The Nervous System, The Brain And Prosthetics

Any trauma that affects the nervous system can leave an individual with paralysis of a limb and the loss of the ability for the brain, sensorimotor system, and rest of the body to be able to connect (Moxon, 2001). The ability to strengthen and widen this communication would result in a computer connected to a human to direct remote control of robotic appliances faster which has led to the field of neuroprosthetics to grow quickly and to include diverse devices for stimulating peripheral nerve tissue through functional electrical stimulation (FES) (Moxon, 2001). By directly getting movement command signals from motor control parts of the brain and changing them into electronic signals suitable for controlling an FES device and designing a system with sensory feedback would allow for more" fine-grained temporal and spatial control of neural prosthetic devices" (Moxon, 2001). Now neural prostheses are becoming more and more common as a practical therapy for those who have any damage to the nervous system. There is a part in the brain called the primary motor system (MI) that is very important in the control of voluntary limb movements so engineers and doctors can record the commands of arm movement in this part of the brain and use those signals to directly control a prosthetic arm.

There was a study done on rats,and eventually monkeys, to test "neurobotic"control but were done with electrodes that were only allowed to record neural signals from a single tip for less than a year. In order to fix this problem a hybrid circuit device was designed that had multiple recording sites that could record single neuron action potential as well as stimulate neural tissue safely. This electrode was known as the ceramic based, multi site (CBSM) electrode (Moxon, 2001). These electrodes were used in three different situations to test viability of using them as a neuroprosthetic. First, chronic recordings of the electrical activity were made from rats implanted with CBMS electrodes. (Moxon, 2001) Second, the electrodes were used to restore spinal tissue and somatosensory neurons in the cortex anf to produce movement of the limb Lastly, recordings performed in a test tube or petri dish were made to assess how well the electrodes could record "micromolar concentrations of neurotransmitters" (Moxon, 2001). These were tested on frogs and rats over a period of three months.

In the frogs neurons were recorded from the spinal cord of unconscious frogs. Where the recording site was triggered, limb went from a relaxed position to a contracted one. In the rats recordings were made from four-site CBSMs put into the MI cortex for three months. The electrodes were placed in a certain cortex of the rat and cells responsible for processing touch stimuli from the rat's whiskers were recorded. When the whisker moved, action potentials could be prompted from cells recorded in the sites at the same time (Moxon, 2001). The electrodes were also able to obtain tactile sensation in the rats by tactile stimulation of the whiskers. The results showed that the CBSM electrodes have the ability to record messages between neurons and the brain for at least three months. The overall results of the study, as well as the results of recording done before, suggests that the electrodes can be used as a neuroprosthetics device to restore bodily function. The ability for these electrodes to do that will make them a vital device to further study diseases and also give an example of the progress of these "brain pacemaker devices" to make the symptoms of diseases that affect the brain, like dementia or Alzheimer's disease, less severe.

In the article, "Experimental Neurology" it discusses the different applications used in the

rehabilitation process to help individuals who have suffered an amputation or brain surgery. They can range from a simple prosthetic aid used for cognition to help someone with an impaired memory due to brain injury, to the electronic properties of muscles in prosthetic arms for those with upper extremity amputations. This article argues that using neuroprosthetics in the rehab treatment improves the care of the patients, but also has more positive outcomes and helps broaden other types of treatment that can be used in the recovery process. Although there is a lot known about understanding the benefits of using neuroprosthetics and applications in the rehabilitation setting there is a lot of hope and promise for research that will be done and the design of tools to ease recovery and improve quality of life of people with disabilities (Eapen, Murphy, Cifu, 2017).