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Simple EMG classification can improve outcome of nerve transfer surgery

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A study by researchers at Hospital for Special Surgery (HSS) finds that electromyography (EMG) testing to determine the quality of donor nerves can improve the outcome of nerve transfer surgery to restore function in patients with a brachial plexus injury. EMG is a sophisticated test used to objectively measure muscle and nerve function.

The paper, "Does Pre-operative Donor Nerve Electromyography Predict Nerve Transfer Outcomes?," will be presented at the annual meeting of the American Academy of Orthopaedic Surgeons on March 13 in New Orleans.

"Our study found that pre-operative EMG evaluation should be considered a critical component of the donor nerve selection process when planning brachial plexus nerve transfer reconstruction," said Scott W. Wolfe, MD, senior investigator and Director of the Center for Brachial Plexus and Traumatic Nerve Injury at Hospital for Special Surgery in New York City.

The brachial plexus is a network of nerves that extends from the spinal cord in the neck, under the collarbone and down the arm. These nerves control the hand, wrist, elbow and shoulder. Injury to the brachial plexus can be devastating, and the most common cause is a serious accident or sports injury. Nerve reconstruction is considered when the nerves are so severely damaged they cannot recover on their own. These complex operations can take up to 12 hours.

One way surgeons can reconstruct nerves is by performing a nerve transfer to restore function. They carefully dissect out portions, or fascicles, of nearby functioning nerves (called "donor nerves") and transfer these fascicles to the injured nerves to restore electrical connectivity and enable nerve regeneration to the paralyzed muscle. "A nerve transfer takes a working nerve from one muscle and transfers part of that nerve to the injured, non-working nerve or another muscle, so the two muscles can share the nerve and regain function," Dr. Wolfe explained.

Electromyography is often used in the pre-operative assessment of brachial plexus injuries to estimate the degree of damage. However, the ability to predict surgical outcomes using pre-operative EMG to test donor nerves had not been previously evaluated. Researchers hypothesized that the health of the donor nerve and corresponding muscle, as assessed by EMG, could predict the outcome of nerve transfer surgery.

A retrospective review was conducted to investigate outcomes of nerve transfers for elbow flexion (ability to bend one's elbow) and shoulder abduction (ability to lift arm away from the body). Muscle strength was graded both pre-operatively and at least one-year after surgery. Pre-operative EMG results for donor nerves were classified on a scale that rated their level of function and then compared with the patient's muscle strength and range of motion after surgery.

Forty nerve transfers were identified. Twenty-seven were performed for elbow flexion and 13 for shoulder abduction. Overall, the 29 transfers using a normal donor nerve showed significantly greater post-operative improvement in muscle strength and function than the 11 transfers with the less robust donor nerve, as classified by EMG.

In the shoulder patients, the use of normal donor nerves resulted in

greater strength and active motion compared to less robust donor nerves. In the elbow cohort, double nerve transfers with two normal donor nerves demonstrated improved strength compared to double nerve transfers when one of the donor nerves was affected by the injury.

Joseph Feinberg, MD, physiatrist-in-chief and co-medical director of the Brachial Plexus Center at HSS, has developed a system to classify potential donor nerves according to four levels of functioning: normal, moderately limited function, very limited function and no function.

"Interestingly, we found that some of the donor nerves that were damaged and had some functional limitations were still healthy enough to do their job after the nerve transfer operation," Dr. Feinberg said. "On the flip side, if electromyography shows that a potential donor nerve is not at all functional, the surgeon may want to consider a different nerve donor, or potentially another solution such as nerve grafting or muscle transfer."

"Our findings demonstrate that a semi-quantitative EMG classification describing the quality of donor nerves can predict outcome as measured by post-operative muscle strength and range of motion," said Dr. Wolfe. "Despite the small numbers studied, we observed significantly greater gains in strength and range of motion in the normal donor nerve group as compared to the less robust donor nerves. EMG evaluation has value as a confirmatory component of the donor nerve selection process when planning brachial plexus surgery."

The Center for Brachial Plexus and Traumatic Nerve Injury at Hospital for Special Surgery offers advanced diagnostic and treatment options, including complex nerve reconstruction surgery. Only 150 to 200 highly specialized surgeons worldwide perform these reconstructive surgeries, and Dr. Wolfe and his colleagues aim to raise awareness that the procedures can restore function in people severely debilitated by a nerve

injury. It is important for patients to be treated in a timely manner.

Unfortunately, some patients suffer long-term impairment from nerve injuries that could have been repaired. Many people, including physicians, are unaware that nerve reconstructive surgery is an option, according to Steve K. Lee, MD, director of research at the Center for Brachial Plexus and Traumatic Nerve Injury. "When a nerve that controls a muscle loses function, it needs to be reactivated within about 12 months, before the muscle atrophies. Studies have shown that if nerve reconstruction surgery is done within six months after a nerve is damaged, patients do much better."

More information: Paper Title: Does Pre-operative Donor Nerve Electromyography Predict Nerve Transfer Outcomes? by Joseph Schreiber et al.

Provided by Hospital for Special Surgery

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