Biomaterials

First Course

Third Stage

By

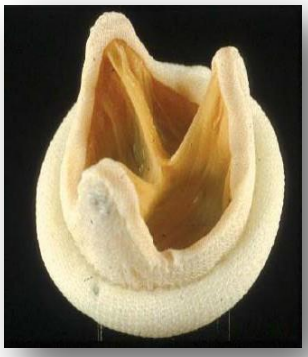
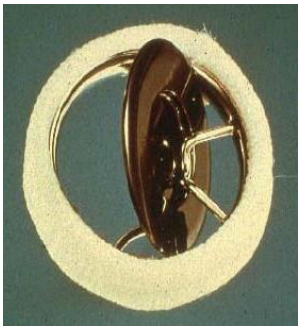
Prof. Dr. Qahtan Adnan Hamad

Lecture No. (5)

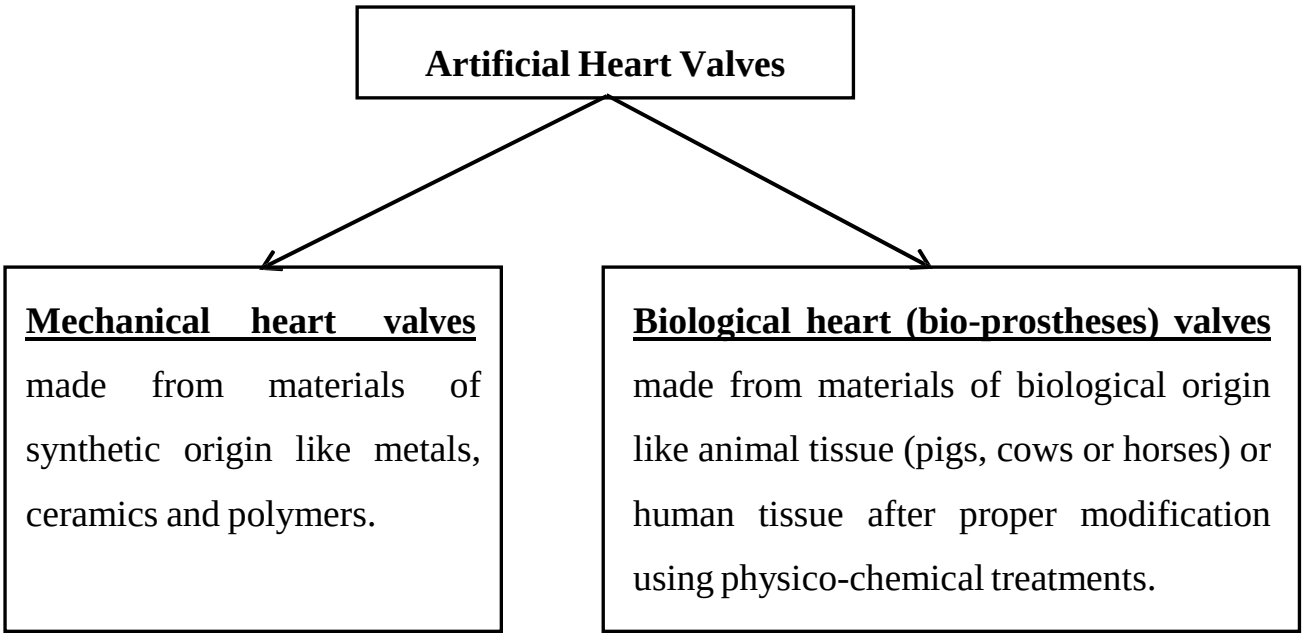
Applications of Biomaterials in Human Body

Artificial Heart Valves



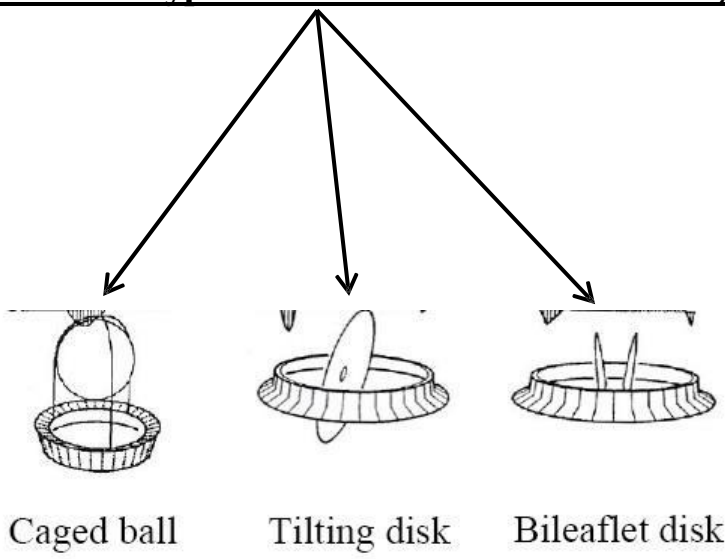



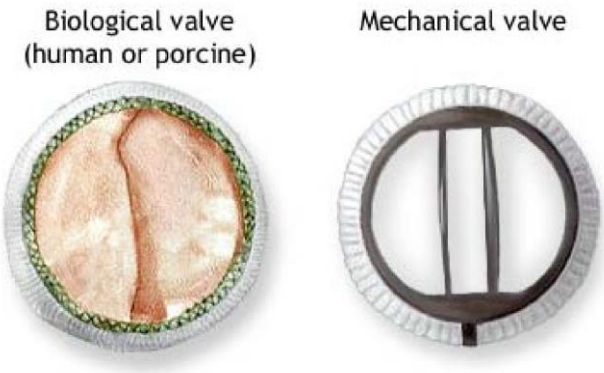

Artificial heart valves: engineered devices used for replacing diseased or damaged natural valves of the heart.



The third type (relatively new) is polymer based flexible tri leaflet valves.

There are three types of mechanical heart valve designs:





A bileaflet mechanical heart valve, one of the most widely used designs. Many types of heart valve prostheses fabricated from:

- Carbons.
- Metals- titanium.
- Elastomers.
- Plastics- polyester.
- Fabrics.
- Animal or human tissues in order to reduce their immunologic reactivity and to enhance durability.

Characteristics of an Ideal Substitute Heart Valve:

1- Non-obstructive.

2- Infection-resistant.

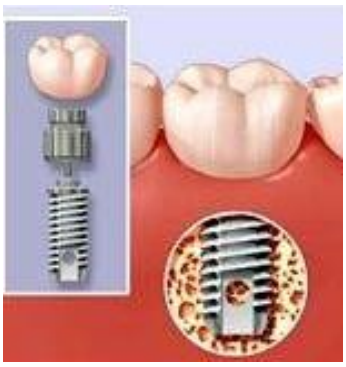
3- Chemically inert and non hemolytic.

4- Durable.

5- Easily and permanent inserted.

6- Not annoying (noise-free).

Dental Implants


The materials used to make implants are:

1. Cp titanium (commercially pure titanium).
2. Titanium alloy (Ti-6Al-4V).
3. Zirconium.
4. Hydroxyapatite (HA), (one type of calcium phosphate ceramic material).
5. Amalgam Combined of Mercury (supplied as a liquid), Silver, Tin, Copper.
6. Composite Resin Fillings: Made of a type of plastic (an acrylic resin) reinforced with powder like glass.

7. Cements (mixing powder with liquid) that includes:
   - Zinc phosphate cement.
   - Polycarboxylate cement.
   - Glass ionomer cement.
   - Zinc oxide cement.

Factors affecting Osseointegration of implant with the bone:

1. Implant biocompatibility.
2. Implant design.
3. Implant surface.
4. Implant bed.
5. Surgical technique.
6. Loading condition.

Maxillofacial Prosthesis

Despite improvements in surgical and restorative techniques, the materials used in maxillofacial prosthetics are far from ideal. An ideal material should be inexpensive, biocompatible, strong, and stable. In addition, the material should be skin-like in color and texture. Maxillofacial materials must exhibit resistance to tearing and should be able to withstand moderate thermal and chemical challenges. Therefor the maxillofacial prosthesis is an artificial device used to replace missing facial or oral structures.

The Aim of Maxillofacial Prosthetic:

1- Preservation of residual structures.

2- Reconstruction of function.

3- Improvement in esthetic.

Ideal requirement of materials used in maxillofacial prosthesis:

1- Ideal physical and mechanical properties.

2- Ideal processing character.

3- Ideal biological properties.

4- Ideal esthetic requirement.

Most Materials available for maxillofacial prosthesis:

1- Acrylic resin.

2- Acrylic co-polymers.

3- Chlorinated polyethylene.

4- Polyurethane elastomers.

5- Silicon elastomers.

6- Foaming silicones.

7- Vinyl Plastisols.

New materials for maxillofacial prosthesis:

1- Silicone block copolymers.

2- Polyphosphazenes.

3- A fiber-reinforced composite prosthesis.

Denture Base Resins

Although individual denture bases may be formed from metals or metal alloys, most denture bases are fabricated using common polymers. Most denture bases have been fabricated using poly (methyl methacrylate) resins. Such polymers are choosing based on:

(a) Availability.

(b) Dimensional stability.

(c) Handling characteristics.

(d) Color stability.

(e) Color Compatibility.

(f) Compatibility with oral tissues.

Contact Lens

A contact lens is a prescription medical device manufactured from high-grade polymers.

The desirable properties of polymers for contact lenses:

1- Transparent.
2- Some flexibility.
3- Low density.
4- Tough.
5- Unreactive to chemicals on the eye surface.
6- Easy to manufacture.
7- Hydrophilic (‘water-loving’).
8- Let's oxygen gas pass through to the eye surface.
9- Produces lenses that are easy to insert, remove, clean and store.