Guidelines For Implant Dentistry

Ahmed Halim Ayoub

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Preface

Implantology is one of the most exciting and dynamic aspects of modern dentistry. Developments in implants systems and techniques have transformed prosthodontic at all levels.

Apart from dispelling much of the mystique that has built up around implants and their use, this book provides an abundance of practical guidance of immediate relevance to everyday clinical practice.

My aim is to provide general dental practitioners with a concise introduction to dental implantology and enable them to discus implant as treatment option with patients.

Ahmed Halim Ayoub

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اسم المؤلف : Ahmed Halim Ayoub

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Chapter 1

INTRODUCTION AND HISTORY

Introduction

- The goal of modern dentistry is to restore the patient to normal contour, function, comfort, esthetic, speech and health.
- The role of teeth is to prepare food for swallowing and facilitate digestion.
- Teeth are also important for the articulation of speech and proper look
- Loss of tooth or teeth results in loss of structural balance, inefficient oral function and poor esthetics.
- Full edentulous patient feel inconvenient and sometimes handicapped

Replacement of tooth or teeth is essential to maintain the occlusal function and optimum oral and general health

Conventional rehabilitation

- Tooth supported removable denture
- Dual supported removable denture
- Fixed bridges

Partial dentures:

- Removable partial dentures has a lot of drawbacks :

  -Reduced Masticatory efficiency

  -Discomfort

  -Difficulty in speech (palate and flanges)

  -Inconvenience and lack of confidence due to the less retentive prosthesis

Fixed bridges:

- Takes support from adjacent teeth
- Provide better Masticatory efficiency
- Comfort and added confidence to the patient

But *It needs preparation of the adjacent teeth

* leading to caries, sensitivity and periodontal

* Disease of the abutments on long term follow up.

Implants: The Numbers

- >400,000 implants placed annually.
- >90% success rate.

- Mandible > maxilla.
- $300-1000$ per fixture.
- $200-400 cost of fixture and drills.
- 6 months-? Amount of time from day of placement to finished restoration.

The clinical replacement of lost natural teeth by osseointegrated implants has represented one of the most significant advances in restorative dentistry. Two decades ago, a majority of dentists were sceptical about implants and rejected them entirely. Today it is rare to find a practitioner who does not work with dental implants or who is not actively participating in one of the many seminars or courses offered by universities, professional societies and implant manufacturers.

History of dental implants

Ancient history of dental implants dates back to Egyptian times when sea shells were literally hammered into the jaw to replace missing teeth. Believe it or not, these shells actually worked. Slots were made into the bone and the shells were pounded in like little wedges. Without Novocain!

-The Ebers Papyri is the most voluminous and best preserved of the Egyptian medical papyri. It is a compilation of Egyptian manuscripts (some of which were written as early as 3700 B.C.). It makes multiple references to dental maladies and discusses treatments for "bennet blisters" and teeth that "grawn into the upper part of the flesh.

A mandible from about 2500 years ago, discovered in Lebanon, shows periodontally involved mandibular anterior teeth splinted together with gold wire

Replantation/Transplantation

The Arabian surgeon, Albucasis (936-1013), is the first person to provide a written description of the replantation process that preceded the concept of transplantation.

Found In Hendouras in 1931 and supposed to be from year 600 D.C. , Dr. and Mrs. Wilson Popenoe, an archeological team, first endosseous implant trials

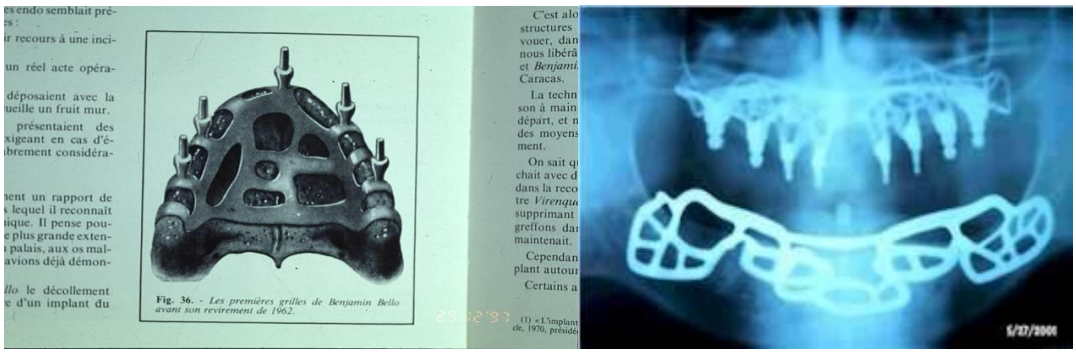
DEFINITION OF A DENTAL IMPLANT

The Glossary of Prosthodontic Terms defines an implant as “a prosthetic device or alloplastic material implanted into the oral tissues beneath the mucosal or/and periosteal layer, and/or within the bone to provide retention and support for a fixed or removable prosthesis.”

Types of implants:

1-Sub-periosteal implants:

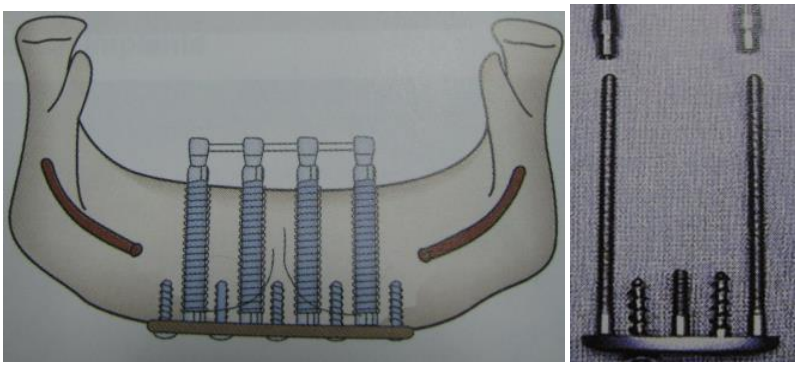
This type of implants consists of a non-osseointegrated framework that rests on the surface bone of the mandible or maxilla. The framework is positioned beneath the mucosa with, typically a number of posts penetrating the mucosa to support an over denture.



United states 1949 Greshokoff and Goldberg

Full thickness flap is raised then an impression to the alveolar ridge is done, Then a metallic framework is fabricated in the laboratory .Later on another full thickness flap is raised again and the metal framework is sited on the alveolar ridge then the flap is repositioned again and the prosthesis is fabricated on the projected abutments from the framework. This implant was so harmful for the patient but provided good lateral stability Periosteal implants are flat, mesh-like frameworks that lie on the osseous surface. They cover a large portion of the bone and wrap around buccally and lingually.

2-**Trans-Mandibular Implants**

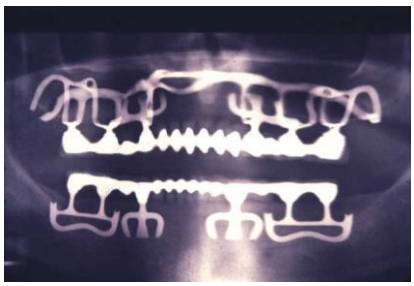


A long screw crosses the alveolar ridge from its crest till it's fixed below the lower border of the mandible (the chin) with a bar and screw.

3- Blade implants:

By making a split in the bone and inserting a small blade implants in it. The stability gained from the bone

growth in the blade holes .but poor lateral forces tolerance existed. Blade implants are flat, small plates that are inserted into a cut in the bone.



4. Endosseous Implants:

Root-form implants represent the most widely-used implants today. They resemble a cylinder or a screw. Screw-type implants are the most common. Root-form implants vary in length and diameter to accommodate different clinical situations. Most possess an attachment for fastening the crown to the implant.

Branmark was studying the microcirculation of bone and problem of wound healing in rabbits 1950-1960 By placing a titanium cylinder into the bone, leaving it submerged below the gum for three to six months then he discovered that this titanium cylinder doesn't go out of the bone; he called this "osseointegration".

Osseointegration: "Direct structural and functional connection between living bone and implant surface" Or "Contact between normal and remodeled bone with a metal implant surface without the interposition of non-bone connective tissue".

It is a histological and not a clinical observation. Around 1980, Branemark brought his research to the U.S. which was an overwhelming improvement to American methods. In turn, American technology quickly adopted these principles. At this time, well over a half million dental implants are being surgically placed annually. And yet, as rapidly as this field of dentistry is growing, the majority of potential dental implant patients is unaware that this treatment exists.

Requirements of Osseointegration

1-Material: Titanium is the only biocompatible metal that allows osseointegration because It forms on the surface a layer of titanium oxide similar to hydroxyl appetite of bone Any contamination including touch by gloves reduce osseointegration.

Aluminum, chrome cobalt, nickel chrome have a surface oxide layer But corrosion results in continuous release of metal ions into surrounding Tissues resulting in a fibrous encapsulation.

Most current dental implants (including all systems considered in this book) are made of commercially pure titanium. Titanium has established a benchmark in osseointegration against which few other materials compare. Related materials such as niobium are able to produce a high degree of osseointegration and, in addition, successful clinical results are reported with titanium–aluminum–vanadium alloys. The titanium alloys have the potential disadvantage of ionic leakage of aluminum into the tissues but they have the potential to enhance the physical/ mechanical properties of the implants. This would be of greater significance in narrow diameter implants.

Hydroxyapatite-coated implants have the potential to allow more rapid bone growth on their surfaces and they have been recommended for use in situations of poorer bone quality. The reported disadvantages are delamination of the coating and corrosion with time. More recently, resorbable coatings have been

developed that aim to improve the initial rate of bone healing against the implant surface, followed by resorption within a short time frame to allow establishment of a bone to metal contact.

2-**Minimal trauma** in bone preparation as osteocytes damages occurs on 47C. Micro damage of bone in bone stimulates bone remodeling as a reparative reaction. So our target is to repair with bone not fibrous tissue.

3-**No space** between implant and surrounding bone .if large space so blood clot will organize into fibrous tissue leading to Fibro osseous integration (tissue implant contact with interposition of dense collagenous tissues between implant and bone surface.

4-Implant and tools must be **sterile.**

5-Priod of **undisturbed healing** micro motion of 150 micron or above is damaging to implant but 50 micron is acceptable. Healing period in maxilla 4 months and in mandible 3 months.

Implant integration

1- Ankylotic-like relationship between the implant and the bone which means osseointegration and bio-integration.

2-development of intermediate ligamental or fibrous like system (fibro osseous retention) cause by:

-Inaccurate primary stability when loading the implant

-Traumatic surgical protocol

-Excessive loading

-Premature loading

-over heating the bone

Clinically, an osseointegrated implant feels solid, and no mobility is present

There is never 100% bone-implant contact

Johansson and Alberktsson 1987 reported:

1-Fibrous tissue interface at 1 month following implant placement

2-50% bone-implant contact at 3 months

3-65% bone-implant contact at 6 months

4-Average of 85% bone to implant contact 1 yr after

Under a microscope, the surface of an osseointegrated implant shows bone attached, but not continuously; there are islands of direct contact, separated by marrow spaces so that only 40% to 50% of the implant surface is in contact with bone.

Surface treatment

Usually Implants body was manufactured polished (machined) .But recently implant companies started to make some modifications on surface by treating it to make it rough for increasing surface area thus increasing implant bone contact, implant stability, better force resistance and longer life.

Untreated implant (polished) 

Treated implant body and polished colar

Methods of implant treatment:

1-HA coated (hydroxyl appetite)

By spraying a hydroxyl appetite on hot implant body, so increasing implant surface area

2-Acid etched

By putting the implant in concentrated acid (similar to the acid etch of enamel)

3-Sandblasting

Spraying aluminum oxide powder on the implant surface to make it rough

4-Titanuim plazma sprayed

Spraying titanium powder on hot implant body, so increasing implant surface area

5-**SLA** (sand blast large grit acid etch)

Combination between 2 and 3

6-Bio coating

Coating the implants with some bio active ceramics, hormones or plasma reduce the osseointegration time

Advantages & disadvantages of surface treatment

Advantages:

-Increase osteoblastic activity.

-Decrease destructive effects of micro motion.

-Increase surface area so better Loading properties.

Disadvantages:

-Bone resorption leads to contact between gingiva and rough surface resulting in gingivitis

-Flaking due to weak bond between HA and implant body & Ha Layer dissolution

-Fast bacterial colonization on rough surface

-Sauserization phenomena: sudden, rapid crestal bone loss around implant after an initial successful biointegration

Types of root form implant

*-Cylinder (press fit):

Less surface area so better be coated

*-Screw type:

Increased surface area, better initial contact, more initial stability. 

Implant abutment interface Or types of connection

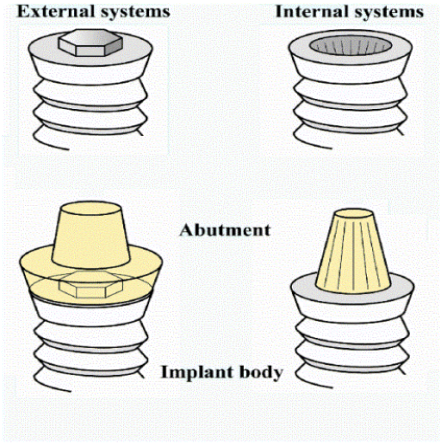
Usually lateral Abutment fixed to the implant with a screw but this is not enough to support the abutment via lateral forces so the screw under lateral forces become loose and thus cause abutment looseness. There are two main ways to anchor the replacement teeth to the implant or abutment − an external connection and an internal connection.

External Connection

When there is an external connection, the attachment rises approximately 1 mm above the implant. The shape of the attachment varies and may be a hexagon or a castle-like design. A screw hole for the abutment or crown lies in the center of the attachment. In cases where the abutment contains the screw in one piece, the implant attachment is not engaged. For instance, the implant head is a hexagon but the abutment is round so that rotation into place is possible.

Internal Connection

When there is an internal connection, the attachment lies inside the implant .The shape of this internal space varies .The abutments may be threaded and screw-retained into the attachment. In systems known as "internal friction systems," abutments are also retained by friction against the inner walls of the implant. Abutments may be shaped like a tooth prepared for a crown (for cemented restorations), or they may contain a central hole for a screw (for screw-retained crowns). The implant platform may be flat or have beveled edges. This design is becoming the most popular.



Connection should provide:

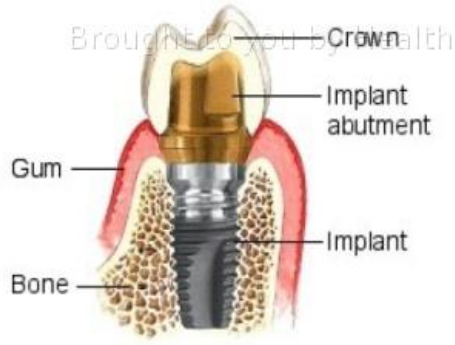
1- Anti rotation

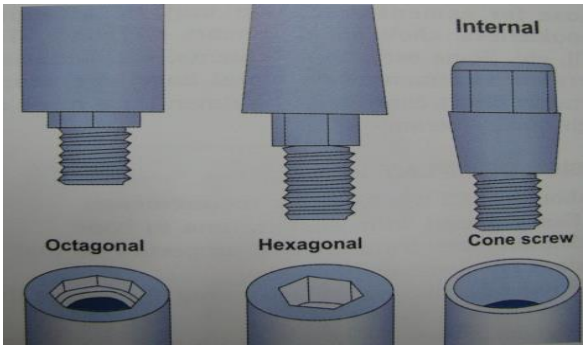
2- Lateral stability

External hex can be short or long, short cause weak resistance to lateral forces leading to screw loosening,

Long internal hex provides lateral stability

Each system has anti rotation design my be:-Octagon (friadent) ,12 (microdent)





Choice of implant system

- Fulfilling national and international standards
- Documented clinical success
- Commercially pure titanium

- Cylindrically, tapered threaded implant design
- Both submerged and non submerged protocol
- Modified roughened surface
- A universal implant for all bone types
- A universal protocol for immediate or delayed loading
- Various lengths and diameters
- Various range of abutments
- Affordable cost to the patient
- Training , education and ongoing support

Special Implants:

Are implants with a special diameter and design and not normally present in all implant systems. Like narrow 2.8mm diameter implant or wide 5.5 mm diameter implants. It facilitate surgeon work in such difficult cases


transitional imp.

Indications of implant treatment:

- For completely edentulous patients with advanced residual ridge resorption.
- For partially edentulous arches where RPD may weaken the abutment teeth.
- In patients with maxillofacial deformities'.
- For single tooth replacement where fixed partial dentures cannot be placed .
- Patients who are unable to wear RPD.
- Patient's desire.
- Patients who have adequate bone for the placement of implants.

Contraindications:

-Presence of non treated or unsuccessfully treated periodontal disease.

-Poor oral hygiene.

-Uncontrolled diabetes.

-Chronic steroid therapy.

-High dose irradiation.

-Smoking and alcohol abuse.

Advantages:

- Permanent solution of tooth loss

-Improved appearance

-Improved comfort for dentures

-Improved self-confidence

-Improved oral health

-More cost effective in long term

-Reliable as success rate of implant is 92- 97% while fixed over denture success rate 80-97 % after 10 years. Implant single crowns had the lowest failure rate at 2.7%.

Other advantages

1. Preservation of tooth structure

As teeth under fixed bridge and after preparation becomes week and more liable to 2ry caries.

2. Preservation of bone

There is a close relationship between the tooth and the alveolar process throughout life. Bone requires stimulation to maintain its form and density.

When a tooth is lost, the lack of stimulation to the residual bone causes a decrease in trabecullae and bone density in the area, with loss in height and width of bone greater loss was demonstrated in the maxilla than in the mandible.

3. Provision of additional support

4. Resistance to disease
Recurrent caries can occur beneath restorations, at the margins of restorations or on the root surfaces Implants have an added advantage in that they are not susceptible to dental caries and can preserve adjacent teeth.

Disadvantages

1-Surgery

2-Prolonged healing period

3-Expences

General considerations:

-Implants are replacement of tooth roots.

-They are specially designed so that they become securely attached to the bone through a process called osseointegration.

-Restorations are screwed or cemented onto implants or implant components, usually after a waiting period that allows the bone to heal.

-Restorations are fabricated by procedures that, in many cases, resemble traditional crown and bridge dentistry.

-It is possible to replace a single tooth, several teeth, or a full arch.

-Implants make it possible to provide edentulous patients with replacement teeth that are much more stable than removable prostheses.

Chapter 2

IMPLANTS BIOMECHANICS

Biomechanics

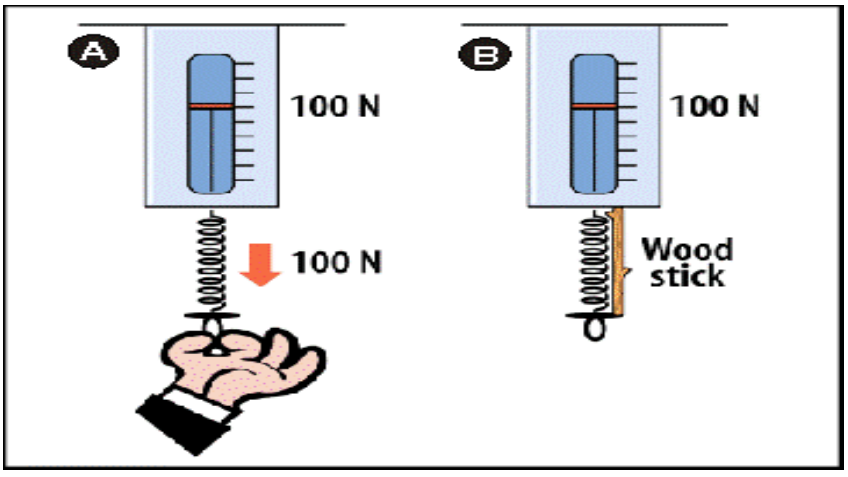
Biomechanics comprises all kinds of interactions between tissues and organs of the body and the forces acting on them. Biomechanics comprises the response of the biologic tissues to the applied loads. Implants are specially designed to withstand biting forces. Both implant components and the surrounding bone play an important role in dissipating forces associated with everyday activities. However, implants, unlike teeth, cannot heal themselves, and excessive force causes irreversible injury to metal structures.

THE ROLE OF BONE

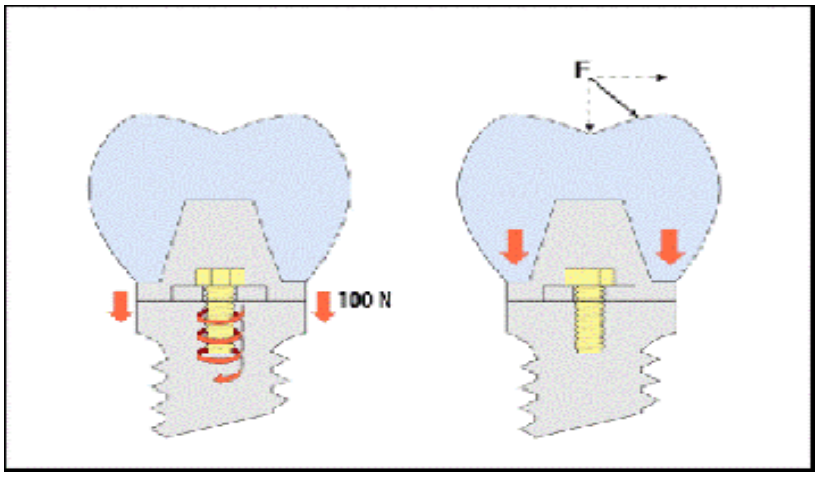
- In normal cases, forces are dissipated through abutments towards the implant and into the bone.
- Much of the force is dissipated in the area of the implant neck.
- Bone remodels around implants in reaction to force.
- This bone remodeling explains one of the key advantages of implants over more conventional methods of tooth replacement. While the bone would normally atrophy in the absence of teeth, the constant remodeling of the bone around dental implants works to preserve bone volume.
- Bone also provides stable support to implants, although slight flexibility is possible.

COUNTERING FORCES WITH SCREWS

- The screws in implants are important not only for clamping parts together, but for protecting the implant against forces.
- Preload is the clamping force that the screw applies between the two parts. If applied correctly, it shields implant components from moderate forces associated with biting and chewing.
- Proper preload is obtained when the screw is adequately torqued.
- Torque is calculated to create the ideal amount of tension in the screw. This stretches the screw slightly, preventing implant components from moving. As a result, the components are protected from force injuries.
- Too little torque will lead to loosening. If undetected clinically, loosening leads to abutment mobility, which can cause screws to bend and, ultimately, to fracture.
- Too much torque will cause screw distortion, which can also lead to fracture.
- Preload is important whether a screw retains the crown or an abutment.



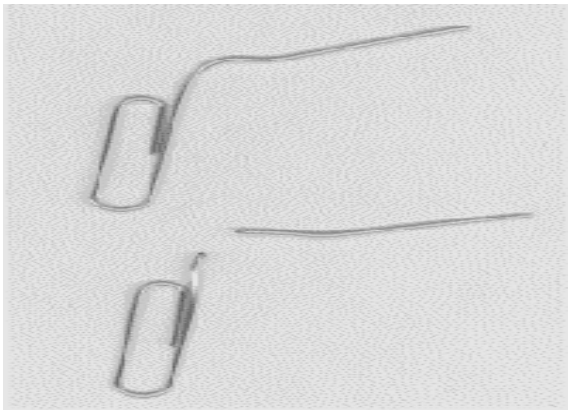
The principle of preload. Tension in the screw introduces tension in the implant complex in an analogous manner to a wood stick in a stretched spring. (A) Tension is placed in the spring by stretching it (B) and inserting a stick to hold the coil in its extended position. Now, the spring can only be extended further if a force that exceeds the initial tension is applied. Thus, the initial tension and the wood stick protect the spring from moving as long as forces are less than or equal to the initial force. A similar tension in implant screws prevents implant components from moving.



In implants, torquing the retaining screw properly creates the ideal amount of tension in the screw. This preload force protects the implant complex from moderate biting forces.

MECHANICAL FATIGUE

- If forces are not properly controlled, implants can suffer force injuries through a process called mechanical fatigue.
- Mechanical fatigue occurs when excessive force on the implant crown leads to irreversible microscopic changes in the metal of implant components.
- Although these changes are not visible to the naked eye, they can lead to fracture.
- This is similar to what occurs when a paper clip has been repeatedly bent too far and loses its shape.
- If forces are low and remain in the elastic range of the implant and its components, fatigue does not occur and the implant will not suffer over time.
- Unfortunately, clinical evaluation is not accurate enough to detect overload. Signs of mechanical fatigue may only be detected during maintenance, after screw loosening or component fracture has occurred.



A paper clip illustrates the concept of mechanical fatigue. (Up) The clip has been bent multiple times, suffering mechanical fatigue, but it is impossible to tell visually whether it is ready to fracture. (Down) One more bend and the paper clip is now fractured because of mechanical fatigue.

Elements That Frequently Undergo Fatigue

- Screws
- Abutments
- Implants

Biting force:

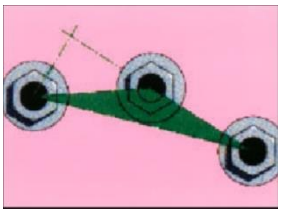
Under normal circumstances, single free-standing tooth or implant is commonly subjected to chewing forces that is usually compressive, but certainly not exclusively compressive, as they are also subjected to tensile and the shear forces.
Owing to the inclined occlusal surfaces of the crown, a food particle typically does not make contact with the crown in such a way that the contact force acts perfectly parallel to the long axis of the tooth (or) implant.

Effect of implant angulation on the stresses in the bone

Angulation of the fixture, in certain situations may lead to better anchorage and/or better implant position. It does not lead to the increase loading, as the superstructure will counteract angulation in the implant as defined by the prosthesis long axis and the implant direction. As long as the inclination of the position of fixture head or abutment head is minimal within the range of 12-15°, the stress distribution in the implant is comparatively very similar to that of the parallel placed implant.

In case of 3 implants

In the case of three-unit prostheses, the ideal situation from a biomechanical point of view is three implants placed in a slightly curved configuration, with the middle implant offset a minimum of 2-3 mm in the buccolingual direction. This tripod implant configuration allows the load transfer to bending forces to be mostly axial, minimizing the stress level.



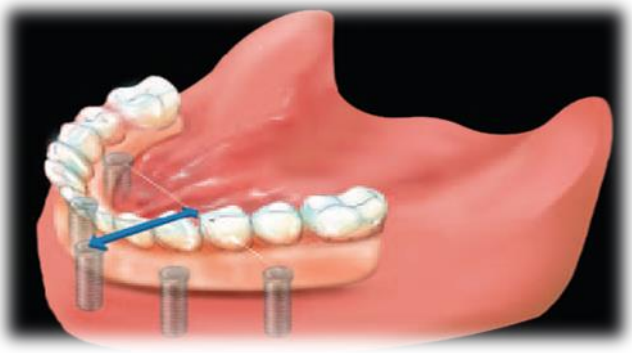
It is estimated that the stress level will be reduced approximately 50% by tripodisation, compared to a straight-line configuration.

Cantilever

Cantilever restorations should be avoided whenever possible because off-center forces are detrimental to implant integrity.

Cantilever restorations should be limited to short spans.

When occlusal forces are applied to the cantilever, the two factors determine the length of the cantilever, the anterior posterior spread and the length of the terminal implant.



Determination of cantilever length:

The distance from center of most anterior implant to a line joining distal aspect of 2 most Distal implant which is called antero-posterior spread Cantilever length =1 ½ AP spread Maximum cantilever length must not exceed 20 mm in mandible and 10 mm in maxilla

Also length of cantilever depends on:

-Number of implants -Quality of bone

-Implant length -Para functional habits

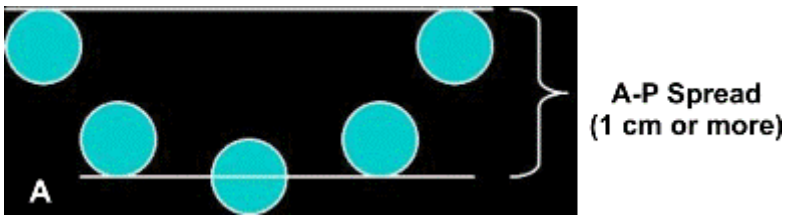
-Implant diameter -Arch Form: -In square arch less

-Opposing occlusion - length of cantilever

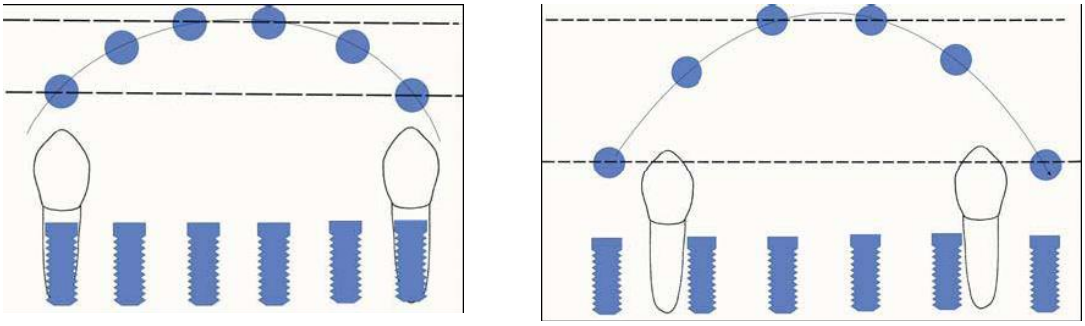
-In V Shaped arch increase Length of cantilever.

Bone Quality: in case of good bone quality 5 or 6 implants are placed then extend **13 mm** from center of most distal implant.

Poor bone quality: 7 or 10 implant are placed and the extend cantilever 10 mm



The distal cantilever should be evaluated early on as it might affect the number of posterior teeth that can be positioned. For example, a short A-P spread might limit the prosthesis to the first or second premolar.



(A) An example of six implants arranged in the lower jaw in the region between the mental foramina, with the most distal implant in the first premolar site. In this case the anteroposterior distance between implants shown by the dashed lines is not very great because of the shape of the jaw. (B) In contrast, in this example the six implants have been arranged so that the most distal implants have been placed distal to the first premolars. The anteroposterior distance between implants has been increased greatly, providing an improved biomechanical arrangement. This arrangement could more adequately support distal cantilever extensions.

Titanium

Titanium is a Light metal belonging to the same group as aluminum; however, the physical and mechanical properties of titanium are more favorable for dentistry compared to Al. Recently it has increasingly been used in surgery, especially in bone surgery. For years artificial hip joints made of titanium have been implanted. The biocompatibility includes freedom from danger of allergic reactions, which has been unknown for other alloys. It can be formed very precisely, which is the requirement for an exact fit. The surface of titanium can be machined easily because it is not very hard. Titanium, being a Light metal with a specific weight of 4.5 is translucent to x-rays, thus the work can be easily checked. Due to its surface inactivity there are no reactions, which is as important as its neutral taste and low heat conductivity. The medical industry has been using titanium very successfully for years. It is the perfect material for artificial joints, bone pins and replacements.
The dental industry began using titanium in the 1960's when Per Branmark discovered the biocompatible bonding principles for Titanium and Bones. But recent strides in titanium processing promise to make it more valuable than ever before in dental prosthetics. The main advantages to Titanium are Biocompatibility, Superior lightness, Accurate fit, Superior appearance, Low thermal conductivity and neutral taste.

Characteristics of Titanium

a. It is lightweight with a specific gravity of 4.5, or around 50% that of copper and 60 % that of iron.
b. It is a strong material with a tensile strength comparable to carbon steels. With a Young's modulus of elasticity only half that of carbon steel. Titanium is soft and readily formed, with spring back greater than carbon steels.
c. It can be formed as easily as stainless steel. Other factors that contribute to its diversity of applications include absence of magnetism, and color by anodizing. Titanium has a linear coefficient of thermal expansion approximately 50% that of stainless steel.
d. One of the major problems of the old stainless steel root canal files was that they could not always bent to the shapes of all root canals. The old files would be sometimes cut their own pathway out of the sides of teeth. The result was often a lost tooth.

Dental implant size in relation to biomechanics

Dental implants tolerate vertical forces well. Lateral forces increase the stress/strain levels at the bone implant interface when compared with vertical loading. Consequently, lateral (oblique/bending movements) forces should be minimized and/or avoided

Wider implants provide for increased implant-bone surface area and therefore improved biomechanical advantages, however, in the anterior zone; wider implants may compromise the mesial-distal restorative emergence profile. Consequently, regular (average of 4-4.3mm) and small (average of 3.5mm) diameter implants are preferred.

Implant width

-Select an implant which is within 1-2mm if size of the restoration at the gingival level.
-small diameter implants (3.3-3.5mm): Maxillary laterals and mandibular incisors

- One piece 3.0mm diameter implants: Lateral incisors, when only 6 mm of inter root space is present and further orthodontic therapy is contraindicated.

- Regular diameter implants (4.1-4.3mm): Maxillary centrals, Canines and premolars.

- Wide diameter implants (5.0-6.0mm) : Maxillary /Mandibular molars. Maxillary canines in select cases (no greater than 5.0 mm diameter)

Splinting Implant restorations
Indications:
- Grafted site.
- Compromised crown to implant ration- long clinical crowns (minimum desired crown to implant ratio is 1:1).
- Multiple regular diameter implants in the posterior zone.
- Implant supported fixed partial dentures.
- Multiple posterior regular diameter implants: splint together to improve stress-distribution and biomechanical advantage.
- Narrow implants.
- Para function.

Chapter 3

DEFINITIONS

Definitions

Abutment – an implant component that lies between the implant and the crown.

Abutment-level impression – an impression taken after an abutment has been delivered clinically.

Abutment screw – the screw that clamps the abutment onto the implant.

Angled abutment – a prefabricated abutment that is angled from the implant body to counter inclination of implants.

Barium sulfate – a radiopaque powder material utilized in radiographic templates to visualize diagnostic teeth.

Blade implants – flat, small implants that are inserted into a cut in the bone.

CAD/CAM – computer-aided design and manufacturing, an engineering process applied to the fabrication of surgical guides to enhance implant placement and to the fabrication of abutments in the laboratory.

Cemented prosthesis – a restoration cemented on abutments.

Close-tray impression – an impression method using a transfer-type impression coping and an unmodified tray.

Computed tomography (CT scanning) – a software-assisted radiographic technique that produces an exact cross-sectional view of the mandible or maxilla.

Cone beam computed tomography (CBCT) – a CT scanner that uses a cone-shaped radiographic source and a large detector to produce a three-dimensional radiographic image.

Cover screw – the screw that blocks the implant entrance during the healing period after surgery.

Critical space – the distance between the implant platform and the edges of the extraction socket. Usually used with reference to feasibility of immediate implant placement.

Custom abutment (also called UCLA abutment) – an abutment that is custom-made in the laboratory.

Emergence profile – the subgingival change in shape of the abutment and/or the crown, between the implant platform and its emergence from gingival tissues.

External connection – an implant-to-abutment attachment that sits on top of the implant platform. A common shape is the external hexagon attachment.

Gold screw – often used to describe the screw retaining the crown of a screw-retained prosthesis. Other screws also contain gold.

Healing abutment – a temporary abutment that is used in place of a cover screw after an implant has been inserted and removed before the restoration is placed.

Hounsfield numbers – an arbitrary scale of values assigned to various radiopaque densities, when using computed tomography.

Immediate implant placement – the placement of an implant at the time of tooth extraction.

Immediate loading – a technique in which implants are restored, and thus, loaded, at the time of their placement.

Implant – a titanium device placed in the bone that replaces the root of a tooth and enables the attachment of prosthesis.

Implant indexing – a method in which an impression is taken at the time of surgical placement.

Implant-level impression – an impression taken with copings that fit onto implants directly. No abutments are present.

Implant success – a label for implants that are functional and satisfactory at the time of examination.

Implant survival – a label for implants that are in the mouth at the time of examination, regardless of the state of the prosthesis or patient satisfaction.

Impression coping – a device used when taking impressions that fits on the implant and enables the capture and duplication of the implant position onto a stone model.

Internal connection – an implant-to-abutment attachment that is placed inside the implant body. These are found, for example, in internal friction systems.

Internal friction system – a system in which abutments are retained by friction against the inner walls of the implant.

Linear tomography – a radiographic method used to obtain cross-sectional images in which the radiographic source and film rotate around the plane of interest.

Load – a measurement of the forces exerted onto implants or teeth.

Mechanical fatigue – irreversible microscopic changes that occur in the metal of implants and components when an excessive force is applied. Fatigue often leads to fracture.

Mucositis – a reversible condition characterized by gingival inflammation around implants without evidence of bone resorption.

One-stage implants – implants that are exposed to the oral cavity on the day of placement.

Open-tray impression – an impression method using a pick-up impression coping and a tray modified to access a screw.

Osseointegration – the attachment of bone to the surface of an implant.

Ostectomy – the removal of bone to modify and enhance its topology.

Osteotomes technique – a term applied to the elevation of the sinus floor via the osteotomy prior to implant placement.

Osteotomy – the surgical procedure of drilling into bone to prepare the implant site.

Passive fit – the placement of a multi-unit restoration onto the implant complex without resistance or distortion.

Peri-implantitis – progressive bone loss and inflammatory tissue pathology that results from plaque accumulation and bacterial infiltration around implants.

Periosteal implants – flat, mesh-like implants that lie on the osseous surface.

Pickup coping – an impression coping that is automatically retained in the impression after removal.

Platform switch – a restorative method consisting of placing an abutment of smaller diameter than the implant platform in order to displace the connection away from bone and avoid osseous craterization.

Prefabricated abutment – a manufactured abutment that arrives with a set collar height, taper, and/or angulation.

Preload – the clamping force that is applied by a screw between the implant and its abutment.

Prepable abutment (also called prepable post) – an abutment that is received as a straight cylinder with no taper or margin level. Preparation is required to set height, angulation, taper, and margins.

Progressive loading – a technique in which a provisional restoration is placed shortly after implant placement.

Radiographic template – an acrylic appliance worn by a patient during a radiographic analysis. It incorporates radiopaque markers to visualize diagnostic teeth and potential implant sites on the films.

Ridge mapping – a clinical procedure in which soft tissue is measured at several locations of an edentulous ridge. Measurements can be reported on a drawing or a model to estimate the width of underlying bone architecture.

Root-form implants – cylinder or screw-shaped implants. They are the most common implants used today.

Scannographic template – an acrylic appliance worn by a patient during a computed tomography scanning that incorporates radiopaque material (i.e., barium sulfate) to visualize diagnostic teeth.

Screw-retained prosthesis – a restoration affixed on abutments or implants using screws in place of cement.

Sinus floor elevation (also called sinus graft; sinus lift) – an augmentation technique used when the maxilla lacks sufficient vertical bone for implant placement.

Splinted implants – implants that are joined by a bar to enable attachment to a removable prosthesis.

Surgical guidance – the surgical method consisting of using a surgical guide or other methods assisting the surgeon in identifying the osteotomy localization and angle.

Surgical guide – an acrylic appliance used during surgery that indicates where the ideal implant placements must be for restorative purposes.

Titanium – a lightweight, soft, noncorroding metal used to make implants.

Tomography – see "Linear tomography" and "Computed tomography."

Torque – the amount of turning force placed on screws at delivery.

Transfer coping – an impression coping that remains on the implant complex after the impression is removed. It needs to be removed and placed onto the impression manually.

Two-stage implants – implants that are covered by the gingiva immediately after placement. A second surgery is necessary to uncover them.

Chapter 4

DIAGNOSIS AND TREATMENT PLANNING

Examination and treatment plan

It is important that these treatment goals are realistic, predictable and readily maintainable: realistic means that the end result can be readily achieved and is not unduly optimistic; predictable means that there is a very high chance of success of achieving the end result and that the prosthesis will function satisfactorily in the long term; and readily maintainable means that the prosthesis does not compromise the patient's oral hygiene and that the 'servicing' implications for the patient and the dentist are acceptable.

Treatment Planning:

-Single most important aspect of dental implantology.
-High success rates are almost always accompanied by careful case selection.
-The increased predictability of grafting procedures allows for optimal esthetic placement.

General contra indications:

1-Patient health status prohibits surgical treatment.
2- Patient with mental psychosis.
3-Alcohol and drug abuse.

Local contra indications:

1-Remaining jaw bone is too diminished in quality to allow fixture installation.
2- Clinical or radiographic signs of pathology in the jaw.

Diagnosis

- I-Medical consideration
- II-Clincal Examination
- III- Radiographic examination
- IV- Cast examination

I-Medical Consideration

1-Smoking

-Low success rate due to increased gingival bleeding, ability to peri- implant inflammation and increased bone loss.

-Decrease ca deposition due to tobacco byproducts

-A few studies have shown that the overall mean failure rate of dental implants in smokers is approximately twice that in nonsmokers.

-Smokers should be warned of this association and encouraged to quit the habit.

-Protocols have been proposed that recommend smokers to give up for at least two weeks prior to implant placement and for several weeks afterwards.

-Failure is more likely in those who have poor-quality bone, which is a possible association with tobacco smoking.

-It should be noted also that smokers followed in longitudinal studies have been shown to have more significant marginal bone loss around their implants than non-smokers. Most of these findings have been reported from studies involving the Branemark system, probably because it is one of the best-documented and widely used systems to date.

2-Radiation Therapy

-Reduction in implant success.

-Impaired bone& soft tissue healing

-Risk of osteoradio-necrosis

Radiation for malignant disease of the jaws results in endarteritis, which compromises bone healing and in extreme cases can lead to osteoradionecrosis following trauma/infection. These patients requiring implant treatment should be managed in specialist centers. It can be helpful to optimize timing of implant placement in relation to the radiotherapy and to provide a course of hyperbaric oxygen treatment. The latter may improve implant success particularly in the maxilla. Success rates in the mandible may be acceptable even without hyperbaric oxygen treatment, although more clinical trials are required to establish the effectiveness of the recommended protocols.

3-Chemotherapy

No Adverse effect on integrated implants

4-Osteoporosis

No publication provided scientific indications that osteoporosis alters the success of osseointegrated implants. Cause loss of bone mass & density throughout the body

The chance of osseointegration is poor .Success rate 97% but we need more Healing period.

5-HIV-Positive Status

6- Psychological problems

The dentist should meet the mind before the mouth of the patient “De Van 1942”

7- Bleeding disorder:

Anemia, leukemia, hemophilia, regular aspirin intake

8- Uncontrolled Diabetes:

Uncontrolled or poorly controlled diabetes is a contraindication for implant placement. Well-controlled type 2 diabetic patients may have a slight increase in early implant failure. Neither type 1 nor type 2 diabetes, when controlled, is contraindications for implant placement. Antibiotic therapy at the time of implant surgery should be considered.

-Risk for postoperative infections.

-Healing problems.

-Inflammatory gingival changes.

-Peri-implant inflammation.

-Increased alveolar ridge bone loss.

9- Bone disease /pathology:

-Histocytosis.

-Pagets disease of bone.

-Fibrous dysplasia.

-Osteoporosis: cause loss of bone mass & density throughout the body The chance of osseointegration is poor .Success rate 97% but we need more healing period.

-Commonly affects postmenopausal females, having its greatest effect in the spine and pelvis.

10-Longterm use of corticosteroids:-

Not absolute contraindication but risky condition may cause:

Delayed healing, reduce bone quality and increase bone loss

Drug abuse may affect the general health of individuals and their compliance with treatment and may therefore be an important contraindication.

11- Age of the patient:

Osseo-integration has no age limit.

Problems with young age (below age of 15 in females and 18 yrs in males):-

1- Implants are ankylosed

2-Submerging of implants into jaw

3-Relocation of implant site

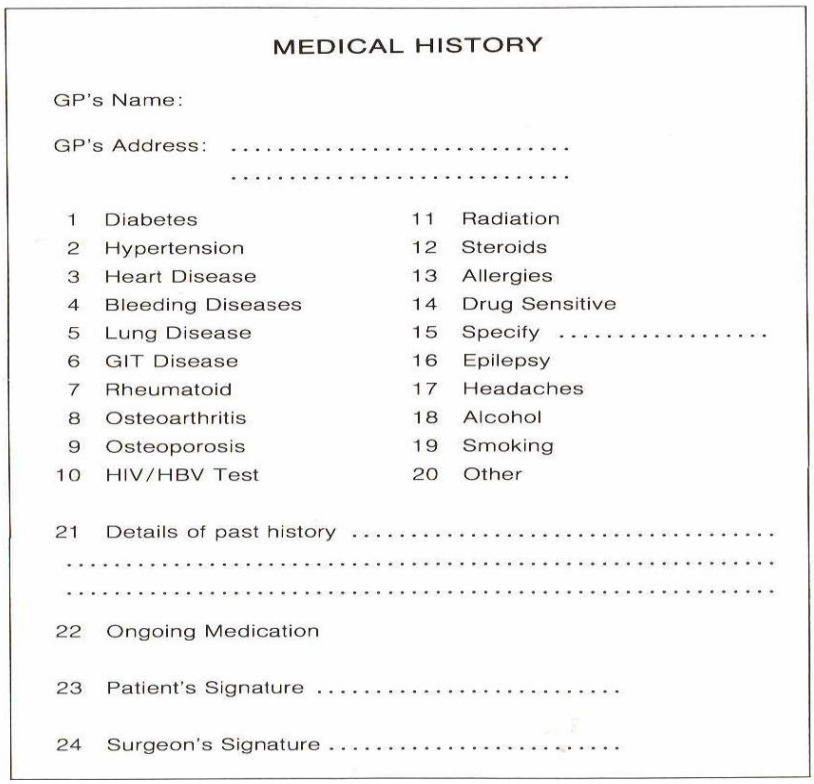
4-Interference with normal growth of the jaws

The fact that the implant behaves as an ankylosed unit restricts its use to individuals who have completed their jaw growth. Placement of an osseointegrated implant in a child will result in relative submergence of the implant restoration with growth of the surrounding alveolar process during normal development. It is therefore advisable to delay implant placement until growth is complete, this is generally earlier in females than males, but considerable variation exists. It is usually acceptable to treat patients in their late teens. Although some growth potential may remain in patients in their early twenties, this is less likely to result in an aesthetic problem.

There is no upper age limit to implant treatment provided that the patient is fit enough and willing to be treated. For example, elderly edentulous individuals can experience considerable quality of life and health gain with implant treatment to stabilize complete dentures.

12- Bleeding disorders

Bleeding disorders are obviously relevant to the surgical delivery of treatment and require advice from the patient's physician.



MEDICAL HISTORY

GP's Name:

GP's Address: .....
.....

1	Diabetes	11	Radiation
2	Hypertension	12	Steroids
3	Heart Disease	13	Allergies
4	Bleeding Diseases	14	Drug Sensitive
5	Lung Disease	15	Specify .....
6	GIT Disease	16	Epilepsy
7	Rheumatoid	17	Headaches
8	Osteoarthritis	18	Alcohol
9	Osteoporosis	19	Smoking
10	HIV/HBV Test	20	Other

21 Details of past history .....
.....
.....

22 Ongoing Medication

23 Patient's Signature .....

24 Surgeon's Signature .....

II-Clinical Examination

A- Extra oral:

1-TMJ and muscles of mastication
2-Facial profile and lip support
3-Smile line

B-Intraoral:

1-Oral hygiene
2-Mucous character
3-Inter arch space
4-Intra arch space
5-Jaw relationship
6-Bone quality
7-Bone quantity
8-Smile line
9-Tooth wear
10-Periodontal tissue
11-Special clinical considerations
12-How much of the prosthesis is revealed during function
13-Evaluation of the edentulous space
14-Palpation
15-Arch curvature

1-Oral Hygiene

The patient should possess both the dexterity and the desire to maintain oral health**.**

2-Mucosal character:

-Caution should be exercised before treating patients with severe mucosal/gingival lesions such as erosive lichen planus or mucous membrane pemphigoid. When these conditions affect the gingiva they are often more problematic around the natural dentition and the discomfort compromises plaque control, adding to the inflammation. Similar lesions can arise around implants penetrating the mucosa.

-Edentulous gingival tissues should be free of inflammation and lesions.

-Traumatic appliances are often the source of inflammation. If this is the case, they should be released or relined.

-Watch lesions until they disappear

-Attached gingiva

Estimate the amount of attached gingiva by outlining the mucogingival junction.

Visualize the presence of attached gingiva using color differences and tissue mobility by placing tension in the vestibule with a mirror in order to displace the unattached mucosa.

Sufficient tension will also reveal high muscle attachments.

Use a periodontal probe to elevate the free mucosa and better visualize the attached tissue.

3-Interarch Space

-There needs to be adequate space available into which a prosthesis/crown can be placed that possesses the required esthetic and structural forms.

-There should be 7-12 millimeters of vertical space for fixed bridge or even a single unit restoration. (7mm for posterior) and (8-12 mm) for anterior.

-3-4 millimeters of minimum vertical space is required for structural integrity in removable partial dentures and posterior single crowns with screw retained prosthesis.

-For anterior single crowns, there should be adequate space present between the opposing tooth and the implant abutment for the type of restoration being fabricated.

Missing single teeth are treatment planned for replacement with implant-supported crowns. (A) However, the mesiodistal distance for the cuspid area is too small. (B) Orthodontic movement is required to obtain an ideal distance, as verified by the periodontal probe. (C) After implant placement, a restoration can be placed

4-Intra-arch space

-At least 6-7 millimeters of mesiodistal space should be available between adjacent teeth for surgical access in placing an implant for a single crown.

-For fixed complete dentures, there should be adequate space between the mental foramina to place 4-6 implants with sufficient bone present between the implants (about 3millimeters) the average dimension between the 2 mental foramina is 47mm.

-It may be necessary to reduce the opposing dentition height in order to establish a proper plan of occlusion. If interarch space is insufficient for stacking implant elements, it may have to be reduced as well.

5-Jaw relationships

6-Bone Quantity

-The occlusocervical height of the residual ridge should be at least 7 millimeters, since that is the shortest available implant length. It should also be remembered that short implants (7-10 millimeters) have a higher failure rate.

7-Bone Quality

The quality of the bone (as determined radio graphically) is an important factor to evaluate since implants that are placed into poor quality bone (Type IV bone) have a higher failure rate. When the data from 7 studies are combined the percent of implant loss in Type IV bone was much higher than the loss in Types I-III bone.

Nomenclature Lekholm and Zarb / Misch	Bone Quality According to Lekholm and Zarb (1985)	Bone Quality According to Misch (1990)
Class I / D1	Compact cortical bone	Thick compact bone
Class II / D2	Thick cortical bone surrounds highly trabecular bone	Thick, dense to porous cortical bone surrounds coarse trabecular bone
Class III / D3	Thin cortical bone surrounds highly trabecular bone	Thin, porous, compact bone surrounds loosely structured cancellous bone
Class IV / D4	Thin cortical bone and spongy core	Loose, thin, cancellous bone

It is difficult to categorize bone quality when looking at a radiograph.

Only a CT scanning survey provides an objective quantitative analysis via Hounsfield units.

Tactile sense during surgery provides the best evaluation, but subjectivity is important, in particular when discriminating between Class II (D2) and III (D3) bone densities.

Clinical significance of bone quality classifications

Class IV (D4) a bone has been associated with higher implant loss. But poor bone quality is also found in combination with reduced volumes.

Class I (D1) provides a poor blood supply, and surgical preparation is difficult. It is often found when alveolar bone has resorbed, and basal bone remains.

Bone density classifications provide an indication of implant survival, but there is no evidence of a direct correlation.

Bone volume classifications

Another classification of bone volumes from A to D.

A is the most intact edentulous architecture, where bone volume is present in all directions, and D is the most atrophic.

After tooth loss, the ridge slowly loses its initial shape, starting as a class A and becoming a class D over the years.

It is estimated that 25% of bone volume is lost during the first year.

Pressure from a removable prosthesis increases bone resorption over time.

Volume classification has a direct impact on treatment recommendations and prosthesis selection. Loss of bone width requires osseous grafting. Loss of bone height is more difficult, and often impossible to recover.

Determination of Bone Quality

- Tomograms
- Conventional dental radiographs
- Clinical sense during bone drilling

Quality	
BHP 1:	Bone with normal healing potential
BHP 2:	Bone with moderately reduced healing potential
	Possible reasons:
	Moderate smoking (approximately 10 cigarettes a day)
	Controlled diabetes
	Osteoporosis
	Nutrition deficiency
	Bone graft
	Regenerated bone
	Long-term treatment with corticosteroids
	Long-term treatment with nonsteroidal anti-inflammatory agents (indomethacin)

BHP 3:	Bone with a substantially reduced healing potential Possible reasons: Heavy smoking (20 or more cigarettes a day) Hyperparathyroidism Thalassemia Gaucher's disease Paget's disease Fibrous dysplasia Diabetes mellitus Severe anemia Antimitotic treatment Severe osteoporosis Irradiated bone Rheumatoid arthritis

Surgical risk factors associated with bone quality and quantity

	Type I	Type II	Type III	Type IV
BHP 1:	Okay	Okay	Okay	Caution
BHP 2:	Caution	Okay	Okay	Caution/Danger
BHP 3:	Caution	Caution	Caution	Danger

8-Smile Line

It is important to determine how much of the teeth and soft tissue is visible during a maximal smile. As with conventional single crowns and fixed Bridges, the display of significant amounts of soft tissue increases the esthetic difficulty of implant single crowns and implant fixed partial dentures.

9- Tooth Wear

The three components of tooth wear (attrition, abrasion, and erosion) are used to provide an indication of the degree of Para-function as well as the typical occlusal loads that the patient would expect.

10-Periodontal Tissues

Probing depths should be recorded in all areas. For patients who show evidence of periodontal disease (probing depths greater than 6mm with bleeding) the use of six point charting is recommended. Points at which bleeding occurs should be recorded as possible indicators of active periodontal disease.

All patients who are compromised periodontally should be assessed and should receive periodontal therapy before implant treatment is started. They should be re-assessed through the course of the treatment and postoperatively.

11-Special Clinical Considerations

Patients with thick alveolar ridges, where the roots are not palpable and not prominent, are less difficult to treat. This is because following tooth loss the collapse of the labial plate is less likely. It is often associated with flat, thick gingival margins.

Patients who have prominent roots that is palpable and protrudes from interdental depressions. The cortical plate surrounding the vestibular aspect of the roots is thin or non-existent and resorbs rapidly to the level of the interdental bone once the supporting tooth is lost. These patients are more difficult to treat

12-How much of the prosthesis is revealed during function

13-Evalutiation of the edentulous space
In all cases, it is critical to evaluate ridges early in the treatment evaluation.

At least 1 mm of bone buccal and 1 mm of bone lingual of the implant are necessary.

Therefore, a 4 mm diameter implant would require a 6 mm (or more) wide ridge.

Bone is usually narrower at the crest; therefore, crestal bone width is most critical.

At least 1 mm of bone is necessary mesially and distally. In addition, the periodontal ligament is ~0.5 mm thick. Therefore, a 4 mm diameter implant requires at least 7 mm of mesiodistal distance between adjacent teeth: 4 mm + 2 x (1 mm) + 2 x (0.5 mm) = 7 mm.

A knife-edge ridge indicates little bone width at the coronal portion. It is usually overlaid by mucosa and a narrow band of attached gingiva. In addition to bone grafting, a gingival graft may be necessary.

A wide ridge is generally indicative of a wider bone structure, although it is possible that the soft tissue may be thick. It is usually overlaid by a wide band of attached gingiva.

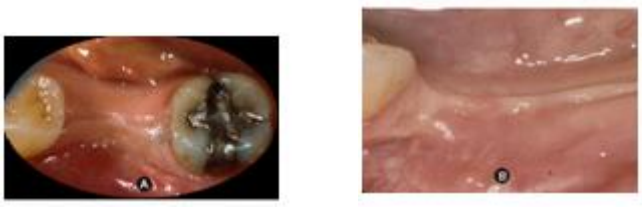
Note buccal concavities by comparing the ridge to adjacent teeth, looking occlusally. Use a mirror if necessary.

14-Palpation

Place a finger on each side of the ridge and palpate the general ridge shape. Note any concavity or exostosis.

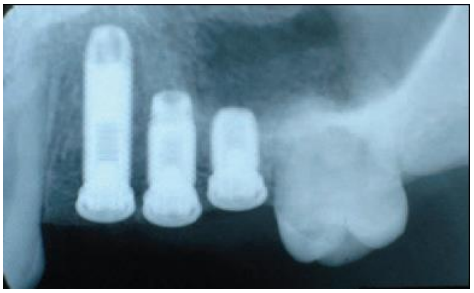
For mandibular posterior areas, slide your finger lingually towards the floor of the mouth and look for a lingual concavity.

Clinical evaluation of ridges and overlaying tissues provides a good estimation of osseous dimensions. (A) A wide ridge is probably a good candidate for implant placement. (B) A narrow ridge will require bone grafting prior to implant placement



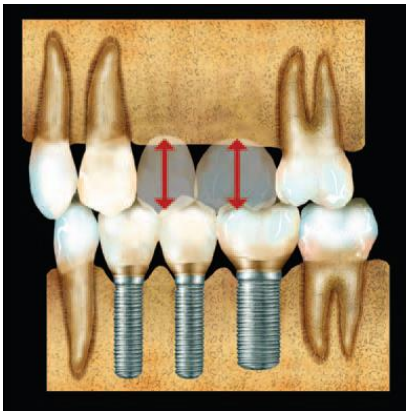
Inadequate mesiodistal space for implant retained premolar sized restoration

Lateral view showing mesial tilting of molar and osseous defect



Implants should be placed at least 1.5 mm away from the adjacent root. There should be a space of 3 mm between implants.

If implant is placed too close to the adjacent tooth there is unnecessary loss of hard and soft tissue. There is also a compromise in the contours of the implant restoration.



Ideally 7-12 mm of space is required from the head of the fixture to the opposing occlusion

Inadequate space in posterior mandibular area for fabrication of a tooth shaped restoration

III-Radiographic examination

Initial radiographic screening

A screening radiograph should give the clinician an indication of:

1. Overall anatomy of the maxilla and mandible and potential vertical height of available bone

2. Anatomical anomalies or pathological lesions

3. sites where it may be possible to place implants without grafting, and sites that would require grafting.

4. Restorative and periodontal status of remaining teeth.

Panoramic Radiography

It provides an image within a predefined focal trough of both upper and lower jaws that gives a reasonable approximation of bone height, the position of the inferior dental neurovascular bundle, the size and position of the maxillary antra and any pathological conditions that may be present. It is therefore an ideal view for initial treatment planning and for providing patient information, because it presents the image in a way that many patients are able to understand.

Indications/Use(s)

-Initial evaluation of bone dimensions and in screening for the detection of pathologic conditions when planning for dental implants

-Provides approximate information regarding the location and dimensions of the maxillary sinus, nasal cavity, inferior alveolar canal, and mental foramen.

Limitations:

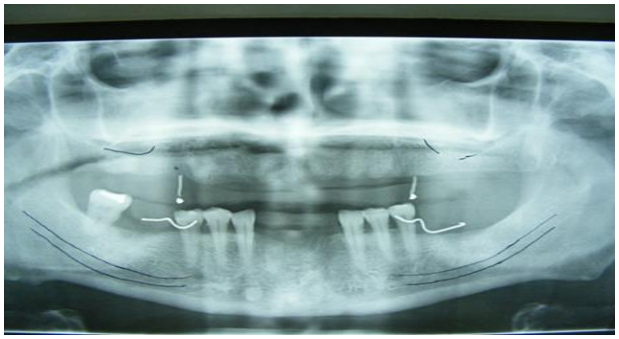
-Magnification of up to 25% which results in error of up to 3.0 mm.

-The poor image resolution and unpredictable image distortion limits its

-Usefulness when assessing bone adjacent to implants during follow-up.

-May provide information to determine vertical dimension, but is unreliable for measurements in the horizontal direction and for assessing bone quality.

Panoramic tracing



Radiographic measurements are usually initiated with traditional two-dimensional methods such as periapical or panoramic films. However, these methods do not allow for buccolingual visualization or evaluation of bone density, and further techniques may be necessary.

Periapical Radiography

• Indications/Use(s)/Advantages

1. Allows accurate horizontal measurement such as the proximity of adjacent Roots.

2. Permits an accurate evaluation of the bone response adjacent to dental implants.

3. Recommended to evaluate passive fit between implant components.

4. High quality.

5. Low cost.

6. Low radiation exposure.

7. Readily available**.**

• Limitations

-Vertical and horizontal linear measurements are accurate if paralleling techniques are used to prevent image distortion.

-Does not provide a cross-sectional view of the bone and only a small area of the jaw is visible

Protocol for Periapical and Panoramic Radiographs in the Presence of Teeth

-Obtain a cast of the jaw under investigation.

-Place a metallic object, such as a 5 mm in diameter metallic ball, on the model with sticky wax. Make every effort to position the markers where implants may be placed.

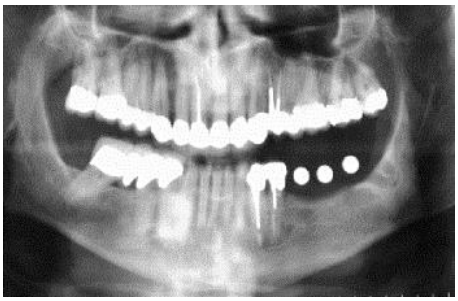
-Press a vacuum acrylic shell (thickness 0.06 inches) and trim so that the shell remains stable on teeth.

-Obtain the radiograph with the template in place.

-Measure the diameter “D” of the disc or length of the imaged marker on the film and calculate the distortion factor.

-Perform your measurements and apply the distortion factor.

-Remember to repeat the distortion factor calculation for each site, as distortion varies along different locations.



Linear tomography

With the use of computer tomography, linear tomography is becoming less useful.

Cross-sectional images of any portion of the maxilla and mandible can be obtained using linear tomography.

Tomograms are panoramic-size machines, which may be present in private offices.

The radiographic source and film rotate around the plane of interest, so that all other planes are blurred. The source often travels in a more complex elliptic motion for improved image clarity.

An occlusal film may be provided. It contains an overlaid drawing of the arch shape and numbered perpendicular lines corresponding to cross sections. When looking at an occlusal radiograph, remember that the patient's left is to the right of the film.

A radiographic template with radiopaque diagnostic teeth or metallic markers is useful for better localization, especially in larger edentulous spaces.

Computed tomography

The most advanced radiographic methodology for dental implant diagnosis is computed tomography (CT scanning).

Because of their large size and high cost, CT scanners are often located in hospitals or large radiographic centers.

The technology is different from the previous methods; it includes a radiographic source with circular movements, a digital receptor, and an advanced software reformatting process.

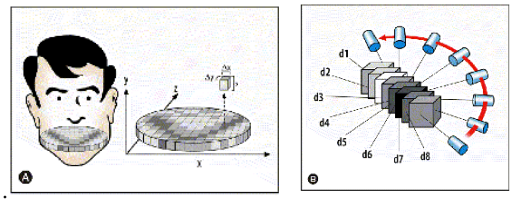
Measurements using CT scanning are more accurate than with any other radiographic method.

Patients lie down and remain still during setup and image capture. The result is a series of cross-sectional images, usually for a whole arch. The computer reformats these views to deliver cross-sectional, axial, and panoramic views.

The radiographic exposure is higher with computed tomography than with other radiographic methods.

Because of cost, radiation exposure, and complexity of referring patients to large centers, CT scans for dental implant diagnosis are ordered for advanced cases such as large restorations as well as those requiring extensive grafting procedures.

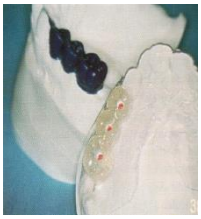
How CT does scan work? (A) The radiographic source and digital receptor rotate around the patient. For each position, the ray absorption is recorded. (B) Later, the computer software estimates the participation of each small unit to the overall absorption and assigns a gray value to the voxel. The length and width of a voxel depend primarily on receptor characteristics. Most CT scanners today render images With voxels that are not isotropic (eg,0.5 x 0.5 x 1mm)



IV-Cast examination

Articulated study casts allow measurements of many of the factors. The proposed replacement teeth can be positioned on the casts using either denture teeth or teeth carved in wax. The former have the advantage that they can be converted into a temporary restoration that can be evaluated in the mouth by clinician and patient. The diagnostic set-up therefore determines the number and position of the teeth to be replaced and their occlusal relationship with the opposing dentition.

Once the diagnostic set-up has been agreed by the patient and clinician, it can be used to construct a stent (or guide) for radiographic imaging and surgical placement of the implants. The stent/guide can be positioned on the original cast and, with reference to the radiographs, the clinician can decide upon the optimum location, number and type of implants



Treatment Plan

Restorative requirements of the patient is one of the keys for our treatment plan

Treatment plan include the following procedures:

I-Prosthetic options

II-Estimation of ridge width

III-Surgical template

IV-Implant selection

V-Provisional planning

VI-Financial considerations

VII-Patient information

Selecting a prosthetic design:

Prosthesis selection involves many decisions, and the principles of selection often depend upon the patient's condition. However, some considerations have wider applicability. In the first part of this section, we discuss the general principles of prosthesis selection. Later, the specific issues linked to particular types of cases are addressed.

General principles

A wide variety of prosthesis types exist, including both fixed and removable restorations.

The options for prosthesis selection differ in cases of partial edentulism and full edentulism.

Diagnostic casts and wax-ups are necessary for visualizing and selecting a prosthetic design. These can also be used during treatment presentation to help patients understand their condition.

General decision criteria

In addition to the specific criteria applying to particular conditions and prosthesis types, the following issues should be kept in mind in all cases.

Comfort level of the dentist and technician

Patient access to maintenance

Feasibility of repairs

Research-based design when available

Patient expectations

I-Prosthetic options

Implant prosthodontic treatment can be provided through

1-single crowns

2-fixed Bridge (Implant fixed restoration)

3-Overdentures

Ball and socket abutment

Housing inn the fitting surface of the denture

II-Estimation of ridge width

The presence of concavities/depressions (especially on the labial aspects) is usually readily detected. However, accurate assessment of the underlying bone width is difficult, especially where the overlying tissue is thick and Fibrous. This occurs particularly on the palate, where the tissue may be very thick, and can result in a very false impression of the bone Profile. The thickness of the soft tissue can be measured by puncturing the soft tissue with a calibrated probe after administering local anesthetic (ridge mapping).

Proclined ridge forms will tend to lead to proclined placement of the implants, which could affect loading and aesthetics**.**

1-Finger Examination:

-Least accurate

-Useful in detection of undercuts

2-Radiographs:

A- Occlusal films: not accurate as it gives the width of the whole bones not the ridge width.

B-Lateral cephlometric: not commonly used

C- CT scan or dental scan: gives real accurate results.

3-Ridge mapping:

Better suited for small edentulous spaces, ridge mapping is the clinical measurement of soft tissue at several coronoapical levels to assess bone width.

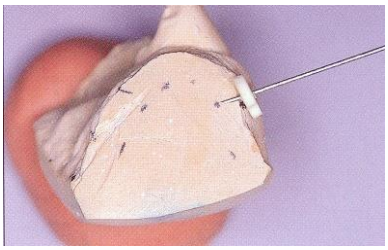
Take an alginate impression and pour with white stone. Section the stone bucco lingually in the middle of the edentulous space at the estimated location of the future implant.

Anesthetize the edentulous area.

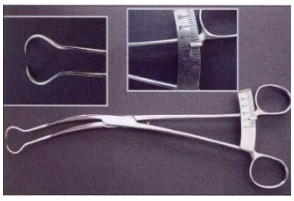
Apply a periodontal probe through the soft tissue at the mesiodistal location where the cast was sectioned. Repeat measurements at different coronoapical levels, starting 2 mm apical to the crest and recording every 3 mm on buccal and lingual sides. Three or four measurements usually suffice. Alternatively, an endodontic file with a stop may be utilized.

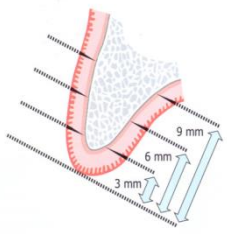
Record your measurements and later report them on the sectioned stone. Join the points with a red line;

this represents the osseous profile.



By using caliper





III-Surgical Template

Laboratory-made Surgical Guides

-A surgical guide is an acrylic appliance used during surgery that indicates the ideal placement of implants.

-It conveys the decisions about implant positions made during the diagnostic and treatment planning stages.

-Help in taking account of anatomical functional, esthetic, hygienic, and phonetic factors.

-Is made to locate -implant in bone- favorable position from prosthetic point of view.

-There are many methods of fabricating a surgical guide

Types according to patient condition:

1- Edentulous patient:-

-Patient existing denture or duplication

-Clear acrylic resin (heat or self cure)

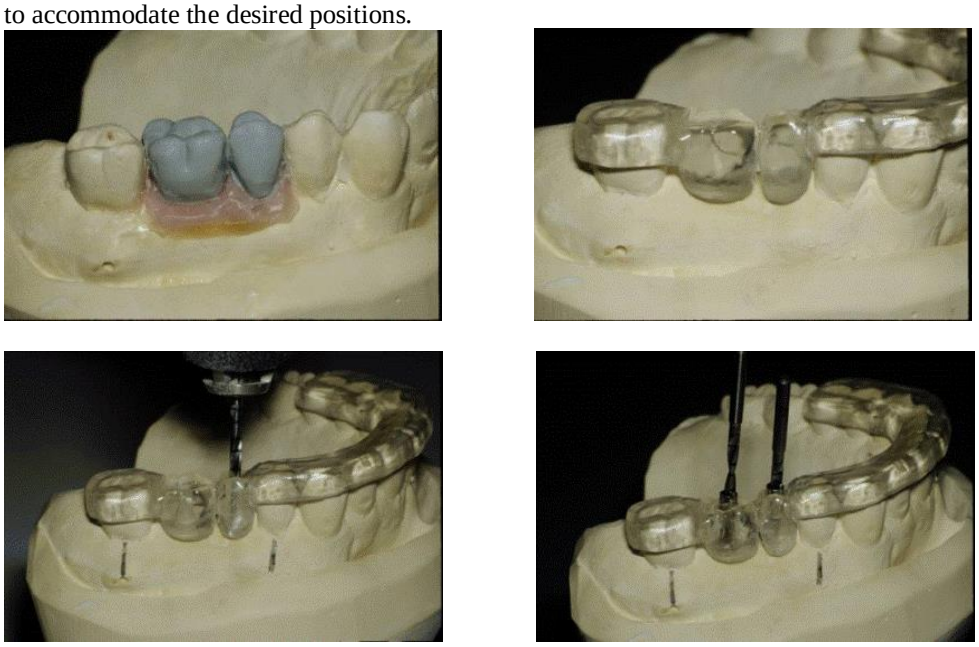
2-Partially edentulous patient:-

-A surgical guide can be fabricated by duplicating the diagnostic teeth or by reproducing the long axis of future restorations.

-It is also possible to save time by modifying a radiographic template into a surgical guide. -The less number of teeth restored the more critical implant position.

-In case of multiple anterior teeth, the template has to be tried in patient mouth to check esthetics and phonetics

-Acrylic stent is produced from the model used during fixture installation and drilling
-Help in taking account of anatomical functional, esthetic, hygienic , and phonetic factors.
-It is more difficult to provide a stable stent in an edentulous jaw. Under these circumstances the stent needs to be extended onto stable mucosa (which is more readily accomplished using the palate) but still allow access and retain stability once the muco periosteal flaps are raised. In completely edentulous jaws and long span edentulous spaces it is important to construct stents in a material that is sufficiently rigid to retain its shape; if it was flexible it would compromise implant positioning
-Providing a surgical guide does not guarantee the location of implants because bone may not be available to accommodate the desired positions.



(A) When possible, a full diagnostic wax-up is preferable in order to best prepare a surgical guide. (B) It is duplicated and (C, D) tubes are inserted in ideal locations to complete the surgical guide.

CAD/CAM Surgical Guides

Surgical guides can also be fabricated using computer aided design and manufacturing (CAD/CAM). The objective is to precisely transfer guide tubes into a guide according to preplanning performed using software.

There are two main CAD/CAM manufacturing methods:

1-3D printing and stereolythography, or computerized drilling. 3D printing uses printer-like units to project and polymerize layers of acrylic. Stereolythography is the use of polymerizing lasers to harden liquid polymers layer by layer.

2-Computerized drilling uses scannographic guides. They are used during scanning, and then later precisely positioned onto a drilling machine in order to perforate tubes according to planning.

Some commercial systems require double-scanning, which consists of scanning the patient with a scannographic guide, and then scan the guide alone. Both sets of data are later fused in order to obtain an accurate image of the guide.

Accuracy is sufficient to prepare well-fitting immediate provisional restorations or final prosthesis (special abutments are necessary to accommodate for small errors always present between planning and placement).

IV- Implant selection

1-Number of Implants

- Number of missing teeth

Full maxillary fixed bridge 6 implants

Full mandibular fixed bridge 5-6implants

Maxillary over denture 4 implants

Mandibular over denture 2 implants

- Available mesiodistal space (6-7mm)
- Type of bone

If patient is a bruxer, and missing both 1st and 2nd molars, use 3 implants to replace 2 molars.

2-Implant length

Implant length is selected according to bone availability.

Measurement from the crest to a vital structure will give an approximation of bone height.

For mandibular posterior areas, it is recommended to maintain the osteotomy at least 2 mm from the nerve.

Many implant drill systems extend 1.5-2 mm beyond the implant length (due to the shape of the drill tip). This means that implant length should be selected to be 4 mm shorter than the crest/canal radiographic distance.

If there is abundant bone, it does not mean an extremely long implant should be selected.

Longer osteotomies do not provide additional retention, and surgical cooling may be more difficult.

3-Implant diameter

Estimate the buccolingual ridge dimension prior to selecting a diameter, remembering that at least 1 mm of bone buccal and 1 mm of bone lingual of the implant must remain. For example, a 6 mm wide ridge is necessary to place a 4 mm implant.

The wider the implant, the more bone/implant contact.

Mesiodistal measurement also dictates the implant diameter. As a general rule, a distance of 3-4 mm between the edges of two implant platforms is necessary, and 1.5-2 mm from the implant to an adjacent tooth is required.

4-Type of Implant

-In routine cases it may not matter which system is chosen; this is particularly the case with treatment in the anterior mandible.
-The choice of a system in any particular case depends upon:
1- The aesthetic requirements

2- The available bone height, width and quality (including whether the site has been grafted)

3- Perceived restorative difficulties

4- Desired surgical protocol

5-Implant surface

When manufactured, implants possess a smooth surface. Smooth surfaces have been utilized extensively and successfully in the past.

The surface can be artificially roughened by acid-etching, plasma spraying, or a combination of both techniques.

There have been many improvements in implant surface engineering. Rough surfaces are recommended because of enhanced bone/implant contact.

Verify specific recommendations with the manufacturers. Some offer implant designs and surface preparations specific to bone quality.

6-Implant position

-For posterior teeth, implant angulations should allow the implant's long axis to emerge from the center of the occlusal surface.

-For anterior teeth, the implant should be aligned in such a way that the long axis is in line with the incisal edges of the adjacent teeth.

-Implant placement should not be compromised by lack of bone width. Bone grafting prior to placement is preferable to poor placement.

-The implant should not touch adjacent roots.

-Implants should be separated from adjacent teeth by a minimum of 1.5 mm from the platform edge to the root surface.

-Multiple implants should ideally be placed at least 3 mm apart.

-Multiple adjacent implants should be parallel whenever possible

• In the aesthetic zone, choose an implant where the crown contour can achieve good emergence from the soft tissue with a readily maintainable healthy sub mucosal margin.

• Choose an implant of the appropriate length and width for the existing crestal morphology.

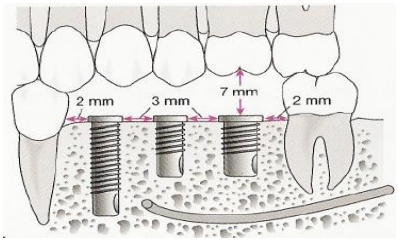
Ensure that choice of a reduced width implant does not compromise strength in the particular situation.

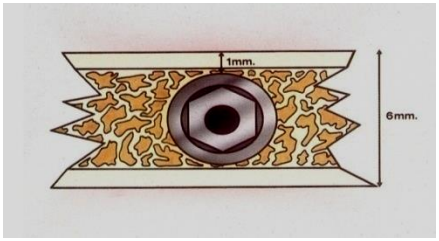
• If the site will only accommodate a short implant or if the bone quality is poor or grafted, then choose an implant with a roughened surface rather than a machined surface.

• If there are likely to be difficulties with prosthodontic construction due to difficult angulations of the implants, choose a system that is versatile enough to cope with these

Difficulties, i.e. has a good range of solutions/components.

• If you wish to use a submerged or nonsubmerged protocol, then choose a system that has a proven published record with that particular protocol.





In case of inadequate bone height

-Use wider and shorter implants

-ridge augmentation

Lateral repositioning of inferior alveolar Canal

-Maxillary sinus lifting

Advantages of increased implant length

-Increase implant-bone contact so better osseointegration

-Better crown root ration 1:1.5

Disadvantages:

-Possibility of interference with important anatomical structures

-Weakening of the bone

-Heat generation if drilling technique is used

Radiographic guide

USE OF TRANSPARENT SHEETS FOR IMPLANT SELECTION

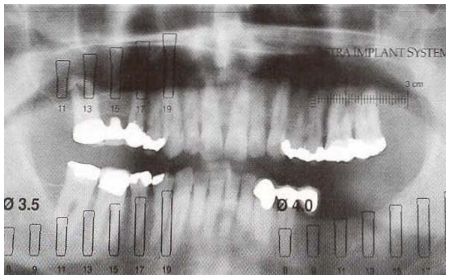
Implant companies provide transparent sheets on which implant selections are drawn.

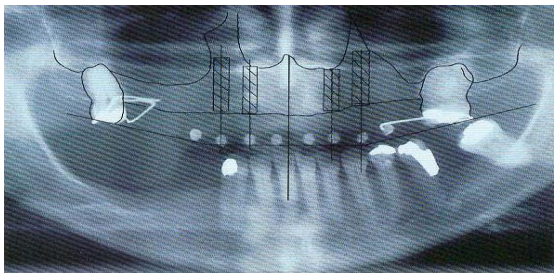
Drawings in a 1:1 ratio are provided, as well as various other distortion factors.

Select the ratio most closely related to the calculation, using a conservative number (rounding up the ratio).

Lay the mask on the radiograph so that the best implant size is in place.

When selecting an implant, remember that many implant osteotomies are prepared 1.5-2 mm apical to the implant length. Add 2 mm to account for distortion. Therefore, the planned implant apex must remain at least 4 mm coronal to vital structures.





V-Provisional planning

In case of edentulous patient:

Makes patient more satisfied.

1- Complete denture: Relief and relining by tissue conditioner

2- Transitional implants: one piece temporary narrow implant placed between permanent implants for a fixed restoration then we remove it after 2 months

Partially edentulous patient:

1- Removable partial denture and relief.

2- Resin bonded bridge

3- Mini implant

4- Using natural teeth after extraction for preservation of contouring of soft tissues

Removable partial denture is used to provisionally restore four missing anterior teeth during the grafting and implant integration period.

VI-Financial Considerations

1-Total cost

2-Possible additional costs

3- Are there any additional procedures that may be needed during the course of therapy and how much would they cost?

4- **Methods of payment**:

A-Check, credit card, installments
B-How many payments and when should each be made?
C- Any discounts for full payment before treatment
D- How much payment is required before treatment is started?

Determination of the definitive treatment plan

Following completion of the radiographic evaluation, ability of the treatment plan can be validated. The number, length and diameter of the implants can be finalized as can the design of the prosthesis. It is also possible to determine if bone grafting will be required to provide more bone height or width. When these decisions are made, it is possible to determine the cost of treatment, total time required to provide the treatment, the approximate number of appointments and the length of time required for each appointment.

VII-Patient information

Before starting the treatment, the entire treatment plan should be explained to the patient clearly.

1. A description of the proposed treatment.

2. The benefits of the proposed treatment.

3. Alternatives to the proposed treatment.

4. Common risks.

5. Limitations of the proposed treatment.

6. Consequences of not performing the proposed treatment.

7. Total cost.

8. Treatment Details/Time.

9. Type of prosthesis.

10. Provisional prostheses required.

Conclusion

-Implants should be placed only in suitable sites in appropriate patients
-Medical and dental contra indications must be fully considered before implant placement
-Most suitable radiographic procedures must be done
-Careful treatment plan using all available techniques
-A risk assessment is made of the various treatment options

Criteria for success of implant

-Clinically immobile

-No peri-implant radiolucency

-Vertical bone loss less than 2mm after than 1st year

-No pain, discomfort or infection

-Implant should allow placement of a restoration that is satisfactory to patient and dentist 85% success rate after 5 years-80% after 10 years

IDEAL BONE CONSIDERATION

1. 3-4 mm minimum distance between adjacent implants.
2. 1.5-2 mm minimum distance between implant and adjacent tooth.
3. Minimum interocclusal distance 6-8 mm to allow for prosthetic components.
4. 1 mm of bone on both the facial and lingual aspect of implant, allowing for a 4 mm diameter of implant body

Chapter 5

SURGICAL TECHNIQUES AND ANATOMICAL CONSIDERATIONS

Surgical technique & Anatomical considerations

Introduction

To carry out precise and successful implant surgery, a throughout knowledge of surgical anatomy and a clear view of planned prosthetic outcome are required. The surgical technique must be atraumatic as possible to both hard and soft tissues.

Loading protocols

-Conventional loading:

The prosthesis is attached in a second procedure after a healing period of 3-6 months.

-Delayed loading:

The prosthesis is attached for some reasons later than 3-6 months

-Early Loading:

The prosthesis is attached for some reasons earlier than 3-6 months

-Immediate loading:

The prosthesis is placed in functional dentition in 48 hours after implant placement

Submerged and non-submerged protocols

The terms submerged and non-submerged implant protocols were at one time clearly applicable to different implant systems.

The classic submerged system

Bone level implants are implants that are placed flush with the crest of the alveolar bone or even slightly below and this was a classical surgical feature of the traditional Branemark implants (countersinking was necessary then to sink the slightly wider implant head within the bone and have the cover-screw placed without protruding through the mucosa after flap closure. The literature ususlly refers to these implants as 2-piece implants as a transmucosal part (abutment) will then be connected to the implant to protrude through the mucosa to carry the restoration.This had several theoretical advantages:

1. Bone healing to the implant surface occurred in an environment free of potential bacterial colonization and inflammation.

2. Epithelialization of the implant–bone interface was prevented.

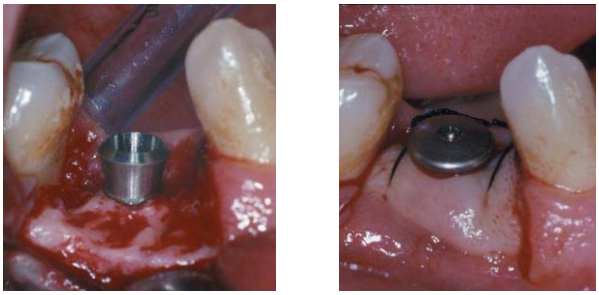
3. The implants were protected from loading and micromovement, which could lead to failure of osseointegration and fibrous tissue encapsulation.

The submerged system requires a second surgical procedure after a period of bone healing to expose the implant and attach a transmucosal abutment. The initial soft-tissue healing phase would then take a further period of approximately 2–4 weeks. Abutment selection would take into account the thickness of the mucosa and the type of restoration.

Non-submerged system

In this case the implant is designed with an integral smooth collar that protrudes through the mucosa, allowing the implant to remain exposed from the time of insertion.

The most obvious advantage is the avoidance of a second surgical procedure and more time for maturation of the soft-tissue collar at the same time as the bone healing is occurring. Although this protocol does not comply with the three theoretical advantages enumerated above, the results are equally successful.



The polished collar is above the crest of the bone. A closure screw has been placed on top of the implant and the flaps sutured around the collar to leave the implant exposed. This implant was designed to be used in this 'non-submerged' technique.

The main controversy between the two types is related to the presence or absence of a microgap at the implant-abutment interface. With the 2-piece implants (ie bone level implants) a gap exists between the implant and the abutment close the crest of the bone such as in the Branemark implants and their alikes, while with the one-piece implants (ie tissue level implants) the gap is shifted more coronally above the bone level such as in the Straumann implants. The significance of this microgap is said to be related to the amount of bone loss expected around these implants and now becoming even more controversial with the emerging platform switching concept.

Clinical considerations

Dense bone:

Dense bone (Type 1 & 2) requires careful attention to drilling with adequate irrigation in order not to overheat the bone. Care should be taken to debride the osteotomy site from bone debris and to widen the site to the manufacturer's recommended diameter prior to tapping the site.

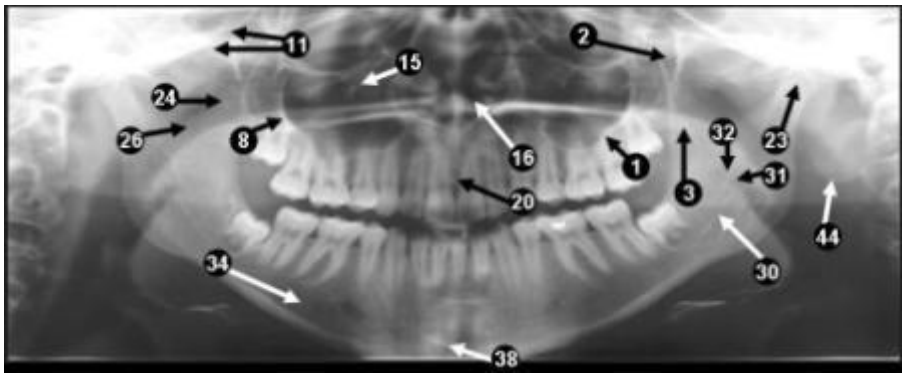
Placing the implant into too tight a site can lead to failure due to pressure necrosis.

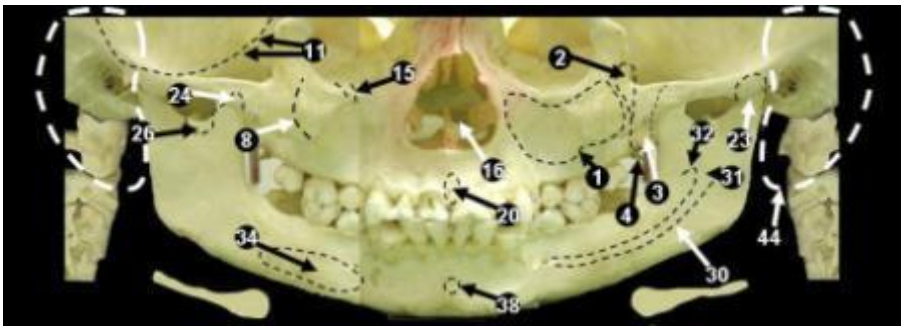
Softer bone:

Type 3 and 4 bone requires modification of the drilling protocol. Care must be taken to under prepare the osteotomy site. Over-preparation or inadvertent implant angulations changes can preclude placement of the implant.

Using the Osteotomes technique can also help initial stabilization by compressing the available soft bone instead of compromising the site with drilling.

Tapered implants have an advantage in softer bone due to the wedging effect at the time of placement.

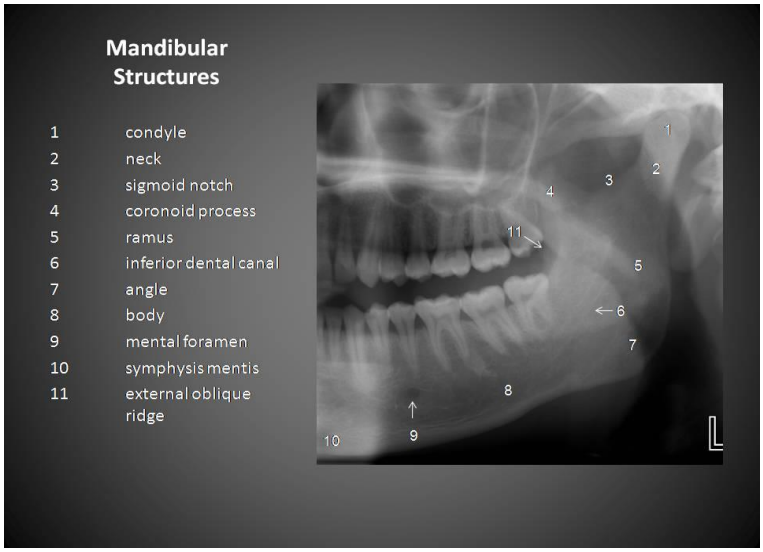




1-Maxillary sinus 2-Pterygomaxillary fissure 34Lateral pterygoid plate 4-Hamulus 5-Zygomatic arch 6-Articular eminence 7- Zygomaticotemporal suture 8-Malar process 9-External auditory meatus 10-Mastoid process 11-Middle cranial fossa 12- Lateral border of the orbit 13-Infraorbital ridge 14-Infraorbital foramen 15-infraorbital canal 16-Nasal Fossa 17-Nasal septum 18-Anterior nasal spine 19-Inferior concha 20-Incive foramen 21-Hard Palate 22-Maxillary tuberosity 24-Condyle 25-Coronoid process 25-sigmoid notch 26- Mesial sigmoid depression 27-Styloid process 28-Cervical vertebrae 29-External oblique ridge 30-Mandibular canal 31-Mandibular foramen 32-lingula mental foramen 33- mental foramen 34-Submandibular fossa 35-Internal oblique ridge 36-Mental Fossa 37-Mental ridges 38-Genial tubercles 39-Hyoid Bone 40-Tongue 41-Soft palate 42-Uvula 43-Posterior pharyngeal wall 44-Ear lobe 45-Glossopharyngeal air space 46-Naso pharyngeal air space 47-Palatoglossal air space

Anatomical considerations

Mandible



Inferior dental canal

-The position of the inferior dental canal can limit the implant placing in its area or even the Length of the implant.

So it is essential to locate the canal accurately to allow optimal length of the implant.

-This can be done by radiographs preoperative and even supplementary views during Operation.

 Allow for at least 2.0 mm above the superior aspect of the inferior alveolar canal.

 Due to resorption, implants here are usually shorter, and cannot engage cortical bone at their apex (implant length of 8-10 mm).

- Due to increased Occlusal forces, consider "over-engineering" (placing more implants than usual) to withstand the Occlusal load.
- Consider longer integration period (6 months)

Mental foramina

-It is the site where the inferior dental canal leaves the mandible usually between roots of premolars.

-Anterior to it we can place longer implant but we have to take care of the looping of the canal leaving a part of the inferior dental nerve anterior to the foramina.

- 5.0 mm anterior to the mental foramen, to allow for its normal course of up to 3 mm anterior to the mental foramen before turning posteriorly and superiorly to exit out of the foramen.

Submandibular fossa

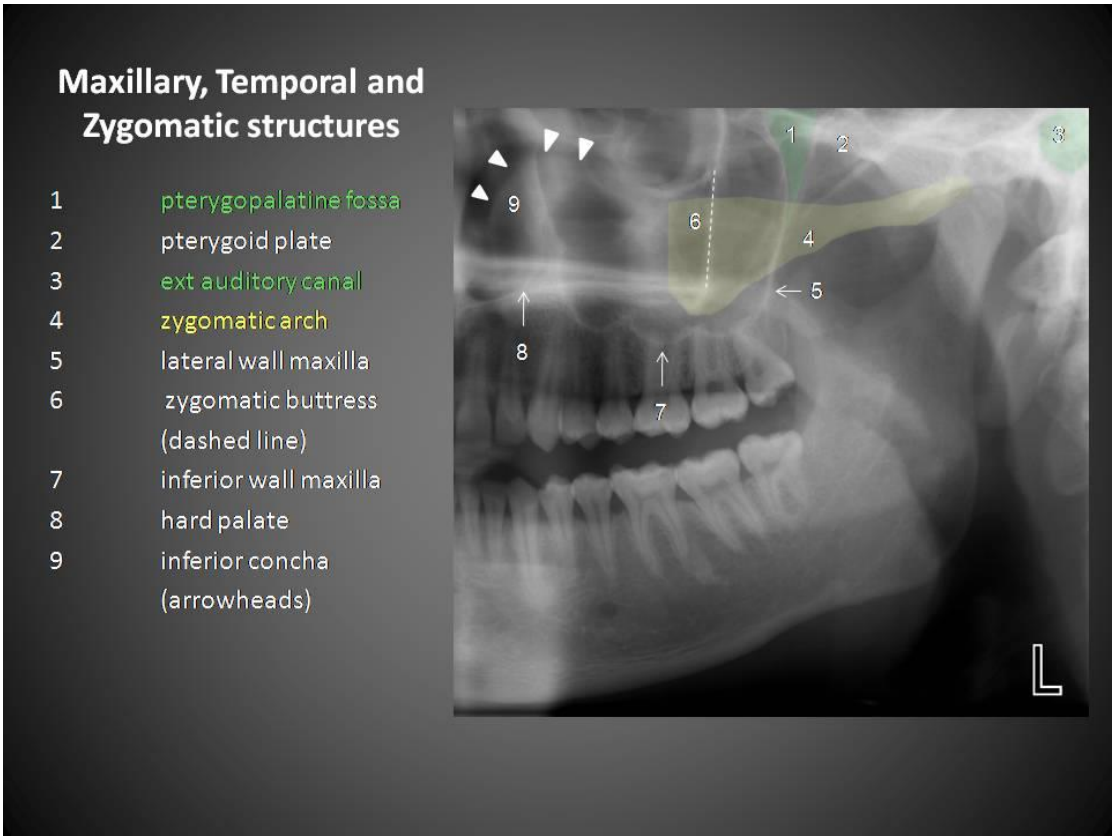
-Lingually positioned to the body of the mandible below the mylohyoid line.

-May limit the placement of implants especially in posterior section of the mandible as we can accidently perforate or penetrate it.

-Position can be easily palpated or through 3d scan.

-Facial artery loops over the Submandibular gland in the region of the first molar and gives a terminal branch in the form of submental artery which if damaged will causes profuse Bleeding.

Maxilla



Maxillary Antrum (sinus)

-Major limiting factor for the use of long implants in the posterior maxilla and frequently making Implant placement impossible without restoring bone height with bone augmentation procedures.

-1.0 mm of bone between the floor of the sinus and implant apex (adequate bone usually found between the nasal cavity and the maxillary sinus)

Incisive Canal

-In the midline of maxilla there is a neurovascular bundle within the incisive canal.

-If the implant encroaches this canal, soft tissue union can be expected in this area which may Influence the success of the implant.

Bone Quality

The anterior mandible is generally considered to be a good site , the posterior maxilla is The least favorable site for implant placement.

Proximity to nasal cavity
- Minimum of 1.0 mm between apex of implant and nasal vestibule. A missing maxillary anterior tooth often leads to resorption and a narrow buccolingual width. Defects often warrant grafting

Implant position

Sometimes we face Lack of harmony between bone position and tooth position

So we put the implant where there was a tooth.

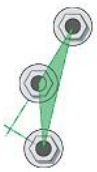
Anterior maxilla and mandible:

-Slightly palatal to artificial teeth

-Corresponding to missing teeth

-Multiple implants should be parallel.

Posterior maxilla and mandible:

-Same direction as occlusal force 

- In center of Occlusal surface
- On tripod design (offset configuration)

TWO STAGE ENDOSSEOUS IMPLANT SURGERY

First stage surgical technique

1. Pre operative patient preparation

2. Instrumentation

3. Anaesthesia

4. Flap design & incision

5. Flap elevation

6. Drilling of bone

7. Implant placement

8. Closure of the flap

9. Post operative care

10. Temporization

11. Healing

12. 2nd stage surgery

1- Preoperative patient preparation:

-Medical history

-vital signs (pulse, heart rate, temperature, respiration)

2-Instrumentation

• Good operating light.

• Good high volume suction.

• A dental chair which can be adjusted by foot controls or by a third party.

• An irrigation system.

• A surgical drilling unit which can deliver relatively high speeds (up to 3000 rpm) and low drilling speeds (down to about 10 rpm) with good control of torque.

• The appropriate surgical instrumentation for the implant system being used and the surgical procedure.

• Sterile drapes, gowns, gloves, suction tubing etc.

• The appropriate number and design of implants planned plus an adequate stock to meet unexpected eventualities during surgery.

• The surgical stent.

• The complete radiographs including tomographs.

• A trained assistant.

• A third person to act as a runner between the sterile and non-sterile environment.

3-Pre operative care, Anesthesia and analgesia

Basic preoperative care should include:

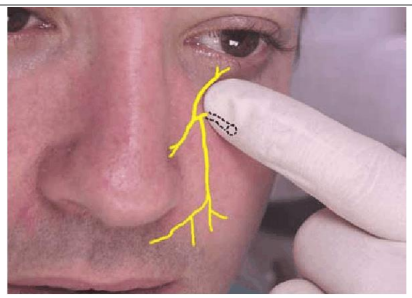
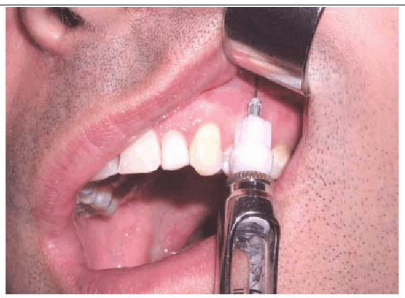
1. Antiseptic rinsing of the oral cavity and perioral skin. Chlorhexidine gluconate (2% or 1.2% proprietary rinses for 1 min) is recommended.

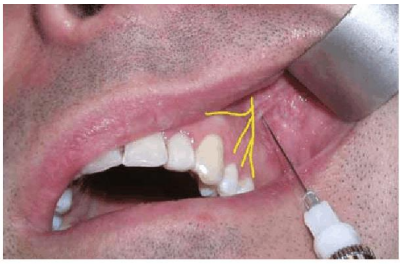
2. Administration of analgesics. Oral analgesics (such as 200 or 400 mg of ibuprofen or a comparable alternative) are usually sufficient in most outpatient cases. Control of pain is more effective if analgesics are given prior to surgery and the levels maintained to prevent development of severe pain.

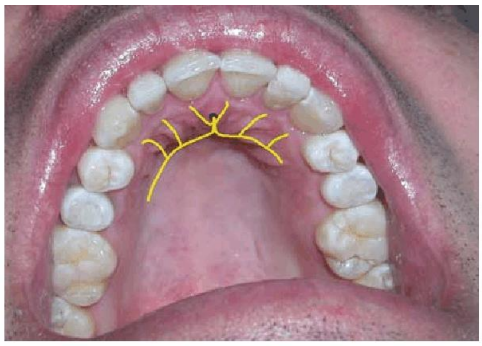
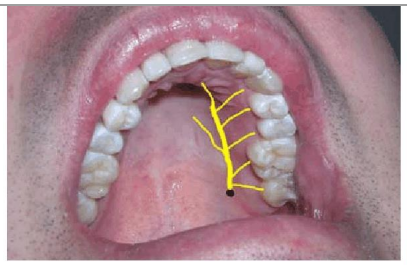
3. Administration of antibiotics. This used to be a routine procedure. Placement of one or a few implants under ideal circumstances probably does not warrant antibiotics. Where antibiotics are indicated (e.g. multiple implants where bone is exposed for long periods of time or grafting is carried out), the clinician could use a standard protocol (e.g. 3 g of amoxicillin preoperatively, followed by a 5-day course). Antibiotic and analgesic regimes will differ according to the status of the patient, the viewpoint of the clinician and the country where the treatment is being carried out

Most implant surgery can be carried out under local anesthesia, although some patients will require sedation or general anesthesia.

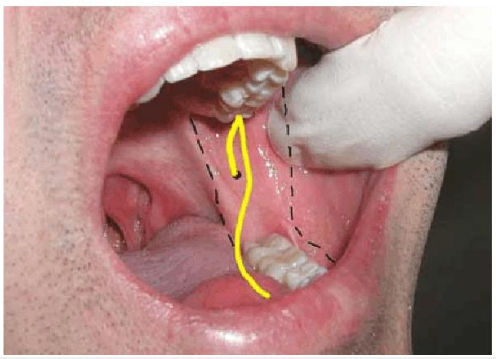
It is essential to use regional block anaesthesia (infra-orbital, palatal) and to supplement this during the procedure .Local infiltrations are also administered as they improve the anesthesia and more importantly control hemorrhage.

Technique / Nerve	Area of Anesthesia	Notes
Anterior Superior Alveolar n. (ASA)	Pulp and buccal soft tissue of the maxillary central incisor, lateral incisor, and canine.	Insert needle at the highest point in the muco buccal fold adjacent to the maxillary canine with the bevel facing the bone. Direct the needle toward the apex of the maxillary canine. Advance the needle 3-4 mm. Aspirate and inject anesthetic solution.
		
Middle Superior Alveolar n. (MSA)	Pulp and buccal soft tissue of the maxillary 1st premolar, 2nd premolar, and the mesiobuccal root of the first molar.	Insert the needle at the highest point in the mucobuccal fold adjacent to the maxillary 2nd premolar with the bevel facing the bone. Direct the needle toward the apex of the maxillary 2nd premolar. Advance the needle 3-4 mm. Aspirate and inject anesthetic solution.

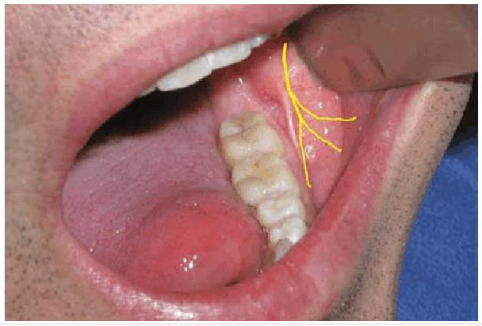
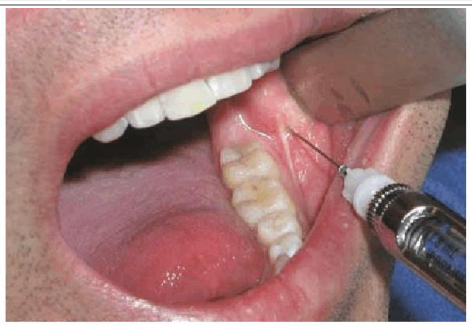
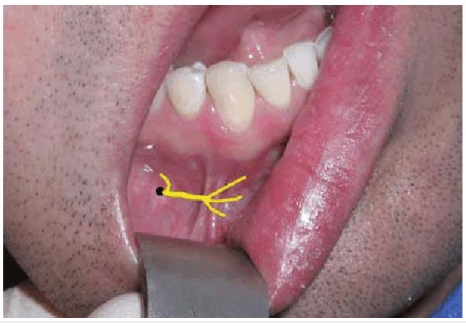
Technique / Nerve	Area of Anesthesia	Notes
 		
Posterior Superior Alveolar n. (PSA) **(Tuberosity or Zygomatic Block)**	Pulp and buccal soft tissue of the maxillary 1st molar, 2nd molar and 3rd molar in the maxilla (**Note**: Mesiobuccal root of the maxillary 1st molar should be anesthetized using the middle superior alveolar nerve block.)	Helpful if patient closes his/her mouth $^{3}/_{4}$ of the way. Locate the distal aspect of the zygomatic process. Position needle at a 45° angle to midsagittal and occlusal planes. Insert needle at the highest point of the vestibule posterior to the zygomatic process. Direct the needle posteriorly, medially, and superiorly. Advance the needle ~15 mm. Aspirate and inject anesthetic solution.
 		
Nasopalatine n.	Palatal gingiva surrounding the maxillary anterior teeth. Mucoperiosteum of the anterior ⅓ of the hard palate.	Apply pressure with a cotton swab adjacent to injection site. This will diminish the pain of the needle insertion. Insert needle at the lateral edge of the incisive papilla. Gently direct the needle medially and superiorly (usually 3-5 mm) until bone is contacted. Deposit ~0.2-0.3 mL of the anesthetic solution. There will be a resistance to the injection and the tissue should blanch. Alternative approach to minimize the discomfort of the nasopalatine injection: Give an infiltration of the maxillary central incisors, insert the needle into the interdental papilla between the central incisors and advance until you are close to the incisive canal and deposit anesthetic, continue with the nasopalatine injection.

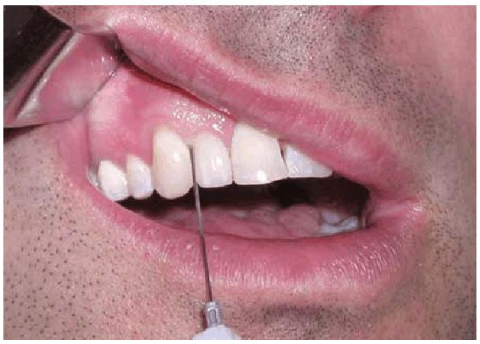
Technique / Nerve	Area of Anesthesia	Notes
 		
Greater Palatine n.	Palatal gingival surrounding the maxillary posterior teeth. Mucoperiosteum of the posterior ⅔ of the hard palate.	Use a cotton swab to locate canal (usually a depression located 3-4 mm anterior to the vibrating line, 1 cm medial to the junction of the 2nd and 3rd molars). Apply pressure adjacent to the injection site to diminish the discomfort of the needle insertion.
 		
Infraorbital n. (I.O.)	Pulp and buccal soft tissue of the maxillary central incisor, lateral incisor, and canine. Also the upper lip, lateral portion of the nose and surrounding tissues on the side of injection. The maxillary premolars will also be anesthetized if the anesthetic reaches the middle superior alveolar nerve.	Palpate the infraorbital rim until you locate a notch or slight depression indicating the zygomaticomaxillary suture - ~7 mm inferiorly is a depression indicating the infraorbital foramen. Keep a finger in place in order to provide protection against needle punctures of the eye. Position the needle at an angle parallel to the maxillary 2nd premolar. Insert the needle ~5-7 mm lateral to the maxillary 2nd premolar. Advance the needle ~10-15 mm toward the tip of your finger resting in the depression of the infraorbital foramen. The needle should slide over the canine fossa. (See Anterior Superior Alveolar n. (ASA)).
V-2 N, **Maxillary n.**	Anesthesia of a hemimaxilla; upper lip, cheek, infraorbital area, and zygomatic process.	Location - Pterygomaxillary fossa; maxillary division of the trigeminal nerve. The needle may have to be bent at the hub to aid insertion and advancement. Advance the needle up

Technique / Nerve	Area of Anesthesia	Notes
		the pterygopalatine canal (superiorly and posteriorly) 2-3 cm. Aspirate and inject anesthetic. If resistance is met during the injection, the needle is still in the canal and needs to be advanced.
		
Inferior Alveolar n. (IA)	Anesthesia of the mandibular teeth on the ipsilateral side of the midline associated buccal and lingual soft tissue, lateral aspect of the tongue on the ipsilateral side, and lower lip on the ipsilateral side.	Identify the coronoid notch and the pterygomandibular raphae. Three quarters of the anteroposterior distance between these two landmarks, and ~6-10 millimeters above the occlusal plane is the injection site. Bring the needle to the injection site from the contralateral premolar region. As the needle passes through the soft tissue, deposit 1-2 drops of anesthetic solution. Advance the needle until bone is contacted. Once bone is contacted, withdraw the needle one millimeter and redirect the needle posteriorly by bringing the barrel of the syringe towards the occlusal plane, medially, parallel with the ipsilateral quadrant of dentition. Advance the needle to $^{3}/_{4}$of its depth, aspirate, and inject $^{3}/_{4}$ of a cartridge of anesthetic solution slowly over the course of one minute. As the needle is withdrawn, continue to deposit the remaining $^{1}/_{4}$of anesthetic solution so as to anesthetize the lingual nerve.

Technique / Nerve	Area of Anesthesia	Notes
 		
Incisive n.	Anesthesia to the mandibular premolars, canine, incisor teeth, lower lip, skin of the chin, and buccal soft tissue anterior to the mental foramen.	Almost identical to the mental nerve block with one additional step (to anesthetize the Incisive, as well as the Mental n.). The target area is the height of the mucobuccal fold over the mental foramen. Identify the mental foramen as described below. Give the patient a mental nerve block as described below and apply digital pressure at the site of injection during administration of anesthetic solution. Continue to apply digital pressure at the site of the injection 2-3 minutes after the injection is complete to aid the anesthetic in diffusing into the foramen (see Mental n.).
Gow-Gates	Anesthetizes the auriculotemporal, inferior alveolar, buccal, mental, incisive, mylohyoid, and lingual nerves. Provides anesthesia to the ipsilateral mandibular teeth up to the midline, and associated buccal and lingual hard and soft tissue. The anterior two thirds of the tongue, floor of the mouth, skin over the zygoma, posterior aspect of the cheek and temporal region on the ipsilateral side of injection are also anesthetized.	The target area is the neck of the condyle below the area of insertion of the lateral pterygoid muscle. The insertion site of the needle will be just distal to the maxillary 2nd molar at the level of the mesiolingual cusp. Bring the needle to the insertion site in a plane that is parallel to an imaginary line drawn from the intertragal notch to the corner of the mouth on the same side as the injection. Advance the needle through soft tissue ~25 mm until bone is contacted. This is the neck of the condyle. Once bone is contacted, withdraw the needle one millimeter and aspirate. Redirect the needle superiorly and reaspirate. If aspiration in two planes is negative, slowly inject 1 cartridge of local anesthetic solution over the course of 1 minute.

Technique / Nerve	Area of Anesthesia	Notes
		
Vazirani-Akinosi Closed Mouth Mandibular Block	Provides anesthesia of the ipsilateral mandibular teeth up to the midline, and associated buccal and lingual hard and soft tissue. The anterior $^{2}/_{3}$ of the tongue and floor of the mouth are also anesthetized.	A useful technique for patients with limited opening due to trismus or ankylosis of the temporomandibular joint. The gingival margin above the maxillary 2nd and 3rd molars and the pterygomandibular raphae serve as landmarks for this technique. The patient should occlude gently on the posterior teeth. The needle is held parallel to the occlusal plane at the level of the gingival margin of the maxillary 2nd and 3rd molars. The bevel is directed away from the bone facing the midline. The needle is advanced through the mucous membrane and buccinator muscle to enter the pterygomandibular space. The needle is inserted to approximately $^{1}/_{2}$ to $^{3}/_{4}$ of its length. At this point the needle will be in the midsection of the pterygomandibular space. Aspirate and if negative, one cartridge of local anesthetic solution is deposited over the course of one minute. Diffusion and gravitation of the local anesthetic solution will anesthetize the lingual and long buccal nerves in addition to the inferior alveolar nerve.
		
Buccal n. **(Long Buccal n.)** **(Buccinator n.)**	Anesthesia of the buccal soft tissue of the mandibular molar region..	Identify the most distal molar tooth on the side to be treated. The tissue just distal and buccal to the last molar tooth is the target area for injection. The bevel of the needle should be toward bone and the syringe should be held parallel to the occlusal plane on the side

Technique / Nerve	Area of Anesthesia	Notes
		of the injection. The needle is inserted into the soft tissue and a few drops of anesthetic solution are administered. The needle is advanced ~1-2 millimeters until bone is contacted. Once bone is contacted and aspiration is negative, 0.2 mL of local anesthetic solution is deposited.
 		
Mental n.	Anesthesia of the buccal soft tissue anterior to the foramen, lower lip and chin on the side of the injection (No pulpal anesthesia should be expected).	The target area is the height of the mucobuccal fold over the mental foramen. The foramen can be manually palpated by applying gentle finger pressure to the body of the mandible in the area of the premolar apices. The needle is directed toward the mental foramen with the bevel facing the bone. Penetrate the soft tissue to a depth of five millimeters, aspirate and inject ~0.6 mL of anesthetic solution.
 		
Periodontal Ligament (Intraligamentary Injection)	Pulpal and soft tissue anesthesia to the individual tooth or teeth, and associated soft tissue to be treated.	The injection site is the sulcus between the gingiva and the tooth. An adjunct to the supraperiosteal infiltration or nerve blocks commonly used to achieve profound anesthesia of the treatment area.

Technique / Nerve	Area of Anesthesia	Notes
		
Local Palatal Infiltration	Hemostasis and anesthesia of the palatal tissue and teeth in the area immediately adjacent to injection.	The area of needle penetration is 5-10 millimeters palatal to the center of the crown of tooth to be anesthetized. Apply pressure directly behind the injection site with a cotton swab. Insert the needle at a 45° angle to the injection site with the bevel angled toward the soft tissue. While maintaining pressure behind the injection site, advance the needle and slowly deposit anesthetic solution as the soft tissue is penetrated. Advance the needle until bone is contacted. Depth of penetration is usually no more than a few millimeters. The tissue is very firmly adherent to the underlying periosteum in this region causing resistance to the deposition of local anesthetic. No more than 0.2 to 0.4 mL of anesthetic solution is necessary to provide adequate palatal anesthesia. Blanching of the tissue at the injection site immediately follows deposition of local anesthetic.
		
Supraperiosteal (Local) Infiltration	Anesthetizes any individual tooth or soft tissue in a localized area, especially the maxilla.	The supraperiosteal or local infiltration is one of the simplest and most commonly employed techniques for achieving anesthesia of the maxillary dentition. Identify the tooth to be anesthetized and the height of the

Technique / Nerve	Area of Anesthesia	Notes
		mucobuccal fold over the tooth. Retract the lip and orient the syringe with the bevel towards bone. This will prevent discomfort from the needle coming into contact with the bone and will minimize the risk of tearing the periosteum with the needle tip. Insert the needle at the height of the mucobuccal fold above the tooth to a depth of no more than a few millimeters and aspirate, inject ⅓ to ½ (0.6-1.2 mL) of a cartridge of anesthetic solution slowly, over the course of 30 seconds. Primarily maxillary dentition, although some practitioners claim excellent efficacy of Articaine/Septocaine infiltrating in the mandible, especially in children (use appropriate caution with Articaine). Contraindications include the need to anesthetize multiple adjacent teeth or acute inflammation and infection in the area to be anesthetized.
		
Intrapulpal Injection	Intrapulpal injection involves anesthesia of the nerve within the pulp canal of the individual tooth to be treated. When pain control cannot be achieved by any of the aforementioned methods, the intrapulpal method may be used once the pulp chamber is open. There are no contraindications to the use of this technique as it is at times the only effective method of pain control. A 25- or 27-gauge short needle is preferred for this technique. The patient usually experiences a brief period of significant pain as the solution enters the canal followed by immediate pain relief.	
Intraseptal Injection	Anesthetizes terminal nerve endings in the surrounding hard and soft tissue of individual teeth.	The intraseptal technique is a useful adjunct to the aforementioned techniques (supraperiosteal, PSA, MSA, ASA) and offers the added advantage of

Technique / Nerve	Area of Anesthesia	Notes
		hemostasis in the area of injection. The target area is the interdental papillae 2-3 mm apical to the apex of the papillary triangle. The syringe is held at a 45° angle to the long axis of the tooth with the bevel facing the apex of the root. The needle is inserted into the soft tissue and is advanced until bone is contacted. A few drops of anesthetic should be administered at this time. The needle is then advanced into the interdental septum and 0.2 mL of anesthetic solution is deposited. Resistance to the flow of anesthetic solution is expected and ischemia of the soft tissue surrounding the injection site will ensue shortly after anesthetic solution is administered.
		

General anesthesia (rarely)

Extensive surgery

In case of patient demand

4-Muco-perisoteal flap

Some surgical texts describe implant placement without flap elevation but this can readily lead to lateral perforation of the bone in inexperienced hands. It is more suited to single implant placement directly into extraction sockets, elevation should achieve complete exposure of the edentulous ridge, including any bone concavities and identification of important anatomical structures. The flap also should be closed easily with sutures under minimum tension, with incision lines based upon sound bone as in any good surgical practice.

Elevation of flaps is best accomplished using periosteal elevators with a fairly sharp edge, especially where the bone ridge is uneven. Fibrous and muscle attachments that tether the flap margins may need to be released by sharp dissection. Flaps should be elevated to allow good visualization of the ridge form but not excessive in opening tissue spaces unnecessarily. However, good reflection of the soft tissues on the lingual aspect of the lower premolars is advised because implant preparations in this area may inadvertently perforate the lingual plate in a natural concavity and

damage a branch of the sublingual artery. This can result in extensive bleeding in the unreflected tissue that is not noticed by the surgeon and results in a deep seated sublingual hematoma. This may present sometime within 24 hours postoperatively and has been reported to threaten the patient's airway. Before closure of the flaps it is important to check that there is no residual bone debris or clot beneath the flaps by careful irrigation with sterile saline and inspection with suction. The flaps are carefully closed with sutures of the surgeon's choice, either non-resorbable or resorbable. In most cases, simple interrupted no. 3/0 black silk sutures are satisfactory. Vertical mattress sutures are recommended by some operators where a more secure seal is required, e.g. over a grafted site. Finer no. 7/0 polypropylene sutures (as used in plastic surgery) are recommended by others, in which case a larger number are required and fine suturing instruments are mandatory. However, the most important factor is to ensure that the wound closure is free of tension. In difficult cases requiring flap advancement, periosteal releasing incisions, vertical relieving incisions and stabilizing sutures remote from the wound edges can be helpful. Firm pressure with moist packs should be applied to re-adapt the flaps and control bleeding.

Some modern modifications:

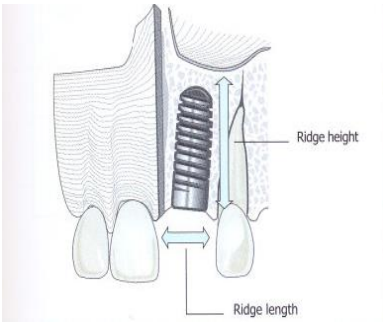
A- Crestal design: The incision is made along the crest of the ridge, bisecting the existing zone of keratinized mucosa.

B- Flapless approach: (will be discussed later)

Both approaches provide:

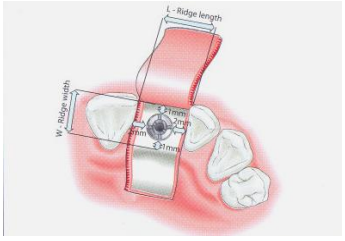
-less bleeding. -Easier flap management. -Less edema. -faster healing

-less vestibular changes postoperatively



The ridge length (L) represents the distance between the adjacent teeth. The ridge height (H) represents

The height of alveolar ridge available for an implant and corresponds to the length of an implant that could be used.



The ridge length (L), which has an impact on the implant diameter the width of the ridge (W), determines the diameter of the implant that can be used. The ideal ridge length and width have been estimated based on the most common implant diameter (approx.3.5mm). The estimated ridge length allows for up to l mm clearance from adjacent teeth and the minimum ridge width allows for 1mm thickness of bone on both the buccal and palatal sides of the implant

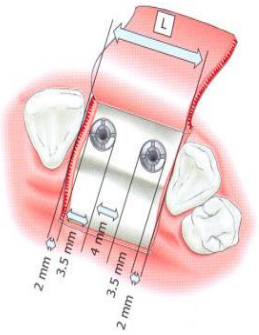


Diagram of the estimated minimum ridge length for two implants placed interdentally. A space of 7.5mm is considered suitable, allowing 2mm clearance between the adjacent teeth and implants and a 4mm clearance between the two implants.

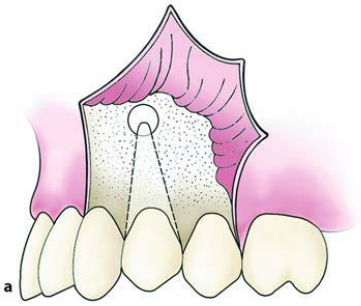
5-Flap elevation:

Types of flaps:

Trapezoidal Flap

The trapezoidal flap is created after a □-shaped incision, which is formed by a horizontal incision along the gingiva, and two oblique vertical releasing incisions extending to the buccal vestibule. The vertical releasing incisions always extend to the interdental papilla and never to the center of the labial or buccal surface of the tooth. This ensures a proper integrity of the gingiva, because if the incision were to begin at the center of the tooth, contraction after healing would leave the cervical area of the tooth exposed.
A satisfactory surgical field is ensured when the incision extends at least one or two teeth on either side of the area of bone removal. The fact that the base of the resulting flap is broader than its free gingival margin ensures the necessary adequate blood supply for the healing process. The trapezoidal flap is suitable for extensive surgical procedures, especially when the triangular flap would not provide adequate access.

Advantages.
Provides excellent access, allows surgery to be performed on more than one or two teeth, produces no tension in the tissues, allows easy reapproximation of the flap to its original position and hastens the healing process.
Disadvantages.
Produces a defect in the attached gingiva (recession of gingiva).



Triangular Flap

This flap is the result of an L-shaped incision, with a horizontal incision made along the gingival sulcus and a vertical or oblique incision.

The vertical incision begins approximately at the vestibular fold and extends to the inter dental papilla of the gingiva. The triangular flap is performed labially or buccally on both jaws and is indicated in the surgical removal of root tips, small cysts, and apicectomies.

Advantages

. Ensures an adequate blood supply, satisfactory visualization, very good stability and reapproximation; it is easily modified with a small releasing incision, or an additional vertical incision, or even lengthening of the horizontal incision.

Disadvantages

Limited access to long roots, tension is created when the flap is held with a retractor, and it causes a defect in the attached gingiva.

Envelope Flap

This type of flap is the result of an extended horizontal incision along the cervical lines of the teeth. The incision is made in the gingival sulcus and extends along four or five teeth. The tissue connected to the cervical lines of these teeth and the interdental papillae is thus freed. The envelope flap is used for surgery of incisors, premolars and molars, on the labial or buccal and palatal or lingual surface, and is usually indicated when the surgical procedure involves the cervical lines of the teeth labially (or buccally) and palatally (or lingually), apicectomy (palatal root), removal of impacted teeth, cysts, etc.

Advantages

Avoidance of vertical incision and easy reapproximation to original position.

Disadvantages

Difficult reflection (mainly palatally),great tension with a risk of the ends tearing, limited visualization in apicectomies, limited access, possibility Of injury of palatal vessels and nerves, defect of attached gingival

Reflection of the Muco periosteum

Reflection is performed to separate the mucoperiosteal flap from the underlying bone. The elevator is in direct contact with bone and reflection starts at the incision, usually at an angle, and is completed with gentle, steady strokes towards the labial or buccal vestibule, without damaging the tissues. When the attachment between bone and periosteum is strong or if symphysis occurs, then scissors or surgical blades may be used with a careful use of sharp periosteal elevator raise the flap till the bone is clear**.**

6-Drilling of bone (osteotomy)

Bone cells will be damaged irreversibly if the temperature is raised in the bone to 47°C for more than 1 min. Bone cell death will result in more extensive resorption and failure of osseointegration. This is avoided by:

• Careful cooling of the bone and drills with copious sterile saline

• Use of sharp drills

• Control of the cutting speed

Coolant is applied to the external surface of the drills or via the internal aspect in specially designed internal irrigation drills. The harder and more dense the bone, the more difficult it is to maintain adequate cooling. In situations where the bone is dense, the surgeon runs the risk of overheating the bone as the depth of the drilling increases. This can be minimized by accepting shorter implant preparations or by improving the cooling efficiency of the bone preparation. Drills are replaced regularly (20 preparations) and care is taken to ensure that the irrigant solution is not blocked in its passage to the working tip.

-Alveolar crest modification (roundation) using bone file or large size rose Head bur to smooth the bone surface. In all systems the implant site is prepared with small-diameter drills in the first place and then the site is gradually made larger with increasing diameter drills. In addition to minimizing heat production, the initial use of small-diameter drills also allows modifications to the initial angle or site of preparation when required. The drills should be sharp. This is easier to ensure using new disposable drills for each case.

The cutting speed of the drills during the main preparation of the sites is approximately 1500–2000 rpm. The flutes of twist drills may be clogged up with bone debris, and therefore it is important to withdraw them from the preparation site at regular intervals during the preparation process to wash away the debris and cool the drill.

7-Implant insertion

- Use the mount to insert the implant and never touch it with finger or gloves

- May need to use the ratchet wrench

- Then screw driver insertion

Ensuring good initial stability of the implant

The surgical preparation aims to provide an implant that feels stable following insertion. This can be judged by:

• Simple clinical evaluation (dependent upon operator experience)

• Torque insertion forces – these can be set on the drilling unit and are usually between 10 and 45 N/cm. Some units record the torque and provide a printout

• Periotest values – the mobility can be measured with an electronic instrument that was originally designed to measure tooth mobility

• Resonance frequency analysis – this latest device measures the stiffness of the implant within the bone through electronic vibration and recording

The last two methods have been used mainly in experimental studies but could find a clinical application. An implant that is loose within the prepared site will not osseointegrate. In the early phases of healing the implant must not be subjected to forces that will cause movement of the implant, even if the

movement is small. It has been suggested that micromovement up to 100 µm may be compatible with healing by osseointegration, but beyond this fibrous encapsulation is more likely to occur. It is not possible to offer comparative data between implants in this respect. However, various approaches can be adopted to ensure a stable implant with the different implant systems. Initial stability of the implant depends upon:

- 1. Length of the implant
- 2. Diameter of the implant
- 3. Design of the implant
- 4. Surface configuration of the implant
- 5. Thickness of the bone cortex and how many cortices the implant engages
- 6. Density of the medullary bone trabeculation
- 7. Dimensions of the preparation site compared with that of the implant

8- Suturing and post operative care

Patients should be prescribed appropriate analgesics, antibiotics if indicated and a Chlorhexidine mouth rinse. They should be advised to use ice packs to reduce swelling and bruising, which does not usually occur with simple cases. Postoperative pain should not be severe. Pain should not arise from the bone because this would indicate poor technique and damage, possibly leading to failure. Surgery close to the inferior dental nerve may result in transient altered sensation and the patient should be made aware of this possibility. In many cases patients are advised not to wear their removable dentures for 1–2 weeks in order to avoid pressure on the wound and implants. This requirement is probably still valid with implant surgery in the edentulous mandible. It is acceptable for the patient to wear a removable denture after surgery with placement of a small number of implants, where swelling is less likely and there is good wound and denture stability. However, the denture normally needs to be relieved and a soft lining added. The patient should be seen 1 week later for suture removal and further adjustment to their denture if required. Patients who are provided with a fixed provisional prosthesis have an advantage in this respect, but may need adjustment to the undersurface of the pontics to accommodate soft-tissue changes

Suture Material	**Absorption**	**Monofilament / Braided**	**Reactivity***	**Notes**
Silk	Progressive degradation (1-2 years)	Braided	++	Most commonly used material due to handling characteristics. Handles well, holds knot well, inexpensive. Natural protein from silkworm, treated with wax, silicone.
Polypropylene (Prolene®) (Surgilene®)	–	Monofilament	+	Very low tissue reactivity. High retained strength. Does not adhere to tissue. Requires extra throws to hold knot.

Suture Material	Absorption	Monofilament / Braided	Reactivity*	Notes
e-PTFE (Gore Tex®)	—	Monofilament	+	Excellent handling, knot holding characteristics. Very costly. Suture material of choice for periodontal regenerative procedures.
Gut	3-5 days, proteolytic enzymatic digestive process, complete @ 70 days	Monofilament	+++	Material is stiff, uncomfortable to adjacent mucosa. Keep moist when suturing. Do not use when extended approximation of tissue required. Does not hold knot well.
Chromic Gut	7-10 days, enzymatic breakdown complete @ 90 day	Monofilament	+++	Gut treated with chromium salts to resist breakdown. Material is stiff, uncomfortable to adjacent mucosa. Does not hold knot well. Keep moist when suturing.
Polyglactin 910 (Vicryl®)	65% @ 2 weeks 40% @ 3 weeks Complete @ 60-90 days	Braided	++	Synthetic copolymer of lactide and glycolide. Not as stiff as gut. Breakdown by slow hydrolysis.
Polydioxanone (PDS®) (Maxon®)	Maintains strength for 40-60 days with hydrolysis complete @ 210 days	Monofilament	+	Polyester polymer Absorbable suture material with little tissue reaction.

Suture Material	Absorption	Monofilament / Braided	Reactivity*	Notes
Polyglycolic acid (Dexon®)	Absorption complete @ 60-120 days	Braided	++	Breakdown by hydrolysis. Maintains high tensile strength intraoral use (16-20 days). Used dry, does not require straightening. Dexon Plus® has decreased tissue drag, decreased knot holding ability.

* Low reactivity = + High reactivity = +++

Suturing

Suturing of the surgical wound is necessary, aiming at holding a flap over the wound, reapproximating the wound edges, protecting underlying tissues from infection or other irritating factors, and preventing postoperative hemorrhage. Suturing may also aid in the following:

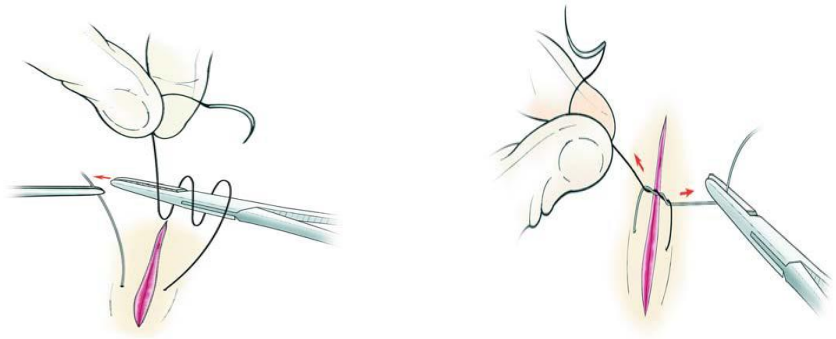
- When hemorrhage is present deep in the tissues and ligation is required or for ligation of a large vessel
- For laceration of soft tissues in general
- In cases of severe hemorrhage where the suture holds the hemostatic plug in place
- For infections, after the incision, for stabilization of the rubber drain at the site of incision
- For immobilization of pedicle flaps in their new position, etc

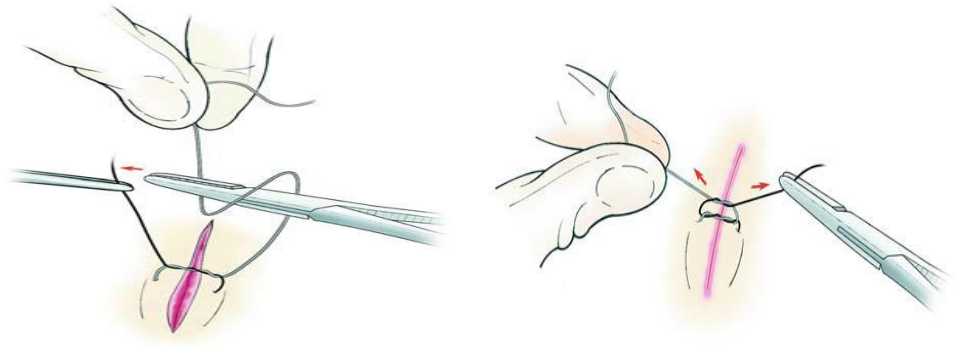
Suturing Techniques

The main sutures used in oral surgery are the interrupted, continuous, and mattress sutures.

Interrupted suture.

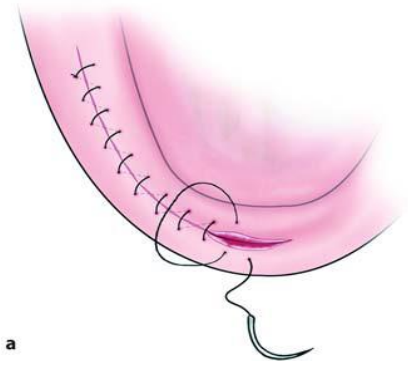
This is the simplest and most frequently used type, and may be used in all surgical procedures of the mouth. The needle enters 2–3 mm away from the margin of the flap (mobile tissue) and exits at the same distance on the opposite side. The two ends of the suture are then tied in a knot and are cut 0.8 cm above the knot. To avoid tearing the flap, the needle must pass through the wound margins One at a time, and be at least 0.5 cm away from the edges. Over-tightening of the suture must also be avoided (risk of tissue necrosis), as well as overlapping of wound edges when positioning the knot. The advantage of the interrupted suture is that when sutures are placed in a row, inadvertent loosening of one or even losing one will not influence the rest.



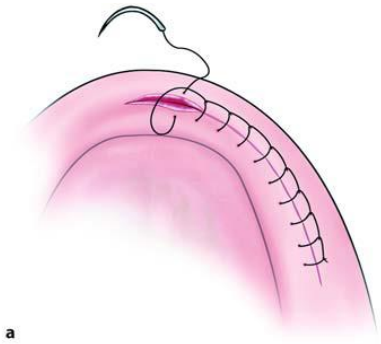


Technique of interrupted suture
Suturing of wound: Suture is initially wrapped twice around the needle holder the two ends of the suture are tightened to create a surgeon's knot over the wound (double knot) Safety knot, created by the single wrap of the suture in the counterclockwise direction as opposed to Tightening of the safety knot over the initial surgeon's knot

Continuous Suture
. This is usually used for the suturing of wounds that are superficial but long, e.g., for recontouing of the alveolar ridge in the maxilla and mandible.
The technique applied is as follows: after passing the needle through both flap margins, an initial knot is made just as in the interrupted suture but only the free end of the suture is cut off. The needle-bearing suture is then used to create successive continuous sutures at the wound margins. The last suture is not tightened, but the loop created actually serves as the free end of the suture. Afterwards, the needle bearing suture is wrapped around the needle holder twice, which grasps the curved suture (first loop), pulling it through the second loop the two ends are tightened, thus creating the surgeon's knot.
The continuous locking suture is a variation of the continuous simple suture. This type of suture is created exactly as described above, except that the needle passes through every loop before passing through the tissues, which secures the suture after tightening. Suturing continues with the creation of such loops, which make up parts of a chain along the incision.
These loops are positioned on the buccal side of the wound, after being tightened.
The advantage of the continuous suture is that it is quicker and requires fewer knots, so that the wound margins are not tightened too much, thus avoiding the risk of ischemia of the area. Its only disadvantage is that if the suture is inadvertently cut or loosened, the entire suture becomes loose.



** Continuous simple suture

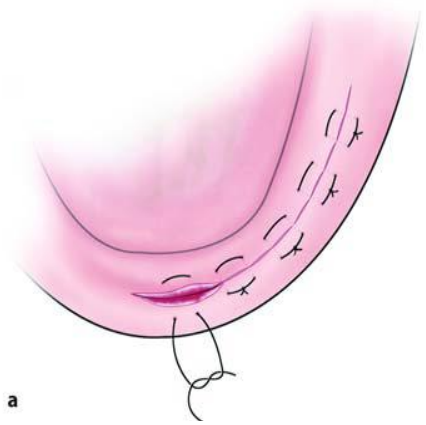


** continuous locking suture

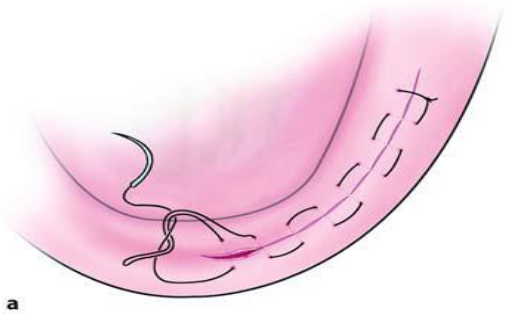
Mattress Suture

This is a special type of suture and is described as horizontal (interrupted and continuous and vertical. It is indicated in cases where strong and secure reapproximation of wound margins is required. The vertical suture may be used for deep incisions, while the horizontal suture is used in cases which require limiting or closure of soft tissues over osseous cavities, e.g., post extraction tooth sockets. Reinforcement of the mattress suture is achieved with insertion of pieces of a rubber drain.

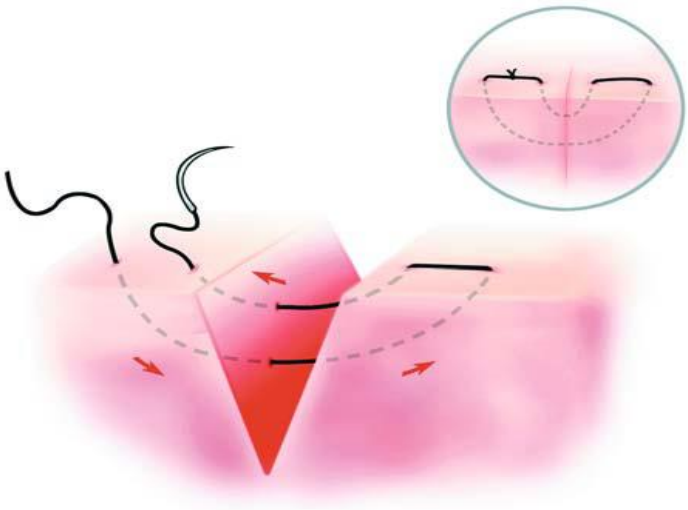
The technique used for the mattress suture is as follows: in the interrupted suture (horizontal and vertical), the needle passes through the wound margins at a right angle, and the needle always enters and exits the tissues on the same side. In the horizontal continuous suture, after creating the initial knot, the needle enters and exits the tissues in a winding maze pattern.
The final knot is tied in the same fashion as in the continuous simple suture.



*Horizontal interrupted mattress suture



* horizontal continuous mattress suture



Vertical mattress suture, used for deep incision

9- Postoperative care

- Antibiotics (amoxicillin,500mg)
- Patient should be asked to apply ice packs extra orally for the first 24 hours.
- Chlorhexidine gluconate mouth rinses should be used twice daily.
- Pain medication should be prescribed.
- Patient should have a liquid or semi liquid diet for the first few days &then gradually return to normal diet.
- Patient should also refrain from tobacco & alcohol use for 1 to 2 weeks postoperatively.

- Oral hygiene instructions should be given.

10-healing

-Period of undisturbed healing for osseointegration

-Softer bone needs more healing time

11- 2nd stage surgery

-Re- exposure of implant & attachment of healing abutment.

-Leave healing abutment 2 weeks in non esthetic surgery and 3 weeks in esthetic surgery.

-We use flap technique if we are not sure of implant position, if sure we just use a tissue punch

-In esthetic area we make T or cross shape incision to avoid loosing of soft tissues and gives better esthetics.

-Of course no interdental papillae so we use papillae regeneration technique in which we use the divergent healing abutment to create an interdental papillae.

-Early exposure of implants indicates crestal bone loss

Criteria of success of implant:

1-Clinical immobile

2-No peri-implant radiolucency

3-Vertical bone loss less than 0.2mm annually after 1st year

4-No pain or discomfort or infection

5-Implant should allow placement of a restoration that is satisfactory to patient and dentist.

Check successful osseointegration:-

1- X-ray (not definitive)

2- Absence of pain or mobility

3- Metallic ringing sound is heard when healing abutment is percussed with metal instrument

Timing of implant placement

Delayed implantation

3 or 4 months after tooth extraction

Advantages:

1-Allow bone and soft tissue to heal

2- Reduce infection risk

3- Reduce soft tissue complications

Disadvantages:

1- Ridge resorption

2-delayed tooth restoration

Immediate implant

-Immediate after extraction in fresh extracted socket but in condition:

1- Tooth free of infection

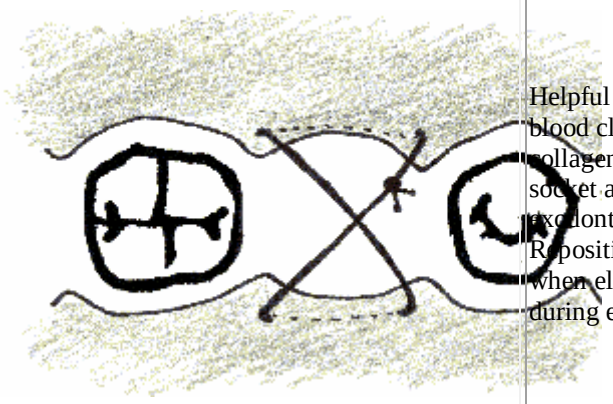
2- Implant longer & thicker than extracted tooth

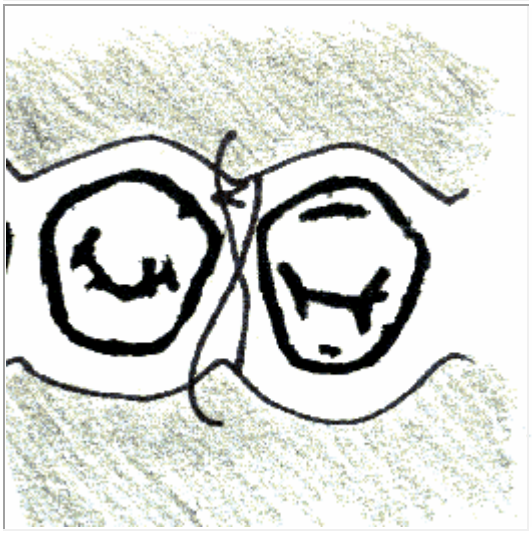
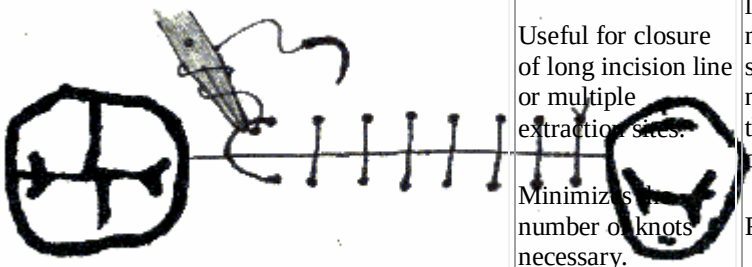
3- Good primary stability

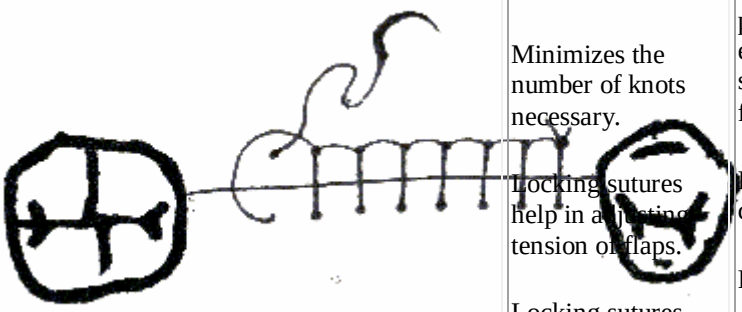
Delayed immediate

6-8 weeks after extraction

Summary

Single interrupted		Simple loop suture Most common suture technique. Coapts buccal and lingual flaps for primary closure.	Penetrate buccal flap at base of papilla. Pass under contact and thru inner surface of lingual flap. Pass under contact to buccal and tie off.
Criss-cross		Helpful to maintain blood clot and/or collagen sponge in socket after exodontia. Repositions papilla when elevated during exodontia.	Penetrate outer surface of buccal flap at base of papilla toward mesial of site. Penetrate inner surface of buccal flap toward distal of site. Cross over extraction site from distal to mesial and penetrate outer surface of lingual flap. Penetrate inner surface of lingual

			flap at distal. Cross to the mesial and tie off.
Figure-of-Eight (interproximal)		Coapts buccal and lingual flaps for primary closure. Suture material is left interposed between buccal and lingual flaps.	Penetrate buccal flap at base of papilla. Pass under contact. Penetrate lingual flap from outer surface. Pass under contact to buccal and tie off.
Continuous (Running)		Useful for closure of long incision line or multiple extraction sites. Minimizes the number of knots necessary.	Start with a simple interrupted suture. Tie knot and only cut short end. Penetrate the outer surface of the lingual flap 2-3 mm from initial suture and pass needle until it exits thru inner surface of buccal flap. Repeat. Leave loop at last suture to tie knot. **Note**: Pass suture farther than usual from wound margin to reduce chance of pull-thru.

Continuous Locking		Useful for closure of long incision line or multiple extraction sites. Minimizes the number of knots necessary. Locking sutures help in adjusting tension on flaps. Locking sutures also aids in preventing wound edges from everting.	Start with single interrupted suture. Tie knot and only cut short end. Penetrate buccal flap 2-3 mm from initial suture and pass needle until it exits thru inner surface of lingual flap. Pass under loop created. Repeat. Leave loop at last suture to tie knot. **Note:** Pass suture farther than usual from wound margin to reduce chance of pull-thru.
Vertical Mattress / Horizontal Mattress	**Interproximal** Vertical Mattress (lingual) Horizontal Mattress (buccal)	Can be used to apically or coronally reposition flaps. Useful when there is anticipated tension on the flaps (anticipated muscle pull). May be used as single suture or as continuous running suture. Everts wound margin when flaps are coapted for primary closure.	**Horizontal mattress:**Pass needle thru outer surface of buccal flap and thru inner surface of lingual flap. Penetrate.

PRINCIPLES OF SUTURING

- Suture from mobile tissue to fixed tissue, not the reverse.
- The knot should not be placed on the incision, tie the knot to the side - preferably on the buccal toward midline.
- The needle should be held in needle holder at right angle and enter tissue at right angle.
- Tissues should lie together passively, do not use sutures to pull tissue together.

- Tie the knot tightly, not the suture - tissues should not blanch.
- Sutures should be placed at least 2-3 mm from incision line or gingival margin to resist pull-thru.

KNOTS

Surgeon's knot	Two wraps around the needle holder followed by one wrap in the opposite direction. Securely holds knot.
Square knot	One wrap around the needle holder followed by one wrap in the opposite direction. Easy but may loosen.
Slip knot	One wrap around the needle holder followed by one wrap in the same direction. Permits tightening after knotting lock in place with one additional throw in opposite direction.

IMMEDIATE IMPLANT PLACEMENT

INTRODUCTION

The original Brånemark protocol advocated placing implants into existing edentulous ridges or extracting severely diseased teeth and placing the implants 6-12 months later, thereby permitting bone to form in the extraction sockets. However, starting in the 1980's, clinicians and researchers began to report the successful placement of titanium root form implants into bone sockets immediately after teeth were extracted and now both data and clinical experience are available.

-The concept of removing a tooth that is failing and replacing it with an implant which is brought into function immediately carries a tremendous attraction.

-Delayed loading of immediately placed implants is a very well established technique that has a high success rate.

-Immediate implant loading is to prognostically evaluate the tooth in question and ensure that it is only the tooth that is compromised and not the soft tissue or osseous form of the surrounding attachment apparatus.

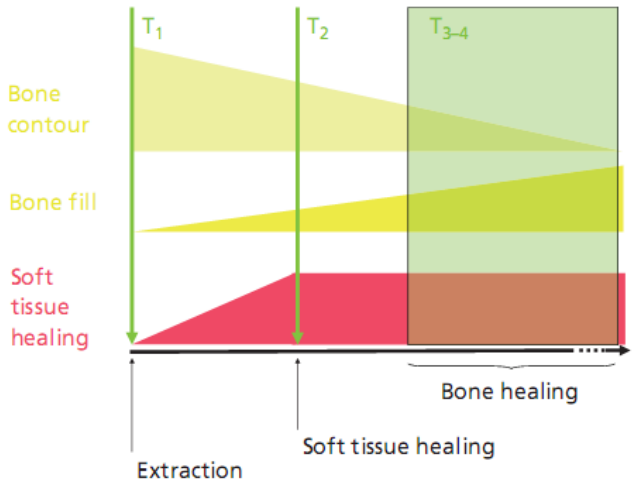
-Immediate implant placement is the placement of an implant at the time of extraction. It has the advantage of minimizing surgeries, but should be considered only when extraction sockets fit all necessary criteria. There are two main concerns with immediate implantation:

-The removal of single or multiple teeth will result in a series of alterations within the edentulous segment of the alveolar ridge. Hence during socket healing, the hard tissue walls of the alveolus will resorb, the center of the socket will become filled with cancellous bone and the overall volume of the site will become markedly reduced. In particular, the buccal wall od the edentulous site will be dimished not only in the bucco palatal direction but also with respect to its apico-coronal dimension (Pietrokovski & Massler 1967 ;Schropp et al 2003) .

-In addition to hard tissue alterations, the soft tissue in the extraction site will undergo marked adaptive changes.

-Immediately following tooth extraction, there is a lack of mucosa and the socket entrance is thus open. During the first weeks following the removal of a tooth, cell proliferation within the mucosa will result in increase of its connective tissue volume. Eventually the soft tissue wound will become epithelized and a keratinized mucosa will cover the extraction site. The contour of the mucosa will subsequently adapt to

follow the changes that occur in the external profile of the hard tissue of the alveolar process. Thus the contraction of the ridge is the net result of bone loss as well as loss of connective tissue.



Primary stability

After extraction, the implant must engage 5 mm or more bone, either apically (such as in the case of a lateral incisor), or horizontally (such as in the case of the inter-radicular area of posterior teeth).

Critical space

This is the distance between the implant platform and the edges of the extraction socket. It should be <2 mm.

For instance, an ideal candidate for immediate implant placement is a maxillary lateral incisor with a diameter similar to or narrower than a dental implant at the cemento-enamel junction. Posterior teeth possess a wider diameter, and often the critical space is exceeded when an implant is placed. In such cases, bone grafting around the implant is a possible treatment, although delaying placement may be a better option.

Extraction of teeth

To decide either extracting functional tooth or not the following points should be put in consideration:

-What is the prognosis and strategic importance of remaining teeth?

-Will the failure of a tooth jeopardise the case and needs extensive correction?

-Would leaving the tooth endanger adjacent implant?

-Would a good implant site become a bad if the tooth were left in place too long?

-Is the outcome of the implant treatment sufficient certain to justify the sacrifice of the tooth?

Timing of extraction

-It is necessary to decide whether the extraction and implant placement should be immediately or following a period of healing before implant placement.

-The period required for soft tissue healing is about a month

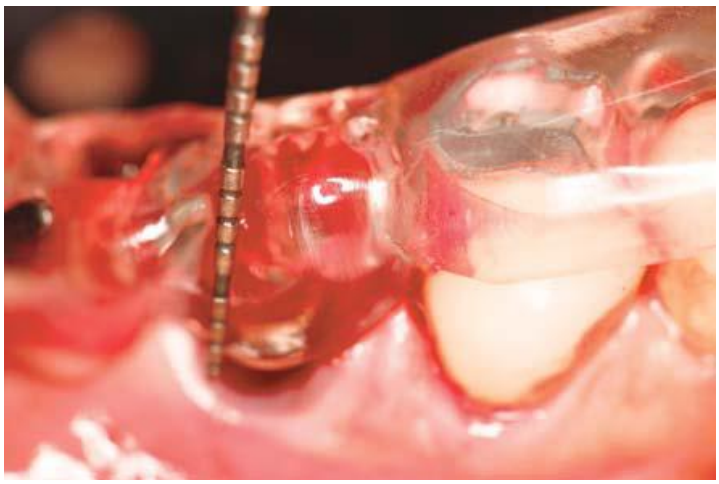
-Bone healing it is usually in excess of four months

The evaluation

Following tooth extraction, the dental implant treatment sequence is largely determined by the integrity of the existing hard and soft tissues. Careful assessment of the extraction defect is therefore paramount to the success of esthetic implant procedures. Extraction defect assessments can be made with or without flap reflection. Given the improved soft-tissue response with flapless procedures, assessment of the extraction defect in this manner will be more challenging but preferable. A surgical template that displays the position of the restorative margin of the future restoration is essential for this classification and used to guide assessments.

Following tooth extraction, a visual inspection of the socket bony walls is initially made. Recognition of the number of remaining socket walls and their condition is vital for this classification. Assessment of the gingival margin position and interproximal papillae and their relationship to the underlying alveolus is also vital. Classification of the periodontal biotype with associated risk assessment for potential recession is then determined. An additional important component of this evaluation also includes noting the degree of blood flow and potential for clot formation. A thorough debridement of the extraction socket and removal of all granulomatous tissue is performed and necessary to promote osseous repair -Mesial and distal interproximal papillae on each side facial free gingival margin.

-Extraction defect sounding is then performed. Using the tip of a conventional periodontal probe, the socket is thoroughly explored. Initially, the crest of the extraction defect is evaluated, noting the position of the crestal bone in relationship to the gingival margin, as well as to the future prosthetic gingival margin using the prefabricated surgical template . Any discrepancies between these two relationships should be noted.Periotome: The instruments are a cross between a miniscalpel and a tiny elevator inserted into the periodontal ligament space to sever the fibers that run from the cementum to the surrounding osseous tissues oscillating motion moving toward the apex the root.



The EDS classification uses a surgical template to make measurements to critical landmarks immediately following tooth extraction

The risk of soft-tissue recession is proportional to the distance between existing bone and soft-tissue; the more distant the position of the alveolus to the soft-tissues, the greater the risk of gingival recession. Sounding of the bony crest includes the buccal and palatal plates as well as the interproximal bone peaks. Further examination of the buccal plate is then performed. While applying slight digital pressure on the outer buccal plate, the periodontal probe explores the inner aspect. This evaluation will uncover any fenestration or dehiscence-type defects. In addition, when sounding the inner aspect of the socket with a

probe, any vibrations felt digitally will indicate a thin alveolar plate. A similar evaluation is also performed on the palatal plate. The thickness of the buccal plate is evaluated visually and digitally using a probe, as well as through manual palpation while sounding the inner aspect. A thin buccal alveolar plate often leads to partial or complete buccal plate loss following healing. When inadequate socket bleeding is present, perforations of the cribriform plate with a periodontal curette or rotary instrument is performed to facilitate wound healing.

EXTRACTION DEFECT SOUNDING CLASSIFICATION

By Nicholas Caplanis *et al*

The EDS, extraction defect sounding, classification describes the condition of the hard as well as soft tissues immediately following tooth removal, prior to healing and remodeling of the extraction socket and provides basic treatment guidelines to achieve predictable implant integration and esthetics. This classification only applies after the treatment decision has been made to remove a tooth and an objective evaluation of the extraction defect is made.

Extraction Defect

Type 1

The EDS-1 is characterized by a pristine, undamaged singlerooted socket, with a thick periodontal biotype in a systemically healthy patient. This defect allows for predictable immediate implant placement in a prosthetically ideal position. An atraumatic surgical technique is vital in preparation for immediate implant placement and is a unique and more time-consuming process in contrast to conventional extraction techniques. This involves the use of microsurgical instrumentation such as periotomes and other similar devices and an acute regard to the preservation of tissues during tooth removal. The EDS-1 has four intact bony walls including a crestal buccal plate thickness of 1 mm or more. With the surgical template in position and using the cervical margin of the future restoration as a reference, the gingival margin should be at the level or above the reference point and the alveolar crest should be no more than 3 mm beyond.

Periotomes used for tooth extraction without dilation of extraction socket

Type 2

The EDS-2 is any socket with up to a mild degree of crestal bone damage or interproximal tissue loss of 2 mm, with a thin or thick biotype, a buccal plate thickness of less than 1 mm, or any combination thereof, in a systemically healthy patient. No more than one socket wall is compromised. The EDS-2 includes fenestrations that do not compromise the integrity of the crestal aspect of the buccal plate, such as apical endodontic damage. Another example of an EDS-2 would include an ideal socket as defined by the EDS-1 that has a thin instead of thick biotype. A further example would include a single-rooted bicuspid socket where the distance between the restorative margin of the surgical template and the alveolar crest is greater than 3 mm but no more than 5 mm. All multiple-rooted sockets with any of the above conditions are considered EDS-2.

Type 3

The EDS-3 is broadly defined. It is generally characterized by moderate compromise of the local tissues in a systemically healthy patient. This includes a vertical or transverse hardand/ or soft-tissue loss of 3 to 5 mm, one or two compromised socket walls, a thick or thin periodontal biotype, or any combination thereof. With the surgical template in position and using the cervical margin of the future restoration as a reference, the gingival margin is positioned 3 to 5 mm away from this cervical margin reference point and the crest 6 to 8 mm away. This type of defect does not allow for routine immediate implant placement given the greater risk of recession, implant exposure, implant malpositioning, inadequate initial implant stability, or reduced bone-implant contact. Examples of an EDS-3 defect include any socket with a buccal plate dehiscence of 7 mm from the reference point. Another example would include a tooth with interproximal bone or soft-tissue loss of 4 mm.

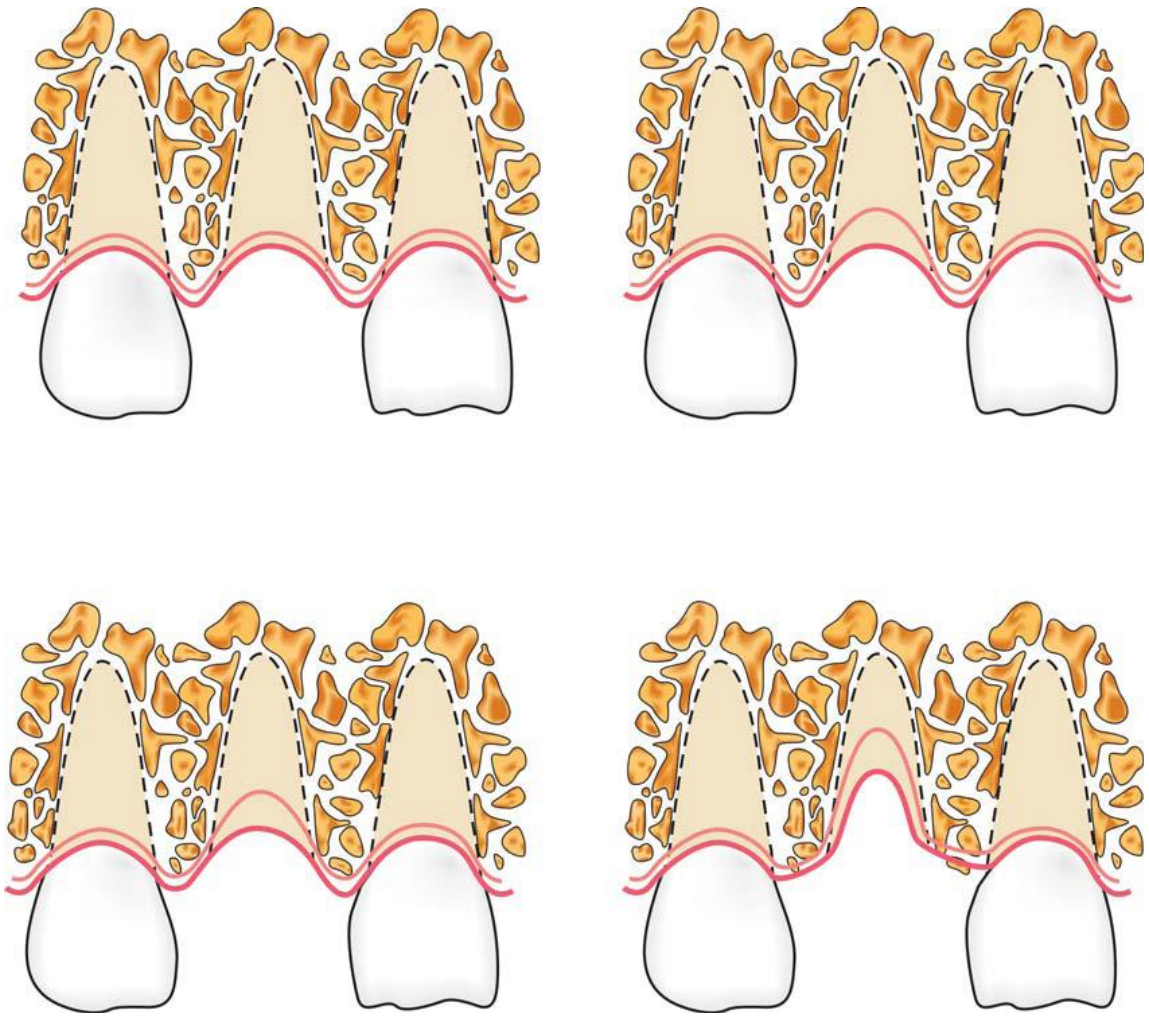
Type 4

The EDS-4 is characterized by a severely compromised socket with greater than 5 mm of vertical or transverse loss of hard and/or soft tissue, two or more reduced socket walls in a systemically healthy individual. The periodontal biotype in these situations is either thick or thin. Immediate implant placement in these situations is not possible without compromised implant stability or significant amounts of implant body exposure. Examples of an EDS-4 defect include sites with an extensive history of periodontal pathosis leading to a severely reduced alveolar housing with destruction of the buccal and palatal plates. Another example would include greater than 5 mm of interproximal bone loss between multiple-tooth extraction sockets. With the surgical template in place, the distance between the gingival margin and the restorative cervical margin exceeds 5 mm. The alveolar crest is positioned greater than 8 mm away from this reference point.

Nicholas Caplanis *et al*

Table 1. The extraction defect sounding classification

Defect type	*General assessment*	*Socket walls affected*	*Biotype*	*Hard tissue*	*Distance to reference*	*Ideal soft-tissue*	*Treatment recommendations*
EDS-1	Pristine	0	Thick	0 mm	0-3 mm	Predictable	Immediate implant (one-stage)
EDS-2	Pristine to slight damage	0-1	Thin or thick	0-2 mm	3-5 mm	Achievable but not predictable	Site preservation or immediate implant (one- or two-stage)
EDS-3	Moderate damage	1-2	Thin or thick	3-5 mm	6-8 mm	Slight compromise	Site preservation then implant placement (two-stage)
EDS-4	Severe damage	2-3	Thin or thick	≥ 6 mm	≥ 9 mm	Compromised	Site preservation then site development then implant placement (three-stage)



TREATMENT RECOMMENDATIONS

The recommended treatment protocol for the EDS-1 is immediate implant placement following tooth extraction. Ideal soft-tissue esthetics are predictable. When immediate implant placement is beyond the surgeon's level of expertise or comfort zone, a two-stage approach is advised as described for the EDS-2.

The recommended treatment protocol for the EDS-2 is a two-step implant placement approach with site preservation techniques performed at the time of tooth extraction . An immediate implant with associated defect repair procedures when indicated can also be considered, however; a greater risk of recession and implant exposure may occur. Site preservation involves atraumatic tooth extraction using periotomes or other microsurgical extraction instruments, thorough debridement of the socket including surgical manipulation to induce adequate bleeding, augmentation of the socket with appropriate biomaterials in order to minimize alveolar resorption, and the use of resorbable membranes to contain the graft and reconstruct missing bony walls including the alveolar crest. In addition, an interpositional connective tissue graft should be considered whenever a soft-tissue deficit is present or a thin periodontal biotype exists in order to enhance soft-tissue thickness or compensate for the thin biotype where recession is anticipated. Implant placement follows three to six months later allowing for adequate wound healing and graft remodeling. Ideal soft-tissue esthetics is often achievable but not always predictable for the EDS-2. The recommended treatment protocol for the EDS-3 is a two-step implant placement approach with site preservation techniques performed at the time of tooth extraction followed by implant placement three to six months later as described with the EDS-2. A secondary procedure to perform site development may be necessary in some situations. Ideal soft-tissue esthetics is achievable but not predictable in the EDS-3. A slight esthetic compromise involving minor interproximal tissue loss or marginal recession can be expected with the final restoration.

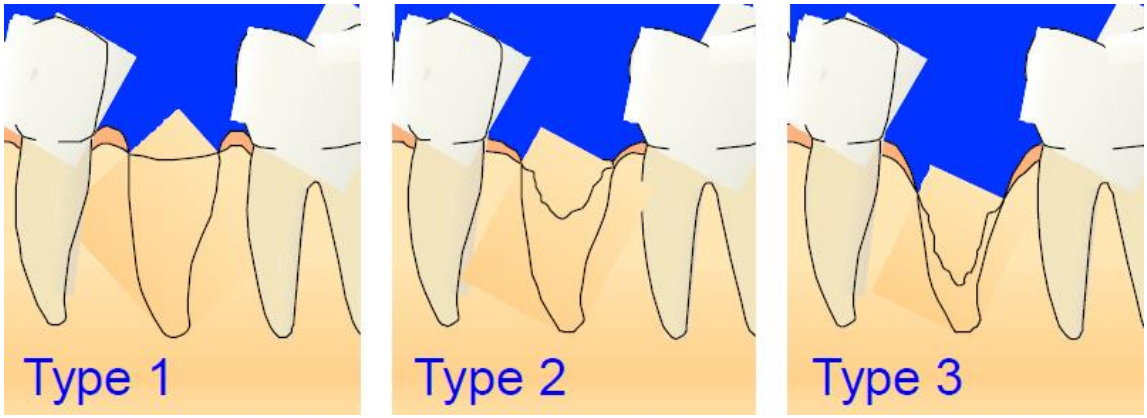
The recommended treatment protocol for the EDS-4 is usually a three-step implant placement approach . Site preservation is performed at the time of tooth extraction as for an EDS- 2 defect. Placement of a graft material serves to preserve the existing alveolus. A resorbable membrane is used to contain the graft and provide space for a modest regenerative response. The addition of a connective tissue graft will help enhance the soft tissue profile and prepare for future primary closure during the subsequent second-stage regenerative procedure. A site development procedure then follows approximately three months later allowing for adequate wound healing. The defect prior to this procedure is a combination-type defect with a loss in both height and width. Multiple site development procedures may be necessary for this type of defect.[21] Alternatively, a defect repair procedure can occur concurrently with implant placement following the principles of guided bone regeneration. However, the quantity of bone developed around the implant and degree of implant integration of this regenerated bone may be less predictable than a staged approach. The use of autogenous bone for site development in either block or particulate form, or combination is preferable for these challenging defects. When autogenous bone is used in particulate form, membranes are beneficial in order to stabilize the graft, preclude soft-tissue invagination and provide space for regeneration. A connective tissue graft is once again performed in order to enhance soft tissue esthetics, as well as to minimize the risk of premature wound dehiscence and graft or membrane exposure. A three- to six month healing period is required prior to the subsequent surgical procedure necessary for implant placement. Ideal soft-tissue esthetics is usually not achievable in the ED-4. A minor to moderate compromise involving modest interproximal tissue loss and/or marginal recession can be expected.

Salama classification of the extracted site

According to this classification, the tooth to be extracted has two definitive zones-the defect at the coronal aspect of the tooth that extends coronally from the osseous crest and the socket that extend apically from the base of the defect towards the root end. Three types of extraction sites and their implant treatment modalities are present:

Pre-operative classification of extraction sites (Salama & Salama)

	Bone dimensions	*Discrepancy between implant head and neck of adjacent teeth*	*Gingival recession*	*Esthetics*
TYPE 1	4- or 3-wall socket Minimal resorption Sufficient bone beyond apex	Acceptable	Manageable	Not essential
▲ Ideal for immediate implant placement				
TYPE 2	Bone dehicence >5mm	Substantial	Significant	Essential
	▲ Orthodontic extrusive augmentation required			
TYPE 3	Inadequate vertical & buccolingual bone	-	-	-
	Recession & severe loss of labial bone plate			
	Severe circumferential & angular defects			
▲ Not suitable for immediate implant placement				



Requirements for Immediate Total Tooth Replacement:

The osseous tissue and the soft tissue should not be affected, and should provide native bone in the socket and beyond for primary stability the form of the soft tissues and the restorative gingival interface should be in harmony with the adjacent teeth and not compromised. Implant length should be at least 11 mm. the use of wider diameter implants to provide maximum primary stability (40 n/cm)

ADVANTAGES OF IMMEDIATE PLACEMENT

1-Placing an implant at the time the tooth is extracted helps preserve the remaining bone and decreases the need for subsequent ridge augmentation procedures.

2-More ideal implant positioning is possible.

3-The number of surgical procedures is reduced.

4- Reduction of the total treatment time.

5-The overall cost is reduced.

6. Soft tissue contours and height are better preserved in esthetic zones.

8. There is better acceptance of the treatment plan by the patient.

9. The opportunities for osseointegration are better due to the healing potential of

Fresh extraction sockets.

10-Bone healing around immediately-loaded implants results in greater bone density

Clinical complications

It has been stated that implants should not be placed when purulent exudates is present and immediate implants are contraindicated in the presence of acute/sub acute periodontal or periapical infection.

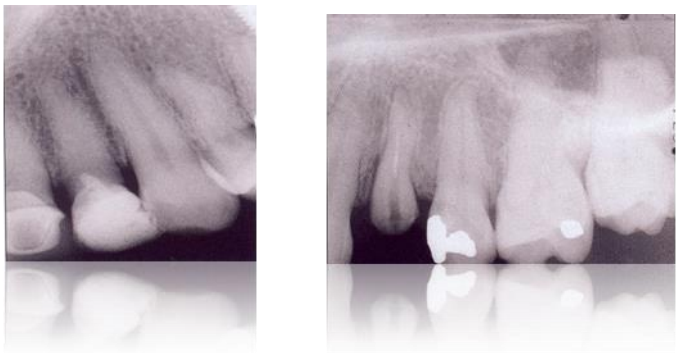
1- Premature implant exposure through the soft tissue.
2- post-operative inflammation
3- Post-operative infections.
4- Membrane exposure before Stage 2 surgery.
5- Bony dehiscence/perforation of the bony housing during site preparation.

6- Parasthesia.

Clinical protocol

1-Absence of Pathology

There should be no acute pathology resent in either the periodontal tissues or in the periapical region



2-Antibiotic Coverage

Taking 2 grams of a broad spectrum antibiotic one hour before surgery and continue with 1 gram/day for 5-7 days after surgery.

3-Extraction/Osteotomy

-Careful extraction so as to preserve surrounding bone.

-The usual osteotomy procedures are completed so the implant engages the walls of the extraction socket.

-Due to differences in the morphology of roots and implants, the implant may not achieve intimate contact with the incisal/Occlusal aspect of the bony socket.

- Extraction forceps with fine beaks may be used in addition to root elevators.

Periotome whose fine blade enables the tooth to be separated from the socket by severing the periodontal ligament.

4-Site Selection

The aim is to obliterate as much of the socket as possible with the implant without perforating the labial or the lingual plate and without damaging any of the adjacent teeth

5-Osteotomy Preparation

A small round bur or a position marker is used at the beginning of the procedure to determine the centre of the osteotomy.

The diameter of the osteotomy is then enlarged until it matches the core diameter of the implant.

Implants must be placed 3.0 to 5.0 mm beyond the apex in order to gain a maximal degree of stability. In cases of multi-rooted teeth, the implant can be placed in the interseptal bone. If prosthetically manageable, it can be placed in the maxillary palatinal socket and in the mandibular mesial or distal socket.

6-Implant Insertion

The implant should be inserted below the bony crest (l.5mm)

7-Horizontal Implant-to-Bone Gap

The gap appears to be a factor that can affect osseointegration. However, the distance where problems are regularly encountered has yet to be identified.

8-Use of Membranes

When there is an incisal/Occlusal space between the implant and surrounding bone or When the implant is not fully encased in bone, membranes have often been used to generate new bone. Greater bone formation occurring when the membranes were left in position until Stage 2 surgery.

-Autogenous bone without a membrane gives clinically and statistically significant amounts of bone formed around the implants.

-The membrane prevent the fibrous Tissue healing from soft tissue above the extraction or osteotomy site

9-Apical Implant Extension

-It is very important to achieve primary stability of the implant in bone by extending the implant apical to the apex of the tooth root by drilling between 3-5 mm apical of bone to the tooth apex is essential to ensure engagement of the implant threads into 3 millimeters of bone.

10-Soft Tissue Coverage

-Primary closure of the soft tissue over the implant has been regarded as one of the important and desirable aspects of immediate implant placement. But in some case this will be difficult because of lack of enough soft tissue after tooth extraction.

11-Use of Chlorhexidine

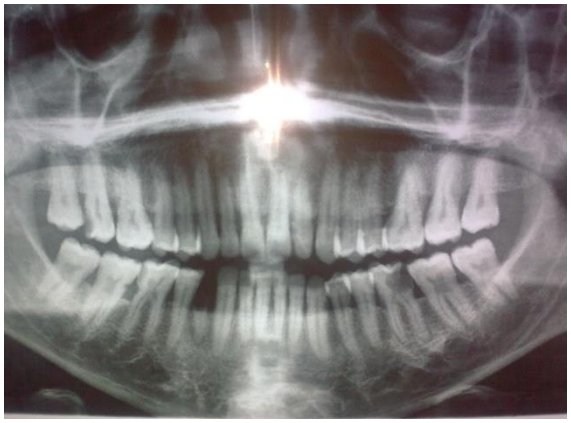
-The use of Chlorhexidine rinses has been recommended until the sutures are removed.
-Premature implant exposure apply 1% Chlorhexidine gel topically applied twice daily from the time of surgery until restoration.

12-Healing Period

-Same healing period as conventional method, placement of healing abutment during healing period gives better esthetic.

Important notes

- Socket of extracted premolars are more wider bucco lingual than mesio distal so we may need bone graft
- In lower molars we use one wider implant or 2 small implants



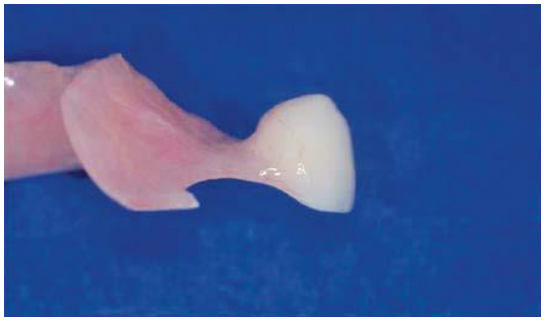
Inflammation and purulence

If any purulent exudate is present during the course of surgery, the implant placement and/or grafting procedures are not carried out. A delayed procedure is utilized instead. According to some authors, the presence of an asymptomatic apical granuloma or cyst is not necessarily a contra indication to an immediate insertion of an implant, but if there are any signs of active inflammation or infection, this must be treated prior to implant surgery. Antibiotic therapy is initiated whenever there is evidence of acute infection.

Special attention must be given implants placed next to natural teeth that are periodontically involved or in patients who are prone to periodontal disease. The same applies for patients under anti depressive treatment. According to studies undertaken so far, a dysfunction of granulocytes might be the cause since, apparently, it prevents a continuous hemidesmosomal epithelial attachement.

PROSTHESIS-GUIDED TISSUE HEALING

Following tooth extraction, classification of the defect and recommended treatment protocols, development and maintenance of esthetic soft-tissue architecture is essential. Interim prosthetic devices are useful in order to manipulate and guide soft-tissue healing and esthetics following tooth extraction and subsequent site preservation and development procedures (Figs 6A and B). These devices include custom healing abutments and ovate pontic designs incorporated within fixed and/or removable interim prostheses. Ovate pontic designs are beneficial in preserving or establishing esthetic soft-tissue emergence profiles following site preservation or development surgery. After creating a master cast to fabricate the provisional, surgery is performed on the cast, removing the stone teeth to be extracted, and then creating a concavity within the model, partially simulating the extraction defects. Ovate pontics apply maintenance pressure on the gingival margin and interproximal papillae, minimizing the tissue collapse following tooth extraction. They can be incorporated within fixed as well as removable transitional restorations either chairside or in the laboratory using conventional acrylic or composite. The ovate pontic surface should extend 2 to 3 mm within the extraction defect and apply facial but not apical pressure on the free gingival margin. It should only apply slight lateral pressure on the existing interproximal papillae and also provide room for coronal enlargement of the papilla to accommodate for inflammation. When removable provisionals are employed, they should include positive rest seats and adequate retention to prevent excessive compression of the extraction defect,augmentation materials and associated tissues.



Profile of a removable transitional appliance with an ovate pontic design

An ovate pontic can guide tissue healing and help improve soft-tissue esthetics

Immediate Loading

Over the course of 30 years of experience in implant dentistry, the authors had the opportunity to observe long-term success and failure with various techniques and devices. An inescapable conclusion is that mobility determines the interface. When implants have been placed using atraumatic surgical techniques with no detectable mobility at the time of placement and have been stabilized so that no forces were exerted to cause movement during function, osseointegration and a favorable long-term prognosis usually have been achieved.

Blade type implants were loaded and placed into function immediately since they had a fixed abutment post as part of the implant. When placed in good quality (Type II) bone, stable fixation and long-term survival generally resulted. When placed in poor quality (Types III or IV) bone, they were less stable at the time of insertion. Movement during the healing phase sometimes resulted in fibrous tissue encapsulation, soft-tissue change, bone loss, and eventual implant removal.

The introduction of two-stage submergible blade implants helped eliminate the possibility of early implant loading that would cause movement, especially in poor quality bone. As a result, implant survival rates began to rise. When root-form endosseous implants were developed, the concept of placing them atraumatically and allowing them to heal out of function became accepted as the best way to promote osseointegration.

In fact, the successes achieved by this approach made it tempting to embrace it as the only acceptable one. In recent years, however, when site conditions allow, a number of practitioners have once again begun placing implants using a one-stage procedure that is, placing the implants so that their coronal portion protrudes through the soft tissue and a second surgical exposure is not necessary.

The conditions necessary for achieving superior success rates when placing endosseous root-form implants in a single-stage procedure are analyzed, as well as subsequent refinements to this approach, namely loading the implant at the time of placement and placing the implant without soft-tissue flap reflection. Case studies illustrating these approaches are included.

Immediate loading is the placement of a final prosthesis shortly after implant placement, typically at the same visit or within 24 hours.

The prosthesis is placed in full occlusion.

Progressive Loading

Progressive loading is similar to immediate loading, but describes the placement of a provisional restoration.

The prosthesis is made of a resilient material, such as acrylic. It can be fabricated out of occlusion.

Progressive loading provides instant functioning, as well as an esthetically pleasing result.

It is theorized that placing load on the bone surrounding the implant progressively provides a better guarantee of implant survival; however, at the present time, little evidence supports this concept.

Johensson & Albrektssan journal of oral and maxillofacial prosthesis 1987:

Advocates of delayed loading allow necrotic bone at implant-bone interface (following osteotomy) to be replaced by new bone capable of load bearing. So delayed loading is therefore recommended.

Piattelli Et at 1997 reports success in immediate loading in mandibular or maxillary implants. 60-70% bone- implant contact was found after 8-9 months of loading.

Table **Definitions of immediate loading**

Review	Definition of immediate loading	occlusal vs non-occlusal loading	No. of studies	Follow-up	Level of evidence
Aparicio 2003	within 72 hrs	full occ contact	consensus	N/A	5
Cochran 2004	within 48 hrs	full occl contact	N/A	N/A	5
Attard 2005	not defined	not defined	not specified	N/A	5
Glauser 2006	within 24 hrs	not defined	17	>12 months	5
Nkenke 2006	within 72 hrs	full occl contact	5	>12 months	1a
Wang 2006	within 48 hrs	clin judgement	consensus	N/A	5
Esposito 2007	within 1 week	same	8	6–12 months	1a
Jokstad 2007	not defined	not defined	22	>12 months	1a
Cooper 2007	same visit	clin judgement	N/A	N/A	5

Drawbacks from Premature loading

-Premature loading is not a problem, the problem is the micro motion at bone-implant interface damaging fibrin clot & vascular structures that are part of early stage of bone healing

-Healing process changes into repair process by collagenous scar tissue instead of bone regeneration.

-Normally we make a second stage in implant treatment when the implants are submerged (to allow period of undisturbed healing)

-In immediate loading there is no second stage which means it's a single stage implant procedure

-Immediate loading of implant is as predictable as delayed loading in mandibular and maxillary arches. Horiachi et al 2003

-It's yet unknown predictability is approached. Esposilo et al 2003

Early implant loading

- Loading after 1 month
- 93% success rate
- After 3 rd week of loading osseous healing start.

Factors affecting immediate loading

1-Patient selection

Patient has to be ideal for implant placement from medical, psychologically, financially and dental (no periodontal disease – favourable crown/root ratio)
Patient has to understand limitation of immediate loading and willing to help and follow instruction.
An understanding of the patient needs & expectation is an essential factor for success

2-Bone quality and quantity

1ry stability is a success key for immediate loading so:
-Better quality of bone for immediate loading is type 1 and type 2 bone.
-Posterior maxilla better to be avoided as success rate is 66% only
-Primary stability in immediate loading must not be less than 30 n/cm .

In cancellous Bone

Poor bone quality (Type 4) often found in the posterior maxilla is associated with higher failure rates. When softer bone is encountered, a revised drilling protocol is employed, designed to enhance primary stability by underpreparing the site. This may involve reducing or avoiding tapping; avoiding countersinking to maximize cortical bone contact; engaging both cortices for bicortical stabilization; under

preparation by using narrower drills than the usual protocol; the use of osteotomes; self-tapping threaded implants and different geometries of implant design for increased compression of the site.

Compact bone

Compact type 1 bone (determined by resistance of initial drill):

Screw the implant in place very slowly

Go with initial drill till the full length

Use of bone expanders in combination of normal drilling technique to get better stability

Most studies support conventional drilling protocols for placement of implants in the anterior mandible. Generally, authors agree that the quality of bone is significant for success in immediate loading. However, there have been no studies that have specifically tested this hypothesis

The number of different protocols and techniques has led to a level of heterogeneity that is difficult to compare and on which to reach definitive conclusions. The prudent experienced clinician is entrusted to treat each patient individually depending on the bone quality encountered, being cognizant of the need to attain a high initial stability of the implant. A high level of clinician experience and competency has been emphasized as necessary for immediate loading protocols.

3-Implant surface area

Increased surface area leads to better bone implant contact and so primary stability .So Increase number of implants which increase support also Increase diameter and length of implants.

No data exist to support the superiority of implant length or implant diameter, however most authors have stipulated a minimum length of 12 mm for immediately loaded implants. Increased length is important especially in extraction sites to engage apical bone, engagement of cortices for bicortical stabilization and an increased area of bone compression where under preparation of the site is employed. Concurrent use of a larger diameter implant for increased surface area has been suggested for the same reasons. These concepts have less importance in sites with a large cortical component.

4-Implant selection

Implant design:

-Cylindrical: widely used, needs modification of drilling technique to get better primary stability by drilling at least 2 sizes of drills smaller than the implant size

-Tapered: better in immediate loading and specially in maxilla as it has a wedging effect and expanding soft bone resulting in getting better primary stability

Screw type implants have shown a significant superiority compared to press-fit implants because their design allows a greater initial bone contact, i.e., within the threads and a mechanical locking to achieve initial stability. Therefore, the threaded implant does not require osseointegration to resist load. This is obviously more important in the immediate loading context.

Implant surface more surface treatment better primary stability and quicker osseointegration

5-Implant placement

-Bone preparation with minimal trauma

-Be sure to have enough primary stability

-May combine immediate placement in fresh extraction socket with immediate loading but be sure you have a primary stability not less than 30 n/cm

6-Prosthetic consideration

-Totally avoid cantilever
-Torque the final abutment at time of implant insertion
-Splint implants together
-Passive fit restoration
-Good crown/root ratio, not more than 1/1.5
-Out of occlusion in case of single unit loading
But in case of multiple implants or full arch advice patient for soft diet intake.

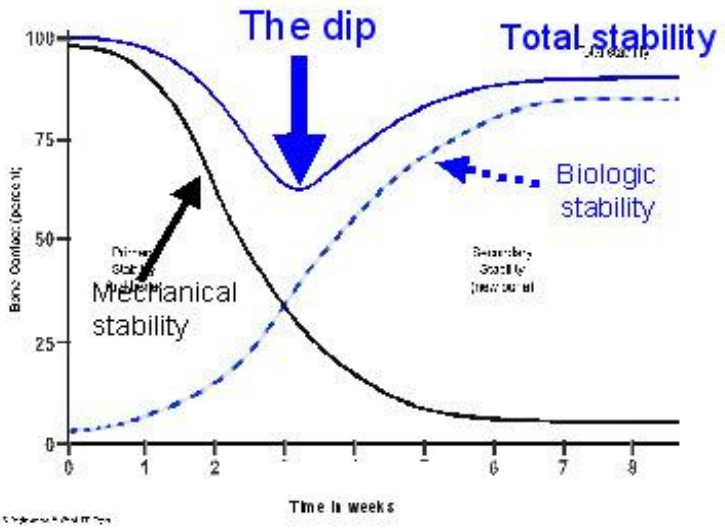
7-Patient instruction and education

-Patient must care about his oral hygiene.
-In case of bridge of full arch restoration, patient must follow soft diet program for first 3 months
-Mouth wash and regular checkup each month

Biological basis of immediate loading

(1) Factors affecting osteogenesis (bone formation)
(2) Factors affecting peri-implant osteolysis (bone resorption)
(3) Micromotion effects on peri-implant osteogenesis.

Osteogenesis is time dependent so the maintenance of implant stability is critical. The initial stability of the implant reduces in the first 3–6 weeks after placement due to remodelling and an increased ratio of woven to lamellar bone. The implant bone interface thus becomes more susceptible to the effects of micromotion. The threshold at which osteogenesis will be detrimentally affected is generally considered to be 150 lm. Clinically, this can be minimized with rigid splinting of implants where applicable and the reduction of occlusal load.
Oxidized surface implants have shown to be beneficial in reducing loss of stability in comparison with machined surface implants.[18] Modified surfaces are recommended in most reviews. This effect is postulated to be due to an increased surface area and hence greater bone to implant contact and stabilization of the blood clot and fibrin network, thereby initiating contact osteogenesis in comparison to distance osteogenesis, i.e., apposition to the old bone of the osteotomy toward the implant. This is particularly important in soft bone that has a reduced capability to resist mechanical load .



Marginal tissue response

Stable peri-implant tissues involving marginal bone levels and soft tissue contours over time are decisive for long-term success. A systematic review of marginal soft tissue at implants subjected to immediate loading or immediate restoration reported that within the limits of the evaluated data, it can be cautiously concluded that once immediately loaded or restored implants integrate successfully, they appear to show a soft-tissue reaction with regard to peri-implant area as well as morphologic aspects comparable with those of conventionally loaded implants. However, follow-up periods are generally short, number of implants per study are few, and most studies present only limited data on peri-implant soft tissue evaluation. More accurate long-term studies with a stronger study design reporting more detailed treatment and follow-up protocols are required to allow proper comparisons and conclusions. Because of the lack of long-term data, questions regarding whether peri-implant health, prosthesis stability, degree of bone loss, and aesthetic outcome of immediate implants are comparable with implants placed in healed sites remain unanswered.

Minimal invasive flapless surgery

The surgical placement of dental implant has undergone changes since the beginning of placement of root form implant. The establishment of peri-implant soft tissue contours with intact papillae and gingival margins is a major esthetic concern, especially for patients whose maxillary anterior gingiva is visible when they smile or speak. Recent studies have shown flap elevation often results in gingival recession and bone resorption around natural teeth. The flapless implant placement has recently become a popular method to minimize the possibility of post-operative peri-implant tissue loss and to overcome the challenge of soft tissue management during or after surgery.

Careful diagnosis and treatment planning are critical for predictable outcomes, especially for flapless implant placement. Evaluation of the dimensions of the available alveolar bone is an important prerequisite for success. Bone evaluation with the help of panoramic and/or periapical radiographs may be insufficient as it only provides two-dimensional information about the implant recipient area. A more accurate assessment of the bucco-lingual dimension of the alveolar ridge is needed for proper treatment planning. The bucco-lingual ridge width can be evaluated by computed tomography (CT). A less costly alternative than CT is ridge mapping using a caliper under local anesthesia. The tips of the caliper are used to penetrate crestal, buccal, and lingual soft tissue layers to determine the bucco-lingual width of the underlying bone as well as the thickness of the vertical soft tissue on the underlying alveolar crest. This is a chairside procedure that provides instant information for the surgeon and may obviate CT scanning for this purpose.

When teeth are present, blood supply to the bone comes from 3 different paths:

1-Periodontal ligament

2-Periosteum

3-Inside the bone (cortical bone is poorly vascularized)

So after tooth extraction the blood supply mainly comes from periosteum.

When raising a flap, a complete cut of blood supply happens to the bone which leads to bone resorption and even reduced healing ability in case of bone fracture

Flapless implant surgery is becoming an alternative protocol for dental implant placement. Advantages of the flapless implant surgery include: less surgical trauma, decreased operative time, rapid post-surgical healing, fewer post-operative complications, increased patient comfort, and preservation of the gingival margin of the adjacent teeth and interdental papillae. However, flapless implant placement has required the used of CT scans in the past to evaluate the alveolar bone before implant placement. Use of CT scanning adds substantial costs for an implant procedure. As a result, pre-operative bone mapping has been used as an alternative bone evaluation method by some clinicians, especially for patients with limited financial resources.

Advantage of Flapless Surgery

- ❑ Minimize post operative complications and surgical trauma (swelling, pain and discomfort)
- ❑ Preserve blood supply to the bone minimize crestal bone loss, soft tissue inflammation.
- ❑ Reduce surgical time and bleeding at time of surgery.
- ❑ Enhance esthetics (absence of scar).
- ❑ Easier prosthetic phase

Disadvantage of Flapless surgery

- ❑ Blind technique, working angulation is critical as the chance of perforation of the buccal bone is increased.
- ❑ Possibility of soft tissue intrusion inside the osteotomy site thus interfering with osseointegration.
- ❑ It requires adequate dimension of bone to minimize the risk of fenestrations.
- ❑ In case of sharp ridge there is no chance to modify the bone crest

To solve first problem

Blind technique, working angulation is critical as the chance of perforation of the buccal bone is increased.

Estimation of ridge width

1-Finger Examination:

-Least accurate

-Useful in detection of undercuts

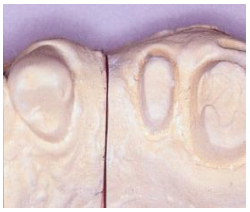
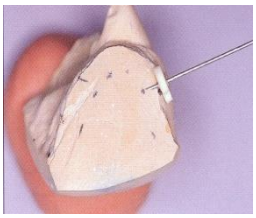
2-Radiographs:

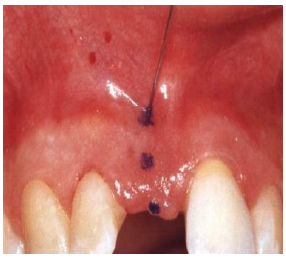
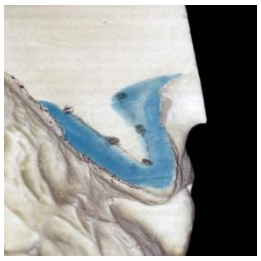
A-Occlusal films: not accurate as it gives the width of the whole bone not the ridge width.

B-Lateral cephlometric: not commonly used

C- CT scan or dental scan: gives real accurate results.

3-Ridge mapping:

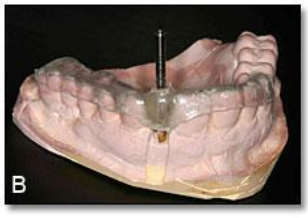



Under local anesthesia map the alveolar bone by inserting endodontic files with rubber stops. Use the recorded measurements to remove an equivalent amount of the soft tissue from the implant area of the stone cast upon which a surgical guide was then fabricated. The implants were placed using these surgical guides. Results showed the cumulative survival rate of 91% after three years.

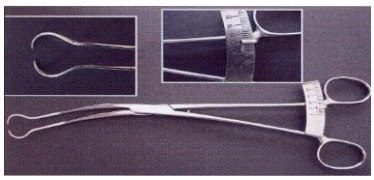
Using a periodontal probe

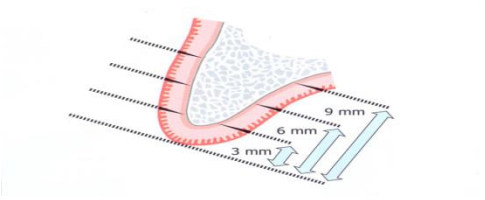
Under local anesthesia a use standard periodontal probe to penetrate the alveolar mucosa to the bone to obtain three pairs (two buccal, two lingual, and one crestal) of measurements in mm to map the bone anatomy.

Remove stone from the same edentulous area of the study cast to the same depths as the soft tissue measurements. This was accomplished by marking the points of the soft tissue measurements on the study model with holes corresponding with the appropriate soft tissue depths using a 1 mm diameter straight fissure bur and then confirming with a periodontal probe. Then remove stone by connecting the depths of the holes which represents the soft tissue thickness to the level of alveolar bone.

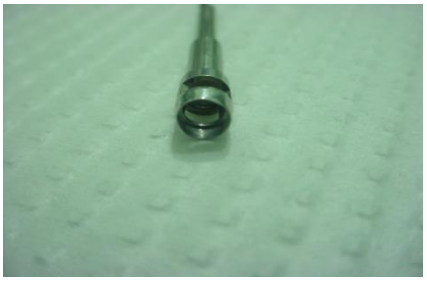
By using caliper





- Original ridge mapping calipers designed by Wilson

Tissue punch



To solve the problem of possibility of soft tissue intrusion inside the osteotomy site thus interfering with osseointegration we use a round scalpel called tissue punch which removes the mucosa above the bone leaving an area of uncovered bone for drilling or osteotomy site creation.

- Tissue punch available with different sizes and diameter.

- Also available hand punch or motorized punch.

Chapter 6

BONE SPLITTING AND EXPANSION

Implant insertion

- Implant usually inserted using special equipments e.g. surgical kit, drills, special motor and special handpiece.

The creation of an osteotomy site for placement of implants by means of drilling is well known in dentistry.

However, valuable bone tissue is removed during drilling; consequently fitting strength of an implant is not guaranteed.

-The bone of the maxilla is considerably softer than the bone of the mandible

-Osteoporosis, the structural change of the bone tissue due to age, also results in porous and soft bones. The drilling for the formation of osteotomy sites in the upper jaw for implant placement proves to be unfavorable, since bone tissue is removed from the soft bone

Problems May occur during drilling procedures

1-Heat Generation

Bone cells death on temp. 47 C Normal bone temperature 37 C

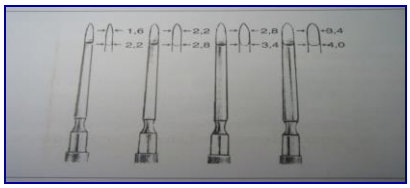
2-Needs expensive special Equipments

3-Needs to be replaced every several cases

Blunt drills causes heat generation for the bone and trauma to the patient

Osteotomes

- First Described by **DR.Hill TATUM**



-Developed by **DR.SUMMERS. 1981**

Ever since their introduction in 1977, osteotomes have been utilized in a variety of techniques designed to elevate the floor of the maxillary sinus using a crestal approach. Summers subsequently adapted the use of osteotomes for the preparation of implant sites in the maxilla as an alternative to traditional drilling procedures. Techniques for expanding the atrophic edentulous ridge and treating the maxillary sinus prior to endosseous implant placement were also developed. These procedures have been subsequently modified by other clinicians. As a result, the osteotome technique has become widely utilized in situations

requiring ridge expansion or less invasive sinus grafting alternatives than the lateral window approach or Caldwell-Luc technique.

Limitations and Complications

While effective in the anterior maxilla, the osteotomes technique exhibits limitations when utilized in posterior areas. The instruments frequently encroach upon the facial soft tissues when treating second premolar or molar sites. Although osteotomes with angled offsets have been designed to circumvent this limitation, they are not as effective in transmitting compressive or expansion forces. By nature, the osteotome technique is a traumatic of the percussive force that is delivered instantaneously provides limited control over the expansion process which often leads to unintentional displacement or fracture of the labial plate of bone. Many patients do not tolerate the osteotome technique well, frequently complaining about the impact from the surgical mallet. In addition, several reports have documented the development of a variety of complications (eg, labyrinthine concussion, benign paroxysmal positional vertigo) that result from the percussive trauma. Preparation of implant sites with osteotomes and a mallet transmits forces capable of detaching heavy inorganic particles from the otoconial layer of the utricular macula. The surgical positioning of the patient, with the head in hyperextension, favors the displacement of these particles into the posterior semicircular canal. Once the patient resumes a seated position, the particles deposit themselves on the ampullar crest, triggering an anomalous stimulus that results in vertigo. Symptoms include dizziness, nausea, and vomiting; in more serious cases, The patient’s gait could be imbalanced and the eyes may show nystagmus (ie, constant involuntary cyclical movement of the eyeball in any direction). The condition is considered self-limiting, usually with a duration of several days, but may last several weeks. If symptoms persist, treatment may include physical therapy, medication, chemical ablation, and surgery. Middle-aged and elderly patients' exhibit increased susceptibility, particularly those with degenerative cervical spine disease that exhibit cervical proprioceptive dysfunction.

Modern osteotomes

Consisting of five tools each tool has 6 marks to determine the length (depth).

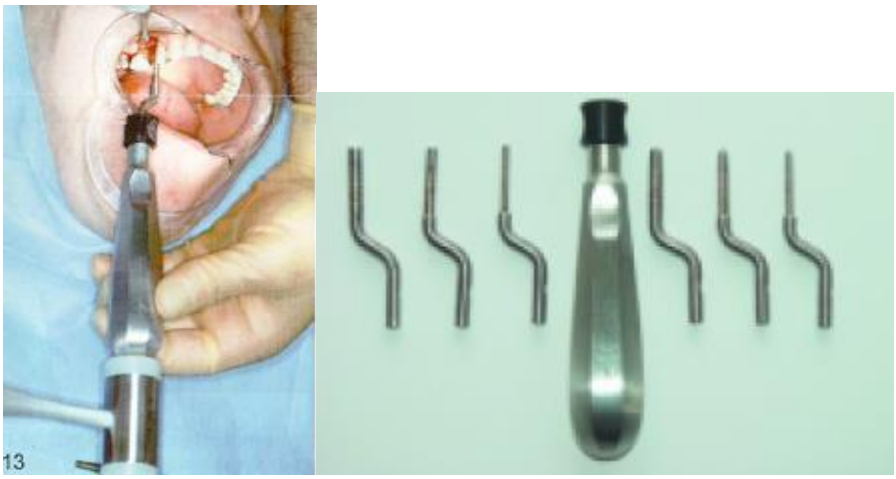
The first and the second tool has sharp end as we can gain the depth we want by them.

The other tools has blunt end as we use it to make the osteotomy site wider (by lateral compaction of the spongy bone).

Osteotomes are used by a tapping motion.

Concave osteomes are used for sinus lifting

Osteotomes



This is the most recent osteotomes by (Eddy palti) Consist of Handel and six tips

Disadvantages of osteotomes

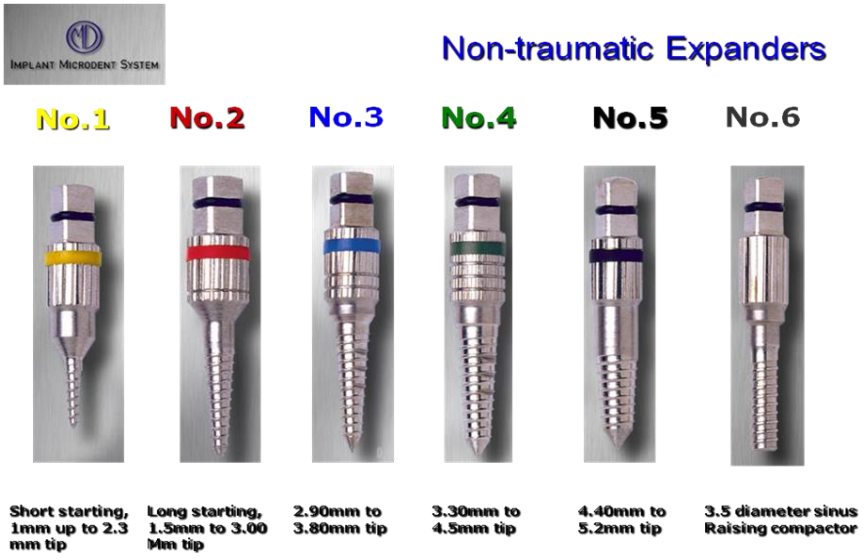
-Breaking and chipping of the bone, as a result of tension created at the dental base with each tap of the small hammer onto the osteotome.

-Complete deterioration of the dental base can occur, and this deterioration of the dental base requires extensive repairs.

-Formation of simple, slightly conical cavities in the jaw, which does not provide a reliable bed for the fixation especially of screw-type implants results in difficulty in the osseointegration and difficulty in the cohesion based on an incomplete contact between the implant and bone.

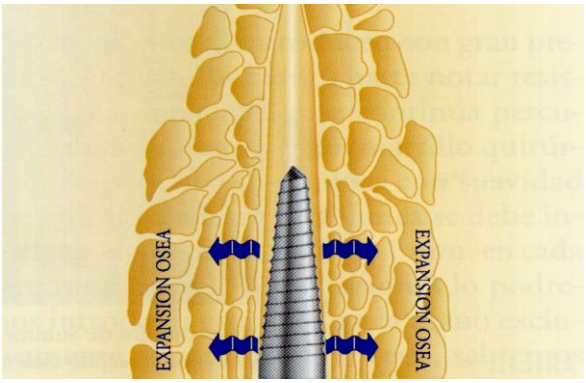
-The alignment defects of the fixation axis because the bone expansion cannot be controlled or adjusted.

-The appearance of a hammer, the shock of the hammer on the metal and resulting fear of the patients.



Threaded expanders

Are group of instruments for bone expansion have a conical shape. They work by rotation, which differentiate them from the osteotomes, which work by impactation. Threaded expanders have an aggressive conical shape and penetrate the bone easily. The principal advantage is that they are less traumatic to the patient and that they can be used in the lower jaw. The rotation movement can be done with a wheel inserted in the back part of the expander, or if more resistance is present, with a racket wrench. The main disadvantage is that is easier to lose the direction of the preparation compared to the osteotomes. Anyway, in both cases an adequate training is important. In more extreme cases, is usually necessary to split the ridge first and then make the expansion.



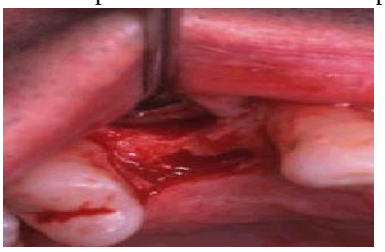
Atraumatic Implant Site Preparation

A technique has been developed that allows the atraumatic preparation of implant sites by eliminating the use of a surgical mallet. This procedure is based on the use of a proprietary ridge expansion system that includes a bur kit and instruments known as bone expanders (ie, Microdent system). The expanders are introduced into the bone with hand rotation rather than hammer taps, which decreases surgical trauma while providing superior control over the expansion site and better tactile sensation. The thread pattern has been designed to compact bone laterally as the instrument advances into the osseous crest. This system allows expansion and preparation of implant sites in Type II and III bone, as well as compaction of Type IV bone.

Atrophic ridges frequently exhibit significant amounts of Type I bone. In addition to being difficult to manipulate, this bone also tends to guide the expansion toward the path of less resistance. With the traditional technique, the osteotome would be forced in a labial direction after encountering the denser Type I bone. This situation would frequently result in expansion of the atrophic ridge purely at the expense of the labial plate, leading to an unusable site, inadequate primary stability, or to an implant placed in an excessively labial position. Non traumatic bone-expander system includes surgical burs that allow drilling into the cortical bone to improve control of the expansion so that the implant may ultimately be placed in an appropriately centered position within the expanded crest. Expansion may be initiated at a more palatal position, and then oriented in a labial direction by applying pressure on the bone expander as it rotates while advancing into the atrophic ridge. Since they are operated manually and they are short tools, the expanders can be utilized in the anterior as well as posterior regions without impingement of the facial tissues or the positional limitations imposed by traditional osteotomes. Furthermore, the rotational control of the expansion permits treatment of the mandibular atrophic ridge. The system can be utilized by itself or with osteotomes and surgical drills to assist in the placement of a variety of implant designs. This technique offers enhanced control of the application, timing, and direction of the expansion forces.

Keys of success of expanders

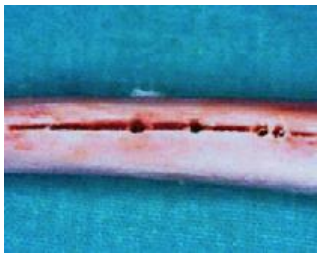
-Minimal incision or using of tissue punch is recommended to provide High blood supply.



-In case type 1 bone use the final drill or insert the implant 2 mm shorter than the expander length




-In case of multiple implant placement and multiple expansion, Crestal bone splitting is recommended to avoid fracture of bone


Advantages

-Expands thin ridges increasing width without bone loss

-Improves surrounding bone quality by creating a wall of dense bone around the implant

-Gives perfect control of implant insertion

-Inexpensive as in some cases it replaces the drills

-Improves primary stability

-Estimation of exact Implant diameter according to bone quality

Soft Bone structure:

Use of bone spreading technique requires correct assessment of the quality of the bone (bone density). In order to make this assessment easier for the dentist, a description of the procedure is given here based on bone density (D1-D4 published by Mish and Judy) since it is an important parameter for performing the bone spreading technique. Bone quality is defined at the latest during surgery.

In soft bone with a consistency of D3-D4 and D5 the aggressive use of bone burs must be minimized. Here we use a pilot drill with a diameter of 2-0-2.3m m in order to achieve the required cavity for the selected implant gently before using bone spreaders with successively increasing diameter The use of the bone expanders also improves bone density, increases primary stability and shortens healing time

Clinical Technique

Site preparation begins with the use of the initial bur at a speed of 700 rpm to 800 rpm with irrigation. This bur will remain in place without vibration or "walking" movements, even when utilized on inclined surfaces or uneven residual ridges. The initial bur is used to a depth of 8 mm to 10 mm, creating an osteotomy of 1.5 mm in diameter. The specific drill and bone-expander sequence followed will vary according to the width of the atrophic ridge, the expansion characteristics of the site, and the desired diameter of the implant.

Provided that the residual ridge is sufficiently wide, the #1 expander and #2 expander will be subsequently screwed in the osteotomy site and left in position for about 30-60 seconds to allow bone remodeling, followed by the #3 expander and, when indicated, the #4 expander.

The bone expanders are driven manually or by an electric handpiece used at speeds of 15 rpm to 30 rpm. The torque settings on the surgical motor should remain between 15 Ncm and 20 Ncm to prevent damage to the handpiece. Once sufficient resistance is encountered, expansion should then continue with a manual ratchet wrench. The instruments may be inserted. Since the bone expanders have a tapered design, it is important that the clinician possess a clear understanding of the dimensions involved in order to avoid excessive expansion that may compromise implant placement. The maximum diameter for each instrument is reached at the 16-mm–length marking. Clinical judgment must, therefore, be exercised to determine the degree to which the bone expander should be inserted in order to accommodate the length, diameter, and design of the implant selected.

Generally speaking, it is safer to keep the diameter of the expanded site less than the diameter of the implant. Final expansion of the site, however, will depend on the type of implant selected. Implants with a tapered, self-tapping design may be placed into a more undersized osteotomy; the only prerequisite is that the site should be prepared to an adequate width to accommodate the implant apex. Conversely, implants with a limited self-tapping ability should be placed into an osteotomy that closely approximates the dimensions of the fixture selected. This situation may require preparation with the corresponding final drill, following the utilization of bone expanders.

Clinical Applications

The non traumatic bone expanders may provide increased control over the expansion site, therefore allowing treatment of more severely atrophic ridges than previously possible with traditional osteotomes. Additionally, once the plastic capacity of the bone has been exceeded, this technique allows a gradual and controlled fracture of the buccal plate that may be deliberately induced to meet the expansion requirements. The displacement of the fractured segments may be closely monitored and, as long as adequate implant stability is achieved, the fracture site may be grafted and implant placement may be accomplished with a single-stage approach. Compared to the smooth-sided osteotomes, the threaded design of the non traumatic bone expanders prepares taps in the osteotomy site that facilitate the subsequent insertion of a threaded implant, and promote initial stability as well.

Furthermore, the dental professional's enhanced ability to manipulate and expand the alveolar walls and interradicular crests may result in an increased number of sites that may be amenable to immediate post extraction implant placement and avoid the need for multiple-stage procedures.

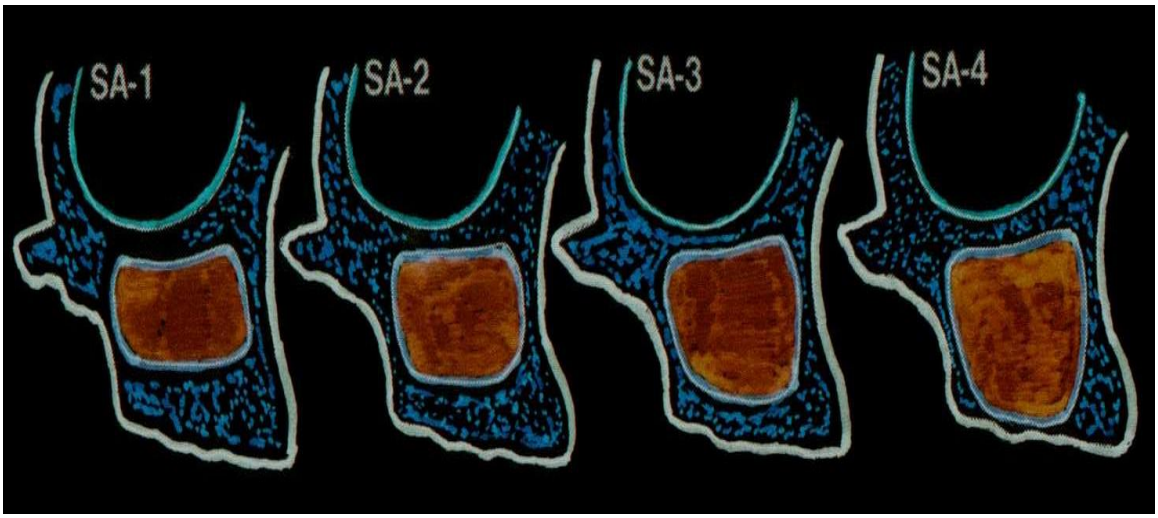
Closed Sinus lifting technique

The summer's osteotomes sinus floor elevation (OSFE) technique is more conservative than the more traditional lateral approach to the sinus. It offers the advantages of reduced morbidity, shorter surgical time, and reduced postoperative discomfort. The aim of the procedure is to retain all the available bone and compact it laterally or superiorly. The antral floor is fractured using root analog instrument with

concave tips. The addition of a bone graft into the osteotomy is referred to as the bone-added osteotomes sinus floor elevation (BAOSFE) created with the concave tips of the osteotomes which provide bone shavings that, along with trapped fluid, help elevate the sinus floor upward. This bone graft is thought to provide a cushion during membrane elevation and reduces the risk for membrane perforation.

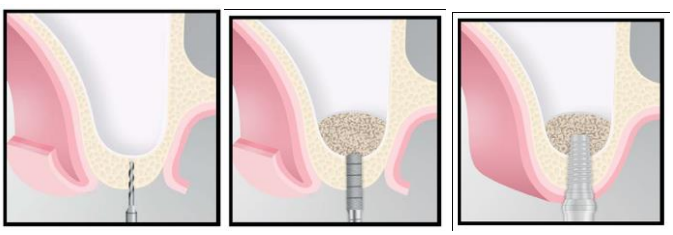
A thorough pre-operative assessment including clinical evaluation and a radiographic examination are essential to evaluate the amount of bone present. The radiographic examination should include conventional radiography (periapical and panoramic films) and sometimes more advanced imaging techniques like cone beam computer tomography (CBCT). Although summers did not define a minimum presurgical residual bone height (RBH) in the original article. A multicenter study by Rosen and colleagues found a minimum RBH of 4 mm was necessary for a high rate of success for implants placed using the BAOSFE technique.

The consensus conference on sinus lifting held in 1996 made several recommendations for the surgical protocol for implant placement based on the volume of RBH. They divided the RBH into four categories:
1. Class A, >10 mm, for which the classic implant protocol could be followed.
2. Class B, 7-9 mm for which a BAOSFE could be performed along with simultaneous implant placement.
3. Class C, 4-6 mm would require a lateral approach with delayed or immediate implant placement.
4. Class D, when there is only 1-3 mm of bone, a lateral approach with delayed implant placement is recommended.



The following is a step-by-step description of the BAOSFE technique:

1. Accurately predetermine available bone.
2. Make a crestal incision towards the palatal aspect of the anticipated osteotomy site and raise a full thickness flap for adequate visualization.
3. Use a small round bur to mark the implant site.
4. Use a 2 mm twist drill to the depth of 1 mm short of the sinus floor.
5. Verify the depth with a radiograph.
6. Widen the osteotomy site to 3 mm with a twist drill.
7. Verify the depth with a radiograph.
8. Place the bone graft of choice into the osteotomy site using a sterile amalgam carrier.
9. Use a suitably sized osteotomes (<3 mm), advance by 1 mm with each mallet stroke till the sinus floor is fractured.

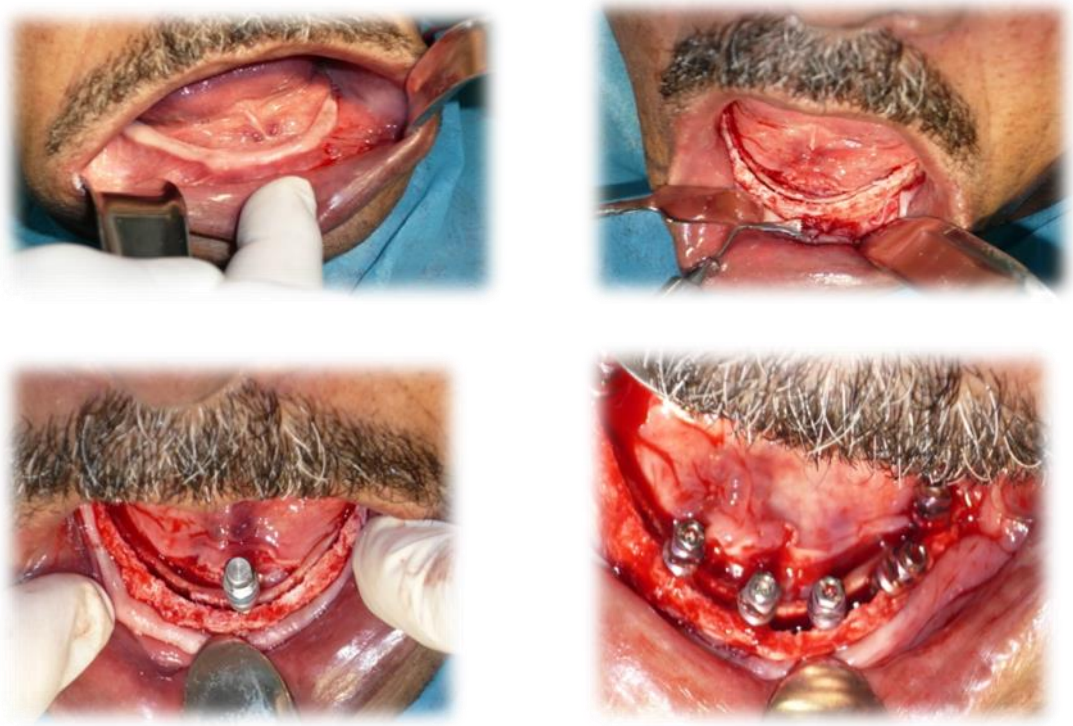


10. Check the membrane integrity by having the patient perform a Valsalva maneuver.
11. Place an additional load (about 3 mm) of bone graft in the osteotomy.
12. Advance the osteotome into the osteotomy to only the preoperative depth (1 mm short of the sinus floor). The sinus floor is elevated primarily by the bone graft.
13. Continue to place bone graft and advance the osteotome using the mallet until the desired bone height is attained. The estimation of the amount of elevation achieved can be based on 1 mm elevation for each amalgam carrier load of bone graft.
14. Widen the osteotomy to the final diameter using larger osteotomes.
15. Place the final carrier load of bone graft prior to implant placement. The implant performs the final step in sinus elevation.
16. Suture the flap to ensure tension free closure

Sinus floor elevation may also be performed with these bone expanders by utilizing a crestal approach to access the maxillary sinus and elevate the Schneiderian membrane. Due to their dimensions and blunt apical design, the #5 expander and #6 compactor are better suited for this purpose. Additionally, these instruments may subsequently be used to pack the grafting material. Although the narrower bone expanders may be utilized to penetrate the sinus floor, caution must be taken because of the increased risk of perforating the Schneiderian membrane.

Bone splitting and expansion

Ridge splitting is a procedure used to expand the bone by separating the buccal and palatal plates. It is normally performed in the maxilla using chisels, osteotomes and a mallet. It could be done also in the mandible, but is a little bit more complicated due to the denser bone. In this case, is recommended to use a cutting disk or piezoelectric devices and threaded expanders, because these are less traumatic. Some authors sets the indications for expanders when the bone is less than 3 mm wide, also if the bone is enough to place an implant but we want to expand it for esthetic reasons.



(A) Patient with atrophic narrow ridge (B) ridge splitting using piezo-surgery (C) expander insertion to expand both sides of the alveolar ridge away from each other (D) Implants in position

Chapter 7

GUIDED TISSUE REGENERATION

Guided Tissue Regeneration (GTR)

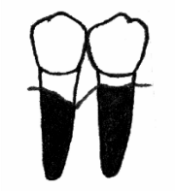
A patient who presents with a vertical or intrabony defect should be considered as a candidate for guided tissue regeneration (GTR). Poor oral hygiene, tooth mobility, root proximity, and horizontal bone loss are contraindications for regenerative procedures. Furcation involvement alters the predictability of GTR; see "Furcation Treatments." The defect should be evaluated for number of remaining bony walls and for defect morphology (depth and width analysis).

DEFECT MORPHOLOGY

- The deep and narrow defect is the most amenable to regeneration. Many different techniques and materials are available to treat attachment loss.
- If the osseous defect is wide and deep, and the tooth is of importance in the arch, regenerative efforts should be considered. Compromised results may be expected compared to the deep and narrow defect (the bigger the defect, the better it works).
- The potential benefit of regeneration is minimal with shallow defects. For both narrow/shallow andwide/shallow defects, consider flap debridement, apical positioned flap with or without osseous resection. Maintenance therapy may be warranted.

NUMBER OF REMAINING BONY WALLS

The greater the number of remaining bony walls, the greater the predictability of regeneration. A space-making defect creates a favorable situation for regeneration.



1 Wall Defect

2 Wall Defect

3 Wall Defect

Treatment	A barrier membrane and bone graft are used together or independently to stabilize the blood clot and maintain space during healing.

The guided tissue regeneration procedure allows for the selective repopulation of a periodontal defect. Bone and PDL cells are selectively permitted to grow in an area separated from other tissues by a barrier, or membrane. The nonabsorbable material most often used is expanded

polytetrafluoroethylene (e-PTFE, or Gore-Tex®) and the most often used absorbable barriers are often polymers of polylactic acid or acetyl tributylcitrate. Bone grafts harvested from the same individual are called autografts. Common donor sites include the anterior mandible, maxillary tuberosity, and mandibular ramus. Allograft and xenograft bone eliminates donor site morbidity. Undecalcified freeze-dried bone allografts (FDBA), decalcified freeze-dried bone allografts (DFDBA), and bovine xenograft (BioOss®) are common examples.

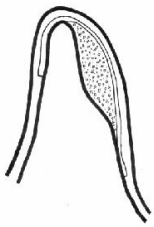
GBR Guided Bone regeneration

GBR is a surgical technique aimed at regenerating alveolar bone specifically for the placement of dental implants.

GBR may be done prior to, or in conjunction with implant placement.

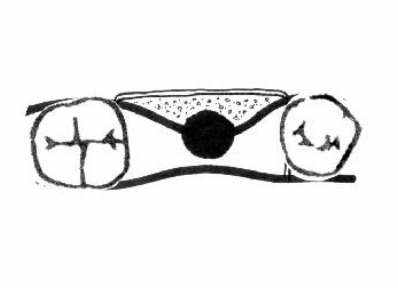
GBR techniques may be used to regenerate bone in an extraction socket, a localized ridge defect, or around an ailing implant (prognosis on ALL ailing implants is guarded).

- Currently, the gold standard of bone grafting material is autologous bone, or the patient's own bone. Common alternatives include freeze-dried bone allograft (FDBA), decalcified freeze-dried bone allograft (DFDBA), and bone xenografts (eg, BioOss®). Either an absorbable collagen membrane or a nonabsorbable e-PTFE (Gore Tex®) membrane (CollaPlug®, Colla Tape®) is used to contain the graft material and prevent epithelial growth into the surgical site.
- Common intraoral sites for harvesting autogenous bone include the mental symphysis, the mandibular ramus, and the maxillary tuberosity. Larger grafts can include corticancellous blocks, whereas smaller GBR sites are successfully treated with particulate material.
- Space-making defects have been treated successfully with a membrane alone (no graft material). Some clinicians use titanium-reinforced membranes or titanium screws to maintain space during healing for the nonspace-making defect.



GBR in a localized ridge defect.

Illustration shows nonspace-making defect with bone graft and membrane.



GBR with bone graft and membrane in a localized ridge defect with simultaneous implant placement.

Tissue Augmentation

Substantial loss of hard and soft tissue may occur with trauma, periodontal disease and the treatment of neoplastic disease. In patients with hypodontia the alveolar ridges are underdeveloped, given the absence of permanent teeth. In cases in which the tissue loss occurred some months or years previously, a number of techniques may be used to augment the tissues, namely:

- Bone graft
- Soft tissue graft
- Guided tissue regeneration (GTR).

Grafting Material Important Properties

It should be:

- Sterile
- Non-toxic
  - Non antigenic
  - Biocompatible
  - Osseoconductive
  - Osseoinductive
  - Easy to use.

Sources of Autogenous Bone Grafts

Intraoral:

- From the drilling site
- Local to the implant site
- From the mandible anterior to the premolars
- Retromolar region of mandible.

Extraoral:

- From the iliac crest
- From the cranium
- From the radius of maxillomandibular reconstruc tion.

The gold standard for augmentation technique is the use of the patients own bone.

Common sites for bone grafts are as follows:

- Chin or retromolar area (when small amount of bone is required)
- Hips or ribs (when more extensive bone grafting is required)
- A number of novel techniques have involved harvesting bone from lower leg and the skull.

Scientific research over recent years has been aimed at providing bone substitutes to reduce risk to the patient. In case of sever bone loss corticocancellous bone blocks are required from the hip or ribs to restore whole arches in the form of

onlay or inlay bone grafts. These are most commonly placed over maxilla or into the maxillary sinus ,

Factors affecting prognosis of bonegraft:

Asepsis
Soft tissue closure
Defect size and topography Autogenous bone
Space maintenance
Healing time
Graft immobilization
Blood vessels-host bone, soft tissue
Growth factors
Collagen
Calcium phosphate.

Layered Approach to Bone Grafting

The host site includes both hard and soft tissue is prepared before the placement of the graft. The bone site is prepared by eliminating any soft tissue on the bone ensuring no infection is present. The soft

tissue is prepared by raising the periosteum near the depth of reflection only and attempting to maintain the blood supply from muscles to the periosteum. The soft tissue is expanded to ensure tension free closure.

The autogenous bone is placed directly on the host site and immobilized by fixation and/or tent screws. Blood vessels from the bone must grow into the site rapidly if the portion of the bone graft is it, remain vital.

Soft Tissue Grafting

Connective tissue grafts are able to improve gingival or mucosal contours. Although they do not contribute to bone volume which does not facilitate implant placement if the bone is insufficient. They may however be used as a supplementary measure if' severe tissue loss has occurred. A number of periodontal plastic-surgical techniques exist to regenerate lost interdental or interimplant papillae.

Guided Tissue Regeneration (GTR)

Guided tissue regeneration has been used in periodontal treatment for many years. Its use in implantology is more recent. The same principle of bone healing is applies. Epithelial and connective tissues are excluded from the healing site and bone allowed to grow preferentially around the implant. It is important for the membrane to cover the whole defect and to be held rigidly in place. It is common use particular autogenous bone or bone substitute as a part of GTR technique to enhance bone healing bone tacks are usually used to secure the membrane healing. Bone tacks are usually used to secure the membrane.

Graft Materials

At Present there are four principal categories of material used to augment the bone which will form the floor of the maxillary sinus:

intraoral or extraoral autographs: Readily available
and is the first choice of bone grafting material used to augment the bone for many clinicians.

Allografts: These are graft material derived from the same species, i.e. bone derived from cadavers and have been used widely in orthopedic and periodontal surgery. The graft may be freeze dried or decalcified freeze dried material. It may be harvested from donors with well documented medical histories and is tested for all common antigens during production. It is therefore considered a relatively safe source of grafting material.

Xenografts: Xenografts are made from bovine bone. From which the proteins have been removed are purely mineral grafts but have been found to be effective when mixed with the patient's blood and packed with sinus.

Alloplastic Grafts: Synthetic alloplastic grafting materials have reduced risk of cross contamination and may well act as a good framework for bone formation.

Advantage of Tissue Augmentation
-Facilitate implant and aesthetics.

Disadvantage
-Increase treatment times
-Complexity of treatment
-Cost.

Chapter 8

OSSEOINTEGRATION

Introduction

Different types of implant systems has been used to replace missing teeth, including sub periosteal implants, endosseous implants with fibrous encapsulation, and endosseous implants with direct bone contact(osseointegrated).
Schroeder et al (1976.1981,1995) used the term "functional ankylosis" to describe the rigid fixation of the implant to the jaw bone, and stated that "new bone is laid down directly upon the implant surface provided that the rules for atraumatic implant placement are followed"

Osseointegration: the direct functional and structural connection between living bone and the surface of a load bearing implant.

Or basically a union between bone and the implant surface.

Measured histologically as the proportion of the total implant surface that is in contact with bone.

Greater levels of bone contact occur in cortical bone than in cancellous bone, where marrow spaces are often adjacent to the implant surface.

In the original two-stage surgical protocol, a two-piece dental implant is inserted at two separate surgical sessions with healing periods of 3 - 6 months in between.

Thus in order to acquire proper condition for osseointegration, the implant must exhibit proper initial fixation following installation in the recipient site. This initial stability is the result of the contact relationship or friction that is established following insertions of the implant, between mineralized bone (often the cortical bone) at the recipient site and the metal device.

Implant Attachment

- Periodontal fibers consist of highly differentiated fibrous tissues with numerous cells and nerve endings for shock absorption, sensory function, bone formation and tooth movement.
- Historically implant attachment with low differentiated fibrous tissues was accepted as a measure of success .
- But later on it was learned that this is a manifestation of adverse reaction that may lead to implant failure includes tissue rejection , pain and loss of the implant

Biology of Osseointegration

Initially, the defect is filled with a fibrin network, derived from plasma, which leaks from a damaged blood vessel at the defects edge.

After 6 to 10 hours granulations cells are present in the wound .

3 to 4 days after later erythrocytes perfuse the healing defect.

Granulation cells stop moving in the wound and their projections connect with each other to form a cellular network, which is still perfused with erythrocytes from blood vessels.

5 to 6 days after the original defect, the wound is perfused by a large number of broad, winding, thin walled newly formed capillaries.

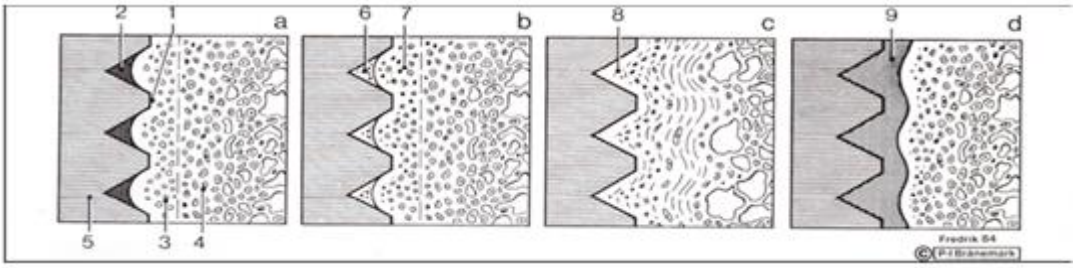
Within 3 to 4 weeks these blood vessels will reduce in number and diameter, creating a characteristic capillary network for connective tissue.

Into this capillary network, fibroblasts from the periosteum, endosteum and red bone marrow invade and produce a network of collagen.

Into this network chondrocytes develop from osteogenic cells and begin to produce a fibro cartilaginous callus. This stage lasts for about 3 weeks.

Osteogenic cells then develop into osteoblasts, which begin to produce spongy bone trabecullae and are referred to as a bony callus, which lasts for 3 to 4 months.

In the final phase or after roughly 4 months, spongy bone is gradually replaced by compact bone around the periphery.



(1)

Contact between the fixture and bone (so called immobilization) (2) Hematoma in a confined cavity bordered by the fixture and bone (3) Damaged Bone (4) Sound bone (5) Fixture (6) Hematoma bone tissue heals through revascularization, demineralization and remineralization (C) After the initial healing phase, vital bone in direct contact with the surface of the fixture without any intermediary tissue (8) Border zone is remodeled in response to functional loading (9) the case of osseointegration failure, non mineralized connective tissue forms in the border zone in contact with the implant

Primary stability

- Stability of the implant following surgery is most important determinant for osseointegration .
- During treatment planning it is important to ensure a sufficient number and spread of implants as well as the stability of adjacent teeth.
- It may be necessary to minimize or reduce occlusal tables.
- Micromotion should not be greater than 100µm while micro motion over 150µm is thought to be detrimental to osseointegration.

When an implant is first placed in the bone there should be a close fit to ensure stability.
The space between implant and bone is initially filled with a blood clot and serum/bone proteins. Although great care is taken to avoid damaging the bone, the initial response to the surgical trauma is resorption, which is then followed by bone deposition. There is a critical period in the healing process at approximately 2 weeks post-implant insertion when bone resorption will result in a lower degree of implant stability than that achieved initially. Subsequent bone formation will result in an increase in the level of bone contact and stability. The stability of the implant at the time of placement is very important and is dependent upon bone quantity and quality

Factors affecting osseointegration

- I-Implant design
- II-Host site
- III-Surgical technique
- IV-Healing and loading time

I-Implant design

1-Implant length:

Within the anatomical it is better to place the longest Implant to have maximum surface area then maximum implant-bone contact resulting in more osseointegration.

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 lengths. There has been a tendency to use longer implants in systems such as Branemark compared with, for example, Straumann. The Branemark protocol advocated maximizing implant length, where possible, to engage bone cortices apically as well as marginally in order to gain high initial stability. In contrast, the concept with Straumann was to increase the surface area of shorter implants by design features (e.g. hollow cylinders) or surface treatments.

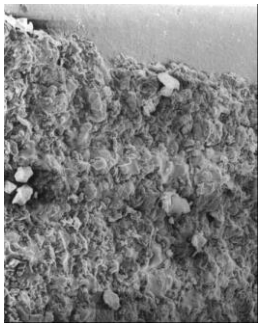
2-Implant diameter:

Narrow diameters can be used in small and compromised spaces; larger diameters can be used in posterior area of the jaw increasing surface area and osseointegration.

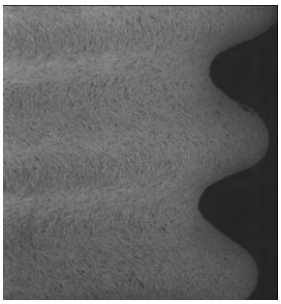
Most implants are approximately 4 mm in diameter. A diameter of at least 3.25 mm is recommended to ensure adequate implant strength. Diameters up to 6.5 mm are available, which are considerably stronger and have a much higher surface area. They may also engage lateral bone cortices to enhance initial stability. However, they may not be so widely used because sufficient bone width is not commonly encountered in most patients' jaws.

3-Surface characteristics:

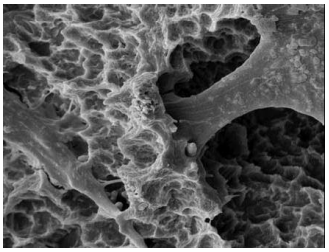
TiO-blasted surface. This scanning electron Micrograph shows the numerous pits of approximately 5 µm.



Plasma sprayed surface at the junction with the polished collar (top).



TiO-blasted surface on the thread profiles



SLA surface produces a complex SL surface produces a complex of large and small pits providing a large area or osseointegration.

II-The host site

1-Bone factor:

-Higher ratio of compact to cancellous bone exists in the mandible; bone density is an important factor for initial stability and prevention of micromovement of the implant

-CT scan can provide an accurate measure of bone density

-Quality of bone can be assessed during surgery based on subjective feel during cutting and drilling

General health:

- Patients having variety of systemic conditions may be successfully treated with dental implants with some precautions.

Age:

Minimum age preferred for implant placement after completing growth. Completion of growth is usually earlier in females than in males

No upper age limit for implant placement as long as the patient is fit and able to undergo the necessary surgical procedures

Radio therapy:

Lower success rate with patient with a history of irradiation

III-Surgical technique

- **Operative conditions**

Surgery has to be highly controlled; contamination of implant surface must be avoided even from patient saliva as it has negative effect on osseointegration.

- **Incision technique**

The choice of best incision for each case is a key of success

- **Drilling technique**

Friction between bone and drill during drilling procedures cause rise in bone temperature, if it exceeds 47 degree for 1 minute this leads to bone necrosis.

This can be avoided by the use of sharp drills, low drilling speed, graduate drill size and use of profuse water cooling

IV-Healing and loading time

Loading protocols, i.e. the duration of time between implant insertion and functional loading,
Look page 50

- **Delayed Loading**

Implant placement after 3-6 months approximately gives better results regarding osseointegration

This has been the traditional approach and has much to recommend it because it is tried, tested and predictable. Following installation of an implant, all loading is avoided during the early healing phase. Movement of the implant within the bone at this stage may result in fibrous tissue encapsulation rather than osseointegration. In partially dentate subjects it may be desirable to provide temporary/provisional prostheses that are tooth supported. However, in patients who wear mucosal supported dentures it has been recommended that they should not be worn over the implant area for 1–2 weeks. In the edentulous maxilla we would normally advise that a denture is not worn for 1 week and in the mandible for 2 weeks, because of the poorer stability of the soft-tissue wound and smaller denture-bearing surface. The original Branemark protocol then advised leaving implants unloaded and buried beneath the mucosa for approximately 6 months in the maxilla and 3 months in the mandible, due mainly to differences in bone quality. There are many data to support the cautious approach advocated by Branemark in ensuring a high

level of predictable implant success. However, the original Straumann protocol did not differentiate between upper and lower jaw, a 3–month healing period being recommended for both.

- **Early loading**

Such implant surface treatments specially bio treatment, allow implant placement in 6 weeks but implants should be placed in a very good quality of bone and under favorable circumstances.

- **Immediate Loading**

With a good quality, quantity of alveolar bone, primary stability of the implant and enough length of implant immediate loading can be achieved with caring of occlusal loads in first 3 months starting 48 hours after the implant placement

Osseointegration, provided that the bone quality is good and the functional forces can be Controlled adequately. In studies on restorations, the crowns are usually kept out of contact in intercuspal and lateral excursions, thereby almost eliminating functional loading until a definitive crown is provided. In contrast, fixed bridgework allows connection of multiple implants, providing good splinting and stabilization, and therefore has been tested in immediate loading protocols, with some success. However, the clinician should have a good reason to adopt the early/immediate loading protocols particularly as they are likely to be less predictable.

PERIMPLANT MUCOSA

Mucosal tissues around intraosseous implants form a tightly adherent band consisting of a dense collagenous lamina propria covered by stratified squamous keratinised epithelium.

Implant epithelium junction is analogous to the junctional epithelium around the natural teeth in that the epithelial cells attach to the titanium implant by means of hemidesmosomes and a basal lamina.

- The depth of normal non inflamed sulcus around an intraosseous implant is assumed to be between 1.5-2mm.
- The sulcus around an implant is lined with sulcular epithelium that is continuous apically with the junctional epithelium.

Main difference between perimplant & periodontal tissues is that:

1. Collagen fibers are none attached & run parallel to the implant surfaces owing to the lack of cementum.

2. Marginal portion of the perimplant mucosa contains significantly more collagen & fewer fibroblasts than the normal gingiva.

The implant bone interface

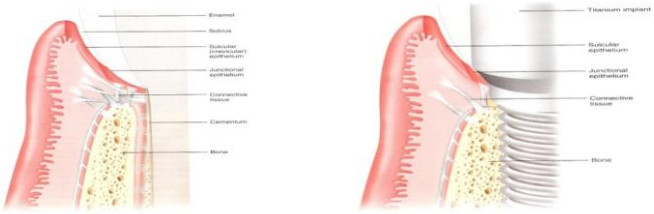
The relationship between endosseous implants & the bone consists of two mechanisms:-

1. OSSEOINTEGRATION-

Bone is in intimate but not ultra structural contact with the implant.

2. FIBROSSEOUS INTEGRATION-

Soft tissue such as fibers &/or cells, are interposed between the two surfaces.



Implant integration:

1- Ankylotic-like relationship between the implant and the bone which means osseointegration and bio-integration.

2-development of intermediate ligamental or fibrous like system (fibro osseous retention) cause by:

-Inaccurate primary stability when loading the implant

-Traumatic surgical protocol

-Excessive loading

-Premature loading

-over heating the bone

There is never 100% bone-implant contact

- Johansson and Alberktsson 1987 reported:

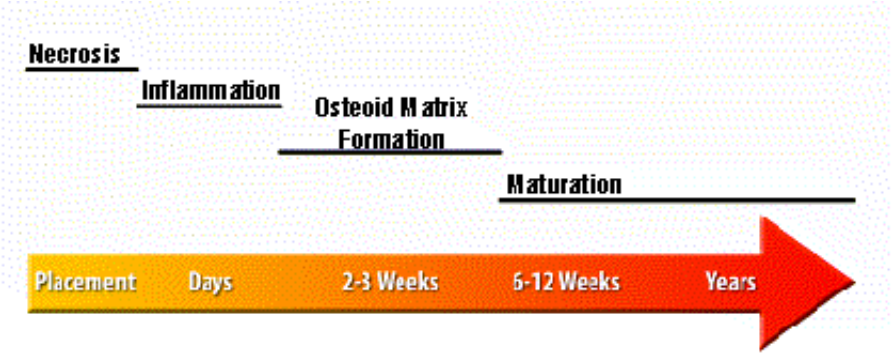
1-Fibrous tissue interface at 1 month following implant placement

2-50% bone-implant contact at 3 months

3-65% bone-implant contact at 6 months

4-average of 85% bone to implant contact 1 yr after

Sequence of events leading to osseointegration. Note that although multiple critical events occur shortly after placement, long-term maturation also takes place.



Implant Physiology

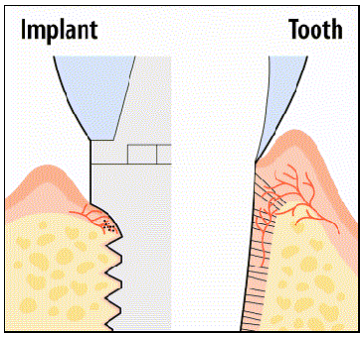
Implants are not teeth and differ from teeth in some important ways. However, by virtue of their position in the mouth, they also share some significant concerns with teeth, such as the attachment of bacteria and the growth of calculus.

Difference between implants and teeth

-Unlike teeth, implants lack healing capacities.

-Implants do not have a periodontal ligament.

-The barrier to the oral cavity is rather different around implants, principally because of a missing connective tissue attachment.



Bacterial attachment and calculus formation

Bacteria attaches to implants and abutments in the same way it attaches to dental surfaces.

Calculus formation also occurs in a similar fashion.

The presence of teeth in the oral cavity is a source of implant bacterial colonization.

Edentulous patients that receive implants rapidly develop a bacterial flora similar to dentate patients.

Plaque accumulation and bacterial infiltration may result in peri-implantitis

Peri-implant mucosa

The mucosa surrounding implants is clinically similar to the mucosa surrounding teeth.

The gingival attachment is comprised of a junctional epithelium (1-2 mm) and a connective tissue attachment (~1 mm).

Unlike teeth, connective tissue fibers are not perpendicular to the implant surface, but parallel.

Blood supply to peri-implant connective tissue is limited. While the blood vessels that lead to the connective tissue surrounding teeth originate in both the periodontium and periosteum, peri-implant blood vessels originate from the periosteum only.

The peri-implant features have important clinical consequences − probing resistance is decreased, and early inflammatory response is limited.

While the implant prosthesis is removed, peri-implant sulcus health can be seen. Note that an epithelium faces the abutment. Insertion of a probe finds little resistance in this area.

Peri-implant coronal bone

After implant placement and exposure to the oral cavity, coronal bone remodels.

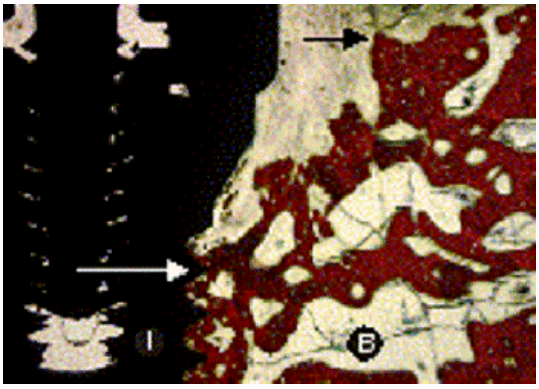
In two-stage implants, bone remodels to the first thread within the first year of exposure.

In one-stage implants that have high, smooth collars, coronal bone remodels to the smooth/rough surface connection.

Even when an implant is placed deep in the bone, remodeling takes place to create a biological dimension. This reaction is similar to the biologic width on teeth.

This normal physiological change resembles bone loss. During maintenance, it should not be mistaken with bone loss related to peri-implantitis.

New implant designs and platform switching have emerged to avoid peri-implant bone loss.



Histology of an implant after bone remodeling has occurred. Note that bone/implant contact occurs at the level of the first thread, although the implant was placed deep in bone (I: Implant; B: Bone; Black arrow: Original bone level; White arrow: Remodeled bone at the first thread).

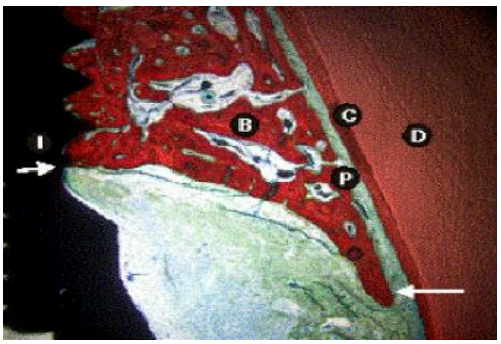
Adjacent Teeth and Osseous Architecture

Teeth that are adjacent to implants maintain their periodontal support. Papillae are maintained, resulting in an aesthetically pleasing outcome.

Two adjacent implants in close proximity result in a flattened osseous architecture. In this case, papillae lose their shape.

However, it is possible to maintain osseous architecture between adjacent implants. If 3 mm or more are left between implants, bone height will be maintained.

Note that when an implant is placed more apically than the adjacent tooth, a normal bony angle results, accompanied by a peri-implant deep sulcus. This is more common on anterior teeth where implants are purposely placed more apically. This state is stable, and should not be mistaken with a pocket.



Histological section of an implant next to a tooth. Note that periodontal height is maintained against the tooth (arrow bottom right), even when bone is apical to the implant (arrow on left). I: Implant; B: Bone; C: Cementum; D: Dentin; P: Periodontal ligament. (Reproduced frp, Sarment, et al, Real Clin, 2003.)

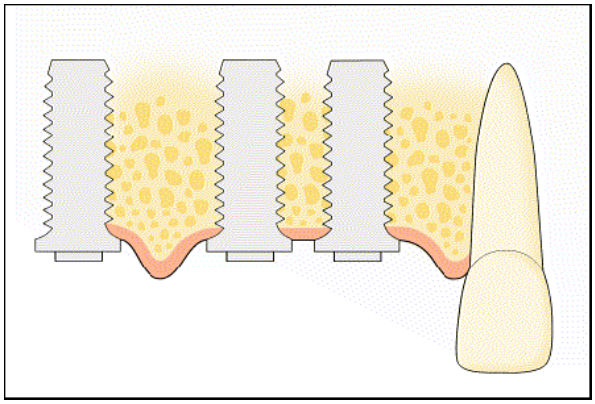


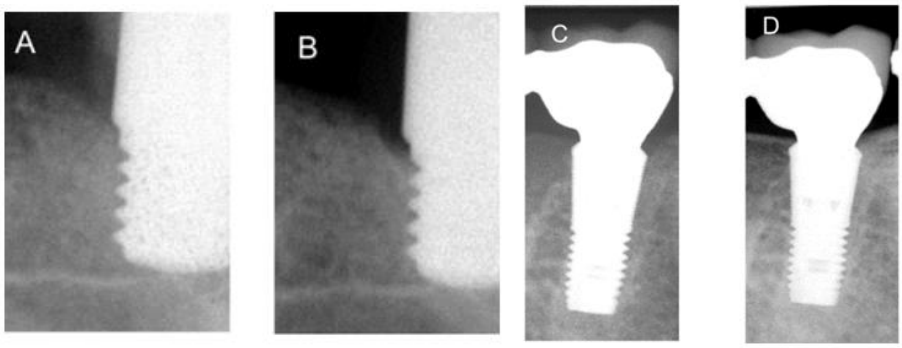
Diagram demonstrating the difference between an implant adjacent to a tooth and two adjacent implants in close proximity. Osseous architecture is maintained with the natural tooth, but not when the two implants are close together.

Beveled Implants and Platform Switch

In order to prevent bone remodeling downwards along the implant, displacement of the implant/abutment connection towards the centre of the implant has been advocated.

This connection displacement has been achieved with implant designs, by creating a bevel, or by "platform switch" which consists of placing an abutment narrower than the implant platform.

There is evidence that such designs and abutment choices prevent bone loss with possible bone remodeling towards the abutment.



Peri-implant bone remodels differently when a platform switch design is utilized. (A, B) An osseous cuff forms over time around this traditional implant. (C, D) By bringing the implant/abutment connection away from bone, maturation occurs without cuff formation. (A and B adapted from Sarment D and Meraw S, Int J Oral Maxillofacial Imp, 2008, 23:99-104.)

Long term physiology of osseointegration

Osseointegration is a physiological state that undergoes maturation over the life of the implant. During implant function, surrounding bone continually remodels in response to biting forces. In rare cases, excessive forces may cause loss of osseointegration.

The implant surface also undergoes long-term changes − the ceramic oxide layer thickens with time.

Chapter 9

SOFT TISSUE MANAGEMENT IN 2ND STAGE SURGERY

Soft tissue management in Second-Stage Surgery

- Dental implant surgery can be accomplished with one-stage or two-stage surgery.
- One Stage: exposes the implant to the oral cavity by means of a gingival healing device or abutment at the time of its placement.
- Two-stage surgery : the implant is left dormant underneath the mucosa for the period of its osseointegration; a second surgery is needed to uncover and expose the implant after the healing period.
- "At the time of implant uncovering, the surgeon encounters the challenge of maintaining or improving the conditions of the implant that was placed months before."

The technique chosen for uncovering will depend on the characteristics of the tissue that overlies the implant.

- The amount of attached gingiva,
- The thickness of the overlying mucosa
- The presence or the absence of interdental papillae

Importance of attached gingiva presence

- reduce the probability of gingival recession in areas of aesthetic margin placement
- facilitate impressions
- widening the attached gingiva enhances plaque removal around the gingival margin, improves aesthetics, and reduces inflammation around restored teeth **

**Cohen ES. Mucogingival Surgery. In: Cohen ES. Atlas of Cosmetic and Reconstructive restored teeth.

The characteristics of peri-implant soft tissue are similar to the soft tissue around teeth. The mucosal seal between the implant surface and the surrounding gingiva will be a barrier to the entrance of toxins produced by plaque that could later jeopardize the treatment if it progresses to bone loss.

Atassi F. Peri-implant probing: Positives and negatives. Implant Dent 2002; 11:356-362.

Biological seal around oral implants consists of two principal layers:

-The epithelial attachment

Which forms a barrier adhered to the surface of the abutment

-The underlying connective-tissue barrier organized in bundles and presenting a constant spatial arrangement

The appropriate second-stage surgery technique can help ensure the presence of enough of this type of connective tissue around the implant.

2nd stage surgery technique

- Excisional technique
- Incisional techniques.
- In some situations, the cover screw will expose itself completely or partially to the oral cavity, perhaps obviating the need for second stage surgery.

  However

If the cover screw is not kept plaque-free during this healing period, the implant could eventually be lost.

In some cases the implant head can be seen or palpated throughout the soft tissues; if not, there is always the help of X-ray films and remaining teeth or other anatomical sites that can be used as reference for locating the implant.

- Or we can use the surgical stent used during surgical placement of the implants.

Excisional techniques:

- Used when the gingival tissue over the implant will be removed and discarded.
- A scalpel blade or a punch instrument can be used to remove the tissues over the cover screw.
- Electro-surgery instruments as well as high-speed motors should be avoided since the implant can be harmed with these difficult-to-control methods.
- Excisional techniques are ideal only if there is sufficient attached gingival tissue around the head of the implant.

Incisional techniques

Preserve the soft tissues at the implant site.

Can be performed with several methods:

1- **The midcrestal incision**

2- **The X or + incision technique**

3- **Preservation of the papillae**

1-The midcrestal incision

- Very useful, especially when there are multiple implants placed one next to the other since they can be located as the incision progresses.
- After the implants have been located and the cover screws replaced by the healing abutments, interrupted sutures are placed between the implants to approximate the buccal and lingual flaps.

2-The X or + incision technique

- This simple technique should be performed when the attached gingival tissue is sufficient.

- There are two ways to start this incision. One is as a small crestal incision that will later give place to a cross-type (+) incision.
- This first incision can be extended and the technique modified to a midcrestal incision if the exact position of the implant was not well targeted.
- The other technique starts with a diagonal incision.
- This should be done if the position is accurate because there is less chance of switching to another technique without mistreating the tissues with excess incisions.
- Once the two overlying incisions are made, the clinician can use a periosteal elevator to elevate the edges outward and allow the appropriate driver to take the cover screw out. the healing abutment is screwed and the corners of the incised tissue elevated with a thin, blunt instrument to make it surrounding the abutment.

2-Preservation of the papillae

- This incision is midcrestal or a few millimeters toward the palate with a U shape and opens toward the buccal aspect of the implant site with slightly divergent arms.
- Cover screw is now exchanged for a healing abutment.
- Once the healing abutment is placed, the flap should be split in whole thickness through its center, separating it into Mesial and distal parts

Modified surgical procedure for implant restoration

- During the implant placement, an impression can be taken to have an abutment and temporary ready for the second-stage surgery. This procedure is recommended so the clinician can achieve a better healing of the soft tissues around the implant after the second stage surgery is performed. The contour of the gingiva will resemble the contour of a natural tooth. This goal can be obtained by the clinician placing the abutment and temporary at the second-stage surgery instead of placing a regular healing abutment.
- This approach enhances not only the tissues and aesthetics but also patient satisfaction, since the patient will have a tooth instead of the regular healing abutment.” This method also can be used for multiple implant restorations.

Chapter 10

IMPRESSION TECHNIQUES

Objective

Is to copy the same position of the dental implant inside the patient mouth to the cast where the lab will put abutments and work on it.

- Taking an impression is the first step in producing a stone model that indicates the positioning of implants and/or abutments in the patient's mouth.
- It often requires impression copings, devices that facilitate the duplication of implant positions on the model.
- Impressions may be taken at the implant level or the abutment level.
- Implant-level impressions involve placing an implant analog, a device that mimics the implant on the stone model.
- Abutment-level impressions involve taking impressions directly on the abutment in patient mouth
- The choice of technique is made by the restorative dentist. The following table outlines major differences.

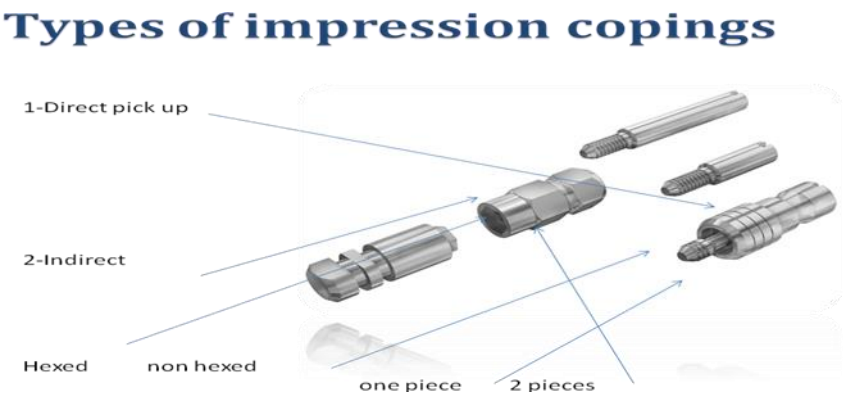
COMPARISON OF IMPLANT-LEVEL AND ABUTMENT-LEVEL IMPRESSIONS

	Implant-level Impression	Abutment-level Impression
Ease of localization	Requires subgingival placement of copings	Easier, because margins are often supragingival
Impression copings	Necessary	Conventional impression without copings is available in some cases
Abutment selection and preparation	On a model in the laboratory	Can be done in the mouth, chairside
Abutment modification	Not needed once delivered	May be needed in the mouth
Custom abutment	Available	Not available (unless an implant-level impression was taken first)
Interim and final crown fabrication	Can be performed in the laboratory, together with the abutment selection and preparation	Chairside relines of provisional restorations and final impressions often necessary

I-Implant-level Impressions

- Implant-level impressions are similar for all prosthesis types.
- There are two main types of impression copings that may be used − closed tray and open tray.
- Closed tray or transfer impression copings remain on the implant complex after the impression is removed and need to be placed into the impression manually.
- Open tray or pickup impression copings are automatically retained in the impression after removal. This usually requires the manipulation of a long screw that is not present in transfer copings.

Types of impression copings



Impression technique

1-Direct impression (Open tray, pick up technique)

2- Indirect impression (Closed tray, transfer technique)

Direct technique:

- Remove the healing abutment or equivalent. Note that there may be hemorrhage from gingival tissue walls the first time a healing abutment is removed, because removal disrupts an initial tissue attachment to the metal.
- Position the coping on the implant and insert the screw. Note that the screw is more prominent for pickup copings than for transfer copings.
- Ensure that the coping is fully seated by rotating it until the connection is engaged.
- Take a radiograph to verify that the coping is fully seated.
- Select and try a plastic tray in the mouth. Open a hole so that the abutment screw can be reached above the tray.
- Place soft wax on top of the abutment screw.
- Practice positioning of the tray to ensure easy access to the abutment screw once the impression material has set.
- Paint the tray adhesive and take an impression, using standard techniques and making sure that the impression of the coping is accurate. Light and medium body materials may be used, but medium body alone is sufficient. To ensure a good impression of the area around the implant, inject the material under the abutment.
- Before the material is set, ensure that the abutment screw is above the tray and accessible for removal.
- After the impression material is set, remove the screw completely, using a driver. The soft wax enables access to the screw top.
- Remove the tray, along with the coping, which is captured in the impression. Reposition the screw through the impression and attach an implant analog.

Indirect technique

Remove the healing abutment or equivalent. Note that there may be hemorrhage from gingival tissue walls the first time a healing abutment is removed, because removal disrupts an initial tissue attachment to the metal.

- Screw the coping onto the implant.
- Ensure that the coping is fully seated by rotating it until the connection is engaged.
- Take a radiograph to verify that the coping is fully seated.
- Select a tray to fit over the coping and teeth. Because of the height of the coping, the tray borders may need to be extended apically.
- Paint the tray adhesive and take an impression, using standard techniques and making sure that the impression of the coping is accurate. Light and medium body material may be used, but medium body alone is sufficient. To ensure a good impression of the area around the implant, inject the material under the abutment. Lack of material on the coping will compromise its stability when the stone is poured.
- Remove the tray after the material is set. The coping will still be attached to the implant.
- Unscrew the coping from the implant.
- Reposition the healing abutment immediately.
- Attach an implant analog to the coping and push the assemblage into the impression until the coping's original position is found. Transfer copings are designed to fit into the impression in only one position. It is recommended to perform this step chairside, and not rely on the laboratory. In the event the impression coping cannot be seated securely, or its stability is not achieved, the impression can be retaken immediately.

Some precautions to take are:

1-Making a radiograph when the impression coping/implant or impression coping /abutment is below the level of the mucosa to insure seating of the impression copings.

2-It has been shown that the pickup type impression coping is the more accurate type of impression as errors occur on removal and replacement of the transfer type impression copings, especially in the occluso-gingival direction.

Impression verification for all techniques

The impression is checked for:
• Coping stability: each coping should be tested with tweezers to ensure that no more than very limited movement occurs.

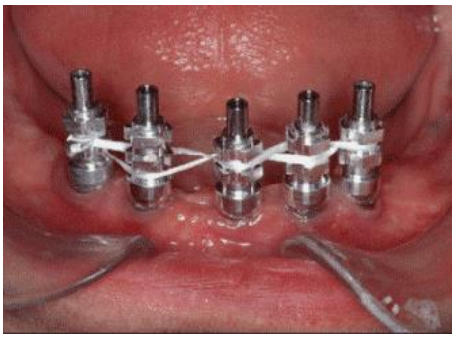
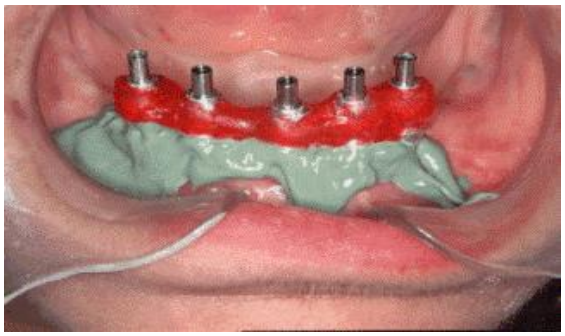
•Adequate record of immediate gingival contours: at least 4–5 mm beyond the coping so that a proper gingival replica can be made.
• Full record of adjacent teeth: to ensure proper contact point construction and harmonious emergence profiles.
• Full record of articular surfaces of whole arch: for accurate articulation of casts.

Multiple Implants and Splinting

When multiple implants are present, pickup copings should be splinted whenever possible. This relates the copings rigidly and increases accuracy. To splint copings:

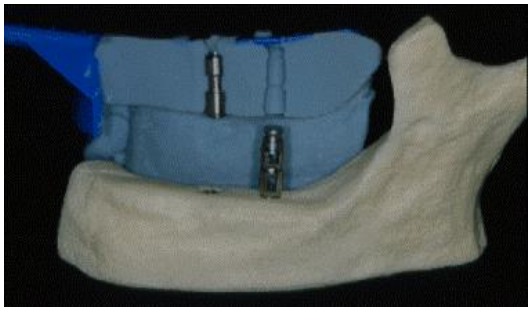
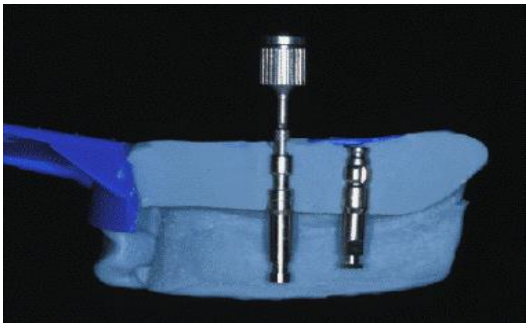
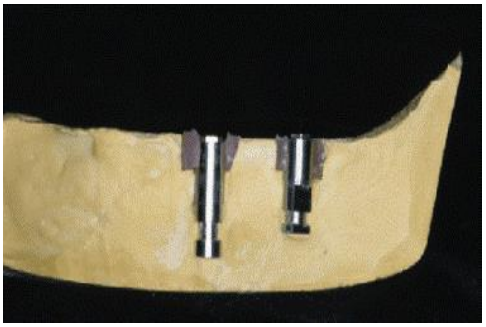
- Place all copings on implants.
- Run a dental floss or an orthodontic ligature wire between copings, crossing them like a ligature.

- Flow a resin or light cure material to connect the copings using the floss to control the flow of the resin.
- Add resin until a solid splint is fabricated.
- Ensure that screw rotation is not blocked by excessive resin.

COMPARISON OF TRANSFER AND PICKUP IMPRESSION COPINGS

	Transfer Copings	Pickup Copings
Interarch space	Less space needed; more adequate for posterior areas	More space needed
Tray preparation	No preparation necessary	Must be perforated
Splinting multiple copings	Not possible	Possible
Precision of impression	Possible distortion, because copings must be reinserted in impression	Less distortion, because coping remains in impression. Splinted copings may improve precision.

Technical differences between pickup and transfer copings: (A) The pickup type requires that the tray be modified by placing a hole for access to the screw. (B) The pickup type remains in the tray while the impression is removed, and the transfer type remains on the implant. (C) An analog is attached. (D) For the transfer type, the coping is now removed from the model.

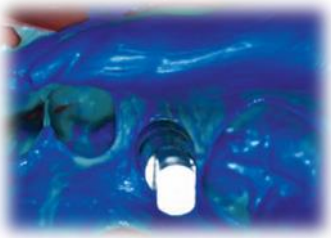
Checking the Model

It is possible to pour the model in the office in order to verify its accuracy before sending it to the laboratory.

- Box the implant in the impression with wax or pieces of a matrix.
- Paint a separator and inject a soft tissue moulage so that it covers the coping and ~3 mm of the implant analogs.
- Let the moulage set and remove the boxing.
- Ensure that the moulage has no undercut so that it can be removed and positioned back into place later. If necessary, cut excesses with a sharp blade.
- Pour the stone and let it set.
- If a pickup coping was utilized, remember to remove the screw prior to separating the model.
- Pull the tray and remove the copings. The model is now ready.
- To check the model's accuracy, you may fabricate an acrylic jig in the mouth that rests on the impression copings and adjacent teeth if present. Place the copings on analogs in the model and position the jig. The position of abutments in the jig should be identical to the one in the mouth

Intra oral view of transfer impression coping in place

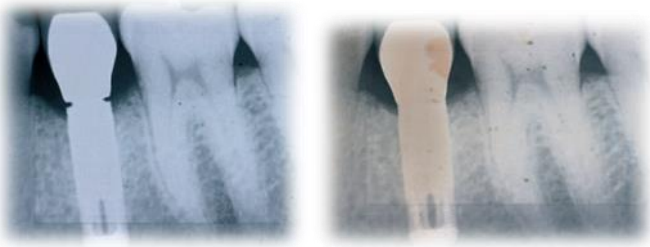
Transfer impression –analogue assembly placed into impression.



Cast of implant analogue with soft tissue cast removed – allowingthe technician access to the fit surface of the implant analogue.

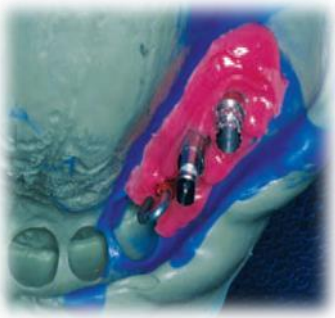
Completed restoration in occlusion on working casts.

Radiograph of restoration indicating poor seating due to interference of interproximal contacts.



***Intra oral view of seated restoration*.**

Intra oral view of pick up impression copings and custom tray.



Impression with implant analogues assembled and soft tissue cast poured

Occlusal view of hard and soft tissue cast recovered from impression.

Impression materials

Polyether and silicone impression materials have physical properties that make them suitable for implant impressions:

• The material should set rigid enough to support the coping and prevent movement of the coping on removal from the mouth and casting of the model.

• It should record enough fine detail to identify properly the gingival contours and other teeth in the mouth.

• It should be dimensionally stable and not react with materials used in model production, such as the gingival replica.

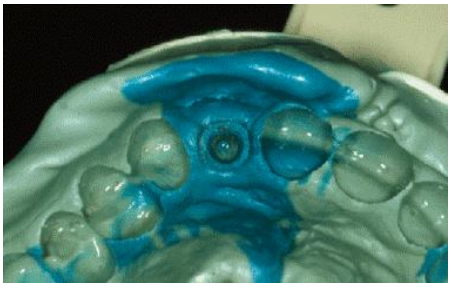
• It should accept disinfection techniques. For these reasons it is not recommended that light-bodied impression materials be used around the impression copings because they will not be strong enough and heavy putty materials will not flow around the copings or record fine details. One-phase medium-bodied paste systems are preferred. Some operators recommend splinting impression copings together with acrylic prior to impression-taking to ensure that the copings are stable relative to each other. There is nothing to recommend such extra complexity.

Closed Tray VS Open Tray Method

- Most implant systems offer both transfer and pickup impression copings.
- In general, pickup copings provide a more precise impression, because the copings do not need to be positioned manually in the impression; however, impressions are fairly accurate with both methods.
- Pickup copings require adequate access and interarch space. Thus, in posterior areas, where access and interarch space are limited, transfer copings are more convenient.
- Pickup copings are particularly useful in multiple-implant cases. Pickup copings, once in place, can be splinted together with acrylic, increasing the precision of the impression.

II- Abutment-Level Impressions

- Abutment-level impressions depend upon the type of abutments that have been selected and how they have been prepared, as well as the system type.
- For prefabricated abutments that have not been modified, a pickup or transfer type impression coping is often available. In that case, the methods are similar to the previous description, except that an abutment impression coping rather than an implant coping is used.
- Some machined final abutments also come with closed tray disposable impression copings
- There is no screw to retain the coping in place as the clipping mechanism is sufficient.
- Abutment analogs mimic various selections and present the advantage of being undistorted and unbreakable dies. They are also slightly oversized to accommodate for metal contraction and cement space.
- If abutments were custom-made or modified, impressions are taken using a method identical to traditional dentistry.



A-The abutment has been prepared chairside to maximize retention and accommodate angulation and interarch space. (B) A traditional impression is taken and (C) a die is fabricated. Note that the preparation is adequately subgingival for the emergence profile to be developed in the crown. (D) A crown is fabricated in a traditional manner. (E) The crown is delivered and the excess cement is carefully removed.

Chapter 11

PROSTHODONTIC PROCEDURES

Introduction

In many ways prosthodontic procedures on dental implants are much simpler than those for conventional crown and bridgework. The ease of restoration depends on the position of the implant. Ideal implant placement is sometimes difficult to achieve

Emergence Profile: Is the profile of tooth while emerging from gingiva

Significance of proper emergence profile:

1- Esthetic

2-Hygiene

To achieve proper emergence profile:

1. Implant selection
2. Implant position
3. Healing abutment
4. Temporary crown
5. Impression coping
6. Abutment selection

1-Implant selection

Implant diameter is very important for good emergency profile, wider implants gives bad profile for narrow teeth. So improper diameter leads to poor esthetic and poor oral hygiene.

2- Implant position

- Labio- lingual positioning
- Mesio-distal positioning
- Apicoincisal positioning

3- Healing abutment

- Allow gingiva to heal on shape of healing abutment
- Have different shapes and diameters

4-Temporary crown

We can use temporary crowns to reshape gingiva to get perfect emergency profile

5-Impression coping

Use impression coping to get perfect contour of the gingiva and surrounding tissues in the impression.

6- Abutment Selection

ABUTMENT SELECTION AND PREPARATION

In this step, appropriate abutments are selected and prepared for delivery.

Abutment Types

- A number of different abutment types are available.
- Prefabricated abutments have set collar heights and taper. Some are angled from the implant body to counter inclination of implants. They may or may not be modified.
- Custom-fabricated abutments (often called UCLA abutments) must be entirely fabricated in the laboratory. They are usually delivered with a machined metal connection and a wax able sleeve. The technician waxes onto the sleeve and casts the abutments using a lost-wax technique.
- Prepable abutments are straight cylinders with no taper or margin level. Preparation is required to set height, angulation, taper, and margins.

Abutment Screws

- The abutment is retained on the implant by the abutment screw. It is important to recognize the existence of the underlying screw because movement in the prosthesis detected during maintenance is sometimes due not to uncementation, but to loosening of the abutment.
- Some abutments are one-piece and include the screw at their base.
- Angled abutments are two pieces, consisting of a separate screw and abutment. This makes it easier to control the angle and avoid contact with adjacent teeth during placement.

Abutment Selection

- The abutment that is most appropriate for a particular case need to be selected before delivery.
- In general, they may be selected on a model in the laboratory or in the mouth, chair side.
- If it is possible to select abutments in the laboratory, this is often advantageous, because this provides a better opportunity to carefully consider all available options.
- Whenever possible, use mounted models for laboratory selection.
- Special laboratory abutments are also available as selection aids.
- Note that in select cases, it may be advantageous to proceed without an abutment.

CRITERIA FOR ABUTMENT SELECTION

Criteria	Implications for Abutment Selection
Tissue height	Abutment margins should be supragingival in nonesthetic zones and slightly subgingival in esthetic areas
Crown height	Abutment height must not exceed the available space for crown materials
Ir proxir distance	Abutment width must be sufficient to support the crown, but interproximal access to hygiene instruments must be sufficient
Angulation	Abutment must counter any implant angulation
Esthetics	Margin must be subgingival in esthetic areas, and the abutment emergence profile must support gingival tissues. A porcelain abutment may improve esthetics.

When selecting abutments, it is important to consider all of the following criteria:

- Case type

Cemented and screw-retained restorations require slightly different abutments. There also may be differences between abutments for single and multiple units.

- Implant Diameter

  Abutments are designed to fit various implant diameters. Make sure to select the appropriate size, as described in the implant catalog provided by the manufacturer.

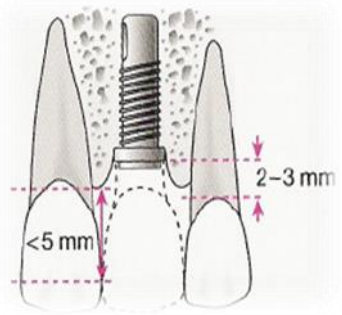
- Intra-arch Space

  Abutment flare should allow for interproximal areas to be sufficiently accessible for oral hygiene.

- Interarch Space Abutment height must allow for restorative metal and porcelain to be built with sufficient thickness.
- Angulation of implants may have to be corrected at the abutment level. In multiple implant cases, abutments should be chosen in order to guarantee a common path of insertion.

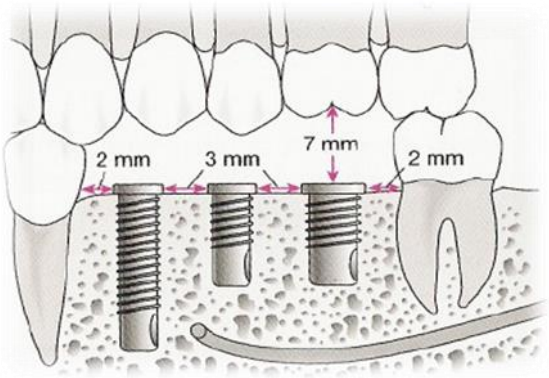
- Gingival Margins: While abutment margins can be placed above gingival margins in areas that are not esthetic, abutments must be subgingival in esthetic areas; however, abutments should not be too subgingival in order to facilitate prosthesis placement and cement removal.

- Subgingival Contours In esthetic areas, the abutment also needs to support and shape subgingival contours.



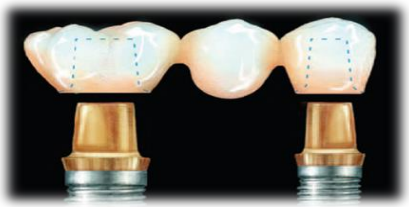
Proper abutment angulations provide good emergency profile

Labial and occlusal view of the ideal positioning of an implant for the replacement of an upper central incisor tooth



Ideal placement of multiple posterior implants.

Cement retained prosthesis



Provides more aesthetic result, as screw access holes can be avoided.

With this practice abutment screws must stay tight because a loose screw cannot be easily accessed.

May require sectioning to tighten a loose abutment. Clinicians often use temporary cements to facilitate this

Advantages of cement retained prosthesis

- ❑ Better esthetic results
- ❑ Lower cost
- ❑ Less screw loosening problems
- ❑ Passive fitting
- ❑ simplicity

Angled Abutment

The access hole for the bridge screw ideally needs to emerge through the centre of the occlusal surface of the restoration. Angled abutments are designed to compensate for a different path of insertion for the bridge and bridge screw compared with the implant

Angled abutments are available in the range 15–35°. Depending upon the position in which the abutment is seated on the implant it is also possible to use this angulation change to ‘move’ the bridge screw access in a mesial or distal direction.

Prepable abutment

They are abutments with a solid head that can be prepared in the laboratory so that they are retentive, have margins in an aesthetic position and have an acceptable degree of parallelism to each other to be able to have a conventional bridge cemented onto them.

Advantages of cement retained prosthesis

- ❑ Better esthetic results
- ❑ Lower cost
- ❑ Less screw loosening problems
- ❑ Passive fitting

- ❑ Simplicity similar to conventional bridge techniques

Disadvantages of cemented bridges

• Retrievability more difficult

• More laboratory time required to produce prepared abutments and temporary bridges if required

• Cementation needs to be controlled, especially with subgingival margins

• Difficult to ensure full seating of the bridge, especially with tight or deep gingival 'collars' or if there is bleeding

• Increased technical costs and chairside time if temporary bridges are required

Abutment Preparation

- Sometimes, abutments require modification after selection.
- Many abutments are never modified. In general, abutments utilized for screw-retained restorations cannot be modified.
- Some abutments may or may not be modified. While prefabricated abutments are designed to fit most standard situations, in some cases, modification may be necessary in order to fulfill the criteria above.
- Prepable abutments require custom modification.
- Custom abutments must be prepared on the model.
- Modification, like selection, may occur on the model or in the mouth.
- In many cases, either preparation on a model or the mouth is possible.
- Internal friction abutments require delivery and preparation in the mouth.

Abutment Preparation on a Model

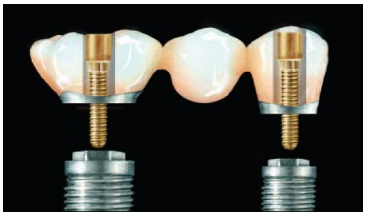
- In this case, abutment preparation requires a model that has been obtained from an implant-level impression.
- Select appropriate abutments on the model before beginning preparation.
- If prefabricated abutments require modification, modify them by further reducing height, slightly modifying the angulation, or displacing the margin more apically.
- To modify prepable abutments, set height, angulation, taper, and margins in a similar fashion to tooth preparation.
- To fabricate custom abutments, the laboratory technician waxes onto the burn-out sleeve and fabricates the abutments using a lost-wax technique. Abutments are then processed, polished, and positioned on implant analogs.
- In all cases, abutments must be tried on the model after preparation. Use a laboratory screw and not the final screw to manipulate the abutment.
- Prosthesis fabrication can be initiated while abutments are on the model in order to avoid taking a second impression after abutment delivery.

Abutment Preparation in the Mouth

- After selecting an appropriate abutment on a model or in the mouth, the next step in preparing an abutment in the mouth is to deliver it. If prefabricated abutments require modification, modify them by reducing height, accentuating angulation, or setting margins more apically.
- To modify prepable abutments, address height, angulation, taper and margins in a similar fashion to tooth preparation.
- Use copious irrigation to avoid heat generation and transmission to the implant.

- Now, it is necessary to take an abutment-level impression. Take the impression using the same method that is employed in traditional dentistry

Screw retained prosthesis



Restoring Without Abutments

- When interarch space is inadequate, but implant angulation is good, it may be advantageous to place a restoration without an intermediate abutment.
- This method may also be employed in the esthetic zone when interarch space is sufficient but the crown is utilized to support soft tissues.
- When restoring without abutments, the restoration must be screw-retained.
- An implant-level impression is taken.
- The prosthesis framework must be fabricated to the implant level. The laboratory uses the castable sleeve that is generally used for fabrication of custom abutments to adapt the framework to the implant head.

Plastic Abutment (UCLA)

-University of California in Los Anglos

-Used to construct prosthesis directly on implant level

-We make a waxing up on the abutment then custom made abutment

-Later on abutment will be a part of the crown so the crown will be screwed directly to the implant

-It can be hexed for single tooth or non hexed for multiple teeth

Indications

- ž Limited inter occlusal space
- ž Minimal soft tissue thickness
- ž Needs for subgingival placement of restoration margin
- ž Can be used for single tooth , multiple teeth , full arch and over dentures

Advantages of screw retained prosthesis

-Prosthesis retrievability

Implant evaluation, soft tissue inspection and any necessary prosthesis modifications.-future treatment considerations can be made more easily and less expensively.

Porcelain repair, changing the shade of a restoration and creating additional access for oral hygiene.

-Not introducing cement into the peri implant areas.

-Can be used when minimal thickness is 2mm or less

-Easy to use.

-Cheapest abutment (plastic)

Disadvantages

- Require precise lab work
- Possible screw loosening

Screw retained VS cement retained

The patient's left lateral is screw retained and the patient's right lateral is cement retained.

When minimal inter occlusal space exists it may not be possible to develop adequate retention to retain restorations to implants with cement. However, screw retained restorations can be secured to implants with as little as 4 mm of space from the surface of the implant to the opposing occlusion.

1- Interocclusal distance :
If narrow IOD we use screw retained ,if wide IOD we use cement retained.

2-Implant angulations:

Slightly palatal implant so we can use screw retained while labial placed implant so we use cement retained.

3-Needs for retrievability: - In case of cement retained we use temporary cement always but in case of screw retained no problem.

4-Laboratory efficiency: - Screw retained restoration need greater laboratory efficiency.

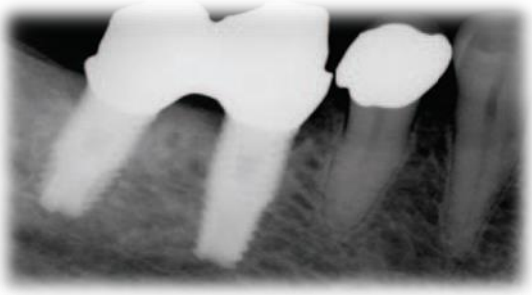
The decision between screw-retained and cemented bridges also depends upon the ability of the dental laboratory to construct an acceptable restoration.

Splinted VS non splinted

-The retention of the prosthesis is also improved with a greater number of splinted abutments.

-Biomechanical advantages in that it will also reduce the incidence of screw loosening and unretained restorations.

-Fewer proximal contacts to adjust and delivery of the restoration can be performed more efficiently.



The additional cost of the two implants was justified by the reduction in prosthodontic risk

-Shorter implants (under 10 mm) can be protected from overload by the other implants, because the rigid structure will distribute the load over the combined surface areas of the implants.

-Implants placed in areas of high potential stress can be protected by linked structures. For example, linking to other implants can protect the most distal implant in a posterior reconstruction.

- Linked implants allow cantilever pontics to be incorporated into a bridge. This is particularly useful with distal extension bridges. It is often difficult to place adequate length implants in distal positions due to lack of bone and anatomical features. By linking implants placed anteriorly, the patient can be provided with teeth in these regions.

Restoration of Single Tooth Implant

A single tooth implant crown is likely to be one of the first restorations a practitioner may undertake. Posterior and anterior restorations differ significantly, and it is advisable to avoid anterior restorations when beginning because of the challenges they can pose.

When aesthetics are important, mostly in the anterior part of the mouth, the healing abutment should be left in place for approximately 3weeks following second- stage surgery. This allows the gingival tissues to take up a stable position. When providing posterior restorations, the healing time is not so critical, 2 weeks is enough

For anterior teeth, the implant should be aligned in such a way that the long axis is in line with the incisal edges of the adjacent teeth. Except in screw retained prosthesis , screw must be more palatal.

For posterior crowns, the long axis of the implant should be aligned so that the screw access comes through the central fossa of the premolar or molar tooth.

Procedures

. Removal of healing abutment

. Impression procedures using an impression coping

.Jaw registration

. Shade- taking

. Temporization

. Radiographic confirmation of abutment placement

. Tightening of the abutment screw with a torque wrench

. Try in and cementation or screw retention.

Gingival measurement before abutment selection.

Posterior restoration

Esthetics are not an issue with posterior restorations, but access can be difficult. Study models are particularly useful in this case, because extra attention needs to be paid to abutment selection, preparation, and delivery.

Cemented Crown

Impressions

- Impressions may be taken as described in “impressions.”

Abutment Selection and Preparation

- Abutment choices include prefabricated abutments, custom abutments, and prepable posts.
- When fabricating or modifying abutments make sure maximum retention is present. Single crowns, unlike multiple units, generally lack sufficient abutment retentive walls.
- When modifying the preparation of cylindrical or conical abutments, make sure that flat planes are present. Single crowns are prone to rotation, and flat planes minimize rotational tendencies and aid crown orientation.
- Another way of improving stability is to slightly flatten the contact points of adjacent teeth, which increases the contact surface with the implant crown.
- In molar areas, it is necessary to compensate for the mesiodistal and buccolingual discrepancy between the implant diameter and the wide crown by developing a smooth and wide emergence profile in the abutment and the crown.

Crown Fabrication

- Although it may seem desirable to build a platform that matches adjacent teeth, it is preferable to reduce the platform in the buccolingual direction. This reduces the impact of biting and chewing forces.
- Because implants possess no mobility, it is important to check interproximal contacts carefully.

Abutment Delivery

- Because of the proximity of adjacent teeth and difficult access, abutment delivery is more delicate with single crowns than in other clinical situations.
- It is recommended to position the abutment with a crown gripper or an abutment holder.

Crown Delivery

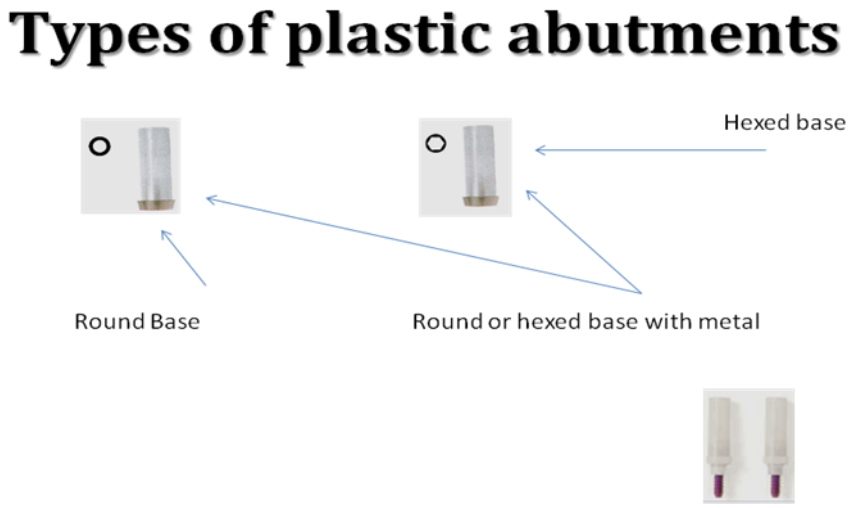
- If a provisional crown was placed, remove all temporary cement and verify the abutment stability.
- Ensure that the abutment is fully seated and properly torqued. (However, in internal friction systems, abutments have already been torqued and should not be displaced at this time.)
- Try the crown and verify that it is fully seated by inspecting the crown/abutment connection using an explorer, and taking a radiograph.
- Check the contact points.
- Check the occlusion. Whenever possible, an attempt should be made to concentrate contact points towards the long axis of the implant. Contact points should remain light but not absent to avoid opposing extrusion.
- Place a cotton pellet or gutta percha on the abutment screw and cement the crown. In this case, temporary cement is often used. Single units are associated with minimum retention and high risk of uncementation.
- Carefully remove the excess cement.

Problem Solving

- The abutment cannot be seated in its final position.
    - Verify that no error was made in selecting the analog. Each implant diameter is associated with one matching analog.
    - Verify that the abutment sits properly on the model.
    - Verify that there is no interfering material at the abutment connection (eg, gold or porcelain projection).
    - Verify that the implant head is free of debris and soft tissue.
- The abutment is in place but its position is different than on the model.
    - For any system except an internal friction system, unscrew slightly and rotate until the correct position is found. Hexagon systems, for example, have six possible locations for abutments.
    - This problem does not exist with internal friction systems since the abutments were delivered prior to impression.
    - If none of the possible locations for abutments is correct, there was an error in the implant-level impression. You may have to retake the impression.
- A straight abutment is in place, and the crown sits properly on the abutment, but the crown is more coronal than on the model.
    - The impression coping (or the analog) was not engaged properly at the time of implant-level impression.
    - One way to solve this is to remove the abutment and crown and retake the implant-level impression.
    - You may also remove the crown, leave the abutment in place, and take an abutment-level impression.
    - Alternately, leave the crown in place and use it as a transfer coping. Take an impression. The laboratory can then position the abutment in the crown, along with a new implant analog.
- The abutment and crown are in place, but the contact point had to be reduced to seat the crown, resulting in an open contact.
    - Verify that adjacent teeth are not interfering with the path of insertion. Unlike teeth, the implant has no mobility to allow for friction in the insertion path, and if the implant is slightly inclined, the crown contacts the adjacent tooth prior to being fully seated.
    - Perform an ameloplasty to flatten contact points and polish adjacent contacts.

- Take an impression with the crown in place. The abutment can be left in place if a provisional crown is available. In that case, a die can be poured in the crown.
- Reinforce contact points in the laboratory.

Single tooth restoration using UCLA abutment (screw retained restoration)



Impressions

- Because abutments for screw-retained crowns remain unmodified, it is often practical to take an implant-level impression.

Abutment Selection and Preparation

- Select an abutment appropriate for screw-retention.
- Crown fabrication can be performed in the laboratory prior to abutment delivery.
- Perfect abutment angulation (or implant placement) is necessary to ensure that the screw-access hole is in the center of the platform.

Crown Fabrication

- Due to the screw-access channel, buccal and lingual metal and porcelain walls may be weak. It is important to pay attention to the thickness of the porcelain to avoid fracture.
- If angulation is inadequate, the channel may exit in an inconvenient location (eg, in a supporting cusp).

Abutment Delivery

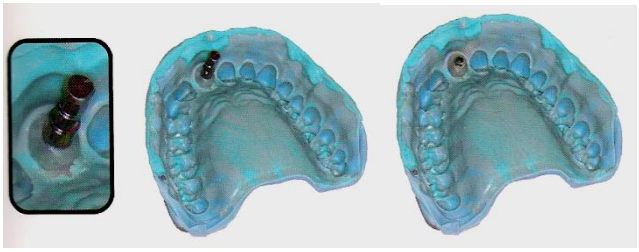
- Screw-retained crowns may require special screwdrivers for delivering abutments. These protect the screw hole in the abutment that will retain the future crown.

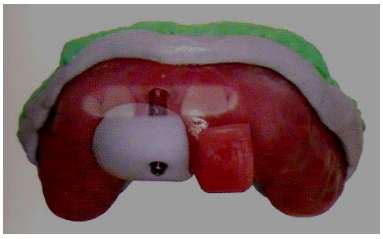
Crown Delivery

- Try the crown without applying full torque to its retaining screw.
- Verify correct seating clinically and using a radiograph. In addition, make sure the screw turns without resistance until the last quarter turn is reached.
- Once the crown is seated, verify and adjust the contact points and occlusion.
- Torque the screw to the recommended amount.
- Block the access channel with a temporary material.
- At a later visit, remove the temporary material and torque the screw to the same value. Protect the screw head with a cotton pellet or gutta percha and place a composite restoration.

Problem Solving

- There is resistance when engaging the screw.
    - Verify that the crown is engaging the implant head or abutment completely.
    - Ensure that there is no debris or soft tissue between the crown and the implant or abutment.
- The crown fits into place but its position is different than on the model.
    - For any system except an internal friction system, unscrew slightly and rotate until the correct position is found. Hexagon systems, for example, have six possible locations for abutments.
    - The abutment cannot be the source of misalignment with internal friction retention since it was delivered prior to impression.
    - If none of the possible locations for abutments is correct, there was an error in the implant-level impression. You may have to retake the impression.





ANTERIOR RESTORATIONS

Anterior restorations are more delicate than posterior restorations because they are located in the esthetic zone. Recall that restorations in this region require extra attention when treatment planning and that lack of soft and/or hard tissues may need to be addressed by grafting surgeries. In order to obtain an esthetically pleasing result, it is critical to develop a smooth emergence profile during the restoration process.

Impressions

- It is recommended to take an implant-level impression whenever possible.
- Because tissues collapse rapidly and anterior implants are placed more apically, the impression should be taken as quickly as possible. This is particularly true in cases where tissue height is important and apically placed external connection implants have been utilized.
- If a provisional crown was present, the impression material must be injected in order to reproduce gingival contours.
- One option to be considered is implant indexing.

Implant Indexing

- Implant indexing is a method in which an impression is taken at the time of surgical placement.
- Taking the impression during surgery allows for the preparation of an abutment and provisional crown during the healing period that follows.

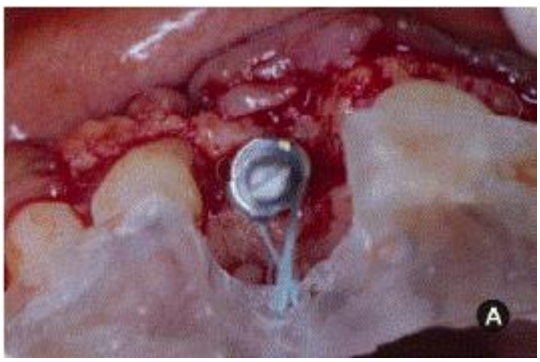
- The main advantage is that it allows for tissue to be shaped earlier than otherwise possible.
- The provisional crown is inserted instead of a healing abutment at the time of implant exposure for two-stage implants, or after placement and osseointegration for one-stage implants. As a result, the tissue can be shaped during this visit and no further visits are needed to address tissue shape.
- A tray technique or a jig technique may be used to take an impression at the time of surgery.

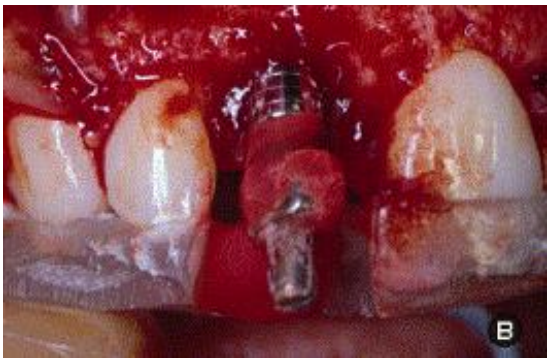
Tray Technique

- It is possible to use a traditional tray technique for implant indexing.
- The use of a pickup coping is recommended to minimize the amount of force loaded onto the newly placed implant.

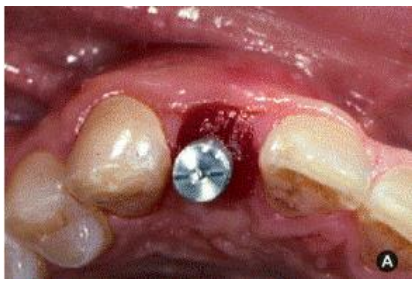
Jig Technique

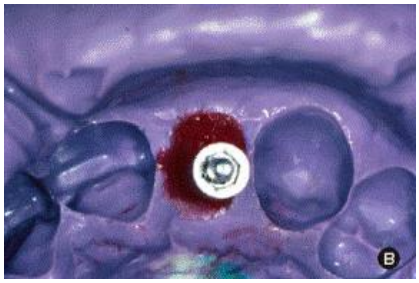
- A jig can be fabricated prior to surgery to avoid using impression material while the surgical flap is opened.
- To fabricate the jig, place and cure a mini acrylic splint (or a small Triad® band) on 3-4 adjacent teeth on a diagnostic cast. Make sure the splint is stable.
- Release a space in the jig for the future impression coping.
- Cold sterilize.
- After the implant is positioned during surgery, place a pickup coping.
- Position the jig in the mouth.
- Relate the coping to the jig using liquid acrylic or Triad® gel. Ensure that the coping screw rotates freely and no undercut locks it in place. The acrylic or gel can now be cured.
- Remove the screw, and free the mini splint with the abutment attached.
- At a later time, release a space on the stone model to accommodate the implant analog.
- Position the jig and the attached analog.
- Pour the stone and remove the jig once the stone is set.
- The implant is now indexed onto the stone model





Indexing with a jig. The impression is being taken at the time of implant placement for future preparation of the provisional crown. (A) An acrylic appliance sits on adjacent teeth. (B) After implant placement, an acrylic material is flowed and set to relate the abutment to the jig. The dental floss helps to carry the liquid acrylic into the appliance. (C) After the pickup coping has been secured on the jig, a model taken prior to implant placement is modified to receive the implant analog.





Impression-taking for an anterior restoration. When taking the impression, it is important to reproduce the gingival contours that were developed with the provisional restoration. (A) In this case, Duralay® is rapidly flowed between the impression coping and the gingiva. (B) As a result, gingival contours are reproduced in the impression.

Abutment Selection and Preparation

- Because esthetics are important with anterior restorations, abutments should be selected and prepared with the emergence profile in mind.
- A custom abutment or a large prefabricated abutment is preferable.
- The goal is to obtain an abutment shaped like the cross-section of the tooth when emerging from gingival tissues. This will allow adequate support and pleasing esthetics.
- If a narrow prefabricated abutment is used, the margin must be more apical in order to maintain tissues using the crown. This requires a cement line that is deeper and more difficult to remove than usual.
- Porcelain abutments are available for use in the esthetic zone. These abutments eliminate the metallic shadow that is sometimes visible when conventional abutments are placed in thin tissues, creating more pleasing gingival margins.

Crown Fabrication

- Sometimes, it may be beneficial to develop the flare into the crown rather than the abutment; however, make sure in this case that the crown provides sufficient support of surrounding tissues.
- Full porcelain crowns may create a particularly pleasing restoration, especially if porcelain abutments are utilized.

Abutment Delivery

- Allow extra chair time for abutment delivery (as well as crown delivery) because subgingival contours often need modification.
- Verify that the margin is apical enough so that it does not show through the thinnest gingival portion. This prevents a dark margin.

Crown Delivery

Contouring Tissue with a Provisional Crown

- A provisional crown should be used to obtain ideal gingival tissue contours. Do not assume that the permanent restoration will provide necessary improvement.
- When inserting a provisional crown for the first time, slight expansion of tissues should provoke blanching for approximately 20 minutes, and may necessitate a local anesthetic.

- Overcontouring causes buccal tissues not only to expand, but also to be displaced apically. Gingival contours react like an elastic band.
- Be prepared to adjust buccal contours in addition to other adjustments.

Delivery of Final Crown

- Place the crown and verify if blanching occurs. Because a provisional crown has already been in place, the final restoration should not require recontouring tissue.
- Adjust contours and contacts. Adjust the occlusion to obtain minimal protrusive guidance on the implant whenever possible.
- Polish the crown and leave it in place until tissues have settled to final contours.
- Take a radiograph to verify that the crown is in place.
- Verify that the abutment screw is tightened to the correct torque level.
- Block the screw access hole with a cotton pellet or gutta percha.
- Deliver the crown. When cemented, retention of single crowns is limited and permanent cement is often necessary. Make sure to maintain pressure on the incisal edge of the crown during setting, because tissue pressure will displace it coronally.
- Remove supra- and subgingival excess cement. Carefully inspect the crown/abutment connection with an explorer.
- Take a final radiograph and inspect it for excess cement. Some cement may not be visible because of the radiopacity of metal components.

Problem Solving

- The buccal gingival margin is too incisal on the implant crown.
    - It may be possible to augment the buccal contour of the crown.
    - Better support will also displace the contour apically.
    - Crown contour modification is only possible if the implant is positioned apically enough for the subgingival contour to be modified.
- The buccal gingival margin is too apical on the implant crown.
    - Check if the crown buccal contour is over contoured. Reduction will decrease tissue support, displacing tissue incisally.
    - Verify that the implant platform is apically and palatally positioned. If so, crown contours can be modified. If not, a gingival graft may be necessary to improve the gingival contour.
- Papillae are collapsed and a black triangle appears.
    - There may be no solution. Surgical intervention is usually not possible in this case.
    - Sometimes, contours of the implant crown can be slightly modified to better support the papillae.
    - Composites, veneers, or crowns on adjacent teeth may be the best way to eliminate black spaces. Verify the esthetic outcome with a diagnostic wax-up.

Multiple tooth restoration

Bridges

Because of the absence of ligaments, there are higher constraints on implant-retained bridges than bridges retained by natural abutments. Implant rigidity does not allow for any error in the path of insertion, nor does it allow for any distortion in the framework. Thus, precise fitting of all parts is essential to the long-term success of the prosthesis.

Impressions

- Use pickup copings whenever possible.
- If transfer copings are an option with your system, they should be reserved for cases in which interarch space is not available, access is difficult.
- When possible, choose an implant-level impression, because selecting and preparing abutments in the laboratory (as opposed to selection and preparation in the mouth) is particularly useful in multiple implant cases.
- If pickup copings are used, relating the implants rigidly with a splint is recommended (see "Multiple Implants and Splinting.")
- If transfer copings are used, it is recommended to fabricate a resin key that engages the component heads (see below.) This can later be used on the model to verify impression accuracy (Figure 14-G).

Abutment Selection and Preparation

- When the system allows it, selection and preparation of abutments on a model is preferable for multiple implant cases. Margin position and parallelism can be more easily established.
- When choosing to prepare or modify abutments in the mouth, it is preferable not to remove them at the end of the visit. This causes the orientation of the abutments to be lost. Instead, a provisional bridge should be relined and cemented.
- If abutments are prepared in the mouth, a traditional impression is necessary. Be prepared to take multiple impressions because accurate capture of all margins at once is difficult.

Bridge Fabrication

Part of fabricating the bridge is making sure that it fits correctly and making necessary adjustments. During try-in visits, make sure to do the following:

- Abutments must be delivered and torqued before trying the bridge framework. If abutments are already in place, verify that abutment screws are tightened to their appropriate torque.
- Try the framework alone and verify its fit. Section and solder if necessary.
- For screw-retained restorations, verify passive fit .After fit has been verified, try in the bisque bake porcelain and perform adjustments. For screw-retained restorations, repeat the passive-fit test because distortion could occur during porcelain firing.

Passive Fit

- Passive fit is a term used to describe the precise insertion of a bridge into its full position without resistance.
- It is important to attain passive fit with implant-supported prostheses because, unlike teeth, implants possess no mobility, and any friction will be detrimental to the integrity of the prosthesis.
- It is a particularly acute problem for screw-retained bridges. Forcing screws into place can cause the framework to bend. This creates tension in the framework, which is unfavorable to the stability of screws and detrimental to the bridge and implants.
- Passive fit is not as easy to detect with cemented bridges − minor distortion is deferred to the cement layer.

Clinical Evaluation of Passive Fit

- Verify that restorative margins are in intimate contact with abutments or implants. This can be difficult if margins are subgingival.
- Using radiographic techniques, look for gaps between metal components.
- First, place the most distal or mesial screw.

- Then, place the opposite screw.
- All screws should fit into position without resistance. Increasing resistance should be necessary only for the last quarter of the last turn (until an adequate torque value is reached).
- Testing should be done with screws that will not be utilized for final delivery – definitive screws may get damaged during try-in visits.
- See table below for problem-solving when screws do not perform ideally

CLINICAL TESTING OF PASSIVE FIT FOR A SCREW-RETAINED BRIDGE

Problem	Problem Cause	Solution
There is resistance when engaging a screw	One of the impression copings was misaligned	Put the framework aside. On the model, fabricate a resin framework and section it between each implant. Try in the mouth. The framework piece that is misaligned indicates the mispositioned analog.
One mesial/distal screw is in place, but the opposite screw is not engaging at all	The framework is distorted mesiodistally and/or buccolingually	Leave the first screw in place. Place a screw in the immediately adjacent implant. If there is a misfit, section between these two implants. If not, repeat with the next implant.
One mesial/distal screw is in place, but the opposite screw engages with increasing resistance	The framework is distorted apicocoronally. The screw is forcing the framework downwards.	Leave the first screw in place. Place a screw in the immediately adjacent implant. If there is a misfit, section between these two implants. If not, repeat with the next implant.

Abutment Delivery

- During try-in visits, deliver and verify the position of all abutments before trying the bridge framework.
- Whenever possible, attempt to deliver the abutments only once. In order to avoid abutment removal, it is necessary to deliver a provisional bridge and take a master impression with the framework in the mouth (see steps below).
- When not using an internal friction system, it is possible to place the abutments when trying the framework and remove them at the end of the visit; however, screws are being tightened and untightened, which is not desirable. Further, abutment position must be verified again at the following visit, which is time-consuming and exposes the patient to unnecessary radiographs.
- Leaving abutments in place is also an opportunity to verify that screws remain fully torqued at a subsequent visit.
- A resin key can be a useful tool for delivering multiple abutments (see below.)

Master Impressions with the Framework in the Mouth

- A master impression is necessary if sectioning and soldering was done.
- Try and adjust the framework.
- Section and solder with an acrylic resin if necessary. Try the framework again after soldering.
- Take a bite registration.
- Take the impression with the framework in place.

- Remount the model in the articulator.

Bridge Delivery

Screw-retained Restorations

- Deliver all screws with adequate torque.
- Protect screws with cotton pellets.
- Temporarily close screw access holes, using a material such as calcium oxide.
- At a subsequent visit, verify the torque and temporize again.
- Permanent closure of screw access holes can be postponed for a few months to allow for a testing period.
- When closing channels permanently, first block the screws with cotton pellets. Use a composite that is a slightly different shade than the bridge if esthetics are not a concern – later removal will be made easier, preventing damage to the porcelain.
- A night guard is recommended to minimize nocturnal lateral forces.

Cemented Restorations

- Use temporary cement. Because of the presence of multiple abutments, retention is rarely compromised and permanent cement should not be necessary.
- A night guard is recommended to minimize nocturnal lateral forces.

Screw loosening

Screw loosening represents one of the most frustrating problems encountered. Some have claimed that the "internal hex" design and proper torque will minimize the problem. The tips below may provide additional insights to all but eliminate this problem.
In a study of 70 implants, 57% of abutment screws become loose during the first year. After three years, only 35% of the implants in the study remained tight without incident. In another study of 107 implants, 26% suffered screw loosening the first year. This frustrating problem may be part of the reason why GPs are not embracing implant technology with more enthusiasm. However, screw loosening is not related to implant design but rather Bruxism and several other controllable factors:

1. If the occlusal table of the implant tooth is NARROWED, there is less screw loosening.
2. Stress on the screw can be decreased by decreasing the crown height, increasing the hex height (though most companies hex is 0.7mm high) and perhaps the best solution for decreasing stress on the screw is to INCREASE the DIAMETER of the implant.
3. When using a torque wrench to tighten the screw, the ABUTMENT should be held securely with a small hemostat so the implant will not turn when the screw is torqued.
4. Torque wrenches LOSE CALIBRATION with use and autoclaving and should be returned to the manufacturer for re-calibration periodically.
5. An implant outside the ESTHETIC ZONE (i.e. in the posterior) should NOT have normal anatomical cuspal inclines as these will greatly increase the LATERAL FORCES on the implant and contribute to screw loosening, bone loss and failure rate. A wide central fossa area centered over the implant is desirable. These two photos of implants posterior to tooth #20 illustrate how 31 "molar" implants should be fabricated. They are no larger than the 2nd bicuspid natural tooth and have flat plane occlusion.
6. Therefore, if the implant tooth is not in the esthetic zone, it should be NARROWER and have basically FLAT PLANE occlusion to avoid unnecessary forces (see also Adjusting the Occlusion of Implants). As Misch often says, "If the implant tooth is out of the esthetic zone and I have made it LOOK like a tooth, I have made it INCORRECTLY."

Combined Natural Tooth/implant support

Connecting teeth to osseointegrated implants presents a biomechanical challenge. This is due to the implant being rigidly fixed to the bone band the tooth being attached to the bone with a periodontal ligament. This ligament allows teeth more mobility than osseointegrated implants. Studies have been equivocal about the efficacy of this connection. Some studies indicate when there is rigid connection of implants to teeth that this is an acceptable procedure and restorations survive. Recent studies indicate that restorations with tooth and implant support are not as successful.

Numerous reports demonstrate a natural tooth may be splinted to an implant. However, when possible, make implant restorations separate from the teeth- for primarily biologic reasons (not biomechanic). When teeth are splinted to an implant (or tooth), the pontic acts as a plaque resevoir and decay affects the tooth 20 to 25% of the time within 10 years. In addition, crowning the natural tooth increases the risk of endodontics (and so does the decay). Therefore, do not crown the natural tooth and splint it to an implant. However, if this is necessary, the risks of the prosthesis may be reduced when:
1. Use a posterior tooth with no lateral force on the prosthesis. The majority of the movement difference between teeth and implants is with lateral forces. Hence anterior guidance or canine protected occlusion with no lateral forces on the posterior teeth make the restoration less at risk.
2. Make a one piece bridge with no precision or semi precision attachment. Solid connectors decrease the risk of tooth intrusion.
3. Use hard cement on the natural tooth. The tooth can not intrude from a one piece casting, unless the cement seal breaks. Limit the pontic distance to the size of 1 or 2 premolars. Cement seals will break more often with larger forces and longer spans between abutments .Carl Misch,DDS, MDS September 15th, 2009

-Connecting implants and teeth is controversial

-Rigidity connecting teeth to implant resulting in damaging forces on implant

-Natural teeth compress 27 downward and 50-100μ laterally during function.

- Normal movement of implant 10 μ
- So only connect when :
    - 1- Natural tooth is in excellent condition with mobility not exceeding normal amount
    - 2-only if the restoration is 2 missing teeth and the implant is one of them

-As a rule, avoid connecting implants and teeth whenever possible; however, with careful consideration, it is not contraindicated.

-Do not connect mobile teeth with the hope of reinforcing them and improving stability. Teeth with poor periodontal support should not be considered for connection.

-When a connection is necessary, treat the tooth as a cantilever from the implant and design the prosthesis accordingly. There should be a sufficient number of implants and adequate positioning to support the prosthesis.

-Posterior restoration supported by 3 implants are better than supported by 2 implants

- High risk of implant fracture with 2 implant in posterior restoration than 3 implants
- More mechanical problems occur with only 2 implants in posterior restorations
- Never cantilever a tooth distal to implants placed in posterior region.

Laboratory procedures
The technical procedures for implant bridges are similar to conventional crown and bridge techniques, but the following features are of note:

• A soft gingival replica is essential to allow for access to subgingival implant heads and abutment margins. The gingival replica is removable to check the marginal fit.

• The highest possible standard of metal framework production is required to achieve a passive fit.

• Care must be taken to ensure that no distortion of the framework occurs during firing of the porcelain. Damage to the framework fit has been reported following acrylic polishing of full-arch bridges if handled roughly.

• Frameworks should be cast in a high strength content metal Several laboratories are able to produce titanium frameworks that may offer more advantages.

• The importance of relating the implant position to the desired tooth position before choosing the abutment has been discussed already. Of equal importance in the laboratory is the relationship of the abutment to the final tooth position so that the framework is the correct contour to support the aesthetic portion of the bridge and the correct occlusal form. Many dental technicians prefer to wax-up the whole bridge and then cut the wax-up back to allow space for the porcelain or resin to ensure this contour.

PROSTHESIS DELIVERY

The steps of prosthesis delivery differ depending upon whether the restoration is screw-retained or cemented.

Screw-Retained Prosthesis

- The restoration is retained by a screw that must be torqued into place.
- Protect the screw with a cotton pellet or gutta percha, in the event access is needed later.
- In general, it is recommended that the screw access be blocked with a temporary material, such as Cavit®. At a later visit, the screw can be tightened a second time and the access hole closed with composite.

Cemented Prosthesis

- Temporary cement should be used whenever possible. There is no risk of caries in this case and temporary cement makes retrieval easier. If retention is good, the cement may never need to be changed.
- At the time of delivery, excess cement must be carefully removed. A radiograph may reveal the presence of remaining cement.

Occlusal Adjustments of Implants

Adjusting the occlusion of implanted prosthetics requires special consideration. As mentioned before, since proprioception of occlusive force in implants is nonexistent, the implant must be protected from the excess forces described earlier.
If the occlusion on a newly restored implant is adjusted to light tapping in the usual manner, the implant will be in HYPEROCCLUSION and subjected to excessive stress during normal function.
Occlusal adjustment and marking of implants therefore needs to be done under heavy biting pressure in order to fully compress the natural teeth. A very thin articulating paper should be used to accurately record prematurities. Under full biting pressure, any heavy occlusive marks need to be relieved, otherwise bone loss around the implant may occur as early as one month. Again, the patient will not be able to "tell" that the implant is too high as there is no proprioception.
The only occlusal contact for an implant crown should be in its central fossa, directly over the implant. Occlusal contact on the marginal ridges will increase chances for screw loosening, bone loss and porcelain fracture. The occlusal table of an implant should NEVER mimic natural dentition.

Chapter12

TREATMENT OF EDENTULOUS RIDGE

Treatment of edentulous Ridge

Restorations of edentulous arches require consideration of a different set of issues than other restoration types because no vertical stop is present, and a denture setup is necessary. The proper choice of restorative design requires careful diagnosis and treatment planning, including articulator mountings and full wax-ups. Unique treatment protocols are necessary to accommodate for lack of occlusal support.

● When restoring the edentulous ridge with implants one of the major decisions to make is often whether the patient should be restored with a fixed or removable prosthesis.

● The number of implants to be placed depends on quality of bone, anticipated force and arch form.

● Removable restorations require more maintenance than their fixed counterparts.

●The original design for full arch restoration is high water bridge design (doesn't

Touch the mucosa) for easier cleaning the implant. But this may interfere with phonetics and esthetics in case of short lip

PATIENT REACTIONS

Note that waiting periods tend to be experienced differently by patients who are newly edentulous and those who have already been edentulous for a long period of time.

Newly Edentulous Patients

The waiting period is usually more difficult for newly edentulous patients who must wear dentures for a few months.

In addition to facing multiple surgeries, patients are also adapting to interim dentures, which often cause local discomfort.

Patients are usually unaware of adhesive materials and need to be instructed about suitable choices.

Longtime Edentulous Patients

When patients have been edentulous prior to the implant phase, they are already accustomed to wearing a denture.

Retention may be impaired by necessary releases at the time of bone grafting or implant placement.

DIAGNOSIS

With overdentures type designs we can obtain support from implants and the mucosa; when there are enough fixtures the restoration can be entirely implant supported.

Where several implants are available of adequate dimensions it may be advisable to divide the restoration into separate bridges so that it is easier to construct and maintain in the future if complications arise.

Treatment plan

In treatment planning the following factors must be considered:

1. Aesthetics and patient desires

2. Type of support

3. Amount of resorption and interarch space.

4. Number of implants

5. Implant distribution

6. Economics.

1. Aesthetics and patient desires

Patients prefer to discard their removable appliance in favor of a fixed alternative.

2. Type of support

There are two categories of prosthesis, fixed and removable. Fixed prostheses included metal ceramic restorations supported by implants and, depending on the severity of the bone resorption some pink porcelain may be required to simulate gingival contours.

In the removable category we have implant supported overdentures and implant retained and tissue supported overdentures. A removable prosthesis can be secured by different methods including, bar and clip, magnet, ball attachments or the use of a precision milled or spark eroded components.

3. Amount of resorption and interarch space

Patients who exhibit minimal or moderate resorption are candidates for a fixed restoration providing parameters of facial and lip support are satisfied.

Patients with advanced resorption can be satisfied aesthetically by fabrication of a removable prosthesis with a flange; this replaces necessary support that has been lost as a result of resorption.

4. Number of implants

Placement of six to eight implants (10-15 mm in length) is recommended for a fixed implant prosthesis with cantilever pontics.

Four implants have been recommended for both an implant and an implant and tissue supported restoration.

The number of implants to place in each patient is determined by:

a. Quality of bone

b. Anticipated force to be placed on the restoration

c. Relationship between the shape of the residual ridge and the dental arch form.

4a. Quality of bone

Frequently type 3 and 4 bone is encountered in the maxilla. Osteotomes are required to develop the site to receive the implant.

The success of implants in the maxilla is less certain than in the edentulous mandible.

When the quality of bone is not optimal often the surgeon and restorative dentist consider placing additional implants.

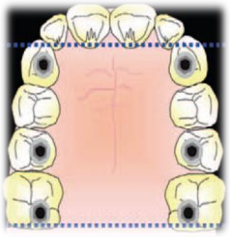
4b. Anticipated force to be placed on the restoration.

The masseter muscles should be observed for any hypertrophy that may be present. In these types of patients it is wise to place additional implants for added support and distribution of force.

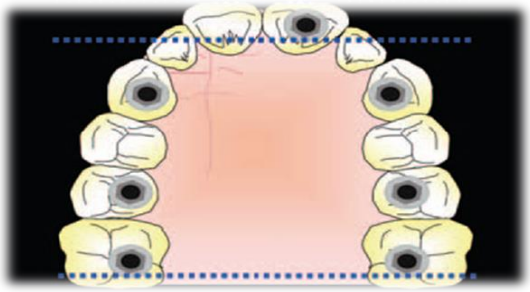
The opposing occlusion also has to be evaluated .Patients are likely to exert less force if the implant restorations are opposed by a complete denture as compared to the force that can be exerted when the patient has a natural dentition. The more the anticipated force on the implant restorations the more implants should be allowed for.

4c. Relationship between shape of residual ridge and the dental arch form

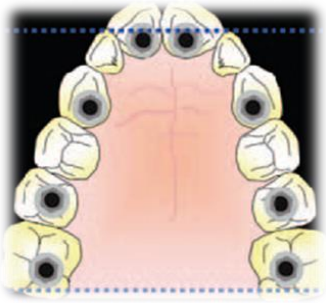
Three typical arch forms are prevalent, square, ovoid and tapering



Square arch form, a minimum of six implants are required



Ovoid arch form, an additional implant is required in the premaxilla to biomechanically stabilize the prosthesis



Tapering arch form, an additional two implants are required in the premaxilla to biomechanically stabilize the prosthesis

5. Implant distribution

Implants need to be placed with a sufficient antero-posterior spread so that load can be distributed equitably and cantilever length minimized.

6. Cost

Restoration of the edentulous maxilla is costly whichever method is used to restore the patient.

Cost needs to be considered not only during fabrication of the prosthesis but also during maintenance.

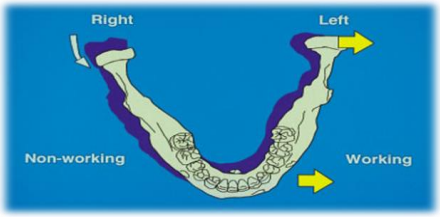
The patient must be made aware that maintenance costs for removable prostheses on implants will be higher than that of a fixed prosthesis.

Cantilever

Discussed before in biomechanics

Mandibular Flexure

Medial mandibular flexure (MMF) is a mandibular deformation characterized by a decrease in arch width during jaw opening and protrusion movements because of the functional contraction of the lateral pterygoid muscles, causing high strain in the symphyseal region. Therefore, it would be reasonable to expect that stronger muscles would be associated with larger mandibular flexure. The influence of geometric facial factors on mandibular deformation is unclear as only a few measures have been found to be statistically significan



EXTRA-ORAL EXAMINATION

Facial and lip support

Facial support if inadequate is obtained mainly by the buccal flange of a removable restoration

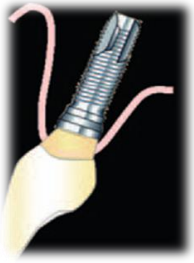
Lip support with denture, lip looks well supported

Lip support without denture. This patient will require a flange to satisfy aesthetic parameters

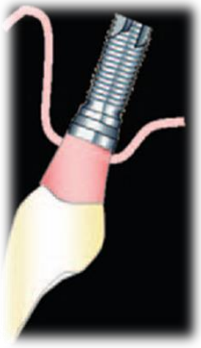
Resorption pattern in maxilla

When restoring early after extraction

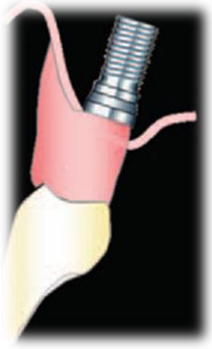
Cross section of tooth indicating bone level



With minimal resorption conventional crown and bridgework can be completed on the implant



With moderate resorption pink porcelain may be required to disguise tooth length if the patient desires a fixed restoration



With excessive resorption a flange of a removal restoration is required to satisfy parameters of lip and facial support

Smile line and lip length

The movement of the upper lip during speech and smiling should be evaluated. The average smile as having the position of the upper lip such that 75% to 100% of the maxillary incisors and interproximal gingiva are displayed. In a high smile line additional gingiva was exposed and in a low smile line less than 75% of the maxillary anterior teeth are displayed.

INTRA-ORAL EXAMINATION

In edentulous patients the interdental papillae is absent. When a tooth is lost the interseptal bone disappears and the bone remodels. What is often the result is a lattened papilla. The papilla height is also depressed as there is lack of interproximal contacts.

Inter arch space

Accurately mounted casts are critical in assessing prosthetic space limitations.

Fixed Bridge construction

Impressions

- An implant-level or abutment-level impression may be taken. Whenever possible, choose an implant-level impression in order to select abutments in the laboratory, where interarch space and angulations are easily visible.
- Use pickup copings whenever possible.
- Verify the accuracy of the impression before proceeding with treatment. If pickup copings are used, place them on the model and relate them rigidly. Then, try the splinted copings in the mouth and verify passive fit, keeping in mind that acrylic bends with less resistance than a metal framework.

Where several implants are available of adequate dimensions it may be advisable to divide the restoration into separate bridges so that it is easier to construct and maintain in the future if complications arise.

Upper cast following implant impressions, implant analogues and soft tissue replicas are required.

A wax rim is constructed then, trimmed and indexed to facilitate accurate jaw relations.

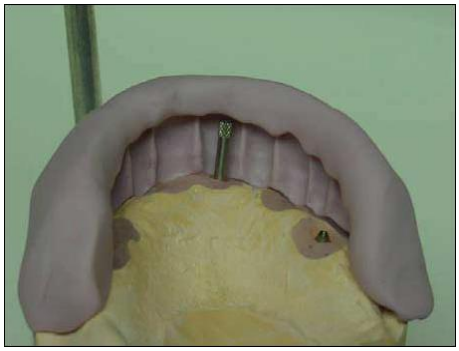
A final interocclusal record is taken.

A full diagnostic set-up of tooth position is then produced

The set-up is tried in. The jaw relations and appearance are assessed and altered as required. The patient can see the result and changes can be made easily at this stage.

Following approval of the tooth position a putty mask is made of the try-in.

If no accurate guide is available and there is any doubt as to the orientation of the implants, it is advisable to produce a new diagnostic tooth set-up that can be tried into the mouth and agreed with the patient before the abutments are chosen. This can be produced as a denture type set-up or ideally as a fixed set-up. Temporary bridge cylinders are linked together with acrylic or laboratory composite resin on the working model and a diagnostic set-up is produced in wax or with denture teeth, which can be tried into the mouth secured to the implants. It can give an exact idea as to the possible complications that may be encountered before expensive abutments and laboratory work have been undertaken. This information can be transferred into a provisional bridge and the patient allowed living with the restoration for a period of time to ensure that it is satisfactory before the final restoration is made.



The putty mask records tooth position.

-It can be located onto the working model and the correct abutment chosen to achieve the desired tooth position.

-If the patient has a satisfactory existing denture or bridge that is to be copied, an impression can be taken of it and a putty mask made of the labial and incisal surfaces.

-This can be tried against the implant head model and will demonstrate the relationship between the tooth and implant. Alternatively, if a diagnostic wax-up has been carried out, from which a surgical stent was provided, this can be related to the new working model.

- The underside of the ridge is carefully contoured and polished to aid cleaning

Try-in

These steps differ depending on whether the prosthesis is porcelain or acrylic.

Porcelain Prosthesis

- Try the framework, section and solder if necessary. Note that once soldered, the framework will not fit on the original model.
- If the framework has been soldered, repeat clinical try-in.
- Include occlusal stops on the framework. These stops may be part of the framework itself if gold occlusal surfaces are planned. They can also be added onto the framework using a resin.
- Once the framework has been sectioned and joined in the mouth, verify the occlusal stops and adjust them if necessary.
- Take a master impression of the framework and fabricate a new master model.

- Retrieve the framework from the impression and mount the new model against the previously articulated opposite arch, using the occlusal stops and a bite registration.

Acrylic Prosthesis

- Try the framework, section and solder if necessary. Note that once soldered, the framework will not fit on the original model.
- If the framework has been soldered, repeat clinical try-in.
- Position the framework on the original model using one screw only.
- It is recommended to perform another wax try-in at this point. This time, wax and teeth should be mounted on the framework.

Placing the bridge

If the definitive abutments have been removed between appointments they should be seated and tightened as recommended, normally using a torque device. The bridge is seated onto the abutments and the fit is verified. There is little point in trying to verify marginal fit visually unless the margins are supragingival.

It is quite normal for there to be some gingival blanching due to pressure on the soft tissues from the new profile of the bridge. Patients should be reassured that this is a temporary problem. If the fit is acceptable, the occlusion is checked.

Occlusion

If the bridge is being placed as a conformative restoration (in a partially dentate patient), it should be checked firstly in the retruded arc of closure to ensure that it does not create an occlusal interference. Next, the intercuspal position should be checked. Ideally, the bridge should be only just in contact when the patient closes lightly and should come fully into contact when the patient exerts heavy force. This will obviously depend upon how many natural teeth remain and how good their occlusal contacts are. This degree of contact is difficult to quantify but the best way of proceeding is to use occlusal indicator paper to get even contact between teeth and implants. Shimstock should then be used and on light contact the implant bridge should not hold the shimstock, but the teeth should. As the patient exerts more force so the implant bridge should hold the shimstock as well as the teeth. Ideally, the areas of contact should be located as close to the centre of the implants as possible so that forces are transmitted down the long axis of the implant under loading. Cantilever pontics should be loaded as little as possible. The bridge is then checked in lateral and protrusive movements. If a natural canine guidance is present, this will protect the bridge from lateral loading. If a group function occlusion exists, the implant bridge should be harmonious with this. If the canine tooth is being replaced as part of the bridge, it is normal practice for the occlusion to be reorganized as a group function occlusion if this can be achieved without sacrificing appearance. If lateral guidance has to be provided, this should be shallow, shared over several teeth if possible and be centred on the strongest implant Protrusive guidance should have been determined prior to construction because the anterior tooth position will dramatically alter this. The protrusive movement should be smooth

and spread over as many teeth as possible, once again ideally centred over the implants rather than on pontics. If a reorganized occlusal scheme is to be adopted, such as a full-arch bridge, this would follow normal crown and bridge and complete denture prosthodontics without the need for a balanced occlusion. The intercuspal occlusion should be provided at the ideal vertical dimension in the retruded arc of closure (retruded contact position), there should be an even and flat forwards movement of 1–2 mm, the lateral movement should be a group function with multiple contacts and the protrusive movement should be shallow and even.

Bridge screw tightening

With short-span bridges the screws can be tightened to 10 N.cm of torque, either manually or with a torquing device. Large implant-supported bridges should be seated progressively to assist with complete seating and prevent overtorquing the bridge screws. The screws in the centre should be hand-tightened first, moving distally and alternating from side to side. When the bridge is first placed, the screw access holes should be sealed with some cotton wool and temporary filling material. There is a significant incidence of early screw loosening, particularly with long bridges. The bridge therefore should be checked after 1–2 weeks and the bridge screws checked for tightness. Movement of a screw by 90° or less is considered acceptable. Any screws more loose than this must be checked a further 1–2 weeks later. It is unusual for a screw not to retain its tightness for the second time and if this occurs it should be checked carefully because it may indicate a poor fit for the framework or that the bridge is being overloaded. Once the screws have remained tight and the patient has approved all aspects of the bridge, the screw access holes can be sealed permanently. In order to allow access in the future without possible damage to the screw heads, they should be covered first with a layer of softened gutta percha or similar material, which will seal the space but not set hard so it can be removed easily if required. The occlusal portion of the screw access hole is best restored with a color-matched light-cured composite resin filling material and the occlusion re-checked afterwards.

Placing the bridge

On completion of a cemented bridge a decision needs to be made regarding the type of cementation required. With multiple parallel abutments the restoration does not require hard (permanent) cement because this will make the bridge difficult to seat fully and will make it impossible to retrieve in the future. Implant bridges therefore can be ‘permanently’ cemented with provisional cements as long as they demonstrate good retention and stability at the try-in. When the bridge is first completed, it is prudent to cement it provisionally to allow the patient to ‘live with’ the bridge for a short while and check on contour, appearance and speech before final cementation. Weakened or modified temporary cement is all that will be required. Provisional seating also allows the gingiva to adapt to the new contour and will make final cementation an easier technique, because the bridge will not be prevented from seating by a tight gingival collar. Prior to final cementation, the abutment screws are checked for tightness and the screw slots sealed with gutta percha. The chosen cement is mixed and placed in the bridge, only a thin layer will be necessary and the excess cement should be kept to a minimum to ease its removal. If hard cement such as zinc phosphate has been chosen, this should not be mixed as a viscous material or the bridge will not fully seat. The margins must be checked very carefully to ensure complete excess cement removal. The occlusion must be re-checked following cementation.

Instruction to the patient

On completion, periapical radiographs should be taken for all implants to confirm seating and act as a future guide for marginal bone levels. If a cemented bridge has been placed, excess cement should also be checked for. The patient is given specific hygiene instructions, particularly on how to access the areas between implants. They should be warned to be careful with the new bridge during function, because they are more likely to bite their inner cheek, lips or tongue as they get used to having a fixed structure rather

than a denture. Patients who have worn a denture long term prior to implant treatment experience more problems at the start and these are best discussed before problems arise in order to prevent the patient from becoming dissatisfied. In particular, speech may be affected when restoring the upper anterior teeth. The perception of speech change is often more apparent to the patient than to anyone else and usually returns to normal after 1–2 weeks. Longer accommodation times are, however, sometimes needed.

Follow up

Following final completion of the new restoration it is wise to arrange for a review within 6 months, particularly to check home maintenance. The marginal bone levels should be checked for stability with new long-cone periapical radiographs after 1 year and then approximately every 2 years.

Over denture construction

Implant-retained dentures are becoming popular, in particular at the mandible where retention and prosthesis stability is much improved in the presence of implants. Once a removable prosthesis has been chosen, it is necessary to make a choice about the method of connecting implants to the prosthesis. The two main categories are splinted and non splinted implants.

Splinted Implants

Splinted implants are joined by a bar that enables attachment to the prosthesis.

Bars are retained on implants by screws that are visible upon examination.

The inside of the denture contains the attachments to the bar.

Non splinted Implants

Non splinted implants remain separated from each other.

An abutment serves as an attachment.

The other part of the attachment (usually the female portion) is located inside the prosthesis.

While several types of attachment exist, the most common shape is a ball.

Splinted VS non splinted Implants

Splinted implants require more prosthetic space than non splinted implants. They should only be considered if a space of 12 mm or more is available.

Non splinted implants are usually preferred if only two implants are present.

Treatment is often simpler with non splinted implants, because an existing denture can be utilized and retrofitted with attachments**.**

Advantages

- Control of profile and flanges
- Being removable

- Ease of maintenance
- Predictable phonetics(specially without palatal part)
- Predictable esthetics
- Useful for severe maxillo mandible relation class 2 &3
- Simpler technique
- Reduced cost

Disadvantages

- Being removable
- Greater need for adjustment and repair
- Needs to change the housing a lot

Implant over denture classification (non splinted)

- Totally implant supported over denture (5-6 implant)
- Tissue supported overdentures
- Implant / tissue supported over denture (2-4) implants

Position of the implants

- Interforaminal region will carry 5 implants
- Inter implant distance should be sufficient for attachment positioning (bar or o-ring)
- Implant should be positioned palatal /lingual to the artificial teeth
- Parallility as much as possible

There are two main techniques of fabricating non splinted implants. One involves chairside delivery of female attachments and the other involves attachment delivery in the laboratory. Chairside delivery is preferred.

ATTACHMENT DELIVERY IN THE LABORATORY

Impressions

- First, take a preliminary impression using standard techniques.
- Later, take a final impression of the implants and denture simultaneously, pouring a model in the standard manner. Utilize both implant-level or abutment-level impression copings and analogs.
- The analogs are now present in the model.

Abutment Selection and Preparation

- If an implant-level impression was taken, abutment selection can be performed in the laboratory.
- Abutment selection and delivery can also be performed chairside, and the final impression be taken at that visit.
- Note that for friction-retained abutments, this technique is not very convenient because abutments must be left in place until the final prosthesis is completed. This requires modification of the interim appliance using a time-consuming chairside reduction.

Prosthesis Fabrication

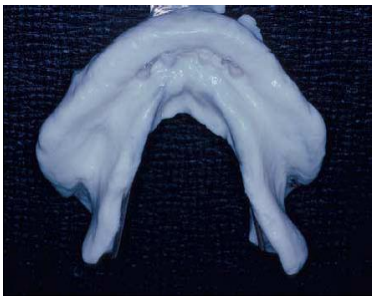
- After taking the final impression, continue denture fabrication, proceeding as if implants were not present.
- The laboratory will place the female components in the denture at the time of acrylic curing.

Abutment Delivery

- Abutment delivery follows the denture try-in.
- Because female attachments are already present in the denture, it is recommended to fully torque the abutments prior to trying the denture. A poorly engaged abutment may remain locked in the denture and pull on the implant threading when the prosthesis is disengaged.

Prosthesis Delivery

- The prosthesis should be tested and adjusted before connection to the implants.



Chairside attachment delivery

Impressions

- Impression techniques are identical to those used for denture fabrication.
- The presence of healing abutments helps stabilize the wax base.
- The laboratory can be asked to free a space around and above the healing abutment in order to accommodate abutment delivery.

Abutment Selection and Preparation

- There are many abutment types available for denture retention.
- Many are modifications of existing retentive anchors utilized in traditional dentistry.
- Straight abutments are preferable to angled abutments.

Prosthesis Fabrication

- Fabricate a denture using traditional techniques.
- During try-in visits, ensure that the wax base has adequate release room where implants are located.
- Note that it is possible to utilize a denture fabricated prior to implant placement and retrofit attachments.

Abutment Delivery

- Place male abutments on implants and relieve spaces in the denture if necessary.
- Place the female component on the male attachment, and carefully block all undercuts. The abutment manufacturer usually provides a written guide for this step, and may also provide a soft plastic ring to block undercuts.

Prosthesis Delivery

- Fill the spaces in the denture with self-curing acrylic and place the prosthesis in position. Ask the patient to occlude normally.
- After the acrylic is set, remove the excess and polish. The female element is now part of the denture.

Bar and clip over denture (Splinted)

Impressions

- The impression technique is a combination of an implant impression, as described in the general section, and a denture impression.
- After fabricating custom trays, the final impression is initiated with border molding.
- Impression copings are then located on the implants and the final impression is performed.
- Implant-level impression is recommended whenever possible. This allows abutment selection to take place on the articulator, where interarch space, angulations, and final teeth positions can be identified easily.

Abutment Selection and Preparation

- If at all possible, select the abutments in the laboratory in order to visualize teeth positions and available room between implants and the denture.
- Abutments must be selected in order to ensure that there is a single path of insertion for the bar, which must be fabricated on a flat plane. This can be difficult, because in this case there are multiple implants, each which may have a different height and angulation.

Prosthesis Fabrication

- Proceed normally with denture fabrication, ignoring the presence of implants.
- Once the denture wax-up is completed, fabricate the metal bar. The presence of teeth helps the technician to find the correct positioning of the bar.

Abutment Delivery

- Orientation may be difficult because there are no landmarks.
- To avoid confusion, deliver one abutment at a time and use a resin key.

Prosthesis Delivery

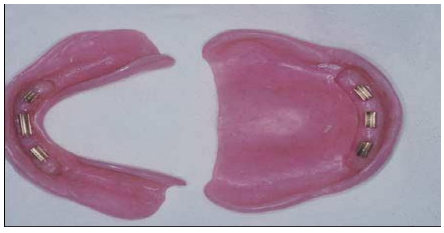
After fabrication and try-in of the bar, there are two possible methods of delivering the attachments. One is performed by the laboratory and the other is performed clinically. Laboratory delivery is preferred.

Laboratory Technique

- In this technique, the attachments are processed in the laboratory, together with the denture.
- This is particularly appropriate if the initial impression was precise and the bar was not sectioned.
- Alternatively, the denture wax-up can be duplicated and serve as an impression tray, and an impression can be taken with the bar in place. A new model is then poured and attachments can be inserted during denture processing.

Clinical Technique

- In this technique, attachments are inserted clinically.
- Place female attachments on the bar and carefully block all undercuts.
- Place self-cured acrylic in the attachment housings, and position the denture while the acrylic sets.
- Once the capture of attachments is complete, add missing acrylic in the voids.
- Note that this method requires adequate blockage of all undercuts.



(Splinted implants)Bar and clip

Advantages:

- Maximum stability
- Increase retention

Disadvantages

* Difficult in construction

Note:

-Bar should be straight on arch to allow movements of the denture

-Bar should be parallel to the occlusal plane

-Allow space under the bar for hygiene

-No cantilevers

Advantages of unsplinted implants (ball and socket)

- Easier to clean
- Simpler in construction
- Can be used with unfavorable implant angulations
- Can be used with insufficient interocclusal distance

Chapter 13

COMPLICATIONS, FAILURE AND MAINTENANCE

Implant Survival and Success

In the literature, “implant survival” and “implant success” have distinct meanings.

“Survival” refers to implants that are still in the mouth at the time of examination, regardless of the state of the prosthesis or patient satisfaction. A nonfunctional implant requiring additional treatment is counted in the surviving group.

“Success” refers to implants that are not only in the mouth, but are also functional and satisfactory. The exact definition varies amongst clinicians.

These two definitions are sometimes misused.

Loss of integration

93% survival rates of dental implants. Implants are more successful in the mandible than the maxilla.

Positional failure

Caused by poor treatment planning and/or poor surgical execution.

The most common errors seen in these types of cases are implants placed in the interproximal areas and differing depth of implant placement. When implants are placed in the interproximal areas it is impossible to obtain an aesthetic result.

Biomechanical failures

The observation that fractures are encountered more frequently in the partially edentulous jaw should not be surprising. When comparing the edentulous jaw to the partially edentulous jaw it is clear that the arrangement of implants in the edentulous jaw creates a more favorable curvilinear pattern. In contrast, implants in the partially edentulous jaw are generally arranged in a rectilinear pattern.

In the posterior portions of the partially edentulous jaw where the magnitude of force generation is greatest Loosening of screws to breakage of implant components and implants.

It is certainly possible that failure of an internal connection could pose a risk similar to or greater than that seen with the externally hexed implants.

Screw loosening especially with single tooth restorations

Complications

- Complications during 1st stage surgery
- Complications during 2nd stage surgery
- Complications after prosthesis placement

Complication during first stage surgery

Problem	**Possible cause**	**Solution**
Hemorrhage during drilling	Lesion or injury of an artery	The implant placement will stop the bleeding
Implant mobility after placement	Soft bone Imprecise preparation	Remove the implant & replace with larger one
Exposed implant threads	Too- narrow crest	Cover the threads with bone grafts or membrane
Post operative pain remain after some days	Aggressive preparation Bacterial contamination	Remove the affected implant
Insensitivity of lower lip	Incision or compression of the mandib. Inf nerve	After a week use ct scan to determine which implant and remove it
Exposed cover screw after few weeks	Pressure in tissue from temporary prosthesis	Repair the temporary implant
Abscess around cover screw	Implant not integrated Infection around cov. Scr.	Remove the implant Make flap &clean

2nd stage surgery + abutment connection

Problem	**Possible causes**	**Solution**
Immobile but painful	Imperfect osseointegration	Cover the implant for 2-3 months again and retest
Mobile and painful	Lack of integration	Remove the implant
Difficulty inserting screw	Damaged thread of screw	Change the screw
Inability to perfectly connect the abutment to implant	Bone over eruption	Local anesthesia , remove excess bone
Granulation tissue around implant head	Trauma during implant placement or compression from the temporary prosthesis	Open the area , disinfect with chlohexidine , may need bone regeneration or grafting
Fair fitting abutment	Fair fitting abutment	Change the abutment with proper size

Prosthetic procedure, control after prosthesis placement

Problems	Possible causes	solutions
Loosening of one or more prosthetic screws after 2 weeks at the 1st check	Occlusal problems	Re-tight , verify the occlusion and re check after 2 weeks
Loosening of prosthetic screws at the 2nd check	Occlusal problem Unfavorable prosthetic design	Verify the occlusion Change the prosthetic design
Abscess close to an implant	Poor fit of the abutment to the implant	Verify the abutment fit with x-ray, remove the abutment , sterilize , remove granulation tissue and replace the abutment
Pain after placement of the prosthesis	Disintegration of an implant Peri-implant infection	Remove the implant

Problem	Possible causes	Solution
Fracture of veneering material	Occlusal problem Bruxism or parafunction	Modify the prosthetic design or occlusion (reduce width of Occlusal surfaces, reduce the width of Occlusal surface, cusps,…
Fracture of the framework	Weak metal frame and or too large extension parafunction	Verify the occlusion Make a night guard
Fracture of a prosthetic screw or an abutment screw	Occlusal problem ,lack of fit between prosthesis and abutment	Modify the prosthetic design Replace the fractures screw
Problem	**Possible causes**	**Solution**
Implant fracture	Occlusal overload	Remove the implant with a trephine drill, wait from 2-6 moths, if possible and place a wider implant
Continuing bone loss around one or more implant	peri- implantitis	Remove the cause (poor plaque control) and consider a bone regeneration procedure
Continuing bone loss around one or more implant	Occlusal overload	Modify the prosthetic design (reduce or eliminate extensions, reduce the width)
Visibility of titanium abutment through mucosa		Make connective tissue graft under the mucosa, change the

		abutment to ceramic material

Gingival inflammation detected during maintenance visits can be a sign of two main problems. It may indicate mucositis, a reversible condition analogous to gingivitis. It may also indicate peri-implantitis, a more serious condition that can lead to bone loss.

Peri-implant Mucositis

and peri-implantitis

Definitions:

Peri-implant disease

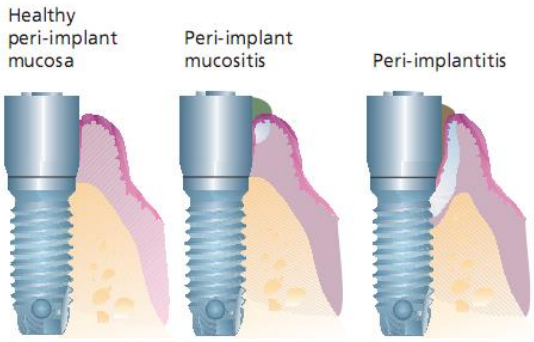
Inflammatory process in the tissues surrounding an implant (Alberktsson & Isidor 1994)

Peri-implant mucositis

Reversible inflammatory process in the soft tissues surrounding a functioning implant

Peri-implantitis

Inflammatory process additionally characterized by loss of peri-implant bone.



Mucositis

- The main sign of mucositis is gingival inflammation around implants without evidence of bone resorption.
- It may be due to poor oral hygiene or a poor prosthesis design that makes access difficult.
- In cases where no tissue loss has occurred, inflammation can sometimes derive from the apical position of an implant. In this case, deep peri-implant sulcus becomes difficult to maintain.
- Most often, however, mucositis results from abutment loosening. The loosening of the abutment enables bacterial infiltration.
- If mucositis caused by abutment loosening goes undetected, it can result in peri-implantitis.
- To detect abutment loosening, look for abutment separation on the radiograph (seen as a dark line between components) as well as prosthesis mobility.
- Abutment loosening can result in uncomfortable pressure on the prosthesis if gingival tissues have overgrown into the opened junction. The excess soft tissue must be removed before the abutment or prosthesis can be tightened back into place.

- In all cases of mucositis, reinforce oral hygiene, debride the area, and schedule another appointment with the patient to confirm healing.

Peri-implantitis

- Peri-implantitis is recognized by radiographic or clinical evidence of bone loss.
- In addition, gingival inflammation may resemble a periodontal abscess, and suppuration and bleeding upon probing can occur.
- It may be due to poor oral hygiene or problems with the prosthesis such as abutment failure.
- Bone loss can spread rapidly, and referral to the surgical specialist is recommended.
- Treatment of peri-implantitis involves inflammation control and modification of the exposed implant surface.
- Resective or regenerative procedures may also be indicated.
- Be careful not to confuse the normal bone remodeling associated with implants with bone loss caused by peri-implantitis.

Reporting a Problem

When an adverse inflammatory or mechanical event is detected, we suggest using a separate form in the office. This can facilitate interoffice communication, as well as detection of recurrent problems. Below is an example of a form that you may wish to adapt and include in your files.

Patient name:
Date:
Clinician name:
Prosthesis type:
Date of implant placement:
Date of restoration:
Briefly describe problem:

Radiographic finding:
Clinical finding:

Is there pain?
How long has the problem been present?
Assessment of cause:
Recommendation to patient:
Recommendation for referral:

Maintenance for Full Arch Removable Prosthesis

Visits in the First Year

- Systemic and clinical evaluation, paying particular attention to mobility.
- Patient interview and comfort evaluation. Evaluate patient ability to insert and remove the prosthesis without damaging the attachments. Verify over- or under-retention of attachments.
- Mechanical evaluation. Use a screwdriver to verify that screws and abutments have not loosened.
- Detailed oral hygiene instructions. Especially focus on areas proximal and lingual to bar or abutment. Prepare and/or offer specific tools.

Long-Term Maintenance

- Systemic and clinical evaluation.
- Yearly mechanical evaluation. Use a screwdriver to verify that screws and abutments have not loosened.
- Yearly radiographic evaluation.
- Check whether change of female attachments in removable prosthesis is necessary.
- Reinforcement of oral hygiene. Remember, for older patients, motor abilities may diminish. Introduce new techniques, if necessary.

Maintenance for Full Arch Fixed Prosthesis

Visits in the First Year

- Systemic and clinical evaluation, paying particular attention to mobility.
- Patient interview and comfort evaluation.
- Mechanical evaluation. If screw access holes are temporarily obstructed, use a screwdriver to verify that screws and abutment have not loosened. Schedule time for removal and replacement of temporary fillings.
- Detailed oral hygiene instructions. Prepare and/or offer specific tools.
- Gentle probing to detect inflammatory changes.
- Sequence as above for instrumentation.
- At one year, refer patient to a restorative dentist for final obstruction of screw access holes.

Long-Term Maintenance

- Systemic and clinical evaluation.
- Yearly radiographic evaluation.
- Reinforce oral hygiene. Remember, for older patients, motor abilities may diminish. Introduce new techniques if necessary.

Examination of Full Arch Prosthesis

It is important to examine the prosthesis thoroughly. This involves assessing mobility, checking screws, evaluating attachments, and examining porcelain restorations, if necessary.

Assess Mobility

- All implant-supported prostheses must be stable.
- To detect mobility, place an explorer or scaler under the embrasures and apply gentle pressure in the buccolingual direction, as well as slight tension in the apicocoronal direction.
- When mobility is present, assume that it originates at the prosthetic or component level, rather than from the implant itself.
- It is often difficult to distinguish mobility of the prosthesis from mobility of the abutments.
- If the prosthesis is mobile and there is no separation between the prosthesis and the abutment, this is a sign of loosening or fracture of the abutment screw.
- Recall that in some cases two screws may be involved: a screw attaching the prosthesis to the abutment and a screw retaining the abutment on the implant. Movement may be due to the loosening of either or both screws.
- Any mobility must immediately be evaluated by the restorative dentist.

Check Screws

- Check screw access holes for closure.
- If screw access holes are uncovered, such as with bar-retained dentures, make sure they are free of debris.
- If screws can be seen, gentle movement with a probe or an explorer will allow you to detect unscrewing or possible fracture. At least once a year, an appropriate screwdriver should be used to verify tightening.
- If you find a loose screw, do not retighten it, but replace it with a new one. The intimate adaptation between the screw and the implant has been lost and some small distortions in the screw may be present.
- Inspect the connection between the prosthesis and the abutment, when supragingival. Increased distance between these elements may be a sign of uncementing or unscrewing of the prosthesis.
- Note that in the presence of periosteal or blade implants, as well as some root-form implants that contain the abutment, any loosening is due to loss of osseointegration or fracture of the implant itself. It must be reported to the restorative doctor immediately.

Evaluate Attachments

- It is expected that attachment parts of removable prostheses must be replaced regularly because of wear.
- The replacement part is most often in the prosthesis itself, and not on the implant attachment or bar.
- Evaluate retention by positioning the prosthesis and removing it.
- Also evaluate prosthetic stability by having the patient apply occlusal and lateral biting forces.
- Patients are often aware of loss of retention and will request a change of attachments.

Examine Porcelain Restorations

- When porcelain is present, it is also important to examine its integrity. Ceramic fractures or cracks are important signs of excessive forces that may need to be addressed.
- When porcelain fractures are found within 6 months of prosthesis delivery, immediate referral to the restorative specialist is necessary. Failure may be due to a fabrication error or to the presence of excessive force (which may be damaging the implants as well as the prosthesis).

Home Hygiene

Good oral hygiene is extremely important with dental implants and contributes to the long-term life of implant components. Keep in mind, however, that many patients become edentulous because they do not prioritize good home care. Without proper instruction, they may lapse into old, ineffective habits after teeth are replaced.

INSTRUMENTATION AND TECHNIQUES

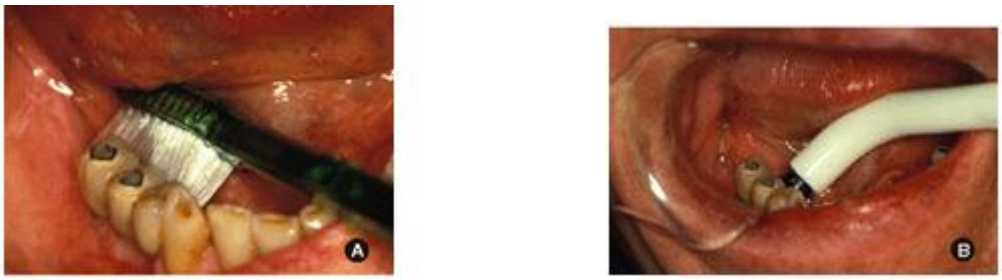
- Dental implants require special oral hygiene techniques.
- The particular technique chosen often depends upon the prosthesis. A removable appliance gives access to the implant-retained bar and an interdental brush and small cleaners are usually adequate because spaces are large. On the other hand, fixed restorations require floss and brushes.

- While there are beginning to be home hygiene instruments designed with implants in mind, in many cases, traditional instrumentation needs to be used and adapted to the special needs of implants.
- Metal tools, such as interproximal brushes with a stainless-steel core wire, must be avoided because they could damage the titanium.
- Appropriate instrumentation and associated techniques are listed below.

Instruct patients to scrub removable appliances in the same fashion as conventional appliances. Patients must be instructed to gently clean the attachments. Commercial denture cleaners may be used for 20 minutes, but not overnight, especially if the denture contains nylon retainers.

Manual or Automatic Toothbrushes

- Brushing is imperative, but may not be obvious for patients who have a full-arch prosthesis. Make sure to stress the importance of brushing.
- Recommend soft or medium toothbrushes.
- Small heads are useful because they allow better access to the cylindrical contours of implants.
- Automatic toothbrushes effectively disturb biofilm and are particularly useful for formerly edentulous patients.
- Specific techniques should be reviewed because the anatomy of an implant is different than the anatomy of teeth. Patients need to reach towards the implants, which may be more lingual than the contour of a tooth. They also need to be made aware of the implant locations, which may not be obvious for multiple unit bridges.

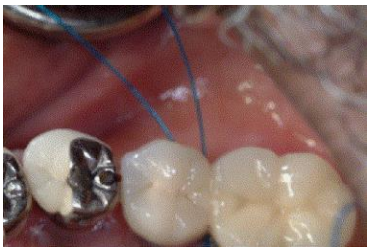


(A) A tooth brush can be used (B) in combination with an end-tuft tooth brush for maximal cleansing of difficult to access areas.

Interdental Threaded Cleaners

- The use of super-floss or floss-threaders is recommended around any implant-supported bridge, crown, or bar.
- Lingual positioning of implants is frequent, and it can be difficult for patients to reach lingual surfaces. In particular, apical positioning due to bone loss can pose a problem.
- Instruct the patient to wrap super-floss 360 degrees around the implant and polish using both horizontal and vertical motions.

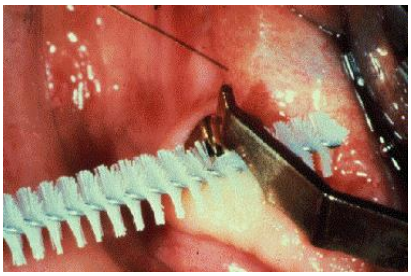
- If patients find wrapping around the implant difficult, another option is to use super-floss or yarn in a “shoe-shine” fashion around implants, making an effort to polish 360 degrees around the cylindrical shape of the implant.



A floss threader is useful to place a floss between two connected implant-supported crowns.

Interdental Brushes and Cleaners

- All wires of interdental brushes must be nylon-coated to prevent scratching the titanium surfaces of implants.
- Instruct the patient to use the interdental brush in a back-and-forth motion to cover the entire proximal surface of the implant and restoration.
- For patients who cannot tolerate the bristles of interdental brushes because of the presence of little or no attached gingiva, sponge tips that attach to interdental handles may be useful.
- Plastic, ridged, and cone-shaped interdental cleaners are available with replaceable tips similar to interdental brushes and are preferred because there is no possibility of metal scratching any surface.

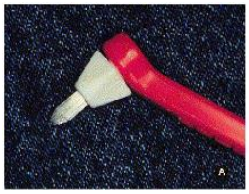


Interdental brushes are convenient for bars because the angle between the implant and the bar are cleaned with the same instrument; however, they must have nylon coated wires.

Super-floss, perio floss, and implant floss with spongy strings are used in a shoe shine fashion to polish the implant.

Reduced Size Brushes

- Many manufacturers of oral hygiene instruments offer specially designed brushes in various shapes and sizes, such as end-tuft.
- They may be used both for individual implants and to engage interproximal areas.
- Small, cone-shaped brushes are particularly useful for bar or splinted implants with large inter-implant spaces.
- Careful instructions regarding angulation and orientation of the brushes is essential to provide optimal plaque removal and avoid tissue injury.
- The angulation and orientation of the brushes should be adapted to contact as much of surface area of bar or splinted crowns as possible.



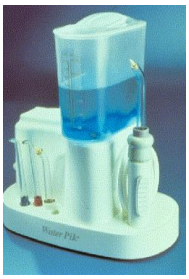
(A-D) End-tuft tooth brushes or gentle use of sulca brushes are useful for embrasure cleaning.

Chlorhexidine Mouth rinses

- Chlorhexidine rinses are routinely used immediately after implant placement.
- They may be useful for short-term control of severe inflammation, but long-term use in difficult maintenance situations should be avoided.

Oral Irrigation Devices

- The use of oral irrigation devices has been controversial due to concerns about incomplete plaque removal and potential separation of connective tissue fibers.
- They may be useful when a prosthesis design does not allow the patient or the hygienist to gain proper access to peri-implant areas, or in other difficult maintenance situations. The most common scenario is implant proximity, resulting in narrow inter-implant space with little or no access with floss.
- The pik pocket tip may be particularly useful because the small tip reduces water pressure and enables access to difficult areas.
- Short-term use of chlorhexidine solution in the irrigation device may be useful for reduction of severe inflammation.



A water pik may be a useful adjunct to implant maintenance when access and dexterity are limited . Small tips are also available for reaching difficult areas.

Chapter 14

SINUS FLOOR ELEVATION

What is a sinus?

- Cavity within a bone
- Canal or passageway leading to an abscess
- dilated channel for venous blood
- any cavity having relatively narrow opening

  The sinuses are essentially mucosa-lined airspaces within the bones of the face and skull
  57 different kinds sinuses in human body!

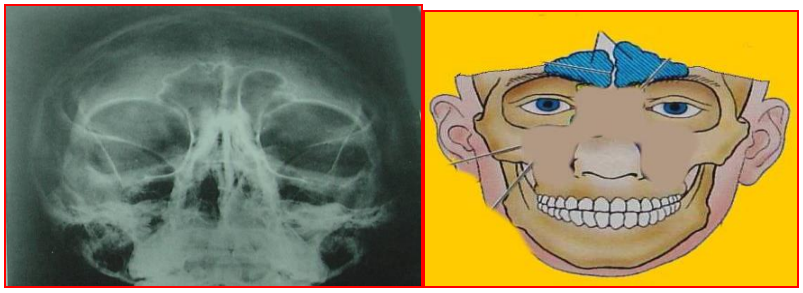
- Heart
- Ankle
- Brain
- Coccyx
- Spleen
- Kidney
- Uterus
- Anus
- Skull- around the nasal cavity known as….paranasal sinuses

There are 4 sets of Paranasal Sinuses

- Frontal
- Maxillary
- Ethmoid
- Sphenoid

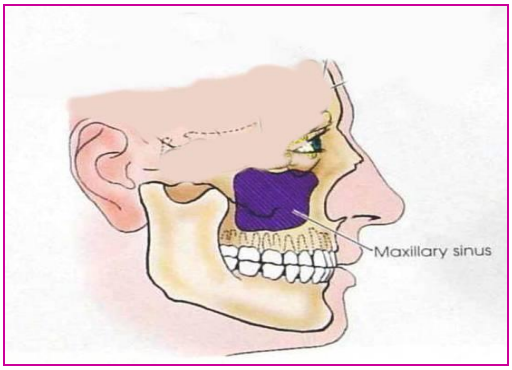
Frontal Sinuses

- 2nd Largest
- Usually paired-sometimes one, three or none!
- Great variation in size and shape-almost never symmetrical (califlower)



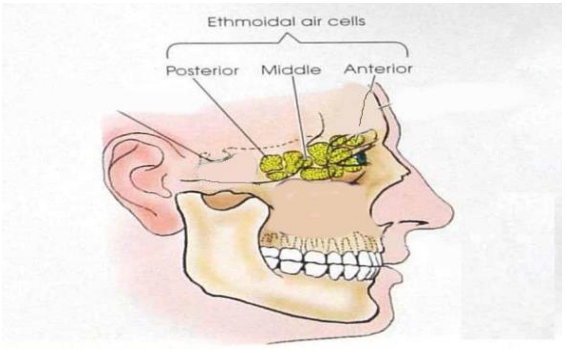
Maxillary Sinuses

- Largest (think Maximum!)
- Two, symmetrical but vary in size and shape from person to person
- Can be seen at birth
- Apices at bottom of sinus!



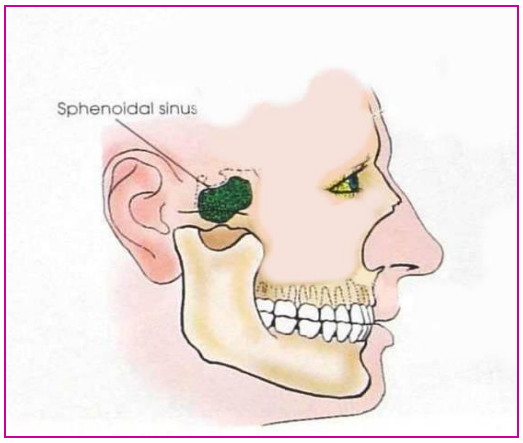
Ethmoid Sinuses

- Paired
- Divided into 3 groups:-
- anterior- 2-8 cells
- middle- 2-8 cells
- posterior 2-6 cells
- 6-22 possible each side



Sphenoid Sinuses

- Paired (sometimes one)
- Great variation in size and shape
- Asymetric
- Directly below Sella turcica



Development

- Start as small sacs around nasal meatus & recesses
- Grow – invading bone- forming air sinuses and cells
- Maxillary seen at birth
- By age 6 or 7 frontals & sphenoids distinguish themselves
- Ethmoids around puberty
- All full developed age 17- 18
- All sinuses communicate nasal cavity and each other

Functions of Paranasal Sinuses

- Not definitely known!- but speculated:
- Decrease weight of skull
- Resonating chamber for voice
- Help warm and moisten air
- Act as airbags in trauma
- Secretion of mucus to assist with air filtration.

Anatomy

-The adult maxillary sinus is a pyramidal in shape .

-Volume of approximately 15 ml (34x33x23mm).

-The base of the pyramid is the nasal wall with the peak pointing toward the zygomatic process.

-The anterior wall has the infraorbital foramen located at the midsuperior portion with the infraorbital nerve running over the roof of the sinus and exiting through the foramen.

-The thinnest portion of the anterior wall is just above the canine.

-The roof is formed by the orbital floor and transected by the course of the infraorbital nerve.

- Behind the posterior wall is the pterygomaxillary fossa with the internal maxillary artery, sphenopalatine ganglion and the Vidian canal, the greater palatine nerve and the foramen rotundum.

-The floor, as discussed before, varies in its level. From birth to age nine the floor of the sinus is above that of the nasal cavity.

At age nine the floor is generally at the level of the nasal floor. The floor continues to sink as the maxillary sinus pneumatizes. Because of the close relationship with the dentition dental disease can cause maxillary infection, and tooth extraction can result in oral-antral fistulae.

Paranasal sinus are joined to nasal cavity and to each other via small orifice called Ostia

What is Sinusitis?

- Inflammation of sinuses- caused by bacterial infection of membrane lining- can fill with pus!
- Usually from common cold (after first attack, recurrence more likely)
- Can spread from upper tooth infection
- Jumping in infected water without holding nose

Symptoms of Sinusitis:

- Loss of smell
- Fever
- Fullness or tension
- Pain
- Treatment :Decongestion opens up ostia to restore drainage

Conditions aggravating Sinusitis

- Scuba diving
- Chlorinated swimming pools
- Drinking alcohol
- Airplane rides (vacuum)

Why we need sinus floor elevation?

Sometimes the sinus floor position interfere with implant placement in the upper maxillary posterior region So pushing the surgeon to place very short implants with higher rate of failure.

Called sinus Pneumatization

What is a Sinus Lift and why might it be needed before a tooth implant is placed?

A sinus lift is a bone grafting procedure that is sometimes performed as a part of preparing a site for a dental implant

A sinus lift is required in those instances where the amount of bone found in a patient's upper jaw is inadequate to accommodate the planned implant.

Sinus grafting is recommended when there is <8 mm of available bone for implant placement – generally, 4-5 mm of residual bone below the sinus for simultaneous grafting and implant placement. Healing times are dependent on graft material and thickness of bone below the maxillary sinus. Conservative healing times are used.

Solving the problem

- **Open sinus lifting technique**

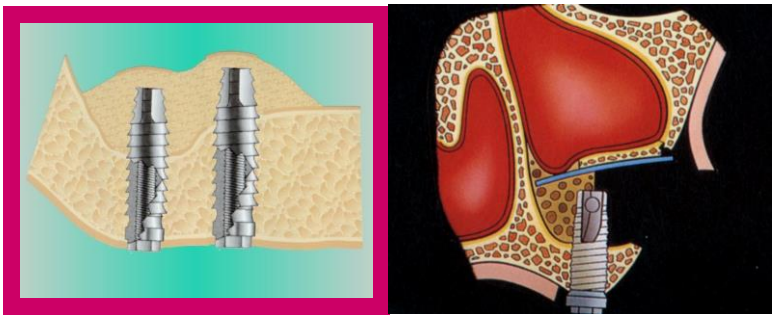
Caldwel luc, EXTERNAL LATERAL APPROACH FOR THE SINUS

- **Closed sinus lifting technique**

-Tatum using osteotomes

-Joaquim Garcia using non traumatic expanders

-The aim is to find a room to place enough length of implant



Residual bone height classification

1. Class A, >10 mm, for which the classic implant protocol could be followed.

2. Class B, 7-9 mm for which a BAOSFE (the bone-added osteotome sinus floor elevation) could be performed along with simultaneous implant placement.

3. Class C, 4-6 mm would require a lateral approach with delayed or immediate implant placement.

4. Class D, when there is only 1-3 mm of bone, a lateral approach with delayed implant placement is recommended.

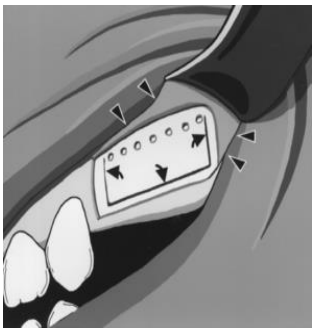
1- Open sinus lift technique
How is the sinus lift procedure performed?

The sinus lift is a surgical procedure. The specific technique that the dentist utilizes can vary depending upon their training and experiences but traditionally the procedure has been performed as follows:

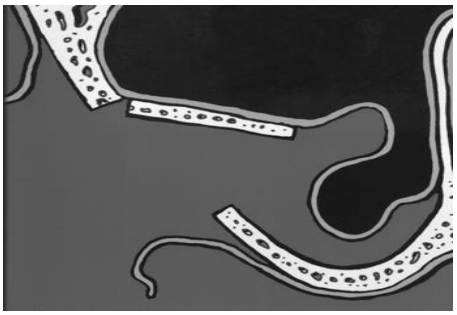
- The dentist will make an incision in the patient's gum tissue on the cheek side of their upper jaw in the area where the placement of the dental implant is planned (in the region originally occupied by the patient's bicuspid or molar teeth). This incision allows the dentist to flap back the patient's gum tissue and expose the jawbone that lies underneath.
  The exposed bone is cut in a fashion where a "trap door" of bone, hinged at the top, is created. This movable section of bone is then pushed gently inward and upward into the sinus cavity. This bone movement caries the sinus membrane attached to it with it, thus "lifting" the membrane (and hence the sinus floor) to a new, higher level. The empty space underneath the lifted sinus membrane is then packed with bone-graft material thus providing the new bone into which the tooth implant will be placed.
- Once the bone-graft material has been positioned the gum tissue is stitched closed.
- In some instances it can be possible that the dentist will place the dental implant at the same time that the sinus lift is performed. In most cases, however, a dentist will allow a healing period of six to nine months before the dental implant is placed. The specific time frame allowed for healing is dependent upon the type of bone-graft material that has been utilized.

What types of bone-graft materials are used with the sinus lift procedure?

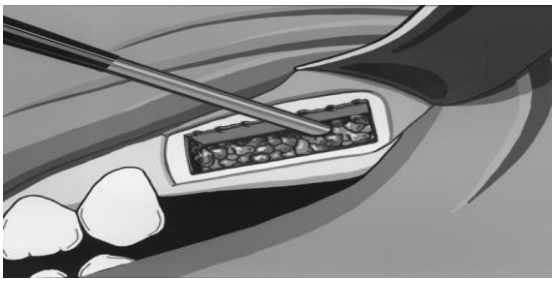
Several different types of bone-graft materials can be utilized with the sinus lift procedure. In some instances the patient's own bone will be used, such as bone harvested from another location in the patient's mouth or else from other bones (including the hip (iliac crest) or shin bone (tibia)). In other instances prepared bone (frozen bone, freeze-dried bone, demineralized freeze-dried bone), either human or from another species (i.e. bovine), can be purchased from a tissue bank for use. Another alternative involves the use of synthetically derived graft material such as hydroxyapatite.



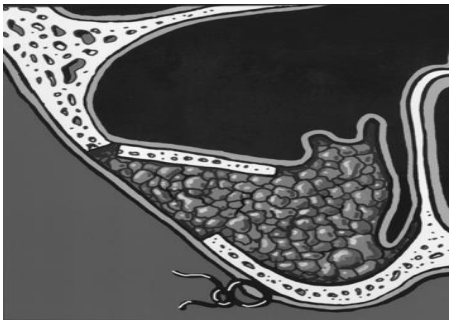
This procedure involves the opening of a window in the upper jaw to approach the sinus from the side. Just beneath the thin layer of bone that forms the side of the sinus cavity, is a thin "inner skin" or membrane quite similar to the membrane that lines the inner aspect of an eggshell. The surgeon will take care to break only the bone and not the membrane that lines the sinus.



With the window opened, the next step is to create a "pouch" to contain the bone. To do that, the surgeon must delicately tease the thin and fragile membrane away from the bone. With a significant part of the membrane being separated from bone, the membrane can balloon inwards or outwards depending on the pressure.



The next step is to pack bone forming material into the sinus. The material will be contained by the intact sinus membrane inside the sinus. Externally, the bone forming material is kept in place when the gums are stitched together. Sufficient bone forming material is packed into the window in the jaw as shown by the diagram above



The original thin layer of bone has been thickened almost 5 times. This is an exaggeration. Most of the time, the floor of the sinus only needs to be raised by a few mm.

Chapter 15

IMPLANT PLACEMENT IN PATIENT HAVING SYSTEMIC DISORDER

Implant therapy can greatly improve the function and esthetics of carefully selected partially or completely edentulous patients. Before any form of implant therapy is considered in any patient, the medical history must be thoroughly reviewed and it' appropriate, a physical examination performed. An existing systemic disease or ongoing systemic therapy may complicate or contraindicate implant dentistry. An increased knowledge of the underlying disease process has improved the management of the patients suffering from bone metabolism abnormalities, diabetes mellitus, xerostomia and ectodermal dysplasias.

METABOLIC BONE DISEASE

Bone mass depends on the equilibrium between bone formation and resorption within a remodeling unit, as well as on the number of remodeling units activated within a given period of time in a defined area of bone.

When bone resorption exceeds bone formation that will results in decrease in bone mass or osteoporosis (metabolic disease). Various case reports given by various implantologists have indicated that implants can be successfully placed in osteoporotic patients.

-Prior to implant surgery, a careful assessment of nutrition and systemic health in patients at risk for metabolic bone disease is recommended

Patients should undergo an endocrinologic, orthopedic, or obstetric examination and be treated, if necessary. Physiologic doses of vitamin D (from 400 to 800 IU/day) and calcium are recommended during the postoperative period. in all cases a balanced preoperative and post0perative diet should be recommended

-Patient should attempt to give up smoking, since smoking is an important risk factor for osteoporosis and implant failure
*In cases of insufficient bone volume, the implant sites should be augmented before or during implant surgery

-The occlusal load should be properly distributed throughout the dentition to avoid overloading the implant which may contribute to implant loss.

-The healing period should be extended, before construction of prosthodontic appliance *Preference should be given to implant designs that will have close bone-implant contact on Insertion to ensure primary stabilization in less dens osteoporotic bone.

Pre and Intraoperative Considerations

- Examination of causative factors for bone disease and treatment
- Bone augmentation if necessary

Postoperative Considerations and Maintenance

- Physiological doses of vitamin D (400-800 IU/ day) and calcium (1500 mg/day) during the postoperative period
- The healing period should be increased by 2 months to 8 months in the maxilla and 6 months in the mandible
- Careful occlusal adjustment and careful examination for signs of occlusal overload, e.g. bruxism

DIABETES MELLITUS

- Analysis of the epidemiological data regarding diabetes mellitus indicates that all dentists will encounter patients with diabetes mellitus and that clinicians who perform intraoral surgery such as implant placement should have a thorough knowledge of this disease. In the oral cavity, diabetes mellitus is associated with xerostomia, increased levels of salivary glucose, swelling of parotid gland, and an increased incidence of caries and periodontitis as well as other infection of the oral cavity. Although dental implant therapy seems to be a helpful tool in restoring the dental status of diabetic patients, it appears prudent for clinicians to adhere to the following guidelines

Gingivitis in diabetic patients

-Proper antibiotic prophylaxis is recommended
-To use chlorhexidine rinses peri and post-operatively at the time of implant placement.

Pre and Intraoperative Considerations

- Metabolic control should be analyzed and optimized prior to implant surgery if not sufficient. A glycosylated hemoglobin level near 7 mg/percent is advisable
- Antibiotic prophylaxis is recommended
- Peri and postoperative rinse with 0.12 percent chlorhexidine digluconate

Postoperative Considerations and Maintenance

- Shorten recall intervals to detect intraoral infectious disease
- Hydroxyapatite plasma-spray-coated implants have been found to have a higher survival rate that titanium implants in diabetic patients. Poorly controlled diabetic patients are more difficult to manage, and delay in surgery is recommended until better control is achieved. The placement of dental implants in patient with metabolically controlled diabetes appears to be successful as in the general population.

XEROSTOMIA

There are numerous pathologic conditions that are accompanied by reduced salivary flow.

- Therapeutic head and neck irradiation
- Autoimmune diseases (Sjogren's syndrome, systemic lupus erythematosus, etc.)
- Infectious disease such as HIV and hepatitis C
- Diabetes mellitus
- Drugs-antihistamines diuretics, tricyclic antidepressants, etc.

Xerostomia or reduced salivary flow causes bacterial infection, fungal infection and adverse effect on successful prosthetic reconstruction especially removable dentures.

Prior to implant placement, the underlying cause of the xerostomia needs to be properly diagnosed and treated. Any oral bacterial infections such as periodontitis, caries, or fungal infections such as candidiasis should be thoroughly treated prior to implant placement. After implant placement, maintenance interval should be shortened to prevent the development of peri-implantitis due to the increased plaque formation in these patients.

Stimulation of salivary flow can be achieved by either physiological (sugar free chewing gum) or pharmacological (cholinergic agonist, e. g. pilocarpin and cevimeline).

Pre and Intraoperative Considerations

- Treatment of bacterial or fungal intraoral infections
- Increase salivary flow

Postoperative Considerations and Maintenance

- Shorten recall intervals to detect infection

ECTODERMAL DYSPLASIA

Ectodermal dysplasia (ED) represents a rare group of inherited disorders that occur in approximately 1 per 100,000 live births. Ectodermal dysplasia is characterized by the classical tried of hypodontia,

hypohydrosis and hypotrichosis and characteristic features such as prominent supraorbital ridges, frontal bossing, and a depressed nasal bridge.

Principal aims of dental treatment are to restore missing teeth and bone, establish a normal vertical dimension and provide support for the facial soft tissues. Conventional prosthodontic treatment (complete dentures, overdentures, or a combination of bridge work and removable partial dentures) often faces severe problems due to anatomical abnormalities of existing teeth and alveolar ridges resulting in poor retention and instability of prosthesis. The short coming of removable prosthesis furthermore includes dental hygiene problems, speech difficulties, and dietary limitations. Moreover, progressive resorption of basal bone when the edentulous ridge is loaded at an early age may even aggravate the problem.

Hypodontia and cone shaped teeth in ectodermal dysplasia

Pre and Intraoperative Considerations

- Whenever possible postpone implantation until skeletal and dental growth has been completed
- If implant therapy is necessary in the maxilla: divide prosthetic bar attachments that cross the maxillary midline
- If implant therapy is necessary in the mandible: implant placement should be done in the anterior mandible

Postoperative Considerations and Maintenance

- Shorten recall intervals to detect infectious disease
- Careful examination for possible movements of the implant due to growth of the jaws
- Adapt prosthetics to growth-induced changes

CARDIOVASCULAR DISORDERS

Hypertension

Essential hypertension is treated with medications, many of which have impact on implant therapy because of their numerous side effects

- A medication such as flurazepam 30 mg or diazepam 5 to 10 mg may be prescribed in the evening to help the patient sleep quietly in the night before the procedure
- Blood pressure above 160/ 100 should be referred to a physician for medical management.

Angina Pectoris

- Angina pectoris or chest pain in the cardiac muscle is a form of coronary heart disease. Etiology is transient myocardial oxygen demand in excess of supply. Classical retrosternal pain develops due to stress and physical exertion, radiates to shoulder, left arm, mandible, neck, palate and tongue. These symptoms are relieved by rest and duration of episode is about 3 to 5 minutes.
- Dental emergency kit should include nitroglycerine tablets (0.3 to 0.4 mg) or a translingual spray, which is to be replaced every 6 months. During an attack all dental treatment is stopped immediately, nitroglycerine is administered sublingually with 100 percent oxygen at 6 It/min. If patient is not relieved within 8 to 10 minutes, patient is transported to a hospital.
- Patients with mild angina attack (One attack/ month) can undergo most nonsurgical dental procedure with normal protocol. Advanced restorative procedures and minor implant surgery is done with nitrous oxide sedation. Appointment should be as short as possible; this may require

more than one surgical or restorative appointment. Use of vasoconstrictors should be limited.

Myocardial Infarction

Myocardial infarction is prolonged ischemia or lack 0 1 oxygen that causes injury to the heart. The patient usually complains of severe chest pain in pericardial or substernal region. Dental evaluation should include the dates of all episodes of MI, especially the latest and any complications. Medical consultation should preclude any extensive restorative and surgical procedure. Longer procedures should be segmented into several shorter appointments. Elective implant should be at least postponed for 12 months following MI.

Congestive Heart Failure (CHF)

Congestive heart failure is a chronic heart condition in which heart is failing as a pump. Symptoms of CHF include abnormal tiredness or shortness of breadth (DYSPNEA) brought on by slight activity or even occurring at rest(these symptoms are due to excess fluid in lungs and partly due to excess work required of the heart), wheezing caused by fluids in lungs (pulmonary edema), peripheral edema or swelling of the ankles (pedal edema) and lower legs, frequent urination at night, jugular venous distention sounds at auscultation, and paroxysmal nocturnal dyspnea, sensation of unable to breathe, which may interrupt sleep.

A lethal dose of digitalis is only twice the treatment dose. The dentist who recognizes the more common side effects should report them to treating physician. Patients on digoxican and diuretics should have serum electrolytes evaluated before surgery to check imbalances.

Subacute Bacterial Endocarditis (SAGE)/ Valvular Heart Disease

Bacterial endocarditis is an infection of the heart valves or endothelial surfaces of the heart. Dental procedures causing transient bacterimia are a major cause of bacterial endocarditis. Implant dentist should be familiar with antibiotic regimens for heart conditions requiring prophylaxis. In some patient with a limited oral hygiene potential implant therapy may be contraindicated because of high risk of endocarditis.

THYROID DISORDERS

The major function of thyroid is production of hormone thyroxin ($^{T}4$). Thyroxin is responsible for the regulation of carbohydrate, protein and lipid metabolism. In addition hormone potentiates the action of other hormone such as catecholamines and growth hormones. Patients with hyperthyroidism are extremely sensitive to catecholamines such as epinephrine in local anesthetics and gingival retraction cords. When exposure to catecholamines is coupled with stress (often related with dental procedure) and tissue damage (Implant surgery) an exacerbation of the symptoms of hyperthyroidism can occur. Hypothyroid patient is sensitive to CNS depressant drugs; such as diazepam and barbiturates. The risk of respiratory depression or cardiovascular depression or collapse, must be considered.

ADRENAL GLAND DISORDERS

The adrenal glands are endocrine organs located just above the kidneys. Epinephrine and norepinephrine are produced by glands, which is responsible for the control of blood pressure, myocardial contractility and excitability, and general metabolism. glucocorticosteriods secreted by these glands help w decreasing swelling and pain. Addisons disease allows decrease in adrenal function. These patients show weakness, weight loss, orthostatic hypotension, nausea and vomiting. When these signs are noted , implant dentist should require a medical consultation. Cushing's disease describes hyper function in adrenal glands; characteristics changes associated with this disease are moon fades, truncal obesity or buffalo hump, muscle wasting and hirutism. These patients bruise easily, have poor wound healing, experience osteoporosis, and are at increased risk for infection.

Additional steroids are prescribed for the patient Just before stressful situation. Patient with known adrenal disorder, physician should be consulted.

PREGNANCY

Implant surgery procedures are contraindicated for the pregnant patient. All elective procedures with the exception of oral prophylaxis should be deferred after childbirth.

HEMATOLOGIC DISEASES

Patient suffering from anemia have bone maturation problem and is impaired in long term anemic patient, basically loss in trabecular pattern of bone which is very important for implant stability. Abnormal bleeding is also common problem of these diseases.

Treatment planning modifications should towards more conservative approach, surgical procedures should be delayed until infection of disease is controlled or returned to a normal condition.

CHRONIC OBSTRUCTIVE PULMONARY DISEASES

Two common forms of obstructive pulmonary diseases are emphysema and chronic bronchitis. The use of epinephrine should be limited. Drugs that depress respiratory function such as sedatives (including nitrous oxide), tranquilizers, and narcotics should be discussed with physician.

LIVER CIRRHOSIS

It occurs as a result of injury to liver cells and progressives scarring. Patient with liver diseases, 50 percent have prolonged PT time and clinical bleeding. The inability to detoxify drugs may result in oversedation or respiratory depression. The laboratory evaluation of implant candidate gives much insight to hepatic function. Elective implant therapy is relative contraindicated in the patient with symptoms of active alcoholism.

VITAMIN D DISORDERS

The deficiency of vitamin D leads to osteomalacia. Implants are not contraindicated, although treatment is same as osteoporotic patient.

HYPERPARATHYROIDISM

Clinical patients develop loose teeth, altered trabecular pattern of bone with ground glass

TOBACCO

Reports in the literature demonstrate lower success rate for endosteal implants in smokers. Although implants maybe placed in patient that smoke, failure rates are quite high in smokers, the risk need to be evaluated and carefully explained to the patient. Ideally patient should be discouraged for smoking

PSYCHOLOGICAL PROBLEMS

The suitability of patients having psychological disorders must be assessed before any implant placement.

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Guidelines For Implant Dentistry

Dental implants are fastest growing method of treatment of dentistry today. The implant systems currently available are diverse. Implant manufacturers have developed individualized designs for their implants and they are continually altering marketing strategies to highlight the feature of each implant. They themselves describe from case selection to completion of implant placement and prosthodontic treatment procedures.

Objective of present book is to give some basic information related to implants right from its inception to use in dentistry in proper way.

I tried to incorporate basic relevant and important features of important features of implants applicable to every system of implant placement. Whole book is divided to several chapters as well as references. The book is well planned to give proper information right from material sciences related to implant to final treatment with implants and prosthesis. in whole book , diagrams are given in proper way to understand implants in better ways. Recent advancement of implant beyond dental use is described in brief.