The Advancement of Biomedical Engineering

“The engineer is the key figure in the material progress of the world. It is his engineering that makes a reality of the potential value of science by translating scientific knowledge into tools, resources, energy and labor to bring them into the service of man. To make contributions of this kind the engineer requires the imagination to visualize the needs of society and to appreciate what is possible as well as the technological and broad social age understanding to bring his vision to reality,” said by Sir Eric Ashby. Biomedical engineering started thousands of years ago, even though it was not called biomedical engineering until recently. The latest archive of biomedical engineering 3,000 year old mummy found with limb prosthesis. Over time, biomedical engineering has become more advance and our engineers have started to think of more ways to help the human population. Biomedical engineers started out forming ideas through accidental or unintentional events and have continued to expand on their ideas until they’ve formed useful, modern day technology. Biomedical engineers have helped many physically impaired patients, as well as their families through creating technology like: X-rays to find discrepancies in the human bodies, ultrasounds to deal with organ diagnosis and centrifugation to separate stem cells bone marrows.

X-rays, also known as a form of electromagnetic radiation, a commonly used machine by the biomedical field to help create better ways to diagnose issues. The X-ray machine was discovered unintentionally in 1985 by a German physicist who went by the name of Wilhelm Conrad Roentgen. Roentgen had been working on an experiment on electromagnetic radiation. He was examining...
electrical rays and their paths through a tube, which was completely covered by black paper, using an induction coil. In the dark room, Roentgen’s experiment took place. He was able to see a fluorescent material covered screen illuminated, revealing the rays in the dark. The physicist later came to the conclusion that many objects could be seen through using these rays, including human flesh. With his new discovery, physicist Roentgen took a picture of his wife’s hand, showing the bones within her hand and her wedding ring. Through revisions and experiments he was able to create the first X-ray in 1896. Although created over 40 years ago, we still continue to use his invention. Using the X-ray, doctors are able to give patients an accurate diagnosis. Doctors use X-ray scans to examine a patient’s bones. With these scans, they can see joint replacement, fractures, signs of cysts or tumors and any increase in bone density or volume. With this information, they can look for any degenerative bone afflictions such as osteomyelitis, which is a bone infection caused by bacteria. Once doctors are able to give their patients a diagnosis, they are also able to give their patients a prescription to treat their prognosis.

An X-ray is simply the wavelength of specific electromagnetic waves similar to the way light is with different wavelength which makes them behave unlike each other. These waves are absorbed by the bone’s tissue. The calcium in the bones takes in the most electromagnetic waves in the body, causing the bones to appear white on the X-ray imaging. Tissue in the body absorbs less electromagnetic waves, causing it to appear grey. Oxygen takes in the least, appearing black on the image. The electromagnetic waves give off small, non-lethal amounts of radiation. Although the

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amount of radiation given off through X-ray imaging is very low, pregnant women may be asked to wear a special lead apron for the baby’s safety or be recommended to switch to a different type of test.\(^5\) If a patient is exposed to too much radiation from X-rays, he or she may be at risk of skin damage.\(^6\) The Mayo Clinic has also stated that cell damage can occur but the radiation level must be very high for this to happen. Light headedness and nausea is also a possible side effect at the contrast medium. There are also rare cases of a patient’s blood pressure lowering or having heart failure.\(^7\) The X-ray is only one of the many devices the medical staff use to help their patients.

Many patients are unaware that the modern day ultrasound has multiple uses. The ultrasound machine was created 40 years ago by multiple scientists. The man who started the creation of the ultrasound was physiologist Lazzaro Spallanzani. He studied the echolocation that bats used to communicate with one another in 1794. His research formed the fundamentals of the ultrasound. Pierre and Jacques Currie, two brothers, were the next to help the ultrasound machine’s creation in 1877. They had discovered piezoelectricity, which is how the ultrasound is able to receive and release sound waves. During the 1920s to the 1940s, the first ultrasound was created and was used to treat European soccer teams through physical therapy. Over time, the initial ultrasound has been improved and revised to become the modern day ultrasound. The modern day ultrasound has been improved greatly since the first model was created. Throughout time, biomedical engineers were able to upgrade the ultrasound, making it more portable and convenient and allowing it to capture 4D images.\(^8\) Ultrasounds are not only for physical therapy anymore. Now, doctors use ultrasound tests to examine fetuses and capture

images of organs inside the body. Doctors use these images to see if the unborn infant is growing at the normal pace inside the womb and to see if the organs are damaged or inflamed. The ultrasound sends out sound waves which bounce off the organs and is received by the machine. Once the machine receives the sound waves, it paints an image of the organs using the sound waves. Although it is known to be safe, scientists have found that the ultrasound can raise the temperature inside the body. When using the ultrasound to see the progress of the fetuses inside the womb, a rise in temperature can cause defects to occur as well as a consequential amount of damage to the central nervous system. Ultrasounds are great when it comes to seeing what is inside the body, but in order to test it that is where a centrifuge comes in handy.

In 1883, a Swedish engineer named Carl de Laval learned that to make the centrifuge, a machine created to separate combined materials from one another, work properly, he would have to make sure it didn’t spin too fast or it would break apart but it wouldn’t spin to slow or it wouldn’t be able to separate materials. During the 1920s, Theodor H. E. Svedberg continued Laval’s studies. Svedberg collaborated with Alf Lysholm to create a centrifuge with a limit speed of 42,000 rpm. The centrifuge machine now plays a key role when it comes to running blood tests. This machine is commonly used to separate the materials inside taken blood samples. The blood samples are placed inside holders inside the centrifuge. The centrifuge then spirals fast enough to force the blood cells and other material to separate due to the difference in density. The centrifuge is also able to extract stem

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cells. Stem cells have the ability to help the human body in many ways. Bone marrow stromal cells (BMSCs) are commonly used in the medical field. Once extracted using the centrifuge and separated from the cell population, stem cells can be mixed in with biomaterials to help bone growth and the regeneration of damaged tissue.  

Without the technology bioengineers created, doctors would not be able to give their patients accurate readings of their internal problems or prescribe treatments and drugs to help them cope with their ailments. Even though our technology is currently much more advanced than it had been to begin with, bioengineers ensure that our current technology will only become better and more effective in the future. Currently, bioengineers are creating many devices for the medical staff to use. Already, biomedical engineers are working on growing artificial organs. They have already grown an artificial liver and are learning how to grow other organs. Biomedical engineers are also creating artificial womb for female cancer survivors who may become infertile after radiation therapy and so women have the choice to go through the stressful months of pregnancy. Artificial bone marrows are even being created now. Biomedical engineers are hoping to be able to create artificial bone marrows in test tubes.  

None of this useful and needed technology would be created without biomedical engineers. They work hard to learn more about what they can do to help others.