Haptic Master
Cerebral Palsy and CP Technology

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Discovered as a strange disorder causing stiff, spastic muscles in legs and arms of new born infants and children of a very young age, Little's disease, named after the famous English Surgeon William Little, became what is now known today as Cerebral Palsy or spastic diplegia. Cerebral Palsy, or CP, has a variety of symptoms ranging from difficulty with motor tasks, such as grasping doorknobs or holding a book, to maintaining balance or walking. Patients with CP suffer from discoordination such as this due to severe problems with their neural motor control and stiffness in their joints. Imaging devices have shown when assessing brain injury in CP patients, damage to the sensory tracts of the brain play a large role in the results displayed by the physical discoordination in these children and adults. This is a serious problem because it directly involves the motor control areas leading to and from the brain to the upper and lower limbs causing miscommunication to the affected areas and muscles. To this day there are still no proven causes for Cerebral Palsy. The number one symptom that leads to the discovery of CP in infants is asphyxia, the lack of oxygen to the brain and body. More major symptoms that lead to problems in CP patients are periventricular leukomalacia (PVL) and placental insufficiency. PVL is damage to the inner part of the brain, which is a major communication area that sends information to nerve cells, the spinal cord and between the two halves of the brain itself. 60 to 100% of infants with PVL develop signs of CP and this occurs mostly in premature infants born before 30 weeks gestation. Placental insufficiency is the result of the placenta's inability to perform its full task of supplying nutrients and removing wastes to and from the developing child.

It has been estimated that over 500,000 Americans have been diagnosed with a form of Cerebral Palsy and since its discovery in the 1860's there has not been much fluctuation. Biomedical research has been organizing studies to better understand the causes of CP and more importantly discover new ways to identify the disease at an earlier age and provide new drugs to apply to infants soon after birth. Because most cases are due to developmental problems of the nervous system while in the womb it is extremely difficult to pin point when and how CP comes about as well as what actions can be taken in this state. Though biomedical and medical research has improved since the discovery of "Little's Disease" there still has yet to be a cure. A cure is not out of reach for American researchers, but there are many who are currently working on post-birth treatments and therapy methods which can be applied at a very young age. The earlier treatment begins in the affected children, the better chance there is to see improvements in their disabilities.

Because physicians are suggesting treatments and therapy at such an early age, therapists are having a difficult time finding activities for children that can hold their attention long enough to receive sufficient treatment. Touch simulation is something that is often used by therapists. Haptics, or the field of computerized touch simulation is not only something that can be used for entertainment at home, but is now being used by therapists all over to simulate the manipulation of virtual objects. Biomedical engineers at the New Jersey Institute of Technology are working to help children with CP improve their movements, reduce their stiffness and spasticity and help them work towards a normal life. The Haptic Master, a robotic arm used along with a variety of virtual reality games, was originally created for recovering stroke victims, but is now helping individuals who suffer from Cerebral Palsy or spinal cord damage. With CP patients this can help work towards overcoming spasticity and sometimes paralysis in the hands by completing repetitive hand and finger movements. These intense exercises are performed while playing a virtual reality video game, customized to fit every childs' therapeutic needs. These children will also wear a computerized cable glove if they need help moving their sometimes paralyzed fingers. With these repetitive, fun activities, therapists say this will help retrain childrens' brains to overcome their discoordination and to re-learn specific movements they will use in their every day life. Users of the Haptic Master will perform simple tasks like pushing a button, causing the patient to lean forward with the Haptic Master fully supporting the child's arm, guiding it in the correct path to complete the task. "The goal of the therapy is not to strengthen the muscles, but to strengthen neural connections. The keys to such rehabilitation are intention and repetition." said Richard Foulds, PhD, an associate professor in the biomedical engineering department at NJIT. These neural connections, also referred to as synapses will become stronger so the patient can begin making somewhat functional use of their limbs. Treatments like this are important because it has been proven that connections that do not get used slowly begin to disappear, deeming the limbs paralyzed.

The Haptic Master does not use joysticks like most game systems because that action involves only the hand. Instead these engineers created something to involve the entire body. The Haptic Master is comprised of a robot arm that has a trough like mechanism where the patient's arm will rest, making it easier to the arm in a full range of motion. The user will wear stereo glasses while watching a computer screen in order to receive the full virtual reality affect. The Haptic Master provides force feedback, making the virtual reality game an extremely enhanced, interactive game.

References:

http://appneurology.com/shoArticle.jhtml?articleId=196800707
http://www.njit.edu/publicinfo/press_releases/release_796.php
http://healthlink.mcw.edu/article/931225858.html
http://www.ucpresearch.org/cerebral-palsy-research/active-research.php
http://www.healthsystem.virginia.edu/uvahealth/peds_hrnewborn/pvl.cfm
http://intron.kz.tsukuba.ac.jp/hapticmaster/hapticmaster_e.html