《生物材料》

图书基本信息

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内容概要

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章节摘录

1Overview of Biomaterials1.1 IntroductionHuman life is invaluable; however, quality and survival of life is greatlyaffected by numerous factors, including medical complications caused bydiseased, damaged, or aged tissues or organs. These circumstances often callfor surgical treatments to repair, replace, maintain, or augment the functionsof affected tissues or organs using some additional functional components.Traditionally, they have been treated with the help of tissues or organs procuredfrom patients or donors. Depending on the location of reimplantationof the procured tissue (also known as graft), they are termed autograft,allograft, or xenograft (see Figure 1.1).If the graft is implanted in the same patient, it is termed autograft and ifit is placed in another individual of the same species, it is termed allograft.If the graft is placed in another species (e.g., bone from animal to human),then it is termed xenograft. Among them, autograft is considered the goldstandard and has been used for a long time with good clinical results, butthe supply of autograft is limited. In addition, allograft and xenograft arenot much preferred because of the possibility of pathogen transfer and graftrejection. Furthermore, tissue/organ procurement is complex, expensive, andrequires additional surgery. As an alternative, attention has been focused onthe use of synthetic material that holds the ability to repair or restore thefunctions of a defective system into a normal healthy system upon implantation,which is termed alloplastic graft. The synthetic material used for thispurpose is called biomaterial. The biomaterial is used either as such or tomanufacture implantable devices or prostheses; some of them are illustratedin Figure 1.2.Currently, there are many definitions for the term “ biomaterial, ” dependingon the user ’ s own verdict. Biomaterial by definition is a substance or a combinationof substances, other than drugs, derived either from natural or syntheticorigin, which can be used for any period of time as a whole or as a partof the system that treats, augments, or replaces any tissue, organ, or functionof the body (Williams 1987). Later, Black (1992) defined the term biomaterialas a material of natural or manmade origin that is used to direct, supplement,or replace the functions of living tissues of the human body. A biomaterialis delineated, according to authors ’ own description, as any material thatis used for repairing or restoring the functionality of a defective biologicalsystem into a normal healthy system.The field “ biomaterials science and engineering ” is a multidisciplinarytheme that essentially coalesces materials science and engineering withbiomedical sciences for the invention of new health-care systems. Since itis a multidisciplinary field, many experts, in particular materials scientistsand engineers, mechanical engineers, physicists, chemists, biologists, andclinicians must work together for its continuous development. It has alsowitnessedstable growth over about half a century of existence with the majorcontribution from these experts. However, further research and developmentis directed at the design and fabrication of novel biomaterials that hold thefeatures and properties analogous to natural tissues or organs. In the followingsection, some imperative successes that have come in the biomaterialsfield are provided.1.2 Biomaterials: From Then to NowThe use of biomaterials to repair human body parts is not new, dating far backinto ancient civilizations. The Egyptians used linen as a suture for woundclosure in around 2000 BC. They also used elephant ’ s tusks, walrus teeth,and some kinds of wood to replace bone or missing teeth (Williams andCunninghan 1979). Substitution of bone parts in the human body was alsocarriedout at that time using copper, but the implant was not successful dueto the effect of copper ion poisoning. As per historical evidence,the Indiansand the Chinese used waxes, glues, and tissues in reconstructing defectiveparts of the human body. It was stated in the Vedic period (1800?1500 BC) ofthe ancient Indian literature that artificial legs, eyes, and teeth were used. Inthose days, Hindu surgeons performed surgery using autogeneous tissuesfor restoring missing parts. Around 600 BC, Sushruta repaired an injurednose with a patch of living flesh taken from the region of the cheek (Bhat2002). Around 200 BC, the Greek literature pointed out the use of metals(e.g., gold). Hippocrates, who is known as the father of medicine, allegedthat metallic wires made of gold might have been used for the treatment ofbone fractures at that time. In the seventeenth century, iron and bronze wereemployed in human systems, but they are more corrosive than gold. Someof the major developments that have occurred in biomaterials are summarizedin Table 1.1 (Park 1984, 2003; Sportnitz 1987; Friedman 1994; Greco 2005;Murugan 2005a, 2005b).The first reported clinical application of biomaterials was carried out inthe mid-eighteenth century. In 1759, Hallowell united the edges of a laceratedbrachial artery using a wooden peg and twisted thread (Wesolowski1963). The use of biomaterials has progressed much since his initial contribution.By the mid-nineteenth century, Mathijsen introduced a notablematerial called lint-reinforced plaster as a bandage in the treatment of bonefractures. In those days, however, infection was the most common problemof the materials that were implanted in the human body. Due to thethreat of infection, clinical application of biomaterials was not very successful.In the 1860s, Lister introduced aseptic techniques, which made somesignificant changes in the surgical implant procedures and paved waysto realize the potential of biomaterials. In 1860, catgut was one of the firstnaturally occurring materials used as a suture for wound closure. In 1880,Gluck used ivory clamps and, in 1989, Jassinowsky used silk on fine curvedneedles to repair vessels. In this period, Lane introduced metallic implantsfor orthopedics.The twentieth century was a milestone in the field of biomaterials becausemost of the currently used biomaterials and surgical implants were developedin this period. The practice of using metals and alloys to repair orreplace human body parts was well established at that time. The first metallicbone plate made of vanadium steel was introduced in 1912 by Sherman,but it was not very successful because of mechanical failure, corrosion, andpoor biocompatibility. Since this initiation, many metallic implants have beenintroduced into the surgical field. Bone plates are surgical tools that are usedto assist in the healing of broken and fractured bones. It is worth pointingout that bone plates are designed essentially to be very strong and absorb thelarge stress forces generated when the bone moves. On the other hand, corrosionis also a significant concern that typically leads to the disintegration ofSource: Adapted from Park, J. B., Biomaterials science and engineering, Plenum Press, NewYork, 1984; Spotnitz, H. M., Handbook of biochemistry, McGraw-Hill, New York, 1987;Park, J. B. and Bronzino, J. D., Biomaterials principles and applications, CRC Press,Boca Raton, FL, 2003; Friedman, D. W., Orland, P. J., and Greco, R. 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主要特点　　全面讲解生物材料历史、现在和未来发展趋势，涵盖纳米生物材料及其潜在应用。　　写作方式通俗易懂，图文并茂，包含最新数据的图表。　　用纳米生物材料的概念整合材料科学与工程、纳米技术、生物工程和生物科学。　　适合生物材料、化学化工、组织工程等领域的师生、科研人员阅读参考。

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