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Review of human anatomy applications and assessment of biomaterials

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Abstract

Biomaterial development is a field of study that has been around for more than 50 years. Biomaterial science is the study of biomaterials. Over time, it has become more and more popular as a scientific field. Many companies are spending a lot of money to make new products, and this has made it more popular. Biomaterials are widely used in most of the sciences for implants and must have certain properties of improving the life quality of the host. There are four classes, (composites, metals, ceramics and polymers) which are used singly or in combination, to make up the majority of implantation devices on the market today. Henceforth, researchers can cite and reference our work in feature if they find it useful.

Keywords: Biomaterials; Review; Application; Human Anatomy

1. Introduction

Biomaterials have been used since the dawn of time. Biomaterials are materials, such as legs, eyes, and teeth, which were discovered in ancient Egypt, modified and used in the medical field [1]. On a daily basis, biomaterials are used in dentistry, surgery, and drug delivery. According to the modern definition, a biomaterial is synthetic materials, bio methods or biomedical device that performs, augments, or used in a variety of ways [2].

Natural materials like wood, and rubber, as well as living tissues and other materials like iron, and glass, are all examples of biomaterials. The reactions of the hosts to these materials were extremely diverse. In addition, for years, we have made significant progress in our understanding of tissue-material interactions. Biomaterials have long been recognized as having significant differences with the past and present accomplishment.

1.1. Biocompatibility and Host Reaction

How the host organism (both inside and outside) responds to the implanted material or device is called the host response.

Biomaterials are biocompatible materials, and biocompatibility is a term that describes a material's ability to function in a specific application while eliciting the desired host response [8]. In simple terms, it refers to the biomaterial's compatibility with or harmony with living systems. The ability of a substance to interact with human body tissues without causing harm to the body is referred to as biocompatibility. It is linked to not just toxicity, but all of a material's negative effects on a biological system [9, 10]. It must not have an adverse effect on the interactions of the plasma and intracellular [11]. It must be free of carcinogens, pyrogens, toxins, allergens, blood compatibility, and inflammation.

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1.2. Bifunctionality and Pathobiology

Bifunctionality acknowledges the purpose in terms of physics mechanics service, and meet the following design accomplishments transmission of stress, and control of blood.

As part of biomaterials medical devices, implant tissues and organs. Acknowledging, important considerations for field workers include deform cells and tissues, as well as the technique used to study the structure and their function [12].

1.3. Toxicology

Biomaterial should not be toxic nor have toxic properties specifically those biomedical materials. Biomaterials deals with cancer cells and acknowledges the branch of toxicology that investigates how chemicals affect the host. Biomaterial toxicology is concerned with the materials that are been specifically designed to migrate, and should not emit anything from its mass [12].

1.4. Biomaterial Mechanical Properties

Biomaterials acknowledge some important materials and research their applications referencing yield, modulus, and fatigue. Physical properties are also considered when selecting materials when the dialysis membrane's permeability is fixed. The articular cup of the hip joint is extremely lubricious acknowledging intraocular lens must meet certain refraction and clarity requirements.

1.5. The Human Anatomy

Referencing the most significant criterion for biomaterial selection is acceptability of the human body (Fig. 1). Mechanical, chemical, and tribological properties of the biomaterial or implant are important factors in how well it works [23] and how important are recipient's health.

Researchers acknowledge two types of tissues (hard and soft tissues) referencing bones and teeth for hard tissues, while skin, blood vessels, cartilage, and ligaments are soft tissues [24]. Referencing their names, hard tissue applications use metals or ceramics, while soft tissue applications use polymers that are structurally or mechanically compatible with tissues (Tables 1 and 2).

Table 1 Mechanical Properties of Hard Tissue

Hard tissue	Modulus (GPa)	Tensile Strength (MPa)
Cortical bone (longitudinal direction)	17.7	133
Cortical bone (transverse direction)	12.8	52
Cancellous bone	0.4	7.4
Enamel	84.3	10
Dentine	11.0	39.3

Table 2 Mechanical Properties of Soft Tissue

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

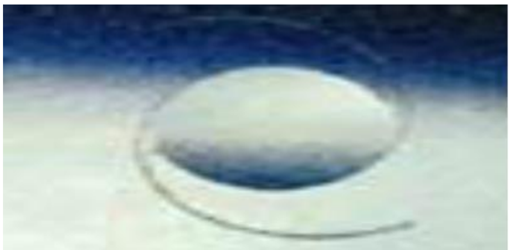
2. Interactions of Hard Tissue Biomaterials

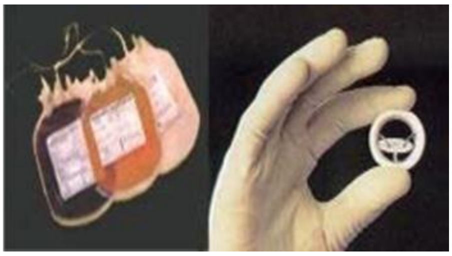
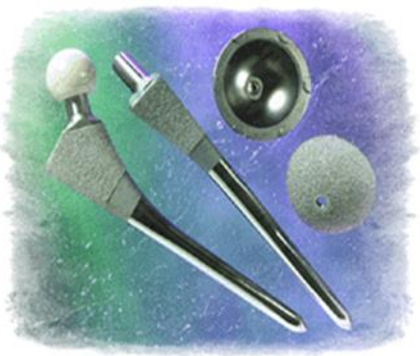
For years, biomaterials have been acknowledged to successfully replace and/or regenerate functioning tissues. Tissue Engineering is a recent scientific field concept that aims to regenerate injured tissues by combining the use of biomaterial-based genetic modulators and is widely used in the treatment of musculoskeletal diseases and disorders. Steel, titanium metals, ceramics, and polymethylmethacrylate are presently used in bone, cartilage, and joint replacement (Table 3 and 4). As a result, the tissue-implant interface has become a hotspot for research into how biomaterials and tissue engineering products affect the body. Research institutions have also paid attention to the surfaces of biomaterials, which are at the forefront of tissue implant interactions, as well (Table 4) [6].

Table 3 Application of Metals as Implants used in Human Body

Types of Materials	Applications
Stainless steel	Joint replacements (hip, knee), Bone plate for fracture fixation, Dental implant for tooth fixation, Heart valve, Spinal Instruments, Surgical Instruments, Screws, dental root Implant, pacer, fracture plates, hip nails, Shoulder prosthesis
Cobalt-chromium alloy	Bone plate for fracture fixation, Screws, dental root implant, pacer, and Suture, dentistry, orthopedic prosthesis, Mini plates, Surgical tools, Bone and Joint replacements (hip, knee), dental implants
Titanium and its Alloys	Cochlear replacement, Bone and Joint Replacements(hip, knee),Dental Implants for tooth fixation, Screws, Suture, parts for orthodontic surgery, bone fixation devices like nails, screws and plates, artificial heart valves and surgical instruments, heart pacemakers, artificial heart valves

Table 4 Some Examples of Commonly Used Biomaterials

	Examples
1.	  Intra ocular lens (Basic materials:PMMA (acrylic), Silicone)
	  Challenge: Combining long term biocompatibility with opticalproperties

2.	  Artificial hip joints
3.	   Basic materials: Stainless steel, titanium & its alloys & UHMWPE. Challenges: - Prevention of wear & loosening over extended periods (11-20 years).
4.	  Indian chitra heart valve
5.	  Vascular grafts (Basic materials: Polyurethane, Teflon & Dacron) Challenges: Maintenance of mechanical integrity, Long term blood compatibility (avoidance of blood clotting)

3. Biomaterial Modelling and Simulation

In biomaterial science, modeling and simulation are becoming more common. The authors of this review talk about how modeling and simulation are being used in the field of biomaterials, which is still in its infancy. The authors focus on physiological and biomaterial properties rather than biochemical or biomedical applications to keep things more focused. The use of atomistic level simulation to research the use of reform cells is discussed. After we will acknowledge mesoscale simulations of structure, properties, and continuum scale approaches [7].

To combat particularly tough dirt, enzymes have long been used in detergent formulations referencing Jonathan Dordick, for researching nanotechnology to create a self-cleaning plastic that includes enzyme molecules. When bacteria or other pathogens come into contact with the plastic, enzymes attack them and prevent them from binding to the surface [8].

4. Bioengineering to Improve Biomaterial Properties: Extracorporeal Circulation Coatings Require

Long-term use of cardiopulmonary bypass (CPB) systems can cause thrombus formation infection and the poor hem compatibility of the CPB circuitry contributes to the problem. Biomaterial science and biomaterial surface engineering with hem compatibility is essentially uncharted territory. Referencing Chandler loop model, he looked at how blood and biomaterials interact under flow acknowledged in less than two hours. This study looks at two commercial CPB tubes, both of which have a coating that is compatible with blood and an uncoated control tube. All of this took place over the course of five hours of testing the host blood from four different donors. The tests also looked at luminal surfaces with scanning electron microscopy and measured the time it took for thrombin to be made. The data revealed that the tubing was significant in different ways and biomaterial coating discrimination appeared to be possible [9].

5. Biomaterials: Where Have We Been and Where Do We Want to Go?

Acknowledging more than 50 years, the science of biomaterials has been growing at a steady pace, new ideas and new ways to make money. This study looks at where we have been, where we are now, and where we might be in ten or twenty years. They talked about some of the most recent biomaterial breakthroughs aimed at controlling biological responses and, ultimately, healing. Biologically inspired materials are materials that are made to look like natural processes. Surface modification, precise immobilization of signaling, the development of synthetic materials, are for diagnostics, of biological inspired materials [11].

6. Biomaterials for Blood-Related Assessment

Blood-biomaterial interactions and assessment methods should be considered when considering biomaterials for blood-contact applications. Blood biomaterial interactions include protein adsorption, platelet reactions, intrinsic coagulation, fibrinolytic activity, erythrocytes, leucocytes, and complement activation, to name a few. Biomaterial structure, the presence of an antithrombotic agent, the patient status as determined by disease and drug therapy, and the nature of the application all influence the blood response to a biomaterial in a clinical application. In addition, vivo and vitro methods are critical in the development of clinical biomaterials [12].

7. Regenerative Medicine as Biomaterials for Tissue Engineering

For nearly three decades, scientific research has focus on tissue engineering (TE) acknowledging key tool in regenerative medicine. Medical application of tissue engineering technologies has been limited due to small biomaterials numbers that have been acknowledged for human use. Despite the development of numerous excellent biomaterials in recent years, clinical adoption has been slow. People have been allowed to use biodegradable polymers for more than 30 years now, so many scientists still use them to make things that break down [17].

8. Systemic Effects of Biomaterials

The tissue response at the implant site is usually used to assess the host response to the biomaterials. In addition, looking at battles outside of their historical context can lead to incorrect conclusions. A broader view reveals a wide range of systemic carcinogenic, metabolic, immunological, and bacteriological effects, both potential and actual. It is difficult to detect these effects in patients because there are few epidemiological studies [18].

9. Biomaterials for Medical Applications

The factors that influence the integration of biomaterials and tissue are exhume in this review. Surface modification techniques and surface-sensitive analysis are disclosed in this article; with authors demonstrate how to test the biocompatibility and effectiveness of various biomaterials and devices in the lab [19].

Researchers were able to implant up to 20000 pancreatic islets into a mini pig using a combination of 20 devices in a plate-type support. The biocompatibility of sterile macro devices implanted in normal mini pigs was examined after 92 days. Despite the fact that fibrosis had been caused, the immune system of the body showed no signs of inflammation or change on the outside [20].

10. Present and Future of Bioactive Specific Biomaterials

Bioactive biomaterials are chemical functional groups that use the macromolecular chain to interact with living systems in specific ways. Polystyrene and dextran are used to make these soluble and insoluble polymers. When these functional polymers meet flowing blood, they anticoagulant heparin-like properties, resulting in low thrombogenicity. When other polymers meet cells, they can alter cell growth and biological functions, as well as the cell's overall characteristics. You can show that these polymers work by showing that their biological properties are related to random distribution of chemical groups [22].

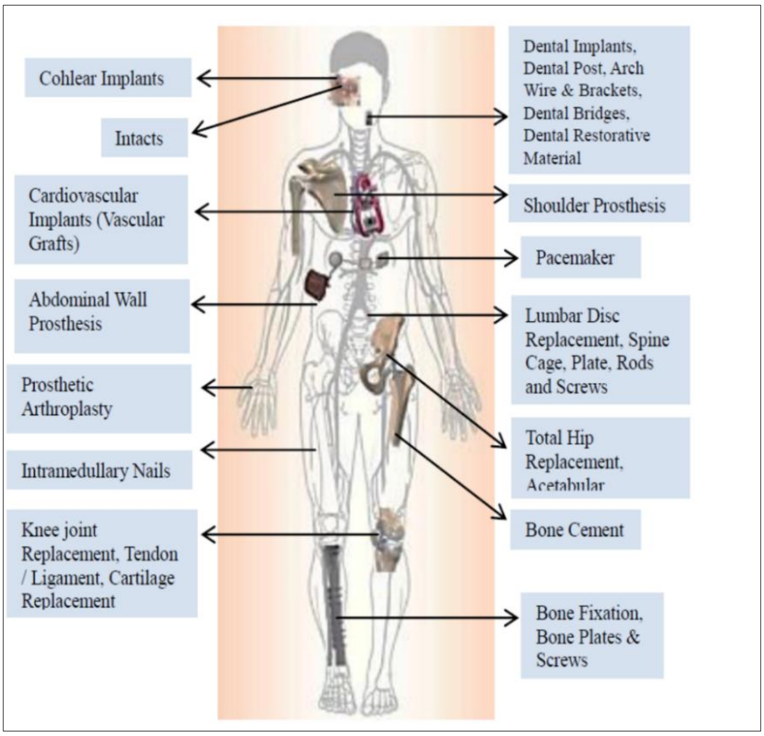
11. Macromolecular Engineering of Fluorinated Polymers and Hybrid Composites for Dental Restoration

The researchers investigated new polymeric materials with low surface energy and reduced polymerization shrinkage. The researchers designed and synthesized new fluorinated ring-opening monomers, which were then used as polymer and composite resin starting materials. Even at very low fluorinated chain side group contents, the chemical structure, thermal behavior, and surface characteristics of various polymeric and polymeric systems have all been thoroughly investigated. Dental composite resins were made with fluorinated ringopening monomers and cross-linkers. Because of how the resin was made, mechanical properties, surface composition and topography, and bacteria adhesion were all investigated. Fluorinated groups significantly reduced volume shrinkage while having no effect on mechanical properties [23].

12. Creating a Suture-Free Vasovasostomy Using Biomaterials and Surgical Sealants

Vasovasostomy reversal is now a common procedure; referencing 500,000 to 800,000 vasovasostomies researched each year and acknowledging rate of 3% to 8%.

The gold standard for surgical reconstruction is a two-layer microsurgical vasectomy. The method, on the other hand, is time-consuming and technically challenging. Scientists investigated how biomaterials and surgical sealants could help surgeons use fewer sutures, improve anastomosis water tightness, and shorten surgery time [24].



www.ijetae.com is the website we referenced

Figure 1 The Importance of Human Anatomy

13. Conclusion

A biomaterial is a substance that has been modified and used in the medical field. Biomaterials can be benign, such as those used in the manufacture of heart valves, or they can be bioactive. Hip implants with hydroxyapatite coating, for example, are more interactive and can last up to twenty years. Because of the critical requirements and biocompatibility, one of the most difficult issues is biomaterial selection, which has piqued the interest of material designers in recent years. The goal of this biomaterials review was to show how far advanced materials have come in their application in the human body.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

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