DIPLOMA OF PRIMARY CARE DENTISTRY

-RCSI-

PART – 1

CLINICAL SKILLS

PART 1: RESTORATIVE DENTISTRY

BASICS OF IMPLANT DENTISTRY

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- Single or multiple dental implants have become a well-accepted method of replacement of missing teeth and their supporting structures.
- They have the advantage of replacing teeth often using available bone without preparing healthy remaining teeth.
- Implantology in restorative dentistry is based on the principle of **osseointegration**, a direct functional and structural connection between a load-carrying titanium implant with bone, with no intervening connective tissue.

- Implants tend to be used in one of three ways:

1. For fixed restorations which are either:
   - Screw-retained.
   - Cement-retained.
2. To retain a removable prosthesis.
3. For orthodontic anchorage purposes.

Two cement-retained implants to replace both central incisors.

⇒ Why replace missing teeth?

- For adequate functioning and aesthetics, it has been proposed that a minimum of 20 teeth are required.
- **The shortened dental arch (SDA)** concept is advocated by many dentists due to its practicality and cost-effectiveness: this is defined as reduced dentition with missing posterior teeth and remaining intact anterior teeth, premolar to premolar in both arches.
- However, the number of teeth required to have a good quality of life can vary between patients due to their personal beliefs, values, and preferences.
- Teeth also contribute to self-esteem, phonation, and aesthetics.

➢ What is acceptable to one patient may not be acceptable to another and therefore an in-depth consultation involving discussion of the patient's expectations and motives for wanting implant treatment is paramount.

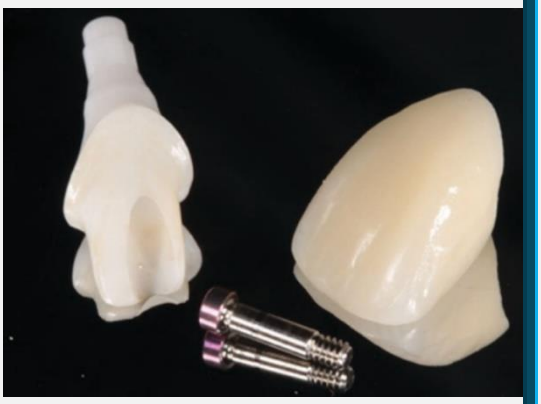
➢ All current implants are based on this now well-accepted concept. Many materials and coatings for implants have been used in the past (ceramics and hydroxyapatite) but success rates have been found to be greatest with titanium fixtures.

➢ As a result, almost all modern implants are titanium. Various shapes, sizes, and designs of implants have been used over the years.

- Nowadays, virtually all designs are of a cylinder-shaped fixture (known as 'root-form' implants) with an external screw-thread to screw the implant into the bone. Internally, the implant has an internal screw thread and some form of internal shape coronally to prevent rotation of the abutment (an internal hex or star shape).

- Modern implants usually have a roughened outer surface to increase the surface area for integration. The surface may be roughened by a subtractive technique such as being grit-blasted (with titanium dioxide) and/or acid-etched.

- Additive techniques can also be used such as coating with hydroxyapatite or a fluoride-modified surface.



Planning for dental implants:

☐ Assessment of suitability for implant placement:

- This is achieved by taking a thorough history, clinical examination of hard and soft tissue availability, periodontal health, dentition, occlusion, available interdental and interocclusal space, and mouth opening ability.
- The volume, quality, and shape of bone are also important considerations when planning implant suitability and placement.
- Radiographic examination with plain films can look at the height of bone and adjacent anatomical structures (tooth roots, ID canal, maxillary antrum, and bony pathology).
- All prosthetic options (no treatment, removable partial denture, fixed bridge, or implant) should be considered and, if appropriate, included in the consent process.

☐ Indications for implants:

- Edentulous or partially edentulous mouths unable to retain dentures.
- Multiple missing teeth.
- Single tooth replacement (providing the space is >6.5mm).
- Maxillofacial or dental prostheses post cancer surgery or trauma.

☐ Relative contraindications for implants:

- Poor plaque control.
- Poor bone quality or soft tissue biotype.
- Smoking.
- Anticoagulation therapy.

- Active chemotherapy.
- Alcohol or drug abuse.
- Radiotherapy to the jaw bones (past or present).
- Diabetes (particularly if poorly controlled).
- Unfavourable smile line.
- Unrealistic patient expectations.
- Oral medicine conditions may compromise healing.
- Cardiac conditions considered high risk for infective endocarditis.
- Chronic kidney disease (healing impairment).
- Immunocompromised (transplant patients, AIDS/HIV).
- Medications predisposing to medication-associated osteonecrosis, such as denosumab or bisphosphonate use (past or present, risk IV > oral).
- Active periodontal disease or history of treated periodontitis (slightly more susceptible to peri-implantitis, implant failure, and peri-implant bone loss).

Planning of implant position:

✓ This uses the ‘top-down’ or ‘prosthetically driven’ approach.
✓ This means deciding on tooth position by first using wax-ups on mounted study models, or digitally.
✓ The wax-up can be used to produce a radiographic stent which is used to help plan the appropriate size and position of the implant.
✓ Further radiographs may be indicated with the stent in position such as a CBCT scan.
✓ CT scanning has the advantage over plain film radiography of allowing a 3-D assessment of the bone volume.
✓ This radiographic stent can often also be converted into a surgical stent to help guide implant placement.

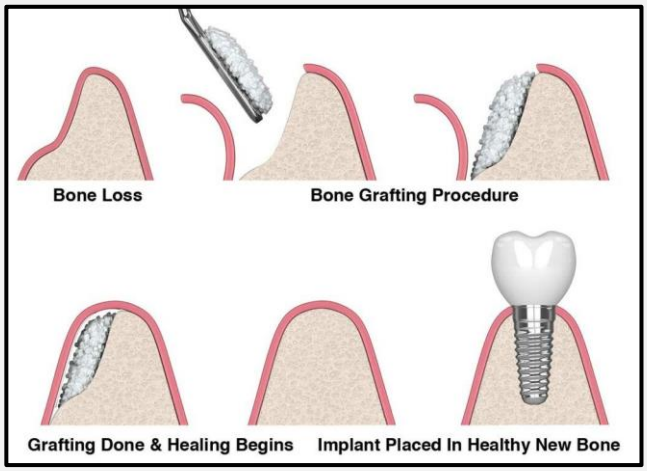
- Digital implant planning systems (SimPlant®) are now available:
  - These allow for 3-D planning and the production of surgical guides.

- Measurements in dental implants:
  - When planning **implants, 1.5mm or more is left between the implant and adjacent teeth**.
  - So, for a single tooth implant the minimum space between adjacent teeth is 7mm for a 4mm diameter fixture; 3mm of space is usually required between adjacent implants.
  - If there is insufficient bone available to allow correct implant positioning, then either bone augmentation is required, or other prosthetic options need to be considered.

- **Bone augmentation:**

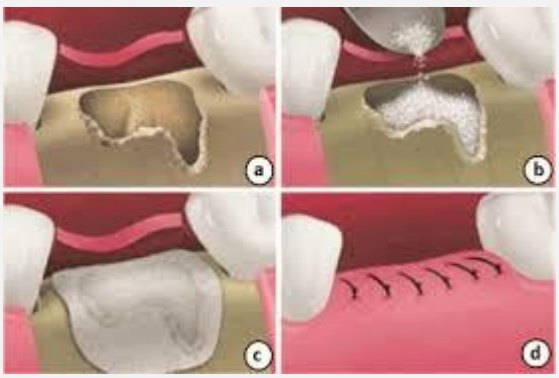
- Bone augmentation may be achieved by a variety of techniques such as guided bone regeneration (GBR), block bone grafting, ridge expansion, sinus elevation, or distraction osteogenesis.
- The materials used may be:

1. Autogenous bone (the patient's own bone, mandible/iliac crest).
2. Allografts (bone from another human, tissue banks).
3. Xenografts (animal-derived bone, e.g. bovine, porcine, or equine origin).
4. Alloplastic materials (inorganic or non-animal derived,hydroxyapatite, calcium sulfate).



⇒ **Barrier membranes** can be used with these materials to exclude soft tissue ingrowth and to support the graft material.

- Bone morphogenetic proteins may be used as bioactive mediators.
- Plasma rich in growth factors (PRGF) produced by the patient's own blood may be applied directly to the implant surface—they are believed to accelerate bone regeneration, improving the osseointegration of titanium dental implants.
- It may be feasible to simultaneously carry out bone augmentation at the time of implant placement if there is sufficient bone to allow 1° stability of the implant fixture and soft tissue closure.
- Alternatively, the bone may need to be augmented prior to implant placement and allowed to heal (for 3–6 months) before the implant can be placed, known as a two-stage approach.
- The later bone augmentation procedures are performed after tooth extraction, the more bone resorption will occur, therefore timing of such procedures should be planned carefully, and implant assessment should take place before extraction of a tooth where possible.



Risks of dental implants:

- ✓ There are risks associated with dental implants as with any surgical procedure—these should be discussed in detail with the patient.
- ✓ Risks include:
  - Pain, swelling, and bruising.
  - Bleeding.
  - Failure to osseointegrate and lack of stability.
  - Peri-implantitis and late failure.
  - Bony necrosis in patients with a history of radiotherapy or bisphosphonate use.
  - Nerve damage.
  - Sinus problems (due to protrusion of implant into sinus).
  - Accidental damage to adjacent teeth and structures.
  - Very rarely, mandible fracture and necrosis of surrounding flap tissue.
  - Infection (including peri-implantitis and peri-implant mucositis).
  - Implant fracture.
  - Gingival recession.
  - Broken, loosened, worn, or discoloured prosthesis.
  - Fracture of abutment screw or implant.

Peri-implant disease due to cement left below the gingival margin.

Implant placement:

⇒ Timing of placement:

- Following extraction of an existing tooth or root, implant placement may be immediate or following a period of healing.
- Timing of implant placement is often categorized as:
  1. Immediate (placement just after tooth extraction).
  2. Immediate-delayed (inserted after weeks up to a couple of months to allow for soft tissue healing).
  3. Delayed (placed thereafter in partially or completely healed bone).

⇒ If implants are placed immediately, less overall surgical time may be required, and post-extraction healing will occur at the same time as osseointegration.

⇒ Bone volumes may also be partially maintained which can improve the aesthetic result.

⇒ However, there can be challenges in achieving 1° stability of the implant and there may be residual dental infection associated with the extracted tooth, with a potential to cause a failure of osseointegration.

⇒ Bone healing and remodelling are also unpredictable.

⇒ Delayed implant placement can mean the overall treatment time is longer but there is time for soft tissue healing and bone healing to occur.

⇒ Not only does this allow for existing infection to clear, it also makes placement, surgical site closure, and achieving 1° stability of the implant more predictable.

⇒ However, excessive healing time following extraction may lead to bone resorption and inadequate natural bone for implant placement.

Techniques for placement:

- The patient must be both dentally and medically fit for surgery.
- Planning should have been completed.
- It is crucial that key anatomical structures are identified by the surgeon prior to and during implant placement to ensure injuries (laceration, section, or compression) are avoided where possible.
- Moderate- to high-risk structures include the inferior alveolar nerve, mental nerve, lingual nerve, and sublingual/submental arteries.
- The surgical procedure is highly equipment dependent and the surgeon needs to be trained in the particular technique and implant system to be used.

- A gingival–mucosal flap is raised and a receiving channel is prepared in the bone, using drills matched to the implant size and type.
- The fixture, depending on the type of implant, is either pressed or screwed into place.

- When placing multiple implants, direction indicators/surgical guides are helpful for achieving parallelism.
- Intraoperative periapical radiographs can be used to further assess the position of the osteotomy site.
- This may be more relevant to smaller spaces where adjacent roots could potentially become damaged.

- In two-stage procedures, the implant has a '**cover screw'** placed and is entirely covered by the flap at the end of the procedure. In a single-stage procedure, a 'healing abutment' is placed on the implant that extents transgingivally—the gingivae are sutured around this, meaning it is visible at the end of the placement appointment.

- In two-stage procedures, the implant head needs to be uncovered (or 'exposed') following a suitable period of integration, during which the cover screw is removed and the healing abutment placed.

➢ **Healing:**

- Osseointegration is a time-dependent healing process.
- Following creation of an intraosseous channel and implant insertion, blood cells enter the space between the implant threads, sitting within a fibrin network that acts as a provisional matrix for erythrocytes, macrophages, and neutrophils.
- The fibrin clot is replaced by collagen-rich granulation tissue.
- The granulation tissue is invaded by osteoblasts, which start to deposit woven bone.
- Over the following weeks to months, lamellar bone and marrow replace the initial woven bone as the bone remodels.
- **Peri-implant mucosa**—soft tissue healing surrounding the implant after placement establishes the peri-implant mucosa.
- The outermost surface of the peri-implant mucosa is pink, firm, and covered by keratinized epithelium.
- **It is poor in fibroblasts, rich in collagen fibres, and has a limited blood supply, and thus has a lower potential for repair than gingival tissue.**

➢ **Integration times:**

- Traditionally the time from placement to integration and loading has been accepted as 2–6 months.
- In certain circumstances, implants may be loaded earlier than this, even immediately.
- However, there are few indications for this and if the implant is prematurely loaded or overloaded during the healing phase, there may be connective tissue encapsulation of the implant body, preventing osseointegration.
- The most predictable treatment plan and gold standard remains the conventional approach.

➢ **Restoration of dental implants:**

∇ Abutment connection: once integrated (and, if necessary, exposed), an abutment is connected to the implant.
∇ This allows the prosthetic superstructure to be manufactured and connected via the abutment to the implant.
∇ Implant superstructures may be a single tooth crown, an implant-retained bridge, or implant-retained overdentures.
∇ There are multiple different abutment/implant connection types available, including internal hexagon design, external hexagon, conical connection, and Morse taper.
∇ Connections may have an anti-rotation device.

Implant abutment in position prior to cementation of final restoration.

➢ Follow-up and maintenance:

- If implants survive the first 2 years, there is a 98% success rate with dramatic improvement in all functional parameters.
- Success rates for the mandible are higher than those for the maxilla (due to bone quality).
- Implant-retained restorations need to be carefully maintained by the patient.
- The implant needs to be followed up long term clinically and radiographically by the clinician.
- Implant failure may be early or late.
- Early failure may be due to inadequate site preparation, overheating of bone, infection, premature loading, or lack of 1° stability.
- Late failure may be due to overloading or infection (peri-implantitis).

➢ Implant success:

- Success rates of dental implants are reported to be in excess of 90% after 10 years.
- There are two ways an implant can be considered to fail:
  - ✓ 1° failure, which is failure of osseointegration.
  - ✓ 2° failure, which is failure to maintain osseointegration.

- The implant can be considered to be successful if it is present and functioning (acceptable mastication, phonation, and pain-free) with a lack of mobility, associated radiolucency, and bone loss of 40% of patients may experience peri-implantitis to some extent.

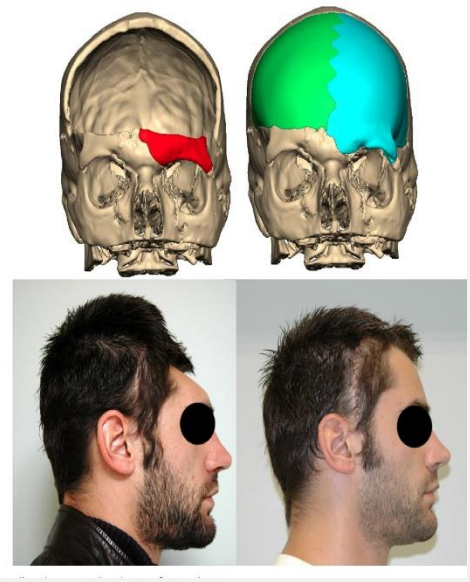
- Peri-implantitis and peri-implant bone loss is not well-understood but i risk is associated with:

- Inadequate OH.
- Prosthesis designs that hinder OH.
- An excessive occlusal load on the implant.
- Poorly controlled diabetes.
- Existing periodontal disease (treated and untreated).
- Smoking.
- Thin bone coverage at the time of implant placement.
- Residual cement from a cemented implant restoration.
- Thin gingival biotype and tissue thickness.

- ✓ Diagnosis involves radiographic examination to look for bone loss around the implant, assessment of the gingival tissue (colour and bleeding), evidence of suppuration, and increase probing depth of peri-implant pockets.

- ✓ Management can range from local debridement and improved OH to surgery with bone grafts and regenerative procedures.

- ✓ <u>Craniofacial implants</u>: Prosthetic eyes, ears, and noses can be securely fixed to the facial skeleton with implants using techniques similar to oral implants.



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