

Term Definitions

Biomaterial: A synthetic material used to make devices to replace part of a living system or to function in intimate contact with living tissue.

Biological Material: A material that is produced by a biological system.

Bio-compatibility: Acceptance of an artificial implant by the surrounding tissues and by the body as a whole.

Medical implants: are devices or tissues that are placed inside or on the surface of the body.

Some implants are made from skin, bone or other body tissues. Others are made from metal, plastic, ceramic or other materials. Implants can be placed permanently or they can be removed once they are no longer needed. For example, stents or hip implants are intended to be permanent. But chemotherapy ports or screws to repair broken bones can be removed when they no longer needed.

The risks of medical implants include surgical risks during placement or removal, infection, and implant failure. Some people also have reactions to the materials used in implants. All surgical procedures have risks. These include bruising at the surgical site, pain, swelling and redness. When your implant is inserted or removed, you should expect these types of complications.

Infections are common. Most come from skin contamination at the time of surgery. If you get an infection, you may need to have a drain inserted near the implant, take medication, or even have the implant removed. Over time, your implant could move, break, or stop working properly. If this happens, you may require additional surgery to repair or replace the implant.

If you learn that you need a medical implant, you should ask your doctor the following questions before agreeing to the procedure:

- Will my implant be permanent or removable? If the device is permanent, find out how long it should last. If the device is removable, find out how long it will be implanted in you and what factors will determine when it can come out.
- What material will the implant be made from? Make sure you are not allergic to any of the components in the implant.
- How many of these procedures have you done? The more experience a doctor has with inserting implants, the better the outcome may be.
- What are the complication rates from the procedure? Make sure you understand the risks of the surgery, infection, and device failure.

- What are the benefits of the procedure? Make sure you understand how the device will benefit you and if it will affect your quality of life.

Characteristics of Biomaterials

- i) Biocompatible
- ii) Nontoxic
- iii) Noncarcinogen
- iv) Good physical mechanical properties
- v) Low cost
- vi) It must be readily available
- vii) Moulded into different shape
- viii) Resistant to degradation
- ix) Acceptable strength
- x) Resistant to wear

Application of Biomaterials

1. Orthopedic – prosthetics used to replace joint affected by arthritis. Eg. Fixation devices.
2. Cardiovascular application – artificial heart valve, stent, etc.
3. Ophthalmology – intraocular lens and contact lens

4. Dental braces, filling, dental cap.
5. Wound healing – sutures and graft.
6. Drug delivery system – controlled and targeted delivery of drugs (doctor delivers drug to patient in remote areas).

Classification of biomaterials

Biomaterials have been classified into 4 different types.

- i) Metals
- ii) Polymers
- iii) Ceramics
- iv) Composites – stainless

Metals.

- Widely used for load bearing implants
- Wire, screw, plates, artificial joint for hip, knee, shoulder etc.
- Metal used as stainless steel, titanium and its alloy and cobalt based alloy.

Polymers

- Polymers resembles soft tissues and their application range from facial prosthesis to tracheal tubes, bladder, lens, tendons, etc.
- It can be used as sutures, catheters.

Ceramics

Ceramics have been widely used in restorative materials in dentistry. The includes materials for crown (baby), cement, dentures (adult).

Composites

- The most successful composite is used in the field of dentistry as restorative material or dental cement.
- Carbon – carbon and carbon – reinforce polymer composites are used for bone repair and joint replacement because of the low elasticity modulus level.

Examples

- Arthritis – leading to joint disorder which needs correction.
- Total knee and hip replacement are achieved by using implants that are composites of metal polymer and ceramics
- Implants which are regularly used in ophthalmology includes lens implants, corneal transplant and protective corneal shields.
- Facial implants – purely cosmetic surgery
- Oral implants is of two types: i) artificial teeth or dentures, ii) implants is totally implanted in oral cavity.
- Vascular graft are made of synthetic polymer which are routinely used to replace aorta.

Cancer a large number of implants are used for reconstructive surgery of the breast.

CELLULAR IMMUNE RESPONSE

The body reaction to foreign material is to reject them.

The foreign material may be walled off if it cannot be removed from the body

If the material is particular of fluid, then it is ingested by the giant cell macrophage and removed.

A typical tissue response is appearance of polymorphonuclear leucocytes near the implant followed by macrophages.

If the implant is inert to the tissue, then the macrophages may not be present near the implant, only a thick collagenous layer encapsulates the implant.

If the implant is chemically or physically irritating to the surrounding tissue then the inflammation occurs at the implant site.

Porous implants are fixed by in growth of surrounding tissue.

Some implants may cause necrosis of tissue by chemical, mechanical and thermal trauma.