THE PHYSIOLOGY OF WOUND HEALING AND LASER THERAPY

Wound healing is an intricate process in which the skin (or another organ-tissue) repairs itself after injury. In normal skin, the epidermis (outermost layer) and dermis (inner or deeper layer) exists in steady-state equilibrium, forming a protective barrier against the external environment. Once the protective barrier is broken, the normal (physiologic) process of wound healing is immediately set in motion. The classic model of wound healing is divided into four sequential, overlapping phases:

1. Hemostasis
2. Inflammatory
3. Proliferative
4. Remodeling

Upon injury, a set of complex biochemical events takes place in a closely orchestrated cascade to repair the damaged tissue. Within minutes post-injury, platelets (thrombocytes) aggregate at the injury site to form a fibrin clot. This clot acts to control active bleeding (hemostasis).

In the inflammatory phase, bacteria and debris are isolated and removed, and factors are released that cause the migration and division of cells involved in the proliferative phase.
The proliferative phase is characterized by angiogenesis, collagen deposition, granulation tissue formation, epithelialization, and wound contraction.

In angiogenesis, new blood vessels are formed by vascular endothelial cells. In fibroplasia and granulation tissue formation, fibroblasts grow and form a new, provisional extracellular matrix (ECM) by excreting collagen. Concurrently, re-epithelialization of the epidermis occurs, in which epithelial cells proliferate and within the injured area, providing cover for the new tissue.

In contraction, the wound is made smaller by the action of myofibroblasts, which establish a grip on the wound edges and contract themselves using a mechanism similar to that in smooth muscle cells. When the cells' roles are close to complete, unneeded cells undergo apoptosis.

In the maturation and remodeling phase, collagen is remodeled and realigned along tension lines and cells that are no longer needed are removed by apoptosis.

When laser light penetrates deep within tissues, photons stimulate physiological processes at the cellular level; this is called photobiostimulation. As cells absorb laser energy, cellular respiratory metabolic rates increase significantly. The physiological effect of these photons upon cells is photochemical and not photothermal in nature.
Photobiostimulation allows for an increase in cellular health and energy. Photons from the laser emission are only absorbed by unhealthy cells and have no effect on normal healthy cells.
Photons penetrate to the individual cells and stimulate both the cell membrane and structures within the cells. Mitochondria are the cellular structures that produce energy within the cells. Photons from emitted laser energy are absorbed by receptors (chromophores) within the mitochondria. The membrane protein cytochrome oxidase is the primary photoreceptor of the photonic energy from the laser emission. This causes increased production of cellular energy Adenosine triphosphate or ATP, which leads to normalization of cell function, added pain relief, and an increased healing process within the cell. The photobiostimulation of the chromophores within the mitochondria and the cell membranes of the individual cells of four main effects:

1. Cellular energy levels are increased within the treatment area
2. Pain relief or analgesia is increased within the treatment area

3. Anti-inflammatory agents are increased within the treatment area
4. Acceleration of the patient's own cellular healing process increases in the treatment area

BENEFICIAL BIOLOGICAL EFFECTS OF LASER THERAPY:
1. Relieves pain (analgesia)
2. Stimulates the release of endorphins
3. Stabilizes the membrane potential of nerve cells
4. Relaxes musculature and increases the threshold of pain perception
5. Decreases the level of circulating Substance P (a neurotransmitter)
6. Provides a reduction of neural activity at trigger points
7. Activates acupuncture points

INFLAMMATION REDUCTION
1. Promotes microcirculation by increasing vasodilation
2. Promotes lymphatic flow and therefore reduces inflammatory edema
3. Inhibits synthesis of inflammatory prostaglandin

ACCELERATED TISSUE REPAIR AND CELLULAR GROWTH
• Photobiostimulation increases the production of Adenosine Triphosphate or ATP (intracellular energy transfer agent) - this increases the energy level of cells and stimulates them to take up nutrients and remove waste products more quickly
• Increases the rate of cellular mitosis and collagen synthesis
• Activates fibroblasts, chondrocytes, osteocytes, and other tissue repair cell types
• Regenerative cells allow tendons, ligaments, bones, and muscles to heal at an accelerated rate
• Accelerates tissue granulation and epithelialization of wounds
• Stimulates regeneration of peripheral nerves

STIMULATES REMODELING TISSUE
• Improved circulation angiogenesis
• Stimulates growth of capillaries and damaged tissue
• Stimulation results in temporary vasodilation of the vasculature
• Accelerates the reabsorption of hematomas
• Reduces the release of vasoactive amines (a substance containing amino groups, such as histamine or serotonin that acts on the blood vessels to alter their permeability or to cause vasodilation)

INCREASES CELLULAR METABOLIC ACTIVITY
• Chromophore stimulation results in increased production of ATP and other cellular enzymes
• Stimulation of the cell wall and unhealthy cells changes the rate of cation exchange

REDUCES FIBROUS TISSUE FORMATION
• Photobiostimulation accelerates wound healing and reduces the formation of scars
• Scar tissue that is already present will be stimulated to remodeling to normal elastic tissue

IMPROVES NERVE FUNCTION
• Nerve cells will have accelerated regeneration after photobiostimulation
• Current nerve fibers will experience an increase in the amplitude of the action potential, normalizing impulse transmission

ACCELERATES WOUND HEALING

- Photobiostimulation stimulates the production of fibroblasts
- These fibroblastic cells are the building blocks of collagen, which is the essential protein required for tissue regeneration and repair
- Increased granular leukocyte and macrophage activity occurs at the site of the wound due to the stimulatory effect that laser energy has on the vascular system
- Small capillaries are regenerated at a much faster rate after laser stimulation

STIMULATES IMMUNOREGULATION

- laser energy directly stimulates the production of immunoglobulin lymphocytes

STIMULATES ACUPUNCTURE AND TRIGGER POINTS

- Photo biostimulation provides a needle-less acupuncture point stimulation
- Relief of pain within both acute and latent trigger points can be accomplished in just a few seconds

SUMMARY

The Diowave™ Deep-Tissue Therapy Laser System provides a noninvasive modality that initiates numerous physiological and biological responses to aid and accelerate the body's own natural healing system, to more rapidly and completely repair injured tissue. No other therapy modality exists to provide scientifically proven results of this nature.