Introduction

Prosthesis: “an artificial device to replace or augment a missing or impaired part of the body” (Merriam-Webster.com).

Prosthetic arms are intended for those who are disabled because of their arm were amputated because of disease or cancer, missing because of birth defects, or past events such as military combat injuries. Prosthetic limbs were started thousands of years ago. A prosthetic toe found on the foot of an Egyptian mummy, which was made out of wood. A speculation was that the mummy lost the toe due to complications from diabetes. (http://www.livescience.com/history/070727_old_toe.html)

The reason for prosthetic limbs is because of amputation. When a person have an incurable disease, deformation, occupational hazard, military combat injuries, or in the unlikely case of rare medicine side-effects. (mention medicine case)

Recent technological innovations made the prosthetic limbs more advanced than before. One of which uses fluid to move the prosthetic arm so the movements are smoother and more natural. Another is skin that has microscopic sensors that can sense temperature and pressure. Maintenance are easy and most tasks can be done at home. Usually the user are only required to keep the product clean. Most other maintenance are either repairs or adjustments which can be done at a local clinic.

History

Amputation was done to get rid of gangrene. This was from fifth century B.C to hundred A.D. Then it was used for ulcers, growths, injuries, and deformities. In the thirteenth century Hugh of Lucca made an anesthetic technique that helped the patients be calm and kept the limb in good condition. Because of Pare invention and William Harvey's discovery of how the body circulates blood two tourniquets where made. The first was Morel's tourniquet (1674) that was a stick wrapped around cloth that was tightened. The second was Petit's tourniquet (1718) that used a screw to tighten it. This helped the patient from losing blood. In 1818 Peter Baliff made an artificial arm that could flex fingers using a trunk and shoulder girdle. Several years later Van Peeterssen made one that could flex the elbow joint. In 1860 Comte de Beaufort made a moveable thumb and elbow. Finally in 1949 Alderson made the first electrical powered arm (Meier pars. 3-6, 8, 10-12, 29-31, 36-37).

Modern Innovations

Utah Arm 1980

At the University of Utah, Center for Engineering Design, researchers developed the Utah Arm. This arm had innovations such as responsive control through the use of electromyographic (EMG) signals. Sensors in modern prosthetic read EMG signals to control the prosthetic movements. It uses two techniques the "freewing" and state-switching. The "freewing" imitates the arm's muscles at a relaxed state this makes it look more natural and allows the user to lower the forearms and extend the elbow with little effort. State switching enables the elbow to lock

after it stays still for a period of time. It can support up to 50 pounds on the forearm. The arm itself is 3 pounds, uses a 12V rechargeable battery and can run up to 450 hours. In the next version, the Utah Arm 3, has a microcontroller user interface for training, troubleshooting, and adjustment.

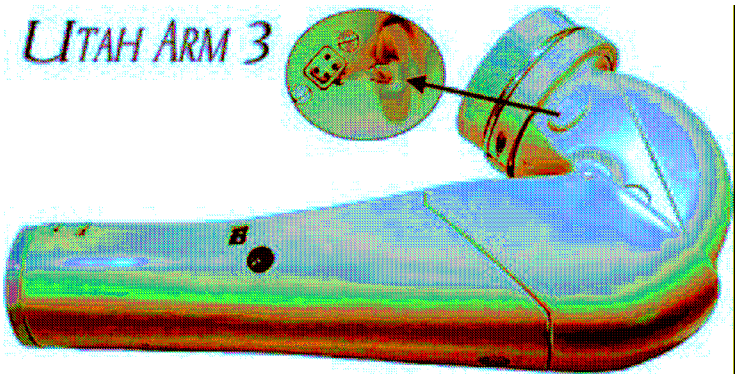


Figure 1: Utah Arm 3

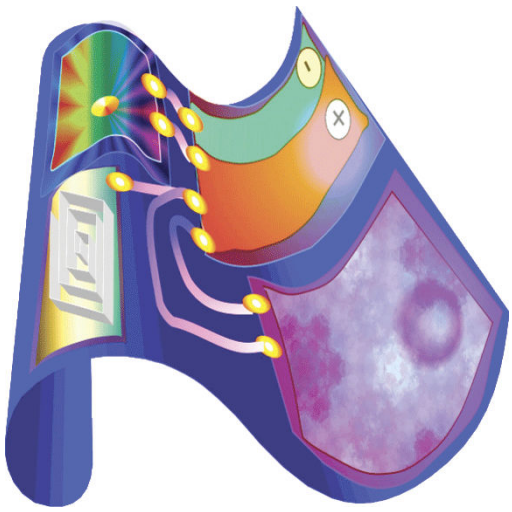
Northwestern University's Prosthetics Research Laboratory

Made the thought controlled arm. By thinking what the user wants the hand to do it sends signals to the chest muscles which go the electrodes. The Robotics and Energetic Systems Group are in the process of making mesofluidic. This gives the joints more force and speed than the electromagnetic actuation in most arms today. A pump pressurizes the fluid that pushes the piston to the end of the cylinder making the joint bend. This way is more energy efficient than the electric motors and acts more like a human muscle. (SOURCE)

Figure 2: Mesofluidic prosthetic fingers with FILMskin patch.

“FILMskin”

FILMskin was designed by NASA (National Aeronautics and Space Administration). FILMskin is flexible, lightweight that can feel temperature and touch. It is made of polymer and carbon nanotubes . Nanotubes can conduct heat that can replicate muscle, fat, and skin. In the future plan to have a sensor for pressure and temperature. The nanotubes could be used because the electrical resistance changes due to temperature. Still need to make them more responisive to pressure. (SOURCE)



FILMskin will sense heat, cold and pressure.

Boston Digital Arm

Made by Liberating Technologies was first arm made by digital signals instead of analog. In the past prosthesis was controlled by the signals made by the upper arm muscles. If these muscles were weak they could not use it or it became very difficult to control. The Digital Arm has amplifiers to increase weak signals. Also old models used the same amount of force for everything. The new sensors can pick up variences in strength to determine how much power to apply. New software allows programming to each user such as voice command. (SOURCE)

Function: How Does It Work?

Arms, hands, and fingers are essential for interaction with the environment and objects around it. Most of the muscles in the arms are surrounded by the long bones that are connected to the hands. These muscles have tendons, which are extensions of the muscles, and they are connected

to all the fingers. These tendons are what allow fingers to contract. There are some additional muscles at the palm of the hand. These muscles give additional strength to grip onto objects.

Artificial arms use a technique called muscle reinnervation that takes the nerves of the arm and puts it in the chest (See picture below point 1). The brain sends the signal to the nerves that acts like an antennae and this signal goes to the prosthetic arm making it move (*www.nytimes.com*). The shoulder has a motor and a gear box driven by a lithium battery (2). To bring the arm toward the chest it has a humoral rotator (3). The control unit coordinates the five motorized joints (4). The hand can not only flex and move but it also has fingertip sensors (5).

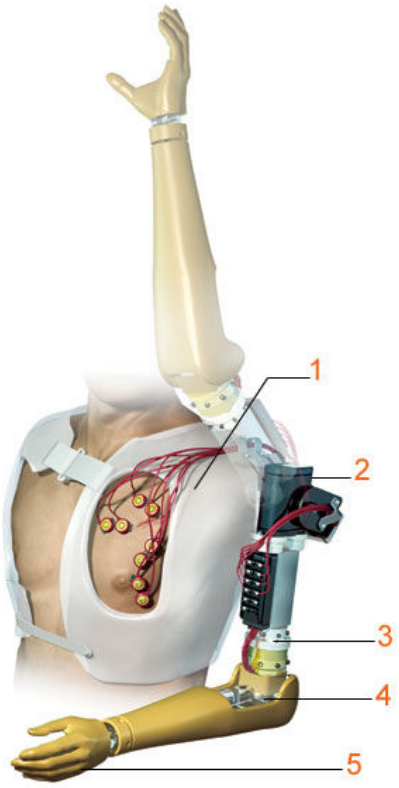


Figure 3 A Toast to the Bionic Man

Maintenance

It is best to put it on in the morning so that it can assist you right away. Most prosthetics have a "pull in hole" so it can ease into place. It may feel tight at first before your body gets used to it. The prosthesis my take a few minutes to be fully functional, this is because it needs moisture to sense the electrical impulses from your body. To quicken this process you may add water to electrode site. DO NOT USE CREAMS, LOTIONS OR OILS AS IT WILL DAMAGE THE PROSTHESIS (Do's and Don'ts pars. 2-4,8-18,20-23).

As children tend to grow it can become very uncomfortable to fit in the prosthesis. It is important to see their doctor regularly for check up to make sure there are no complications. It could

damage the skin or have blood circulating problems in which case they should get a larger size(Do's and Don'ts pars. 2-4,8-18,20-23).

Make sure to wear the prosthesis a little each day increasing the amount of hours incrementally. Do not wear extensively until your body becomes used to it or you will become sore (Do's and Don'ts pars. 2-4,8-18,20-23).

After each day wash the arm with soap and water using a damp face cloth. If this is not done it may led to skin irritation and a very smelly prosthesis. In very bad cases alcohol may be used to clean them. If there are any bruises or cuts on residual limb leave the prosthesis off for a couple of days to allow it to heal(Do's and Don'ts pars. 2-4,8-18,20-23).

The cosmetic glove has a separate set of instructions. It can stain very easily. Anything such as pens, newspapers, or new clothing may stain the glove. These will come out if removed right away. Keep the glove away from heat as it will melt. It is okay to add lotion and to wash it thoroughly to keep it in proper shape. Do not put in water when it is damaged as it will ruin the rest of the arm. If water or dirty enters prosthesis bring it to your doctor to get is fixed immediately (Do's and Don'ts pars. 2-4,8-18,20-23).

Heat rashes may occur due to the heat and sweat produced by the closeness of the prosthesis to the skin. If this happens it is okay to use cream on the skin of the residual limb but not the prosthesis arm (Do's and Don'ts pars. 2-4,8-18,20-23).

Never charge battery while you are wearing the prosthesis as this my led to electric shock. Also

make sure it is turned off before you try to take it off as it may “go out of control”(Do's and Don'ts pars. 2-4,8-18,20-23).

Conclusion

Prosthetic limbs has been around for thousands of years, and each innovations contributed to the advancement of prosthetic technology. With each innovations, it makes the prosthetic limb easier to use and easier to maintain. All prosthetic arms are custom-made. Each prosthetic are customized based on the user's body and how many features are in the prosthetic.