Advancements in the Biomechanical sub-field of Biomedical Engineering

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Definition:
Biomechanical Engineering is "the application of mechanical engineering principles, and the use of new materials to biology, especially to surgery and prosthetics." Applied mechanics such as thermodynamics, and mechanical engineering branches such as fluid and solid mechanics, play a very crucial part in the study of biomechanical engineering.

Applications:

- *Surgical Implants*

As part of a now very common procedure in hospitals, surgical implants are manufactured to replace a missing biological structure, to support a damaged biological structure, or to improve an existing biological structure. Surgical implants are man-made as opposed to a transplant, which is more frequently human/animal tissue. The surfaces of implants which will contact tissue in the body are usually made of materials such as titanium, silicone or apatite (a major component of bone material) depending on which material is the most functional.

- *Artificial "Organs"*

The application of fluid and solid mechanics to human biology has led to the development of many revolutionary devices which mimic the functions of a human organ.

For example, the Massachusetts based biomedical company **AbioMed™** has successfully produced the **AbioCor® artificial heart**. It is fully implantable within a patient and runs on a rechargeable source of power, an internal battery, which is charged by a transcutaneous energy transmission (TET) system. This means that no wires or tubes are needed to penetrate the skin, which reduces the risk of infection. However, more research is needed in order to perfect this product. Due to its size, this heart is only compatible with larger male individuals. It also has a product life expectancy of only 18 months.

Another device is the implantable **artificial "lung"**. Currently in the last stages of development, the MC3 Company has introduced the BioLung®. The BioLung® is an artificial lung that can "replace the gas exchange function of a person's native lungs during recovery from injury or illness, or until donor lungs are available for transplantation." Once perfected, the BioLung® is expected to be marketed commercially through various biomedical firms.

There have also been major developments concerning deafness. Frequently called the "bionic ear", a **cochlear implant** is a surgically implanted electronic device that provides sound to a person who is profoundly deaf or severely hard of hearing. It consists of a: *i)* microphone which picks up sound from the environment, a *ii)* speech processor which filters sound to pick up audible speech. Electrical sound signals are sent through a thin cable to the *iii)* transmitter, which is held in position by a magnet placed behind the external ear, and transmits the processed sound signals to a *iv)* receiver and stimulator, which are secured in bone beneath the skin. This converts the signals into electric impulses and sends them through an internal cable to electrodes wound inside the cochlea, which send the impulses through the auditory nerve system to the brain stem.

The applications and advancements made through biomechanical engineering have allowed many critical patients to survive during the waiting period of an organ transplant. It has allowed many injured or elderly people to be able to return to their everyday lives after a successful hip or knee surgery. Due to the ongoing developments in this field, many people are given a second chance at life.

<u>*Sources:*</u>

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