IMPLANTS

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Implants are fixtures or devices inserted into the bone and anchor a tooth or teeth or act as an anchor for an implant supported fixed partial denture. Its concept depends on an Osseo integration between the fixture and the bone without any C.T. in between i.e. direct connection. (the accepted theory)
OSSEointegration

Theories of Implant to tissue integration:

1. **Wiess’ theory of fibro-osseous integration:**
   - Proposed by Dr. Charles Wiess
   - Complete encapsulation of the implant with soft tissues
   - Soft tissue interface could resemble the highly vascular periodontal fibers of natural dentition

2. **Branemark’s theory of osseointegration:**
   - Osseointegration is characterized by direct contact between bone and the surface of a functional implant
   - It has also been achieved by the use of bioactive materials that stimulate formation of bone
Implant engage the superior cortical and the inferior cortical bone
There are three types of implants: Subperiosteal, Transosteal, Endosteal.

The first two are used to angular shaped implant for completely edentulous patients.

Endosteal implants are further divided into – plate form (blade). Wedge shaped or rectangular shaped implants

The plate implants are inserted into a precise slot within the bone and subjected to immediate loading, its length is 15-30 mm, height 8-15 mm, and depth 2-5 mm.

Root form (cylindrical) its length 8-20 mm and diameter 2-6 mm, it has a several designs taper, cylindrical,
Trans-osteal and Subperiosteal
Plate form, Root form implants
Implants could be classified into one-stage implant, in which the implant is inserted into the bone and projected into the oral cavity, and the implant is immediately loaded or shortly after insertion by a provisional restoration in a period not more than two weeks after implant placement.

The bone quality and quantity must be of favorable condition, and the patient must be of good health and the occlusion also is normal.
Two stage implant, in this case, the implant is inserted into the bone and the flap is sutured, and after three to five months, until Osseo-integration is completed, the flap is reflected and the fixture is exposed intra-orally and the abutment is then tightened to it.

In mandible, this takes 3-5 months while in maxilla it takes more time according to the bone quality.
The most common implant related complications are biomechanical problems that occur after implant is loaded.

Thus the overall treatment plan should:

1. Assess the greatest force factors in the system
2. Establish mechanisms to protect the overall implant-bone prosthetic system

**Box 4-1 Stress Treatment Theorem: Biological versus Biomechanical**

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<th>Biological</th>
<th>Biomechanical</th>
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**Prosthetic Complications: Mechanics**

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<th>Biological</th>
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<td>Implant body fracture</td>
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<tr>
<td>Framework fracture</td>
<td>Opposing prosthesis fracture</td>
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X-ray films of implants
Advantages of two stages implants:

- Increased rate of success.
- Adapted to all most all patients conditions.
- In office procedure. correction of implant failure is possible.
- Precise implant site preparation.
- Multiple restorative options.
- Versatility of second stage components: - angle correction, esthetics correction, choosing the right crown contour ,selecting cemented or screw type abutments.
- Retrievability in the event of prosthetic failure.
Indications of implants

- Inability to wear a removable partial denture.
- Long span edentulous ridge with questionable prognosis.
- Unfavorable number and location of potential natural teeth.
- Single tooth replacement in case of undamaged neighboring abutments.
Destructed bone replaced by acrylic denture base
Contra-indications

- Acute illness.
- Terminal illness.
- Uncontrolled diabetes.
- Tumor or large cystic lesion causing bone resorption.
- Improper patient motivation.
- Lack of operator experience.
- Inability to restore with a suitable prosthesis.
Treatment planning

1- Clinical examination:*soft tissue is examined to detect any flabby tissue that should be corrected before insertion of implant, soft tissue inflammation or ulceration, swelling, granuloma, any pathological lesions should be corrected first.

Hard tissues like bones should be detected and corrected. (sharp ridge, destructed ridge, resorbed ridge)
TREATMENT PLANNING FOR IMPLANT DENTISTRY

Carl E. Misch developed a treatment plan sequence to decrease the risk of biomechanical overload, consisting of the following:

1. Prosthesis Design
2. Patient force factors
3. Bone density in edentulous sites
4. Key implant position and number
5. Implant size
6. Available bone in the edentulous sites
7. Implant design
PROSTHETIC OPTIONS IN IMPLANT DENTISTRY

• According to stress treatment theorem by Misch, the final restoration is planned, similar to the architect designing a building before making the foundation.

• Only after this the abutments necessary to support the specific predetermined restoration can be designed.

• An axiom for implant treatment is to provide the most predictable and cost-effective treatment that will satisfy the patient’s anatomical need sand personal desires.

Box 5-2: Advantages of Fixed Restorations in the Partially Edentulous Patient

1. Psychological (feels more like natural teeth)
2. Less food entrapment
3. Less maintenance (no attachments to change or adjust)
4. Longevity (lasts the life of the implants)
5. Similar overhead cost as completely implant-supported overdentures.
Box 5-1 Advantages of Removable Implant-Supported Prostheses in the Completely Edentulous Patient

- Facial esthetics can be enhanced with labial flanges and denture teeth compared with customized metal or porcelain teeth. The labial contours of the removable restoration can replace lost bone width and height and support the labial soft tissues without hygienic compromise.
- The prosthesis can be removed at night to manage nocturnal parafunction.
- Fewer implants may be required.
- Less bone augmentation may be necessary before implant insertion.
- Shorter treatment if no bone augmentation is required.
- The treatment may be less expensive for the patient.
- Long-term treatment of complications is facilitated.
- Daily home care is easier.
Surgical stent with labial surface of lateral incisor to guide the insertion of the implant
Bone grafting

Soft tissue graft
Radiographic examination

- Panoramic radiographs: to trace vital structures e.g. maxillary sinus.
- Cephalometric radiograph to detect bone depth.
- C.T. scan to trace maxillary sinus and inferior alveolar nerve, and canal, foramina.
- Periapical radiographs to evaluate areas of placements.
Data from CT scan can provide information on the available volume of the jaw at sites selected for possible implantation. The intended position of the dental arch will assist in assessing the suitability of these sites.
Diagnostic casts mounted on an articulator to determine the inter occlusal distance and the width and dimensions of the edentulous span.

Bone sound, bone examination: under anesthesia the sound of bone is examined and the thickness of the soft tissue is measured using a puncturing needle.
Piercing of needle to detect thickness

Thickness of soft tissue
Implant must be confined within the bone away from the vital structures, ideally 10mm of vertical bone and 6mm of horizontal bone should be available for implant placement, this will leave 1mm of bone lingually and 0.5mm buccally to implant. The distance between implants is 3mm, and between implant and natural tooth is 1mm.
Implants should be placed at least 3 mm apart and 1 mm from adjacent teeth.
Improper positioning of the implant causing crushed inter dental papilla

Proper mesio-distal position
The implants location: - Anterior Maxilla 1mm from nasal cavity and away from midline to be away from incisive foramen.

Posterior Maxilla: 1mm away from floor of the maxillary sinus.

Anterior Mandible: 3mm away from mental foramen.

Posterior Mandible: 2mm away from the superior aspect of inferior dental canal.

If the space is not adequate: short implants are used or sinus lifting repositioning of inferior nerve. Sometimes bone grafting is performed to increase the bone level available for implant.
Location of the implant

1- labio-palatal position

Flat emergence profile
Too far buccal placement causing bad esthetics and violation of buccal plate of bone.
Too far palatal placement of implant requires the use of modified ridge lab crown to preserve the esthetics.
Apico-incisal location

Too far apically

Too far incisally

Ideal position
Delineate the embrasures.

Locate the implant within the contour of the restoration.

Align the implants within the long axis of the restoration.

Identify the level of CEJ or the tooth emergence from the soft tissue.

It's of great importance specially in anterior of maxilla or in posterior area if there is long edentulous span.
Surgical guide template
The vacuum formed surgical template helps in tracing the proper position of the implant.
Components of the implant restoration system

- Implant body. (threaded or serrated or not), formed from titanium or titanium alloys, coated with hydroxy appatite or not coated
- Short wide or long narrow, with anti-rotational feature
2-Sealing screw: screwed over the body of the implant after the first stage, larger than the implant body, prevents the bone from growing over the implant.
Anti rotational feature

External standard hexagon  internal hexagon
Sleeve in the abutment to engage into the internal anti rotation feature
3-healing caps

Dome shaped screws placed after the 2nd stage surgery and before insertion of the prosthesis, to guide gingival healing around it. They project through the soft tissue into the oral cavity.

Either engage into the fixture or onto the abutment.
4- Abutments

These are components of the implant system that will retain the prosthese and screw directly into the fixture or in cemented typ prosthesis they shaped like a prepared tooth and cemented into the implant.

They are of straight sided walls, length 2-10 mm made of titanium, gold or all ceramic material usually of in-ceram either alumina or zirconium types.
In case of non esthetic zone, the abutment should allow for hygienic and in esthetic zone the abutment is selected to allow the retainer to be of sub-gingival margin to create maximum esthetics.

- Angled abutments used to correct the mal aligned implants or divergent abutments.
- Segmented and non segmented abutments which are necessary when soft tissue thickness is less than 2mm.
- All ceramic or esthetic abutments which are made by the CAD-CAM system.
Esthetic abutments
Unique castable long abutment
Screw type abutments are used in case of accessibility and if Retrievability is desired, in case of there are enough inter arch space.

Its great disadvantages are the screw loosening (interlocking device or anti rotational feature) and the screw hole should be covered by suitable restoration that may affect esthetics and be subjected to wear.

Cemented abutments are more easy to use and could be used anywhere in the oral cavity but cement failure and irreversibility in technique are the most annoying problems.
5. Impression post: (Transfer coping)

- These components facilitate transfer of the intra-oral location of the implant or abutment to a similar position on the laboratory model. They may screw into the implant or into the abutment and are customarily subdivided into fixture types and abutment types.

- With the transfer impression post in place, an impression is made intra-orally.
Laboratory analog

Flat side
Laboratory analogue resembling the superior part of the implant
Biomechanical factors in long term success

✔ Occlusion: it must be designed to reduce the damaging force at the implant tooth interface. The occlusal surface must be of flat cusp incline and cusp to fosse relationship, this is to direct the forces in the long accesses of the tooth and to eliminate any lateral destructive forces.

✔ Premature contact or overloading must be prevented, the number of implants must be increased in stress area even so, the molar must be replaced by two implants and not only one wide implant to decrease the torque on the part not supported by the fixture.
Buccal view of custom-cast gold abutment (splinted) on 2 standard 20-degree abutments.

Radiographic view of the restoration.

Occlusal view of the restoration.
Connecting natural tooth to implant

- Combining two systems with a great difference in rigidity (teeth have a mobility on the order of 10 times greater than that of implants) may result in unbalanced load sharing between the supports.

- **Principles of implant-tooth connection:** may be either:
  - One implant sharing the load with a tooth or teeth through rigid connection.
  - Multiple implants supporting a tooth or teeth through stress breaking attachment.
  - Multiple teeth (abutments) incorporated within the long span implant restoration.
Telescopic crown should be used to cover the natural tooth to prevent decay if loosening occur.

Potential problems encountered with connecting natural tooth to implant are:

- Cement failure of natural abutment.
- Break down of osteointegration.
- Screw or abutment loosening.
- Failure of the implant component.
- Intrusion of natural tooth is possible
Solder joint fracture between tooth 37 and implant at 36 with soft tissue irritation.
Intrusion of natural tooth
Shock absorbing elements:

Because there is no movement between the implant and bone, it may be advisable to incorporate a shock absorbing layer to decrease the impact of occlusal forces. This shock absorber could be incorporated in the implant system or in the occlusal surface of the restoration (it is made of acrylic).
Long edentulous span

- The length of the span is very important in flexion of the fixed partial denture. The beam will flex to the cube ($x$) power relative to additional length. A beam flexion is absorbed to a limited degree by the movement of the periodontal ligament apparatus in natural tooth-supported prostheses.

- Overtime, excessive flexion can fatigue and fracture the metal, crack porcelain, or failure of luting agent with loss of retention and/or recurrent caries.
To optimize stress distribution and to allow for better load distribution:

- Increasing the number of dental implants.
- Selecting an implant geometry that has been carefully designed to maximize functional cross sectional area.

The clinical success and longevity of endosteal implant are controlled in a large part by the health of the surrounding crestal region of bone.
Implants in tri pod geometry
Surface area:

The number and size of implants used to support a given prosthesis is directly proportional to the surface area of support. Each slight increase in implant height can improve dramatically the surface area support.

The increased implant length also provides resistant to torque and shear forces. Wide root form implants have a greater area of bone contact than narrow implants (of similar design) resulting in enhanced bone contact areas. Each 0.2 mm increase in implant width may increase the overall surface area approximately 5% to 10%.
The clinical success and longevity of endosteal implant are controlled in a large part by the health of the surrounding crestal region of bone.
The current hypotheses for the cause of early loss of crestal bone have ranged from:

- Reflection of periostium during surgery.
- Preparation of the implant osteotomy.
- Bacterial invasion.
- Wrong Establishment of the biological width.
- Under estimation of Stress factors.
- Inadequate fit or non passive fit.
- Systemic causes, tobacco use, diabetes, radiotherapy
Any bone loss around the implants that exceeds 0.2mm per year cause our concern.

These are factors associated with bone loss:

1- improper shape and size, improper no of implants, bad bone quality and quantity.
2- compromised healing stage, contaminated implant, excessive force on insertion,
3- deficient fit of the abutments and subsequent loss of the prosthesis.
4- Excessive loading, early loading in wrong case selection.
Prosthetic failure
Fracture of implant components usually due to bad design and improper impression technique which leads to improper fit.

Excessive fatigue and wrong design of occlusion.

Connection of implants and natural abutments with rigid connection without shock absorbing element or stress breaking element.

Long span or completely edentulous mandible restored with less than 5 implants.
THANK YOU