CLINICAL RESEARCH

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The cellular processes of tissue and bone healing are complex and multifactorial. The Scientific basis for ARPWAVE Neuro Therapy is the positive cellular effects of direct current electrical fields on these processes.

Direct current has been shown to affect cellular migration and orientation, endothelialization, protein synthesis, and calcium regulation, as well as stimulation of a new bone formation and fracture healing.(4,6,7,10,18,19,21,22,24,25)

The initial response after injury is coagulation modulated by plasma platelet cells that form fibrin clots to stop bleeding.

The clots attract polymorphonuclear neutrophils (PMNs) and fibroblasts that, in turn, adhere to the clots forming a fibrin gel. The PMNs consume bacteria and wound debris by secreting proteases.

Platelets also release growth factors that attract monocytes to the site of injury. Monocytes mature into macrophages that become the controlling cells in tissue healing.

Macrophages continue the process of bacteria phagocytosis and cleaning of wound debris and also secrete growth factors that attract and activate fibroblasts.

Fibroblasts proliferate and migrate, and produce a collagen matrix. Concomitantly, endothelial cells migrate to the collagen matrix to produce new blood vessels in this matrix.

Granulation tissue is formed composed of fibroblasts, endothelial cells, PMNs, and a collagen matrix.

Direct current electrical fields can modulate a number of factors involved in the healing response. A major process that is affected by direct current is cellular migration and orientation.

Cooper and Keller, working with amphibian neural crest cells exposed to a direct current field, demonstrated a migration of cells towards the cathode with a resultant perpendicular cellular orientation.(7) In further studies, Cooper and Schliwa concluded that cell locomotion could be controlled with manipulation of the direct current field.(8)

This process, called galvanotaxis, has been demonstrated also in neutrophils, macrophages, and fibroblasts.(10,18,21,22,23)

Direct current can also produce changes in endothelialization. Nannmark et al reported an increased permeability to macromolecules, and changes in capillary permeability to white blood cells with exposure to low levels of direct current.(19)

Direct current can affect the migration of endothelial cells in vitro.(24)
Intracellular processes are also affected by exposure to direct current. Cheng et al established that relatively low levels of direct current can raise the adenosine triphosphate (ATP) level almost 500 % and increase protein synthesis and membrane transport.(6)

Bourguignon et al demonstrated an uncapping of insulin receptors on the cell membrane and enhancement of protein and DNA synthesis within the first minute after direct current stimulation.(4)

New bone formation and fracture healing are positively affected by the application of a direct current electrical field.(11,12,14,17)

The net effect of direct current on bone is an increase in osteoblastic activity and new bone formation around the cathode. These effects are optimally demonstrated with a current level of 5 to 20 micro amps. Studies have shown increased spinal fusion rates, and increased healing of fracture nonunions.(5,9,13)

The scientific basis for the use of direct current stimulation in tissue healing has long been established. The clinical problem has been in the application of the direct current without severe discomfort and skin damage. With precise application of an ingenious, patented background waveform, ARPWAVE Neuro Therapy technology allows clinically appropriate levels of direct current to be delivered to tissues safely.

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