



## **'Neural Regeneration'**

**by**

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The severance of nerves in all living beings occurs frequently. Every deep cut severing capillaries will usually also sever some nerve fibers. It is apparent that as the normal process of healing the wound takes place, the injured nerve fiber also heals; otherwise all areas of injury would probably end up numb permanently. The amount of healing that takes place and the method by which it is caused to happen may be due to several factors. Becker's theories of Perinueral currents along the glial cells offer a possible insight into the process.

When an injury takes place along a nerve fiber, the 'circuit' for Perinueral current flow is broken. A small current flows from the proximal severed fiber to its distal counterpart. The research carried out by Becker suggests that this current of injury has two possible effects. These are:

- a) Repair is initiated in the damaged glial cell.
- b) The small current flowing across the injury site stimulates healing.

Nerve regeneration takes the form of a tube of glial cells slowly growing across the injury site to meet up with its distal segment. This is followed by the nerve fiber (axon) regenerating within the tube. The method of targeting with small nerve injuries to the correct distal segment may be due to chemo tactic processes, that is, chemical signals given out the distal site will cause regenerative growth to a very specific point reconnecting the nerve and establishing its original function.

Regeneration of more complex bundles of nerves servicing motor functions and from dermal regions would have greater problems in their regeneration process. This is because of location of the nerves, i.e. within the central nervous system or in the peripheral system. Neural repair to severances in either the whole or part of the spinal chord rarely re-establishes normal function because of the many fibers bundled together and also the type of glial cell surrounding them. Within the central nervous system each nerve fiber is surrounded by myelin formed from Oligodendrocyte cells. These cells have up to sixteen 'arms' which each wrap around nerve fibers. Damage to just one cell, therefore, affects many fibers. Research studying severed spinal chords has shown some evidence of re-growth of the nerves but where the fracture has been successfully bridged, these have been shown to be relatively few in number and also random in their attachments.

The peripheral nervous system is less complicated since each glial cell is single celled. These are called Swann cells and are known to recover from injury. With the total severance of major peripheral nerve bundles some repair and regeneration may take place but it is debatable whether full function would ever be regained.



The question as to whether any aid to the repair and regeneration of nerve injuries can take place depends on the type of therapy being used. The normal process would take place unless multiple injuries or disease have affected the area. Speeding up the process may be aided by pulsating magnetic fields. This may induce extra current flow into the Perinuclear current flow and increase the current of injury. Also, damaged Schwann/Oligodendrocyte cells may be helped in the normal process of repair as with any cells by assistance to cationic/anionic flows through their membranes. There has been some research into the use of PMF to aid regeneration, such as that by Siskin (1990) and Walker (1993) and this has generated interest in further trials using pulsed magnetic therapy.

A possible treatment regime for nerve injuries would be pulsed magnetic therapy set at specific frequencies. Research has suggested that neurons respond more to pulsating frequencies of 200Hz and above. This causes hyper-polarization at the synapse and is more to do with the inhibition of chemical transmissions across the synaptic gap. However, where there is neural injury applying the 200Hz may have a number of effects.

These are:

- a) Possible greater induction along the glial cells than induced by 50Hz. This may aid the establishment of currents of injury to sufficiently high levels to initiate glial cell regeneration.
- b) Supply the proximal and distal segments of the injured axons with the required nutrients to sustain them, thereby preventing the possibility of a permanent injury.
- c) Another benefit may be the reduction of pain from receptors in close proximity to the site.

Pulse frequencies applied with the 200Hz would have to be determined by effect as they may differ for the type and size of injury. One possible method would be to use a constant setting in the initial stages, which may be reduced to 5Hz once healing is established.