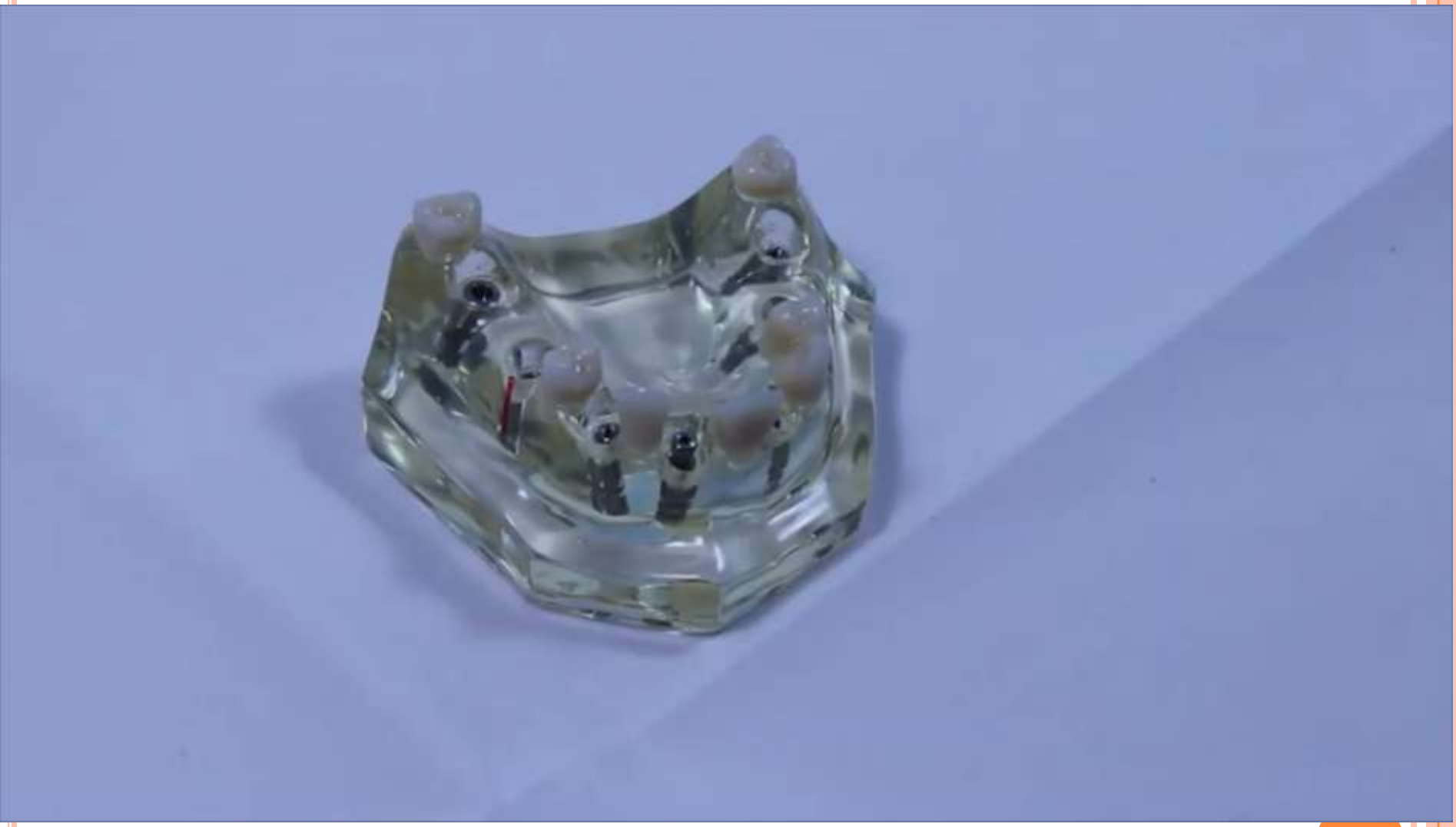
3. Polyvinylsiloxane impression material is injected around the impression coping



4. Impression is made with a heavy body impression material.

5.Impression coping removed from the fixture

6.Coping placed in the impression



Closed Tray Impression Technique

Advantages

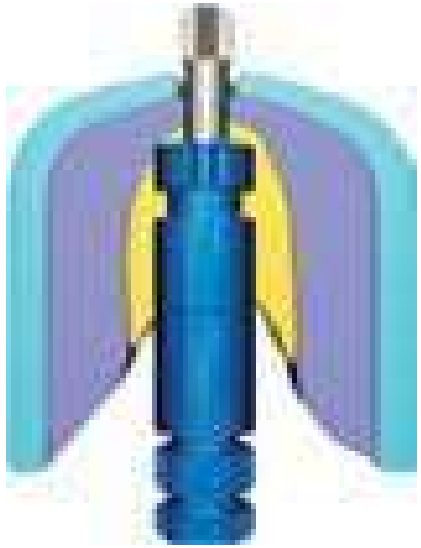
- ✓Easier
- ✓Impression coping for closed tray are usually shorter, making it easier for posterior areas and for patients with **limited mouth opening.**
- ✓Less time for impression preparation: cutting holes in the impression tray usually not needed Impression cap type techniques.

Closed Tray Impression Technique

Disadvantages

- Less accurate with multiple units.
- Some implant systems require more clearance than other implant systems, therefore may still necessitate cutting holes in the impression tray as with the open tray technique, and as a result, may be less accurate depending upon several factors.
- Positional timing error, depending upon the impression coping design.

Open tray – Direct Pick-up Impression Technique



In the Open Tray Transfer technique, the Direct Pick-up Copings remain in the impression when removed from the mouth. For this pick-up technique a custom tray or modified stock tray with screw access holes in the areas above the implants is required.

OPEN TRAY IMPRESSION TECHNIQUE

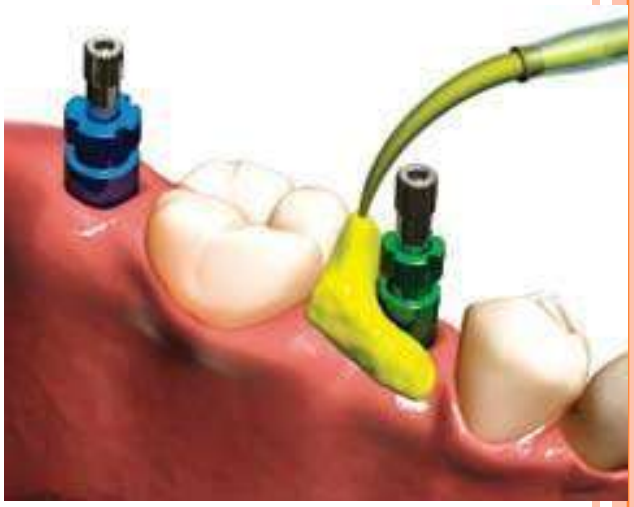
Clinical 1 - Remove healing abutment

Clinical 2 - Place impression coping

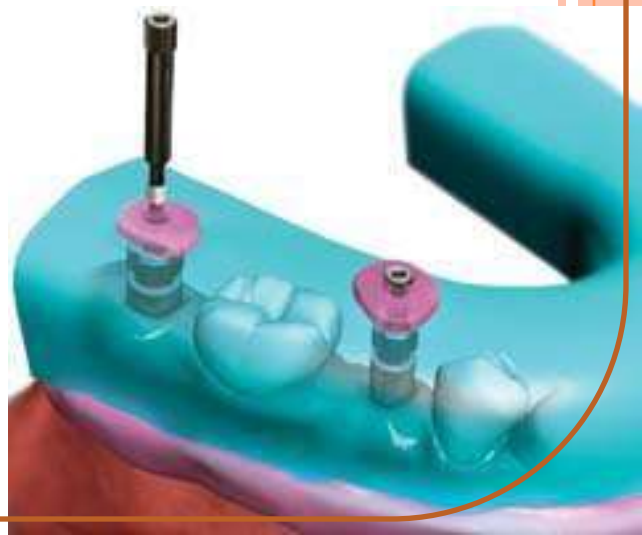
Clinical 3 - Try-in impression tray

Open tray impression technique

Clinical 4 - Make an impression



Clinical 5 - Remove coping screws



Open Tray Impression Technique

Indications

- Usually used for multiple units
- Use non hex (non engaging) impression copings if implants are not in alignment

Advantages

- More accurate for multi units

Open Tray Impression Technique

Disadvantages

- More impression preparation and impression time

  -Test fitting impression copings and cutting holes for the impression copings

  - Additional time to “unlock” the impression copings
- Adequate mouth opening required.
- More possibility for gagging

Complications

- Intraoperative
  - Flap tear
  - Insufficient irrigation
  - Perforation of buccal or lingual cortex
  - Inferior alveolar nerve injury
  - Implant/Drill impinges on adjacent tooth root
  - Perforation of maxillary sinus
  - Perforation of pyriform fossa base
  - Lack of primary stability of implants
  - Fracture of implant

- Immediate postoperative
  - Swelling
  - Nerve injuries
  - Pain(unusual)
  - Haemorrhage(Rare)
- Delayed
  - Infection
  - Secondary Haemorhhage
  - Nerve injury
  - Loosening of implant
  - Implant Exposure

Implant failure

- Mobility of implant during healing period
- Pain , infection
- Radiolucency around implant.
- whatever the cause,the implant should be removed.
- Grafting and reinsertion can be done after 8-10wks.


Thank You