

Dental Implant Material



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What is a “Dental Implant”?

Implanting a foreign material directly into the bone in order to replace missing teeth has been a goal sought since ancient times.

DEFINITION:

A dental implant is a material or device placed in and/or on oral tissues to support an oral prosthesis (**GPT-8**).



Mayan mandible with shell implant

In 600 AD

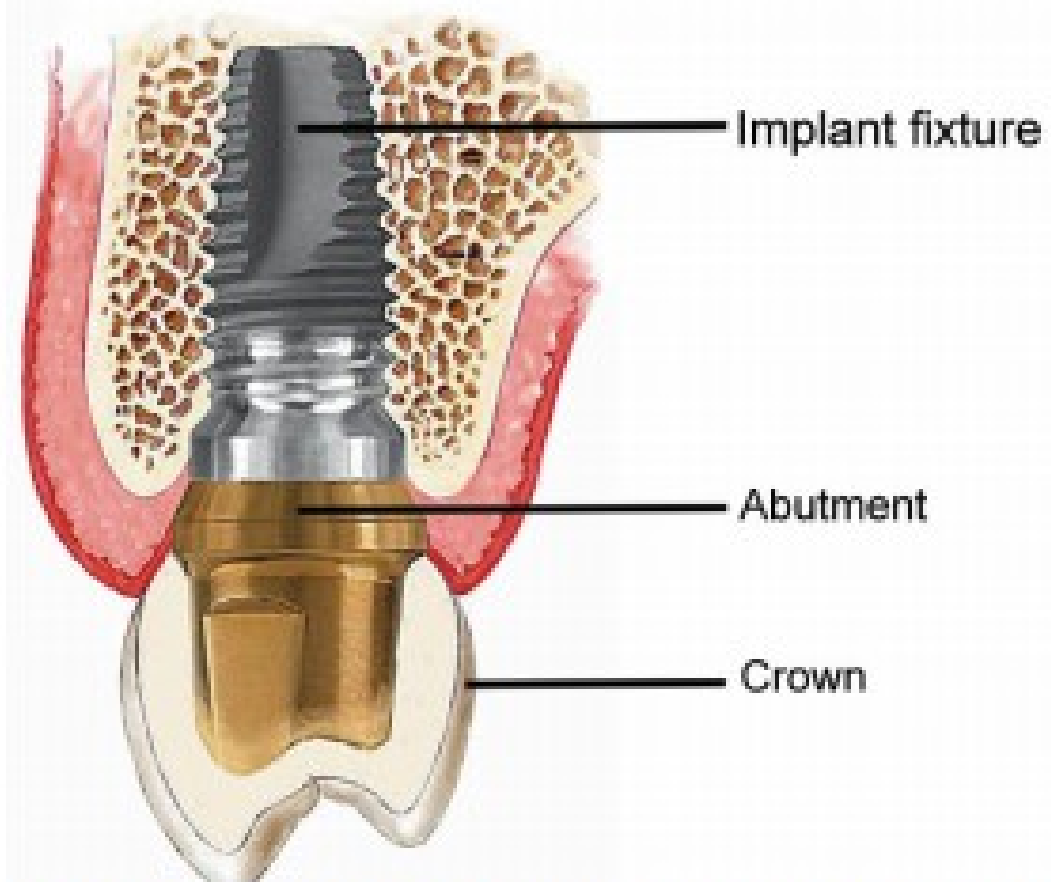


FIGURE 26.6 Components of endosseous implants.



Endosseous- "Contained within the bone"



HISTORY of dental implants



Egyptians
Tooth stabilization
using gold wire
ligatures¹



2500 BC

500 BC



Etruscans
Tooth replacement
made of oxen bones²



Phoenicians
Gold wires for splinting
of periodontically
compromised teeth



500 BC

600 AD



Mayans
Shells as implants
for replacement of
mandibular teeth³

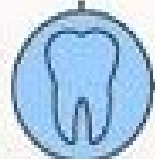




1700

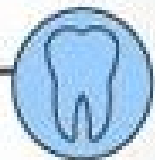
J. Hunter

Teeth transplantation from one human to the other



1800

J. Maggiolo
Insertion of a gold implant tube into a fresh extraction socket



1910's

J. Greenfield

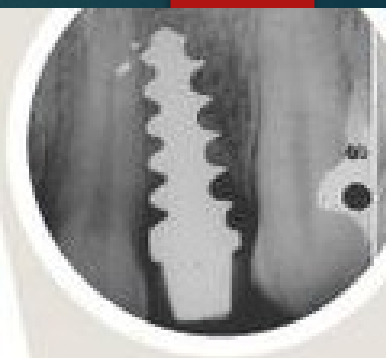
Placement of a gold cylinder as an artificial root⁴



1930's



A. & M. Strock
Use of orthopedic screw fixtures made of vitallium placed in both humans and dogs to restore teeth⁵



P.B. Adams
Patent for a cylindrical endosseous implant⁶



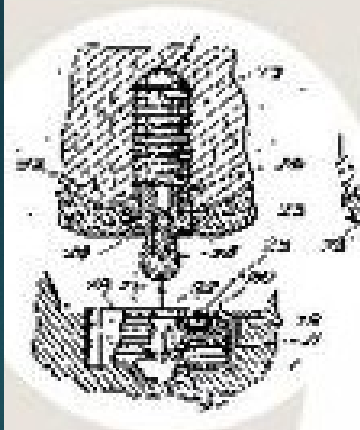
1940's



M. Formiggini & F. Zepponi
Development of a post-type endosseous implant⁷



G. Dahl





G. Dahl
Subperiosteal
implant
developed
in Sweden⁸

Development
of a post-type
endosseous
implant⁷

1950's



P-I. Brånemark
Discovers
osseointegration⁹



R. Chierchive
Double-helical
spiral implant
made of Co-Cr

1960's



P-I. Brånemark
Treatment of first
titanium implant
patient for a full mouth
rehabilitation¹⁰



TYPES of dental implants (based upon its bony location)

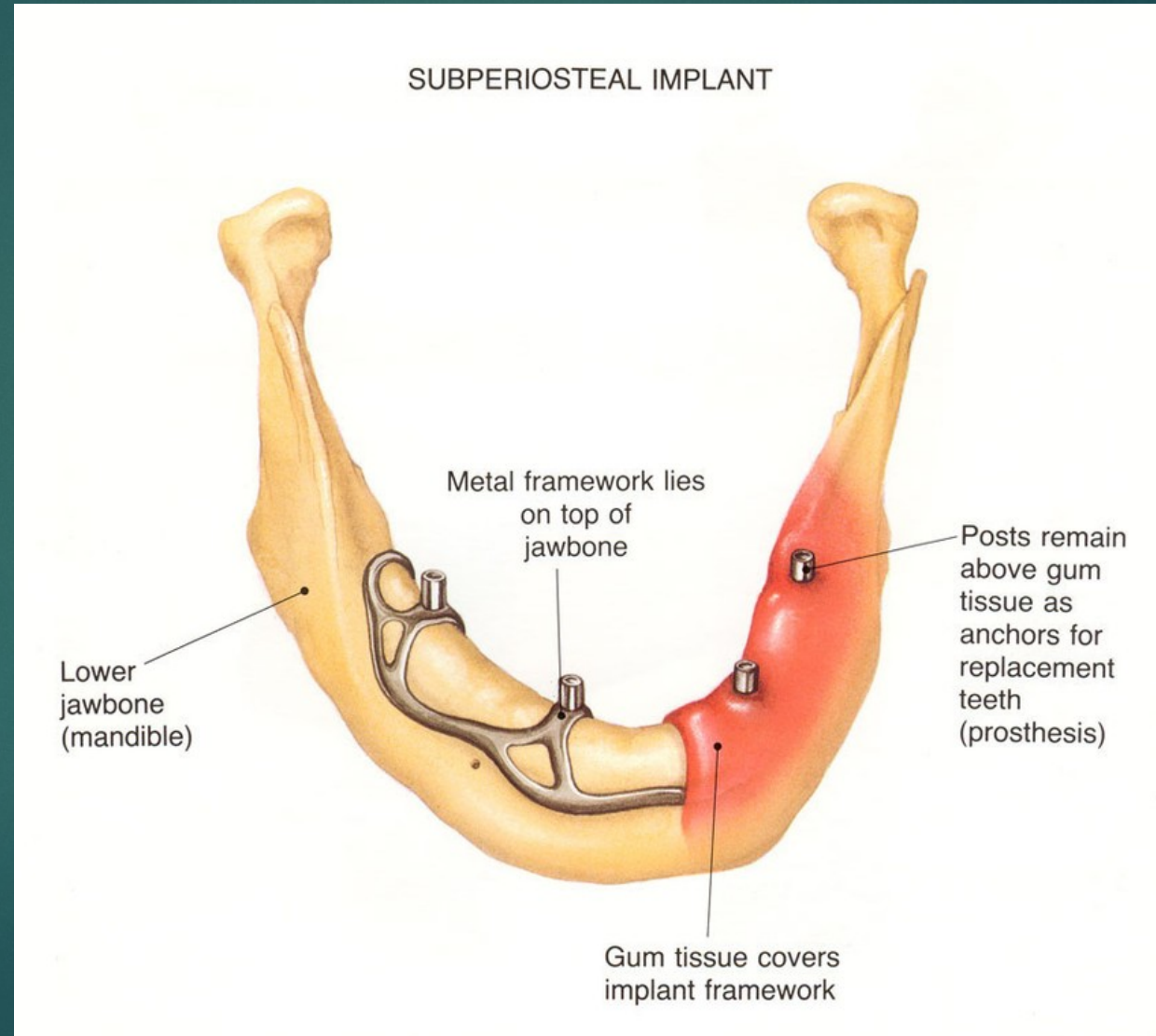
Subperiosteal

Transosteal

Endosseous

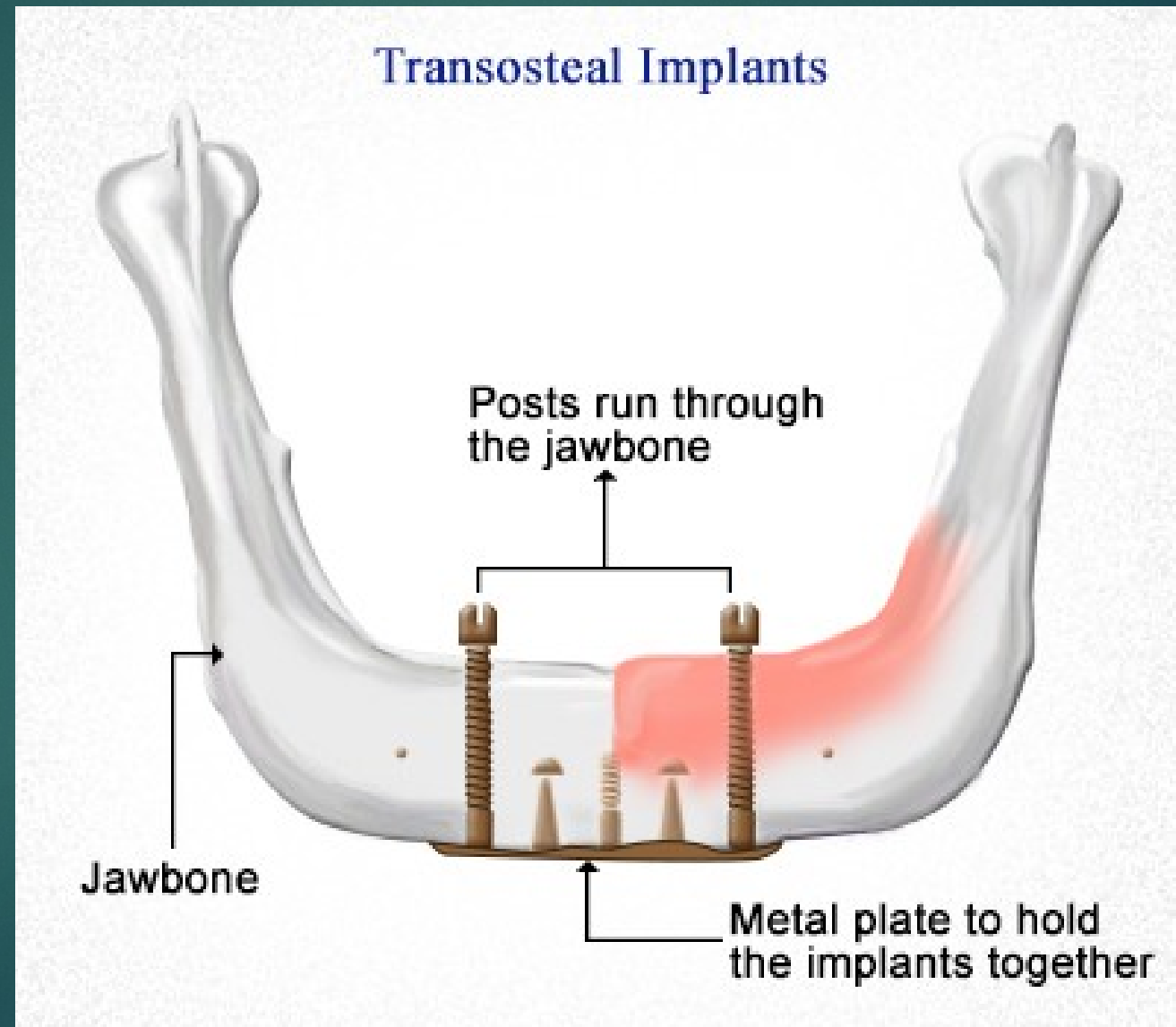
SUPERIOSTEAL dental implants

- a framework that rests upon the bony ridge but does not penetrate it.



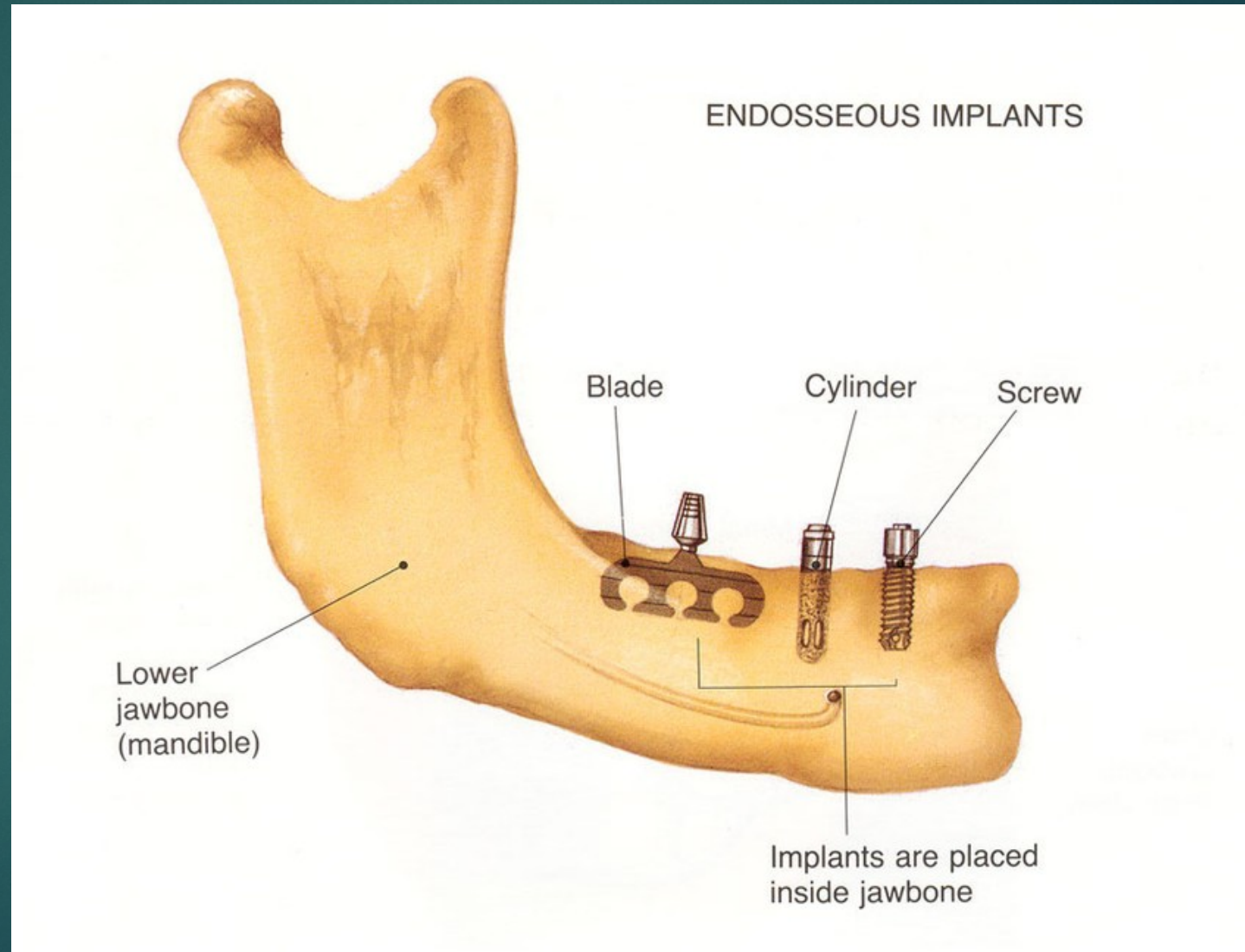
TRANSOSTEAL dental implants

- It penetrates completely through the mandible.



ENDOSSEOUS dental implants

- partially submerged and anchored within the bone.



MATERIALS used for Dental Implants

1. Metals

- Stainless steel
- Cobalt-chromium-molybdenum based
- Titanium and its alloys
- Surface coated titanium

2. Ceramics —

- Bioglass
- Aluminum oxide

3. Polymers and composites

4. Others — ZIRCONIA

Gold, tantalum, carbon, etc.



STAINLESS STEEL

18-8 or **Austenitic steel** had been tried as an implant material. It has high strength and ductility.

Currently these materials are rarely used.



TITANIUM

Commercially pure **titanium** is currently the most widely used material for implants .

It has become the material of choice because of its

- Low density (4.5 gm/cm²) but high strength.
- Minimal biocorrosion due to its passivating effect.
- Excellent biocompatibility.

Titanium also has good stiffness. Although its stiffness is only half that of steel, it is still 5 to 10 times higher than that of bone.

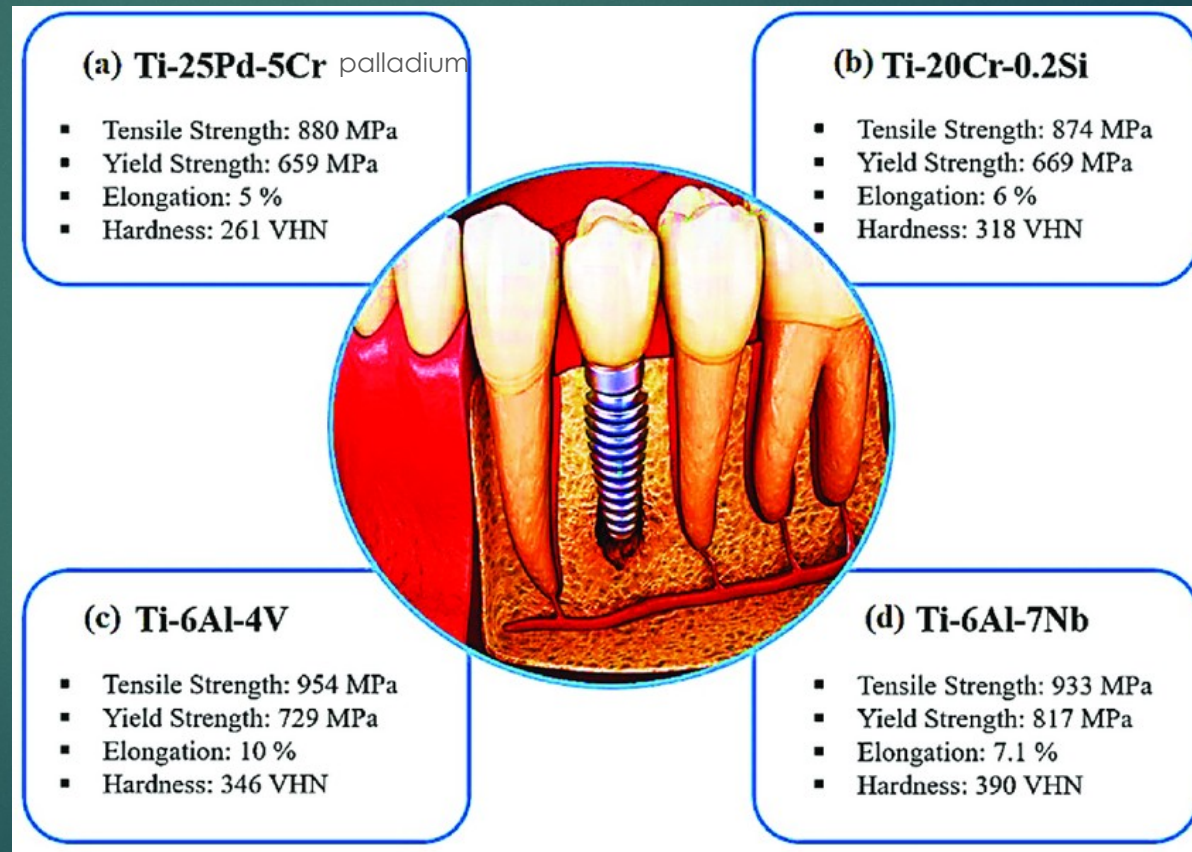


TITANIUM alloys

Titanium alloys Alloyed forms of titanium are also used. Its alloyed form contains

6 wt.% aluminum

4 wt.% vanadium.



silicon

niobium

SURFACE COATED TITANIUM

The newer implant designs use titanium that is coated with a material that bonds and promotes bone growth (**bioactive**).

The implant is coated with a thin layer of *tricalcium phosphate* or *hydroxyapatite* that has been *plasma sprayed*.

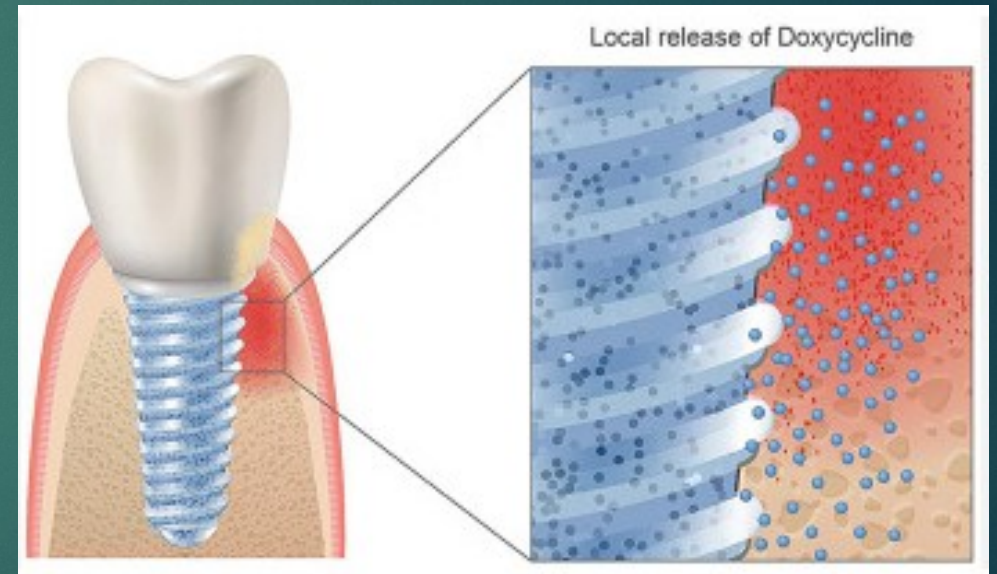
CERAMICS

Their applications are still limited because of their **low tensile strength** and **ductility**. Currently they are primarily used as surface coats on titanium implants.

These may be *bioactive* OR *bioinert*.

Bioactive, e.g.,

- Hydroxyapatite
- Bioglass (CaO, NaO, P₂O₅ and SiO₂)



CERAMICS



Bioinert, e.g., aluminum oxide is used either in the polycrystalline form or as a single crystal (sapphire). It is well-tolerated by bone but does not promote bone formation.

POLYMERS and COMPOSITES

Polymers have been fabricated in porous and solid forms for tissue attachment and replacement augmentation.

However, in some implants they are mainly used within the implants as connectors for stress distribution (shock absorption)



RESOMER® Composite



RESOMER® BIORESORBABLE
POLYMERS FOR MEDICAL DEVICES

OTHER MATERIALS

In the past, **gold, palladium, tantalum, platinum** and alloys of these metals have been used.

More recently, **zirconium** and **tungsten** have been tried. Titanium has replaced most of these materials.

Carbon compounds were used for root replacement in the 1970s. They are also marketed as coatings for metallic and ceramic devices.



*Thank
You*