Many types of wounds cross the exam table each day. Some are intentional (surgical), some traumatic, others dermatological, a percentage infected, and all painful. Each wound is unique, yet they all have one entity in common: they all benefit from laser therapy.

All three phases of wound healing: inflammatory, proliferative, and remodeling are influenced by the biochemical cascade of events initiated by photobiomodulation. With laser therapy, each phase of the dynamic process of restoring the individual cellular structures and organizing tissue repair is accelerated resulting in a restoration to the earlier natural state.

Photonic energy stimulates the photoreceptors on the mitochondria resulting in a decreased reaction time for cytochrome c to become cytochrome c oxidase. As a result of this reaction, there is a release of Nitric oxide and an increase in ATP synthesis. In conjunction with all of the actions of NO, i.e. pain relief, the increased levels of ATP provide energy at the cellular level to initiate a return to normal metabolic function within the compromised cells.

The inflammatory phase is the body’s natural response to injury. After the initial infliction of a wound, the blood vessels in the wound bed contract and a clot is formed. Once hemostasis has been achieved, through the use of ice and/or pressure, laser therapy should be applied. This will cause an immediate vasodilatation within the vasculature which allows essential cells, antibodies, white blood cells, growth factors, enzymes, and nutrients to reach the wound. Photobiomodulation of the tissues relieves pain, reduces swelling, and causes vasodilatation which allows the phagocytic cells, neutrophils and macrophages to invade the area to autolyse and devitalize any damaged cells or tissues.

In summary, the effects of photobiomodulation on the inflammatory phase of wound healing are:
- Decreased duration of this phase
- Vasodilation
- Increased phagocytic activity

The proliferative phase is characterized by angiogenesis, collagen deposition, granulation tissue formation, epithelialization, and wound contraction. Application of photonic energy accelerates the process of angiogenesis. In fibroplasia and granulation tissue formation, fibroblasts grow and form a new, provisional extracellular matrix through the formation of collagen. Photobiomodulation of these regenerative cells results in an increased activation rate which allows tendons, ligaments, bone, muscle, and other tissues to heal at an accelerated rate. Concurrently, re-epithelialization of the epidermis occurs, in which epithelial cells proliferate and migrate atop the wound bed.
The effects of photobiomodulation on the proliferative phase of wound healing are:

- Decreased duration of this phase
- Production of growth factors
- Fibroblast growth and migration
- Formation of collagen
- Epithelialization

When the levels of collagen production and degradation equalize, the remodeling or maturation phase of tissue repair begins. The application of laser therapy accelerates mitosis and collagen synthesis.\textsuperscript{13,14} During maturation, type III collagen, which is prevalent during proliferation, is replaced by type I collagen. Originally disorganized collagen fibers are rearranged, cross-linked, and aligned along tension lines.\textsuperscript{15} This event results in an increase in the tensile strength of the wound and a reduction of scar tissue formation.\textsuperscript{16}

Dosage requirements are unique to each wound. Very superficial wounds may need only .5 to 2.5 J/cm\textsuperscript{2} to respond. Deeper wounds may require 2.5 to 5 J/cm\textsuperscript{2}.\textsuperscript{14,17} These dosages should be administered aggressively initially, i.e. every day or at least every other day and then followed by successive treatment until the wound is completely healed.

All phases and stages of wound healing benefit from laser therapy. Each type of wound will heal at an accelerated rate due to the biochemical cascade of events induced by photonic energy at the cellular level. This versatile modality is becoming the standard of care for wounds and many other maladies.

References:


