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Bioartificial Organs: Ongoing Research and Future Trends

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Abstract: *Constructing and installing artificial organs, an extremely research-intensive and expensive process initially, may entail many years of ongoing maintenance services not needed by a natural organ. Artificial arms and legs, or prosthetics, are intended to restore a degree of normal function to amputees. Mechanical devices that allow amputees to walk again or continue to use two hands have probably been in use since ancient times, the most notable one being the simple peg leg.*

Key words: *artificial organs, multimedia, cosmetic restoration, Internet links, electronic resources, learning environment, limb.*

Artificial arms and legs, or prosthetics, are intended to restore a degree of normal function to amputees. Mechanical devices that allow amputees to walk again or continue to use two hands have probably been in use since ancient times, the most notable one being the simple peg leg. Since then, the development of artificial limbs has progressed rapidly. New plastics and other materials, such as carbon fiber have allowed artificial limbs to become stronger and lighter, limiting the amount of extra energy necessary to operate the limb. Additional materials have allowed artificial limbs to look much more realistic. • New advances in artificial limbs include additional levels of integration with the human body. Electrodes can be placed into nervous tissue, and the body can be trained to control the prosthesis. This technology has been used in both animals and humans.The prosthetic can be controlled by the brain using a direct implant or implant into various muscles. The two main methods for replacing bladder function involve either redirecting urine flow or replacing the bladder in situ. Standard methods for replacing the bladder involve fashioning a bladder-like pouch from intestinal tissue.[14] As of 2017 methods to grow bladders using stem cells had been attempted in clinical research but this procedure was not part of medicine. Neurostimulators, including deep brain stimulators, send electrical impulses to the brain in order to treat neurological and movement disorders, including Parkinson ' s disease, epilepsy, treatment resistant depression, and other conditions such as urinary incontinence. Rather than replacing existing neural networks to restore function, these devices often serve by disrupting the output of existing malfunctioning nerve centers to eliminate symptom. In cases when a person is profoundly deaf or severely hard of hearing in both ears, a cochlear implant may be surgically implanted.

Cochlear implants bypass most of the peripheral auditory system to provide a sense of sound via a microphone and some electronics that reside outside the skin, generally behind the ear • Thomas Cervantes and his colleagues, who are from Massachusetts General Hospital, built an artificial ear from sheep cartilage by a 3D printer. With a lot of calculations and models, they managed to build an ear shaped like a typical human one. The most successful function-replacing artificial eye so far is actually an external miniature digital camera with a remote unidirectional electronic interface implanted on the retina, optic nerve, or other related locations inside the brain. The present state of the art yields only partial functionality, such as recognizing levels of brightness, swatches of color, and/or basic geometric shapes, proving the concept' s potential • Advances towards tackling the complexity of the artificial connection to the retina, optic nerve, or related brain areas, combined with ongoing advances in computer science, are expected to dramatically improve the performance of this technology.

Cardiovascular-related artificial organs are implanted in cases where the heart, its valves, or another part of the circulatory system is in disorder. The artificial heart is typically used to bridge the time to heart transplantation, or to permanently replace the heart in case heart transplantation is impossible. Artificial pacemakers represent another cardiovascular device that can be implanted to either intermittently augment (defibrillator mode), continuously augment, or completely bypass the natural living cardiac pacemaker as needed. Ventricular assist devices are another alternative, acting as mechanical circulatory devices that partially or completely replace the function of a failing heart, without the removal of the heart itself. • Besides these, lab-grown hearts and 3D bioprinted hearts are also being researched. Currently, scientists are limited in their ability to grow and print hearts due to difficulties in getting blood vessels and lab-made tissues to function cohesively.

Current clinical approaches to treat patients with end stage renal disease (ESRD) include hemodialysis, peritoneal dialysis, and renal transplantation. Dr. Kurtz working with US Kidney Research Corporation and University of Arkansas have designed a novel dialysis-free and waterless artificial kidney technology that has the potential to mimic the filtration properties of the renal glomerulus and the ion/water transport processes in the nephron. Importantly, the device does not utilize external water/dialysate or living cells. This waterless technology creates more than a replacement for dialysis, it allows increased freedom for patients. • The device couples for the first time newly designed nanocellulaose ultrafiltration membranes and multiple mesh activated wafer electrodeionization (AWEDI) technology for ion transport that has been patented, which responds dynamically using ion sensors to changes in blood chemistry. 3D bioprinting is an additive manufacturing process where organic and biological materials such as living cells and nutrients are combined to create artificial structures that imitate natural human tissues.

In other words, bioprinting is a type of 3D printing that can potentially produce anything from bone tissue and blood vessels to living tissues for various medical applications, including tissue engineering and drug testing and development. Regardless of the bioprinting method, instead of inorganic raw materials such as filament, resin, and metal, here, the feedstock material is composed of biological agents and living cells. • These materials are known as bioinks, which are mainly composed of living matter like cells within a carrier material – like collagen, gelatin, hyaluronan, silk, alginate, or nanocellulose – that act as a molecular scaffold for the structure to grow and nutrients to provide support.

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