

NERVE INJURY & RECOVERY

The Problem

An injury to a nerve can result in a problem with the muscle or in a loss of sensation. In some people it can also cause pain. To understand the nerve injury and recovery, it is important to understand the different types of nerve injury. The type of nerve injury will determine the type of treatment that will be needed.

Anatomy

Nerves connect your brain and spinal cord to the muscles and skin giving you movement and feeling. If there is an injury to the nerve, there will be an interruption in the information being conveyed to the skin or muscles to and from the brain. The larger nerves in your arm and leg, which are about the size of a pencil are made up of tens of thousands of nerve fibers, similar to the telephone cable and the nerve fibers are grouped together in fascicles. Some nerves like the median and ulnar nerve in your arm have motor and sensory fascicles giving you movement and feeling to your hand.

Nerve Injury

Two nerve injury classification systems have been described and they are outlined in Figure 1. A first degree injury or neurapraxia will recover quickly within days after the injury or it may take up to 3 months. The recovery will be complete with no lasting muscle or sensory problem. A second degree injury or axonotmesis will also have complete recovery however the recovery will be much slower than a first degree injury. The nerve must grow back to reinnervate the muscle or skin and nerves grow back at the rate of an inch per month, therefore the time for recovery will be much longer than with a first degree injury. A third degree injury will also have slow recovery however only partial recovery will occur. The amount of recovery will depend on a number of factors; for example,

the more scarring in the nerve the more likely there will be poorer recovery and the potential mismatching of sensory and motor fibers and the less likely that the nerve will fully recover. A fourth degree injury occurs when there is dense scar tissue within the nerve completely blocking any recovery and a fifth degree injury is when the nerve is completely separated, like with a cut nerve. Both a fourth and fifth degree injury require surgery for recovery. A sixth degree injury is a combination the other types of nerve injury and recovery and treatment will vary depending on which type of nerve injury is present.

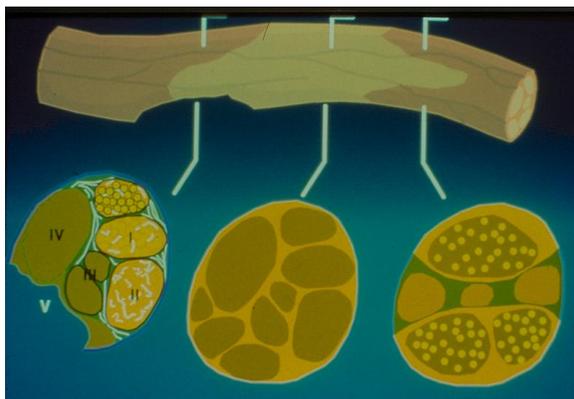
Nerve Recovery and Regeneration

Following nerve injury, the nerve will try to repair itself by sprouting regenerating nerve units. These regenerating units will then try to grow down the nerve to reinnervate muscle or skin. If they make a correct connection, motor nerve to muscle or sensory nerve to skin, then recovery of muscle function and skin sensation will occur. If however, the regenerating nerve fibers do not make a correct connection then no recovery will occur.

Nerves will regenerate at the rate of 1 inch per month. While sensation can be regained even after long periods of denervation, muscle reinnervation will not occur after long periods of time without nerve innervation. Therefore it is necessary to get nerve to muscle as quickly as possible if it is not going to recover on its own. Often electrodiagnostic tests, including electromyography (EMG) and nerve conduction studies are used to see if the muscle is recovering. An EMG will show muscle recovery before you can see the muscle contracting. If no evidence of recovery is seen by 3 to 6 months following nerve injury, surgery is usually recommended.

Figure 1
Nerve Injury and Anticipated Recovery

Degree of Nerve Injury	Spontaneous Recovery	Rate of Recovery	Surgery
First Neurapraxia	Full	Occurs in days to 3 months following injury	None
Second Axonotmesis	Full	Regenerates at the rate of 1 inch/month	None
Third	Partial	Regenerates at the rate of 1 inch/month	None or neurolysis
Fourth	None	Following surgery at the rate of 1 inch/month	Nerve repair, graft or transfer
Fifth Neurotmesis	None	Following surgery at the rate of 1 inch/month	Nerve repair, graft or transfer
Sixth (Mixed Injury)	Recovery and type of surgery will depend on the injury and the combination of degrees of nerve injury		



Surgery

If surgery is necessary there are several different types of surgery that might be

recommended including nerve repair, nerve graft, nerve transfer or neurolysis.

For nerve regeneration, the regenerating nerve fibers need the guidance of the nerve for direction to the muscle or sensory unit. If the nerve has been cut, a nerve repair is used to sew the two ends of a nerve together. This is usually possible in cases where the nerve has been sharply cut. However, in cases where there is more extensive damage it may not be possible to sew the two ends of the nerve directly together, once the damaged nerve has been trimmed away. In these cases, a nerve graft is used. A small piece of donor nerve is used to bridge the gap between the two nerve ends and the nerve will then regenerate across this “bridge” to provide recovery. The donor nerve is taken from other areas in your body using small non-critical sensory nerves. Depending on how much donor nerve graft is needed, there are several nerves that are commonly used including the sural nerve in your leg and the medial antebrachial cutaneous nerve in your arm. The sural nerve runs up the back of your leg and will leave you with a scar to the back of your leg and numbness to the outside of your foot. The medial antebrachial cutaneous nerve is taken from your inner upper arm and will result in numbness to the inside of your forearm. After surgery you will have large area of numbness in the region of the donor nerve that will get smaller over several years. As this donor area reinnervates with sensation, you may feel more tingling in the area of numbness.

In some cases where sensory or muscle recovery is not anticipated for a very long time, nerve transfers may be used. Nerve transfers use functioning nerves that are close to the target muscle or sensory area and transfer them to the injured nerve. This provides a close source of nerve for faster recovery.

A neurolysis refers to the removal of scar from the nerve and may be used if scar tissue is blocking the nerve from regenerating.

Complications

Complications from surgery include infection, bleeding and delayed wound healing of the primary surgical site or the donor nerve site in cases of nerve graft. This type of surgery involves nerves and therefore there is a risk that

your nerve function in the region of your injury will be downgraded with respect to sensory or motor function or that pain may develop.

Postoperative Management

After surgery, you will have a soft bulky dressing at the surgical site for comfort and support. The dressing will be removed 2 or 3 days after surgery and depending on the surgery you may need a splint to hold your arm or leg still for a longer period of time. You may shower over the area and the stitches will be removed about 2 weeks after surgery. You will be instructed in range of motion exercises as indicated depending on the type of surgery that you had. If a nerve repair, nerve graft or nerve transfer was done, the area may be immobilized with a splint for 2 to 3 weeks, although some restricted movement is advised to prevent tight scar from developing around the nerve. In cases of a brachial plexus reconstruction, you will be in a shoulder immobilizer for 4 weeks to protect the repair of the pectoralis major muscle that was detached to allow for surgery on your

brachial plexus. Supervised therapy will begin 3 to 4 weeks after surgery. As the nerves begin to grow, nerve recovery is monitored using a Tinel's sign. When the nerve is lightly tapped, you will feel an "electric tingling" feeling as the nerve regenerates.

If you have had surgery to get back sensation, supervised therapy is necessary to instruct you in specific sensory reeducation exercises. When you have some return of feeling, you will begin sensory reeducation to help you maximize the your sensation. As the feeling comes back, you may find some uncomfortable tingling or discomfort, similar to what you feel when your foot falls asleep or when the feeling comes back after you have had a local anesthetic. As your muscle reinnervates, you will be instructed in strengthening exercises to increase your strength. Initially, to relearn to use the reinnervated muscle you may be instructed exercises in gravity- eliminated positions. When the muscle recovers more strength, you will be instructed in exercises with more resistance including weights.

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