Marcus Seawright

Mod 6/7

6-4-14

Anatomy Research Paper

Future and advancement of limb replacement with prosthetics

Limb are parts of the body that allows for so many different things in life. For example the human hand allows us to grip things from a flower to a ten pound weight and it allows us to do this with a greatly controlled force. This force can vary and range depending on the strength needed. But all that changes when you lose this limb. That can be a devastating loss. This is where prosthetics come in to play. They allow for us to continue everyday task without a problem. The evolution of prosthetics has forever been a great innovation towards an ever changing future where trauma and disease exist and prosthetics help in this cause. Prosthetics are innovations that continue to evolve and help people as they evolve. Prosthetics have continuously evolved throughout the world. Prosthetics started to arise in about 424 B.C. There was an artificial leg found and dated to be around from 300 B.C. it was unearthed at Capua, Italy, in 1858. It was made of bronze and iron, with a wooden core for a below-knee amputee. More evidence was found that prosthetics were dated that early because in 424 B.C., Herodotus wrote of a Persian seer who was condemned to death but escaped by amputating his own foot and making a wooden filler to walk 30 miles to the next town. As prosthetics advanced on into The Dark ages there was little evolution into the design changes. Most prosthetics of the time were made to hide deformities or injuries sustained in battle. A knight would be fitted with a prosthesis that was designed only to hold a shield or for a leg to appear in the stirrups, with little attention to functionality. Outside of battle, only the wealthy were lucky enough to be fitted with a peg leg or hand hook for daily function. The Renaissance experienced a huge evolution into the world of prosthetics. By returning to the medical discoveries of the Greeks and Romans concerning prosthetics, the Renaissance proved to be a rebirth in the history of prosthetics. Prosthetics during this period were generally made of iron, steel, copper and wood.In 1508, German mercenary Gotz von Berlichingen had a pair of technologically advanced iron hands made after he lost his right arm in the Battle of Landshut.

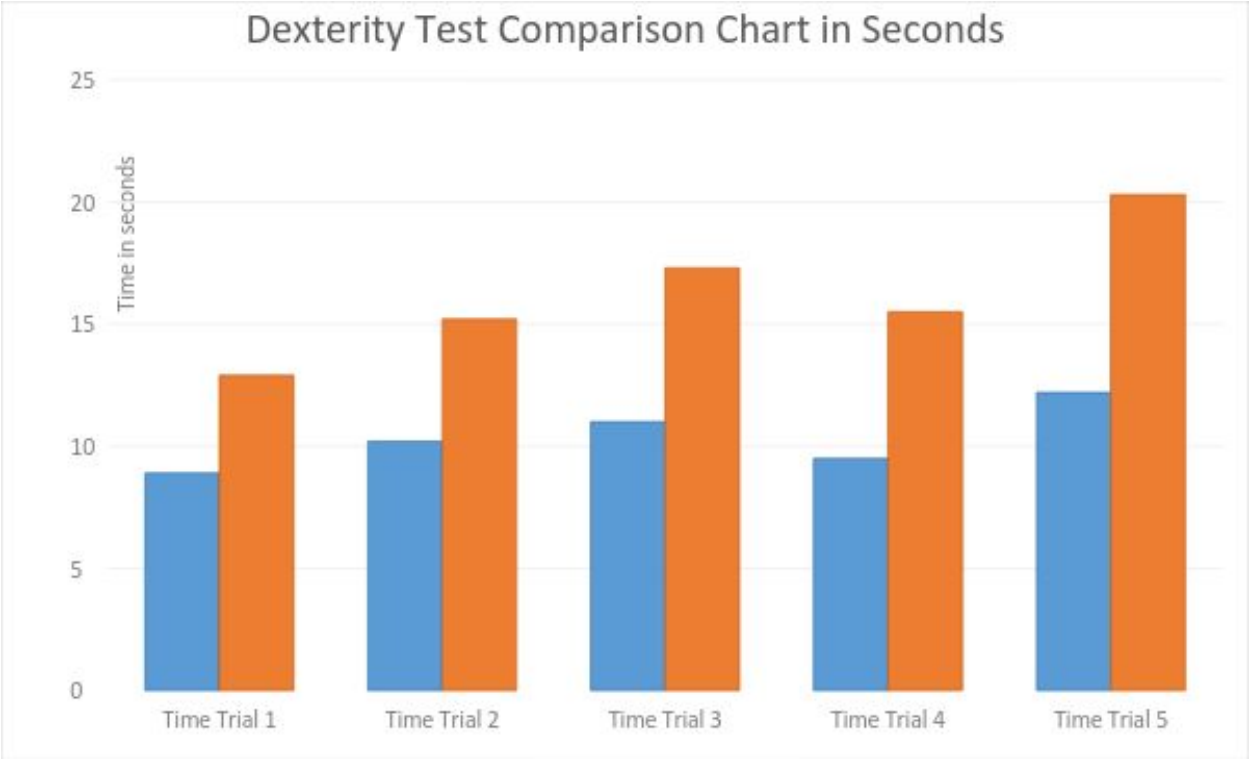
The hands could be manipulated by setting them with the natural hand and moved by relaxing a series of releases and springs while being suspended with leather straps.In 1696, Pieter Verduyn developed the first nonlocking below-knee prosthetics, which would later become the blueprint for current joint and corset devices. In 1800, a Londoner, James Potts, designed a prosthesis made of a wooden shank and socket, a steel knee joint and an articulated foot that was controlled by catgut tendons from the knee to the ankle. It would become known as the Anglesey Leg after the Marquess of Anglesey, who lost his leg in the Battle of Waterloo and wore the leg. William Selpho would later bring the leg to the U.S. in 1839 where it became known as the Selpho Leg. In 1843, Sir James Syme discovered a new method of ankle amputation that did not involve amputating at the thigh. This was welcome among the amputee community because it meant that there was a possibility of walking again with a foot prosthesis versus a leg prosthesis. As time continued to progress prosthetics became more and more useful to society for example in the U. S. Civil War dragged on, the number of amputations rose astronomically, forcing Americans to enter the field of prosthetics. James Hanger, one of the first amputees of the Civil War, developed what he later patented as the "Hanger Limb" from whittled barrel staves. People such as Hanger, Selpho, Palmer and A.A. Marks helped transform and advance the prosthetics field with their refinements in mechanisms and materials of the devices of the time. Prosthetics are simple devices that can make a huge difference in a person's life. A prosthetic is a device that replaces a lost limb on or in the body. The limb loss can vary from different locations on the body such a leg or an arm. More than 1.6 million people in the U.S. have some type of limb loss, excluding fingers and toes. More than 185,000 amputations are performed annually in this country. Statistics tell us

that the majority of people in the United States who require an amputation are age 65 and older. Main causes are deadly diseases of diabetes, obesity and severe peripheral vascular disease all of which can lead to amputations. These rates are increasing at horrifying rates as the overall population ages. More than 40,000 Veterans, and a total of more than 250,000 Americans, have serious spinal cord injuries and disorders that may interfere with brain signals that control muscle movement. Many others have become blind from the loss of photoreceptors in the eye. For Veterans with these and some other types of functional loss due to disease or injury VA investigators hope to restore function with electrical currents delivered through means of a neural prosthesis. There are two types of external prosthetics they are upper or lower extremity. The prosthetics my group and I built was an upper extremity prosthetic, it replaced a human hand and forearm. This was a trans-radial prosthetic meaning below the elbow. To build and effective and useful upper extremity trans-radial prosthetic we needed to focus on the human and forearm. We needed to focus on a hands key attributes. The strength, precision, and the ease of use for the user to make the prosthetic as natural as possible. When building the prosthetic we looked at other more expensive prosthetics to get a good idea of what our prosthetic needed to be able to do in an effective manner while not. With a good idea on what our prosthetics needed to do we started to build a prosthetic with cheaper materials to cut down on price and the bulkiness of other upper extremity devices. Now as the low cost prototype prosthetic was being built we still needed to focus on the hand that would be a part of the prosthetic. So to get a better understanding of the hand in comparison to other prosthetics and the actual human hand we did a lot of research and trial and error when coming up with the best idea for a final build. The organ function of the hand is

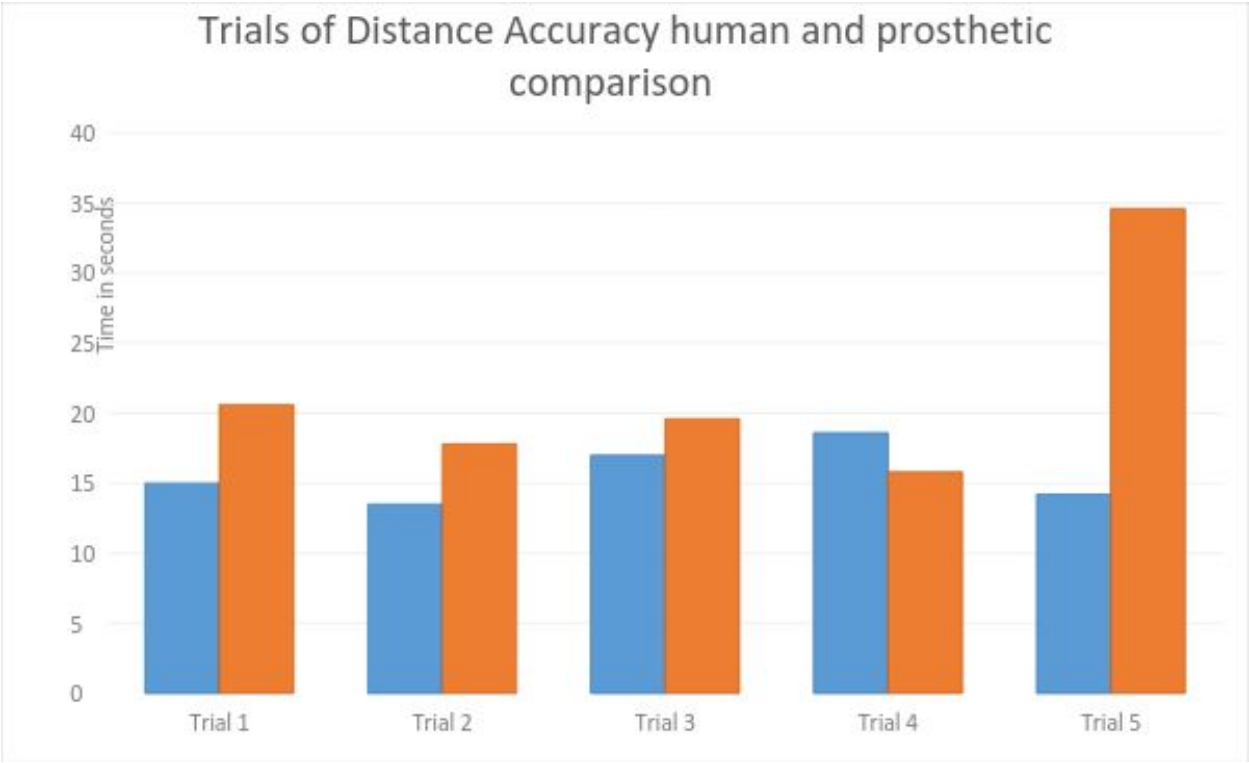
to grasp, hold, and manipulate items. Along with allow humans to complete everyday task of a different variety of strength to the most fragile touch. While knowing this we were able to focus on grasp types and the precision in our prosthetic. The prosthetic went though many tests to judge how precise our design was. One test was called dexterity a simple test in which we needed to pick up nuts and bolts of various sizes and connect and then thread them on. Another task was called object relocation a test in when a person wearing the prosthetic must move objects of various weights from a ruler to items as heave as a two litter water bottle. The third and final task our prosthetic was put though was call distance accuracy a task in which the prosthetic holder must pick up different ball types such as a tennis ball, hacky sack, and ping pong ball these balls must be tossed into buckets placed at various distances. Our prosthetic went though many changes in order to make it a very efficient and low cost prosthetic coming in at about 22 dollars. Compared to the many more expensive prosthetics costing various amounts. A lower extremity prosthesis can range in cost from $5,000.00 to $50,000. An upper extremity device can range from $3,000.00 to $30,000. Examples of these prices are listed Partial foot ($14,187), Ankle disarticulation ($16,356) Trans tibial or below the knee ($16,690), Knee ($45,563) Trans femoral, or above the knee ($45,563), Hip ($45,633), Trans pelvic disarticulation ($49,208). In conclusion prosthetics are a very effective way to do almost duplicate a real human hand and arm. A prosthetic arm can be just as strong and precise as a real hand. A prosthetic can also be just as versatile as you need it to be. As a nation prosthetics are continuing to grow and advance to become even more helpful, realistic, and convenient.

The data shown is comparisons of the human hand and the prosthetic. The following data was

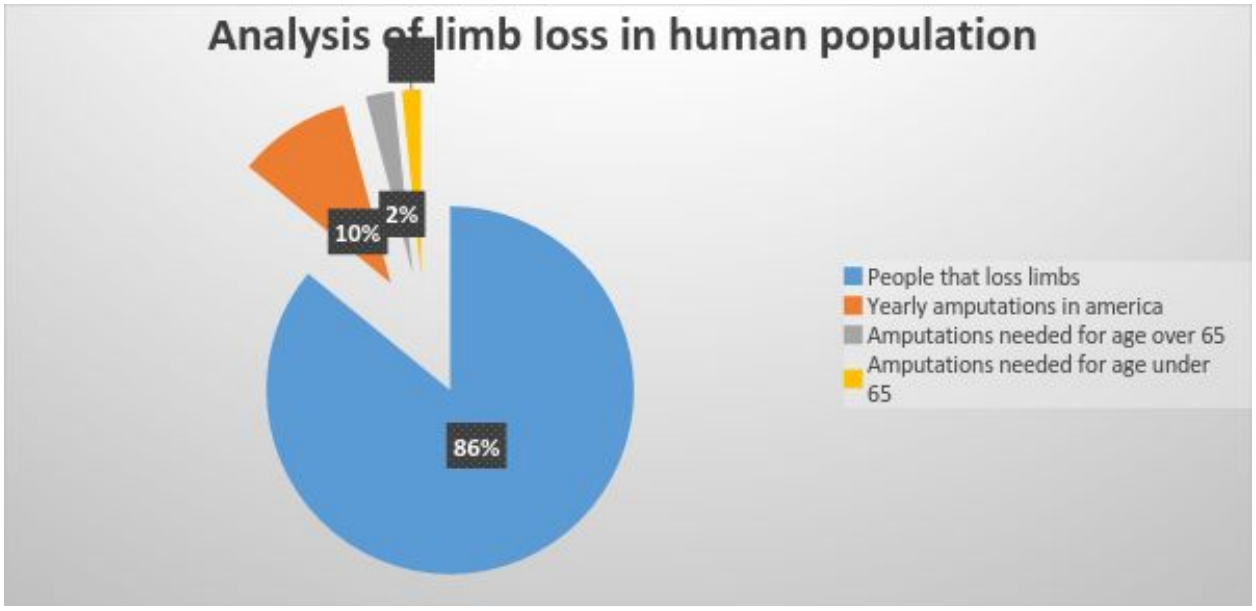
collected in sets of trials. There was always five trials done and data was collected written down and converted into these charts:



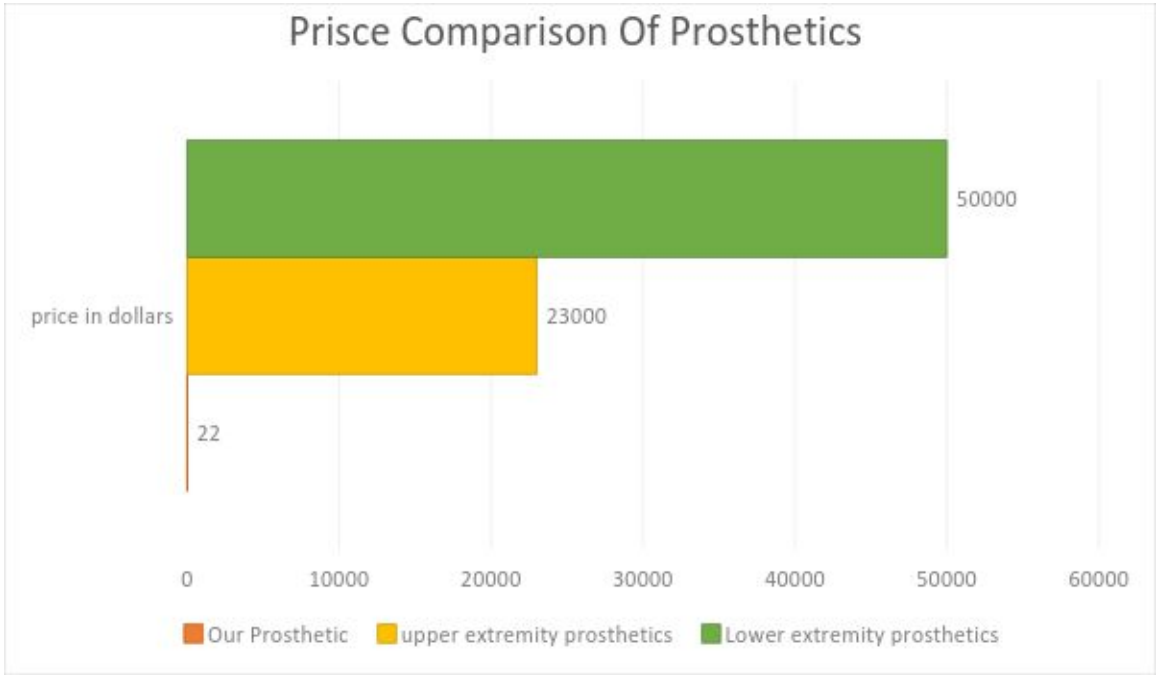
The chart above displays the task of dexterity a task in which you are supposed to thread a nut onto a bolt. The objective of the task is to thread a nut onto bolts of various sizes in the shortest time possible.



This chart shows the comparison of human times to the prosthetic in distance accuracy. This task is how fast you can throw three different ball types into a bucket at different ranges. The ball types consist of tennis balls, ping pong balls, and hacky sacks. The objective of this is to make at least one of each ball type in the shortest time possible.



This chart shows an overview look of what part of the population losses limbs and how many need amputations on a yearly bases. Approximately there are about 1.6 million limb losses a year.



This is just a basic overview comparison of price based on our prosthetic compared to others.

Resources:

http://www.amputee-coalition.org/inmotion/nov_dec_05/pros_rehab_tech_seniors.html

http://www.hangerclinic.com/limb-loss/Pages/default.aspx

http://www.research.va.gov/research_topics/Prosthetics.cfm

http://www.disabled-world.com/assistivedevices/prostheses/