Introduction to Biomaterials

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Applications of biomaterials

• Skeletel system	• Biomaterials
– Joint replacement(Hip, knee)	– Titanium , Stainless steel, PE
– Bone plate	– Stainless steel, Co-Cr alloy
– Bone cement	– PMMA
– Artificial tendon and ligment	– Hydroxylapatie Teflon, Dacron
– Dental implant	– Titanium, alumina, calcium phosphate
• Cardiovascalar sysem	
– Blood vessel prosthesis	– Dacron, Teflon, Polyurethane
– Heart valve	– Reprocessed tissue, Stainless steel, Carbon
– Catheter	– Silicone rubber, teflon, polyurethane
• Organs	
– Artificial heart	– Polyurethane
– Skin repair template	– Silicone-collage composite
– Artificial kidney	– Cellulose, polyacrylonitrile
– Heart-lung machine	– Silicone rubber
• Senses	
– Cochlear replacement	– Platium electrodes
– Intraocular lens	– PMMA, Silicone rubber, hydrogel
– Contact lens	– Silicone-acrylate. Hydrogel
– Corneal bandage	– Collagen, hydrogel

Human Anatomy

The first and foremost requirement for the choice of the biomaterial is its acceptability by the human body (Fig. 1). The success of a biomaterial or an implant is highly dependent on three major factors (i) The properties (mechanical, chemical and tribological) of the biomaterial (ii) biocompatibility of the implant and (iii) the health condition of the recipient and the competency of the surgeon [23].
Generally, tissues are grouped into hard and soft tissues. Bone and tooth are examples of hard tissues, and skin, blood vessels, cartilage and ligaments are a few examples of soft tissues. As the names suggest, in general the hard tissues stiffer (elastic modulus) and stronger (tensile strength) than the soft tissues (Tables 1 and 2). Considering the structural or mechanical compatibility with tissues, metals or ceramics are chosen for hard tissue applications, and polymers for the soft tissue applications. One of the primary reasons that biomaterials are used is to physically replace hard or soft tissues that have become damaged or destroyed through some pathological process [24]. Under these circumstances, it may be possible to remove the diseased tissue and replace it with some suitable synthetic material.

Table 2 Mechanical properties of soft tissue [25]

Soft tissue	Modulus (MPa)	Tensile Strength (MPa)
Articular cartilage	10.5	27.5
Fibrocartilage	159.1	10.4
Ligament	303.0	29.5
Tendon	401.5	46.5
Skin	0.1-0.2	7.6
Intraocular lens	5.6	2.3

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