Materials For Construction of Implant

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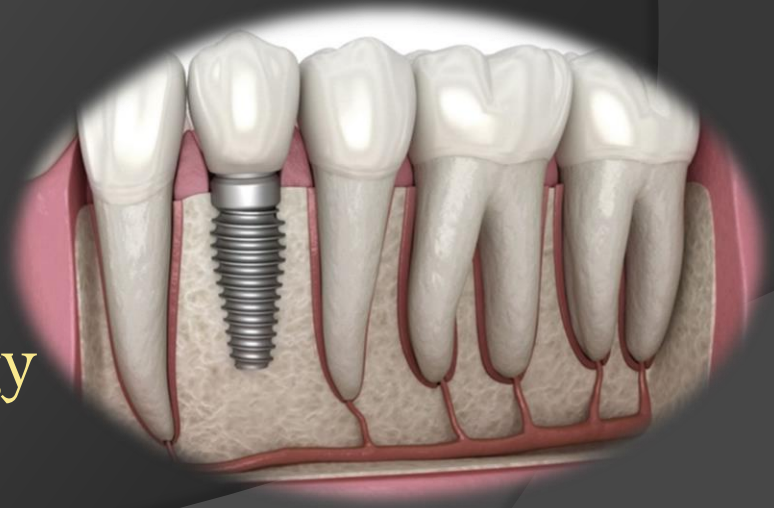
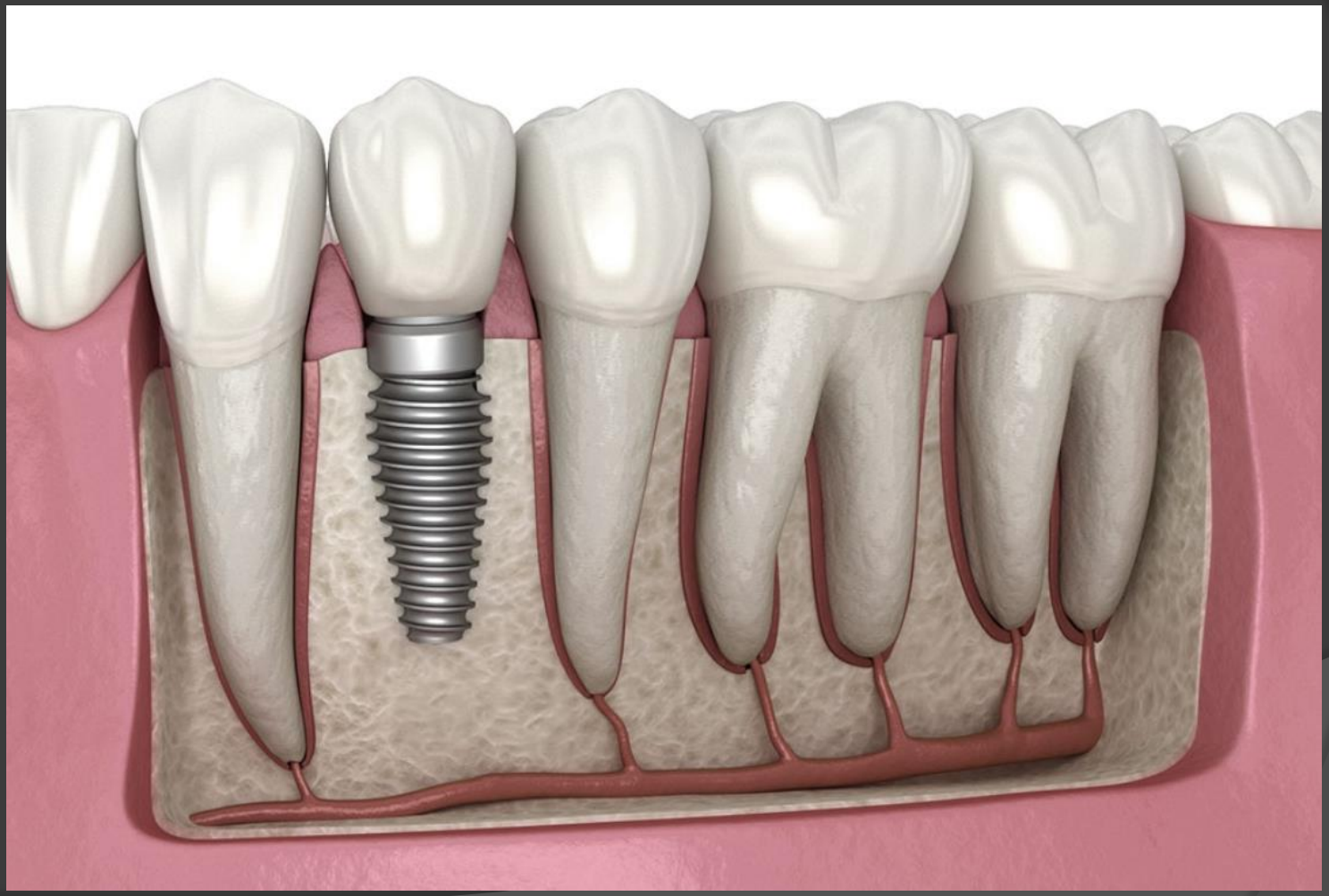
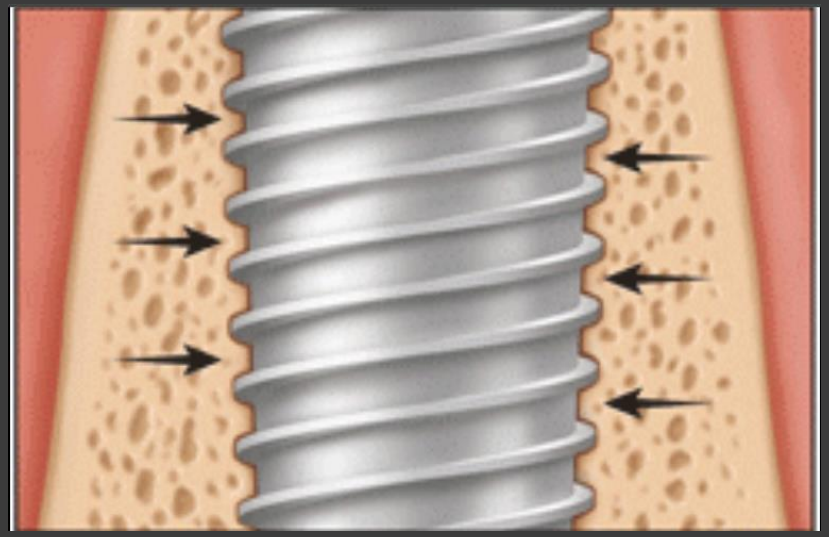
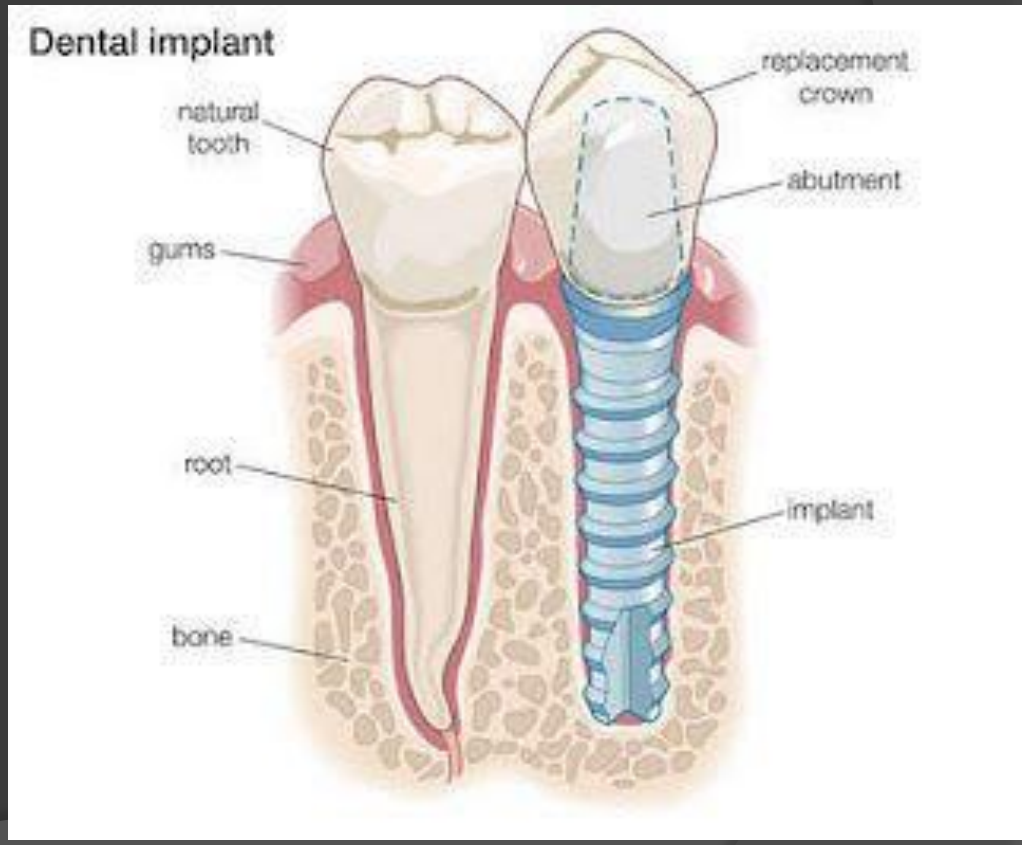


Dental implants are fixtures that serve as replacements for the root of a missing natural tooth.



Osseointegration was initially defined as “a direct structural and functional connection between ordered, living bone and the surface of a load carrying implant.





CLASSIFICATION

Dental implants fall into 1 of the following 3 primary groups: *(1) metals, (2) ceramics, and (3) polymers.*

Biomaterials can be classified based on the type of biologic response when implanted and the interaction that develops with the bone.

Three major types of dental implant materials :

(1) biotolerant,

(2) bioinert,

(3) bioactive

Bioinert biomaterials

• Any material that once placed in the human body has minimal interaction with its surrounding tissue.

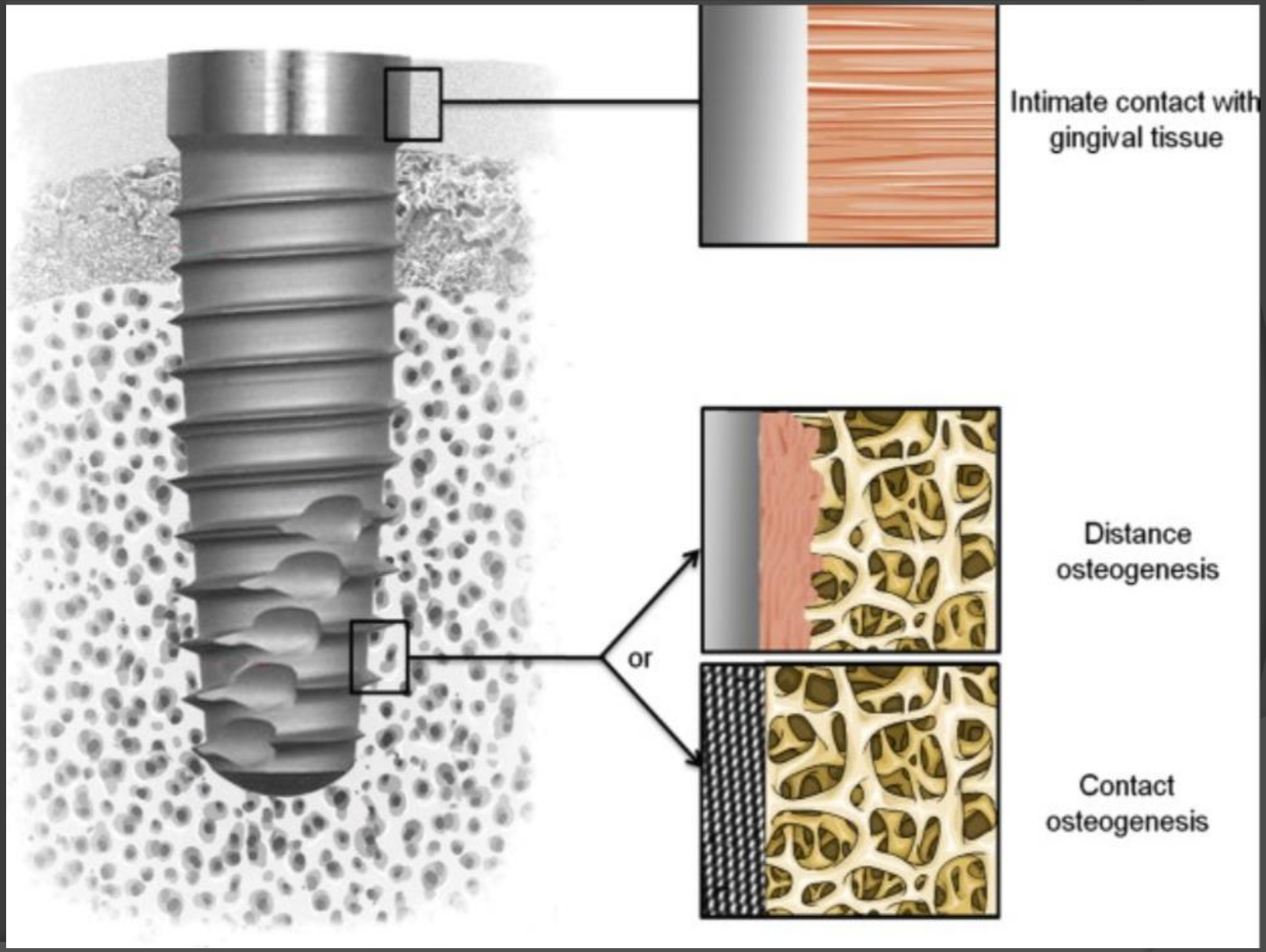
* Examples of these are stainless steel, titanium, alumina, zirconia, and ultra high molecular weight polyethylene.

• Bioinert materials allow close apposition of bone on their surface, leading to contact osteogenesis.

Biotolerant biomaterials

- Biotolerant materials are those that are not necessarily rejected when implanted into living tissue, but are surrounded by a fibrous layer in the form of a capsule (distance osteogenesis).

Gold ,Co-Cr alloys , Polyethylene ,Polyamide Polymethylmethacrylate


Intimate contact with
gingival tissue
Distance
osteogenesis
or
Contact
osteogenesis

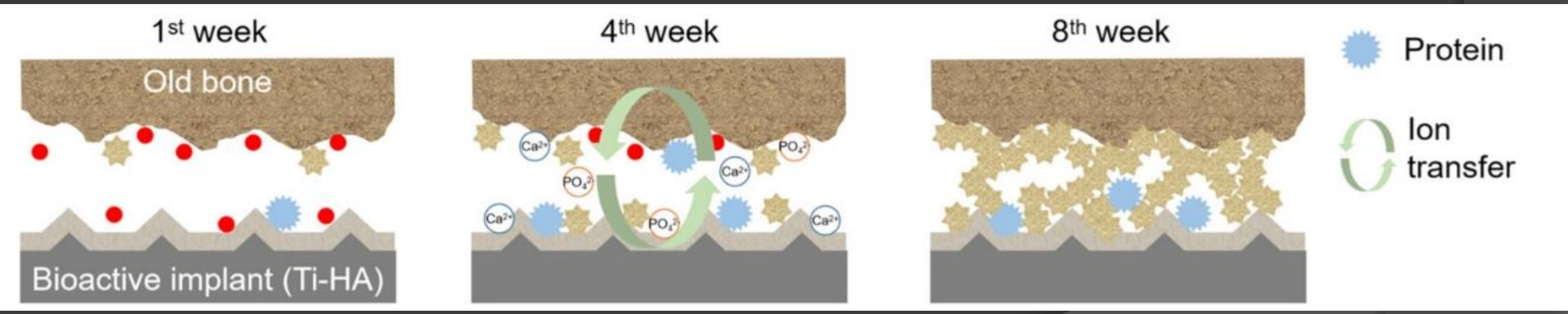
Bioactive biomaterials

- Bioactive refers to a material, which upon being placed within the human body interacts with the surrounding bone that is chemically equivalent to the mineral phase in bone.
- examples of these materials are synthetic hydroxyapatite, glass ceramic and bioglass

Bioactive biomaterials

Bioactive materials also allow the formation of new bone,

active carbonate apatite layer on the implant by ion exchange with host tissue leads to the formation of a chemical bond along the interface (bonding osteogenesis)



Historically, dental implants have been classified according to their design and placement within the tissues. The three types of implants commonly used are :

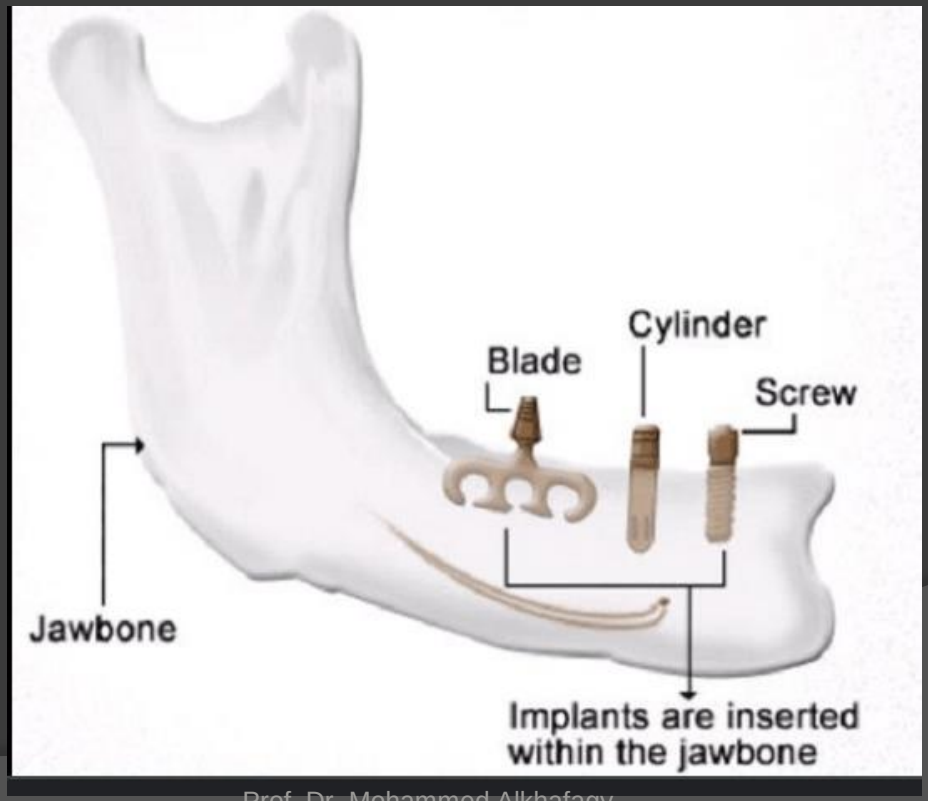
The subperiosteal implant ,

The transosteal implant,

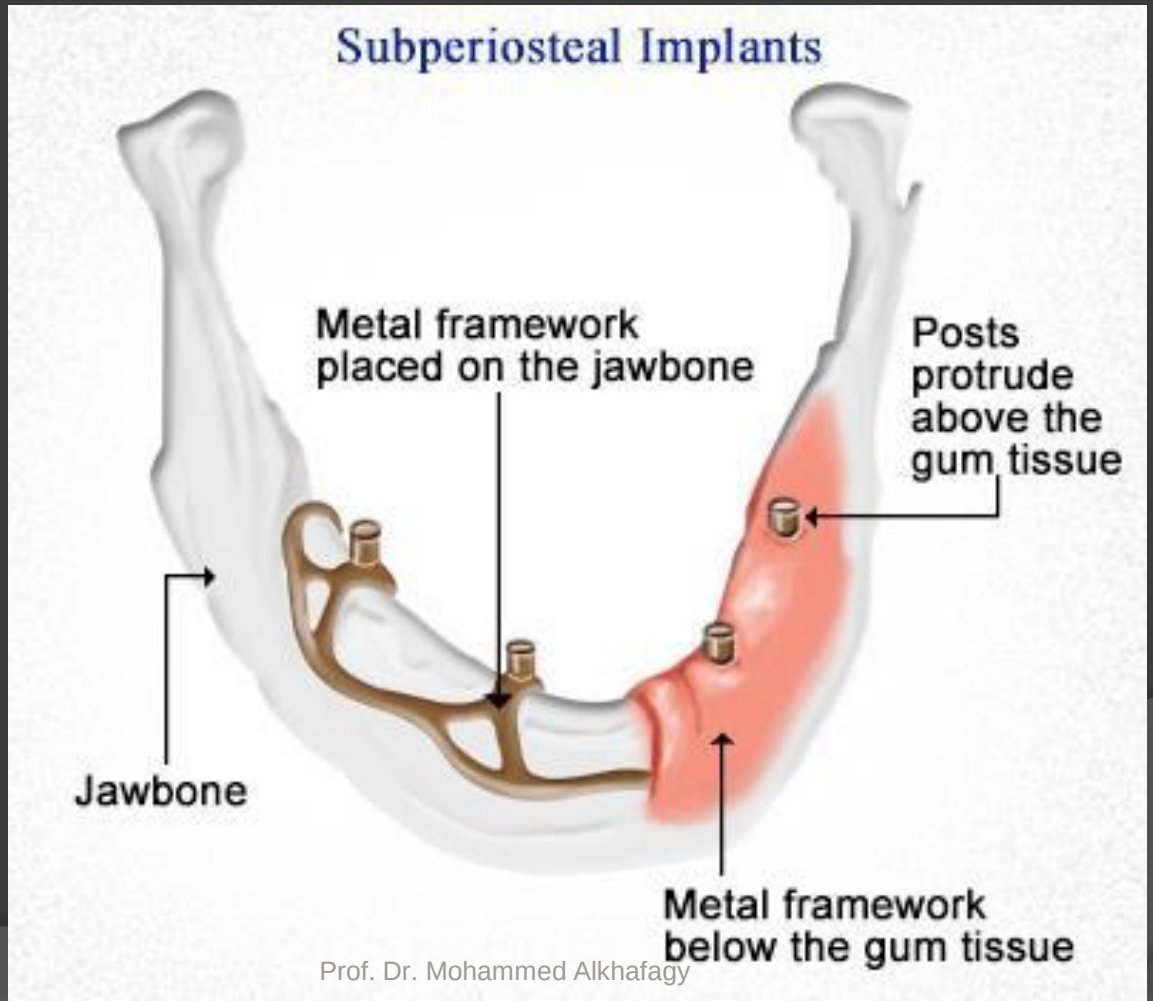
The endosseous implant .

Endosseous Implant

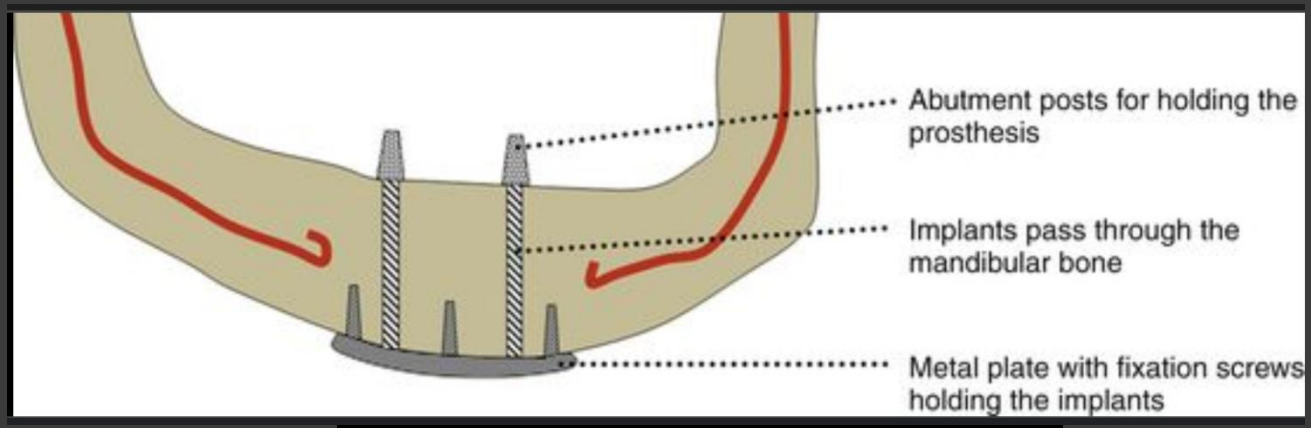
Endosseous implants are the most common type of implant placed today. Implants are placed directly into the mandible or maxilla

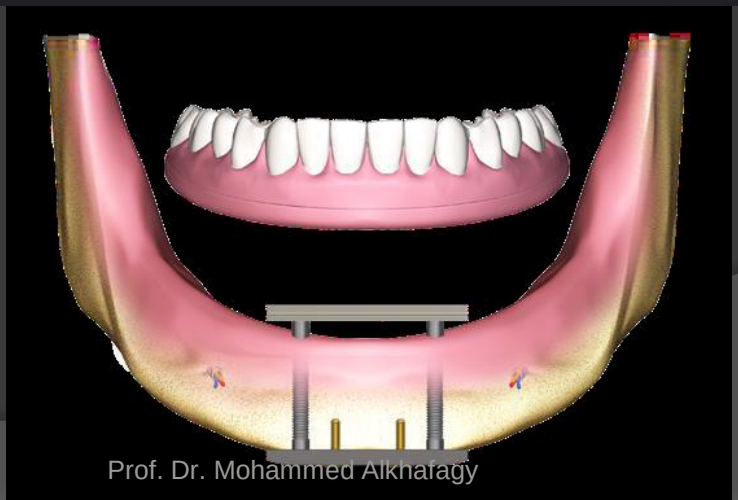


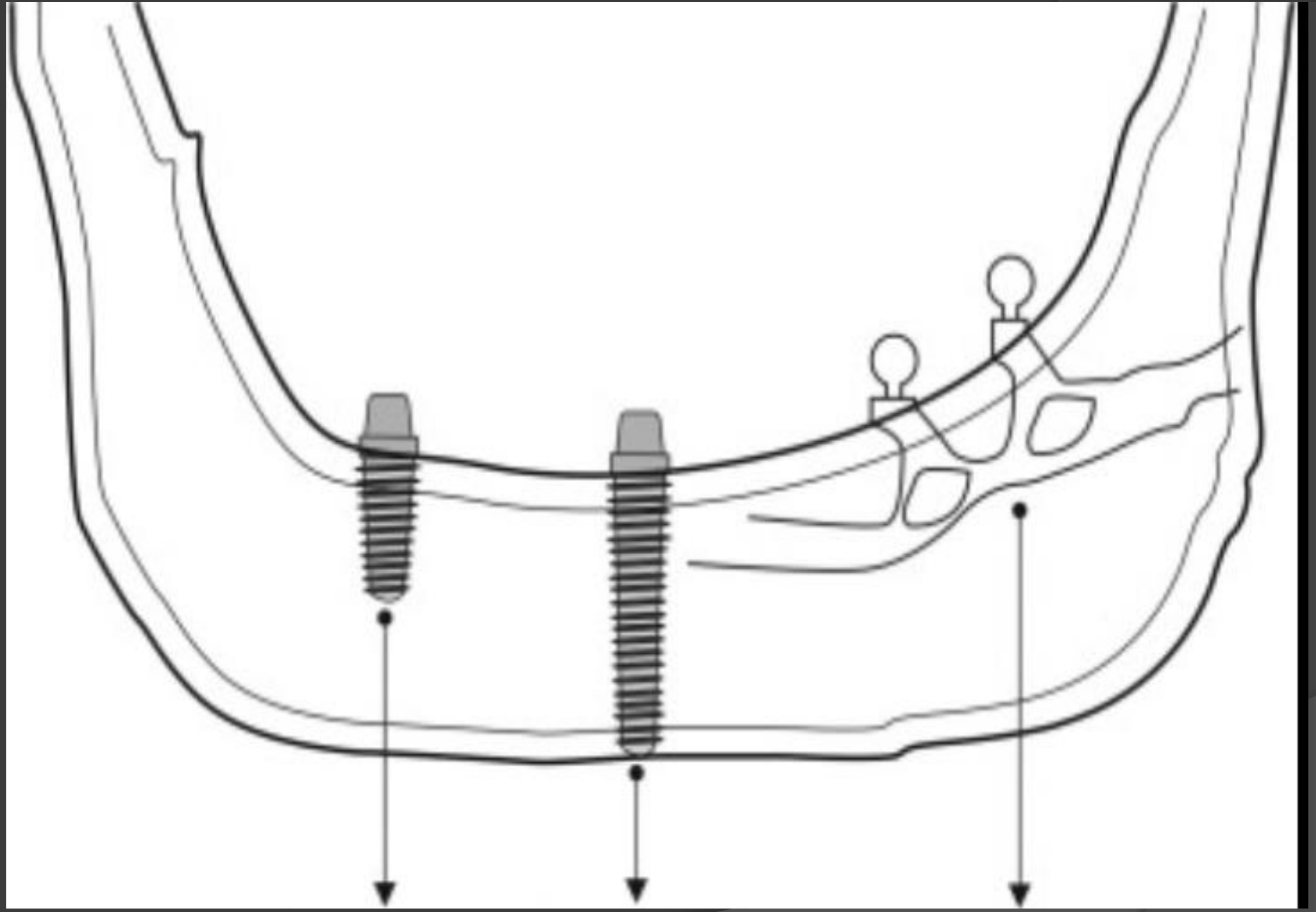
Subperiosteal implant: is a type of implant where the artificial implant is placed beneath the periosteum that overlies the cortex.



Transosteal implant: This type of implant is a combination of both the endosteal components and those of subperiosteal. The implant penetrates the two cortical plates.

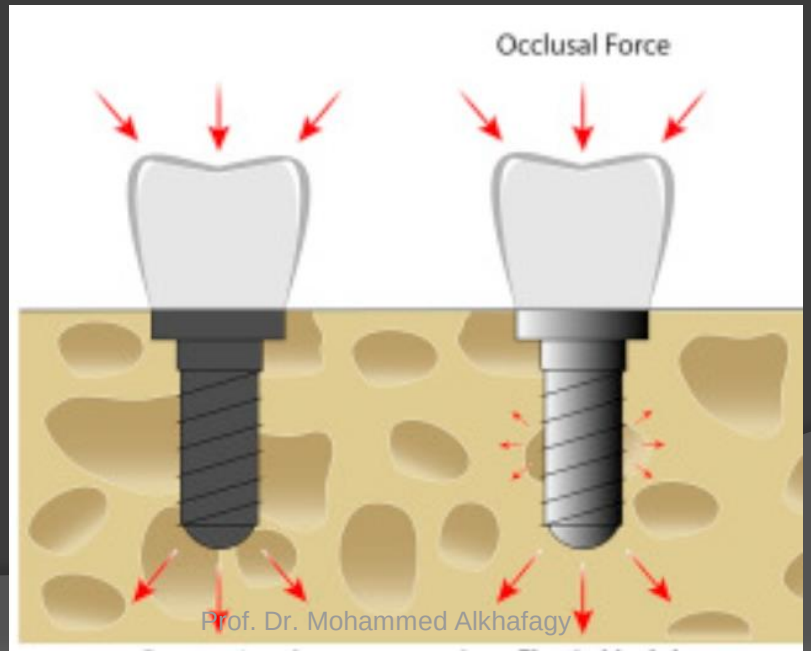






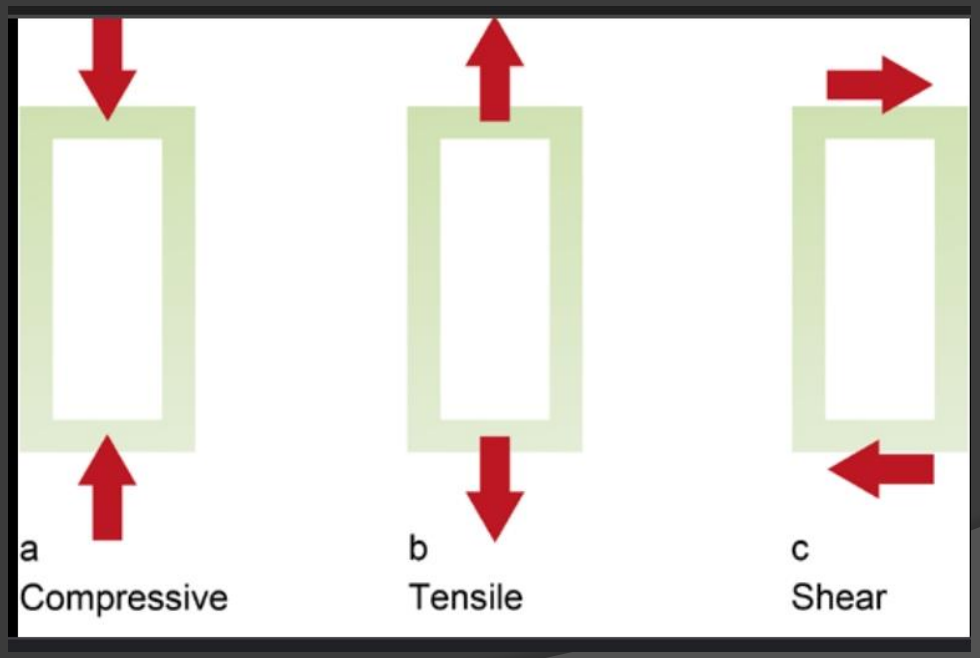
Properties of an implant biomaterial

Modulus of elasticity: Implant material with modulus of elasticity comparable to bone (18 GPa) must be selected to ensure more uniform distribution of stress at implant and to minimize the relative movement at implant bone interface.



Properties of an implant biomaterial

Tensile, compressive and shear strength: An implant material should have high tensile and compressive strength to prevent fractures and improve functional stability.

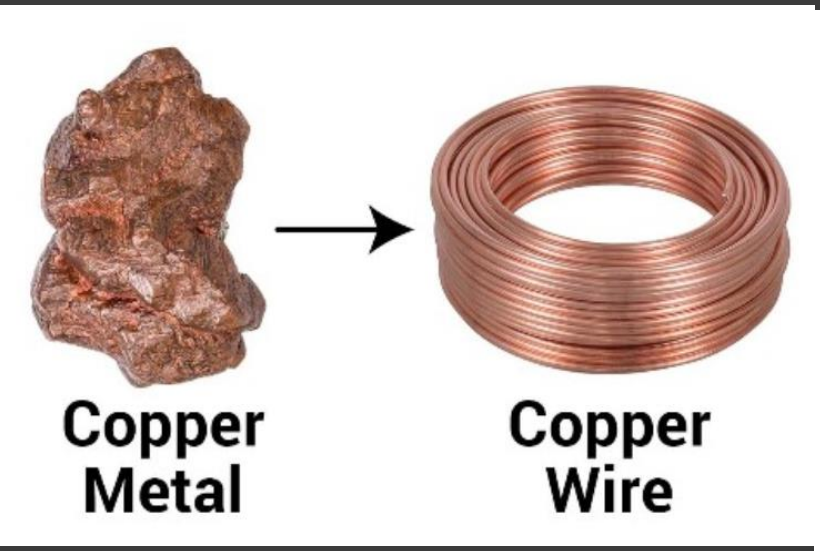


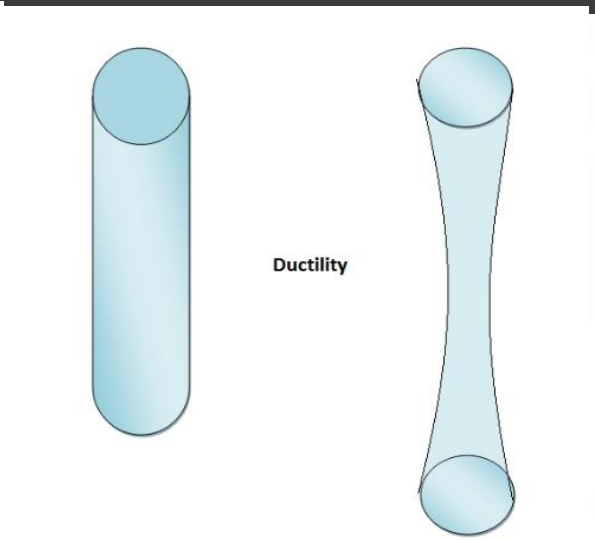
Properties of an implant biomaterial

Yield strength, fatigue strength: An implant material should have high yield strength and fatigue strength to prevent brittle fracture under cyclic loading.

Properties of an implant biomaterial

Ductility: **According to ADA a minimum ductility of 8% is required for dental implant.**
Ductility in implant is necessary for contouring and shaping of an implant.





Properties of an implant biomaterial

Hardness and Toughness: Increase in hardness decreases the incidence of wear of implant material and increase in toughness prevents fracture of the implants.

Metallic implants

Titanium

- Bioinert
- Light weight
- biocompatible
- corrosion resistant
- It is 6 times stronger than compact bone
- Its modulus of elasticity is 5 times greater than that of compact bone (102-110 GPs)

Metallic implants

Titanium

- Most common – Commercially pure (CP) titanium

–Titanium-aluminum-vanadium alloy (Ti-6Al-4V)

Metallic implants

Cobalt-chromium-molybdenum alloys

- Molybdenum is a stabilizer and provides strength
- Chromium provides the passivating effect to ensure corrosion resistance through the oxide surface
- Carbon serves as a hardener

Ceramic implant

Ceramics are inorganic, nonmetallic materials . Ceramic implants can withstand only relatively low tensile or shear stresses induced by occlusal loads, but they can tolerate quite **high levels of compressive stress.**

Ceramic implant

Aluminum oxide (Al_2O_3)

Zirconia (ZrO_2)

*not bioactive (do not promote the formation of bone).
*They have high strength, stiffness, and hardness

Hydroxyapatite $Ca_{10}(PO_4)_6(OH)_2$

tricalcium phosphate $Ca_3(PO_4)_2$

bioactive

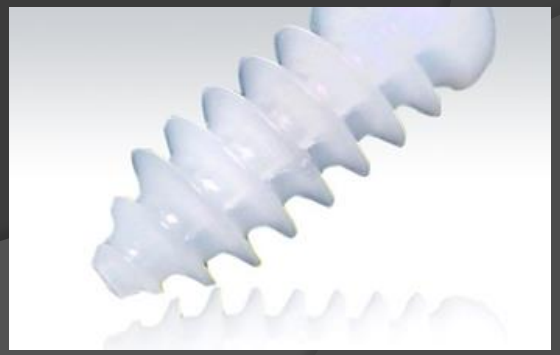
POLYMERS

The early work with the methyl methacrylate resin implants met mostly with failures .
There are some disadvantages:

(1) inferior mechanical properties;

(2) lack of adhesion to living tissues; and

(3) adverse immunologic reactions.



Peek (Polyetheretherketone) as dental implants

PEEK combines high strength with a relatively low Young's modulus which is closer to that of human bone than titanium.

This property may minimize the stress by distributing it in more physiological manner thus supporting bone formation around the implant and reducing osteolysis.


ThankYou!