ELECTIVE AMPUTATION OF CEREBRAL PALSY PATIENT SUCCESSFULLY WEARS ELECTRIC PROSTHESIS

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Cerebral Palsy affects 15-20 new borns in every 10,000. Currently, near a half million people in the U.S. are effected with C.P. Diagnosing the condition is done clinically, with lab test only ruling out other diseases. The tests performed, such as manual muscle testing, ROM, physical and emotional development, are all compared to normal childhood outcomes. Therefore, many infants are not diagnosed with C.P. until the age of two or three. Symptoms are normally weak or tight muscles, poor balance and gait, along with seizures in approximately half of the effected people. Over time, weak muscles can often develop severe joint contractures, classified as spastic Cerebral Palsy. (1,2,3)

In the fall of 2000, 48-year-old Mr. Cline presented with spastic hemiplegic Cerebral Palsy affecting the arm and leg of the left side. He was also diagnosed with Polio at the age of four, but the Medical team now believes that his limb condition is secondary to C.P. Mr. Cline showed some difficulty ambulating, secondary to poor musculature in his left leg. His left arm was in 60° flexion contracture, 80° abduction contracture, forearm at 135° flexion contracture, with wrist, hand and fingers all flexed; All conditions present since four years of age. ROM at gleno-humeral was passive only, with full active scapular-thoracic motions. Flexion and extension of the elbow along with the wrist and hand were passive. The elbow only allowed 20° degrees of extension from the flexed position. EMG testing showed 100+ microvolts of the triceps and less than five microvolts of the biceps. No EMG signals were found distal to the elbow. His right arm and right leg were not effected and normal with full ROM and 5/5 manual muscle test.

Mr. Cline is employed as a delivery driver for an auto parts store. Duties include packaging and lifting heavy boxes and transporting them to car dealerships and other parts stores. In his spare time he enjoys fishing and yard work, along with daily chores and activities. Mr. Cline presented with extreme frustration performing his daily activities with respect to the condition of his left arm. He believed he could perform better at work if the arm was not an obstacle getting in the way. Mr. Cline and the surgery staff decided to amputate his arm even if the prosthesis would be of no benefit. The rehab team consisting of an orthopedic surgeon, physiatrist, occupational therapist, physical therapist, and two certified prosthetists decided to not make conclusive decisions on prosthetic components until after the amputation knowing that ROM may drastically change.

Mr. Cline commenced occupational therapy three weeks prior to amputation to improve ROM and EMG signals. Duration was three times a week for 30-minute visits. Unfortunately, the only benefit was a marginal 10° of passive extension at the elbow.

In December of 2000, amputation occurred at the humerus, three inches proximal to elbow center. Aggressive measures for edema control, healing, and OT immediately took place. Two weeks after amputation we reevaluated for prosthetic components. Unfortunately, gleno-humeral ROM did not improve, nor was there any improvement of bicep EMG. The decision was made for a full electric system of elbow, wrist rotator, and terminal device. For optimal control, two myosites with adequate signals and separation were desired. However, upon evaluation the triceps always interfered with the biceps signal, and the biceps could never achieve a higher signal than the triceps. The decision was made to have a servo controlled elbow, single site control of the TD, and to delay the wrist rotator control. The single site electrode was placed on the biceps, in hopes to increase stamina and isolate the biceps-triceps antagonistic signals.
This prosthesis was fit when the limb was completely healed at four weeks post surgery. Using an expedited fitting protocol, it was fit in a temporary setup with a Boston Elbow 3 with single site hand threshold-servo elbow strategy, shoulder saddle and chest strap, flexible inner liner with rigid frame, and Otto Bock hand and Greifer. On the same day we cast the limb, Mr. Cline was able to function with the temporary setup. He wore the arm for six weeks, receiving therapy three times a week for the first four weeks, then once a week for two more visits. By this time Mr. Cline was able to, for the first time ever, do bimanual activities such as hold on to a cup while he pours, hold on to a fork while he cuts, grooming, and bimanual activities at work.

After six weeks of wearing the arm, reevaluation of the prosthetic components took place. The flexion and abduction contractures of the shoulder were still present, yet lessened to 30° flexion and 40° abduction. EMG signals of the triceps were still more than adequate at >100 microvolts and the biceps improved to near 40 microvolts. More importantly, there was only a 15 microvolt cocontraction of the triceps when the biceps fired. Mr. Cline stated difficulty at work controlling the elbow with a servo because of the body motions necessary along with inadvertent triggering. Therefore, combined with his personal preference, the elbow was switched with a Utah 2, dual site myo elbow and hand, using rate cocontraction to unlock the elbow and a switch to toggle between TD and wrist.

Currently, Mr. Cline is wearing the arm 10-12 hours a day and uses it very well. He is able to do everything he wishes with the arm and enjoys the benefits and ease of activities with bimanual grasps. He wears the arm most of the time, and the hand while at social activities or dining. He stated he’s noticed the ability to do more with his sound right side hand, possibly from a decrease of fatigue and overuse syndrome. Mr. Cline’s life has completely transformed from a person with a limb disfigurement to a natural, two handed person able to do whatever he wants, and have a much better outlook on life.

References