Important news for patients with musculoskeletal injuries and those who have recently undergone surgery

Healed!

By Gary Reinl

According to an article published in the Journal of the American Academy of Orthopedic Surgeons entitled: "Loading of Healing Bone, Fibrous Tissue, and Muscle: Implications for Orthopedic Practice**"** *by Joseph A. Buckwalter, MS, MD, and Alan J. Grodzinsky, PhD*, there is a way to accelerate healing and, conversely, a way to do the opposite.

Even though the article cites 69 diverse peer-reviewed references; the message is very focused and easy to understand: "early controlled resumption of activity that loads healing tissues during the repair and remodeling phases of healing accelerates restoration of tissue structure and function. And, treatment of injuries with prolonged rest delays recovery and adversely affects normal tissues."

Factors That Limit or Prevent Proper Loading

There are two key factors that prevent or limit proper loading: (1) Not knowing what to do and; (2) If what to do is known … when to do it.

No doubt, what to do, and when to do it is best controlled by the involved physician and/or therapist. That said, the article referenced above provides the following general advice:

What to Do: "*In the clinical setting loading of healing tissues may be done with various combinations of active and passive motion, with or without resistance, or by isometric muscle contraction."* Other advice includes: *"loading of injured bone, tendon, ligament, and skeletal muscle should be minimized during the period of acute inflammatory response that follows tissue injury. However, once this response subsides and the initial repair tissue has been formed, loading should be increased to promote further repair and remodeling."*

When to Do It: "*The time required for resolution of the acute inflammatory response and formation of the initial repair tissue varies with the type of tissue, the nature of the injury, and the individual characteristics of the patient. In some minor injuries and following certain surgical procedures, there is minimal acute inflammation, and the tissues are stable; in that situation, motion and loading can be initiated almost immediately. When there is minimal tissue loss or necrosis, little disruption of the blood supply, and close approximation of the surfaces of the injured tissues, the initial repair tissue forms within 3 to 10 days. Examples of these types of injuries include closed impacted or minimally displaced metaphyseal fractures, repaired flexor tendon lacerations, medial collateral ligament tears, and skeletal muscle strains. Motion and loading of these injured tissues can be started as soon as the acute inflammation and accompanying pain have subsided. In injuries with segmental tissue loss, compromised blood supply, or large gaps between tissue surfaces, formation of the initial repair tissue requires more time. Loading before stable repair tissue has formed may adversely affect the result."*

"One of the most important concepts in orthopedics in this century is the understanding that loading accelerates healing of bone, fibrous tissue, and skeletal muscle."
Journal of the American Academy of Orthopedic Surgeons, Vol 7, No 5, September/October 1999

Additionally, once the decision to introduce activity that loads the healing tissue is made, techniques that help calm irritated muscles and nerves and/or evacuate waste from the area around the healing tissue like: lymphatic massage, acupressure, trigger point release, muscle activation (i.e. ankle pumps, non-tetanizing powered muscle stimulation), etcetera, are generally considered a good idea and will likely make the "loading" process easier to control, more comfortable and more effective.

The History of "Loading" Healing Tissue

Due to the nature of the following information; accurately citing credit is nearly impossible. That said, the text in "quotes" on this page appeared in the September/October 1999 issue of the Journal of the American Academy of Orthopedic Surgeons, Vol. 7, No 5, September/October 1999.

Wolff's Law

"In 1892, Julius Wolff suggested that changes in the loading of bones cause changes in their structure in accordance with mathematical laws, an observation that has become known as Wolff's law. Recent investigations have provided insight into the mechanisms responsible for Wolff's law and have shown that connective tissues other than bone also respond to changes in loading. These studies have shown that tissue loading influences cell shape, gene expression, and synthetic and proliferative functions. Bone, tendon, ligament, and joint capsule respond initially to loading by a mechanism of cellular detection of tissue strains, followed by modification of the tissue."

"The effect of loading on bone, fibrous tissue, and muscle healing has been a subject of controversy since the establishment of the specialty of orthopaedics. Some of the most respected physicians and investigators concerned with the musculoskeletal system, including Nicholas André. (1659-1742) and Just Lucas-Championnière (1843-1913), taught that early controlled activity promotes healing and accelerates restoration of function. Other respected authorities, including John Hunter (1728-1793), John Hilton (1807-1878), and Hugh Owen Thomas (1834-1878), advanced the opposite view.

The latter researchers and their followers argued that absolute rest allows healing to proceed at the maximum pace, and that early use of injured tissues increases inflammation and disrupts repair tissue, thereby delaying or preventing healing. Hugh Owen Thomas emphasized that the only way a surgeon could promote healing was by giving an injured part rest, and that an overdose of rest was impossible. A series of investigations conducted over the past several decades has resolved this controversy and provided the basis for approaches to accelerating restoration of function following musculoskeletal surgery or injury."

Benefits of Proper Loading

Skeletal Muscle:

- More rapid disappearance of the hematoma and inflammatory cells
- More extensive, rapid, and organized myofiber regeneration
- More rapid increase in tensile strength and stiffness

Fibrous Tissue:

- Increases the strength, size, matrix organization, and collagen content of tendons, ligaments, and their insertions into bone

Bones:

- Causes bone formation to exceed bone resorption and can result in increases in overall bone density, volume, and strength

Harms of Not Loading

Skeletal Muscle:

- Prolonged immobilization after injury produces muscle atrophy and poor organization of the regenerating myofibers
- The atrophy caused by disuse also decreases the tensile strength of the muscle and thereby increases the risk of subsequent injury

Fibrous Tissue:

- Tissue stiffness and strength decline
- Affects ligament, tendon, and capsular insertions into bone

Bones:

- Without weight bearing, bone mass declines to less than half the normal value after 12 weeks. The resultant changes include decreased density of cancellous bone, loss of trabeculae, and thinning of cortical bone. These alterations decrease bone strength and increase the probability of fracture.

Inflammation, NSAID's & Healing

"Inflammation can occur without healing, but healing cannot occur without inflammation."

For various reasons, almost everyone believes that they need to prevent or, at the least, limit inflammation related to tissue damage. It doesn't seem to matter to those with such beliefs that inflammation is phase one of a three-phase, life-saving response to injury or that without it, normal healing is impossible.

But what do the experts say? Is it okay to significantly modify or skip the inflammatory phase of the healing process? What are the facts related to this topic?

Although there are many viable answers to these questions from a wide variety of sources, here are two concise, well-referenced explanations that are consistent with related clinical textbooks and other published evidenced-based material:

"A major rationale for using NSAIDs in the treatment of musculoskeletal injuries has been their anti-inflammatory quality. The prevailing argument is that healthy tissue is not inflamed; therefore, if we stop the inflammation in an injured tissue, the tissue will be healthy. The problem with this viewpoint is that, in addition to being a sign of injury, inflammation is a necessary component of the healing process. As noted by Leadbetter 'inflammation can occur without healing, but healing cannot occur without inflammation.'

Whether the injured tissue is a ligament, tendon, or muscle, the body responds to injury with a sequence of events that begins with an influx of inflammatory cells and blood. The inflammatory cells remove debris and recruit cytokines and other growth factors toward the injury site. This inflammatory phase is partly mediated by the same prostaglandins that are blocked by NSAIDs. In a healthy healing process, a proliferative phase consisting of a mixture of inflammatory cells and fibroblasts naturally follows the inflammatory phase. The fibroblasts build a new extracellular matrix and persist into the final phase of repair, the maturation phase, where, if all goes well, functional tissue is laid down. The key point is that each phase of repair is necessary for the subsequent phase."

[The Physician and Sportsmedicine: Volume 31: No.1 January 16, 2003 NSAIDs and Musculoskeletal Treatment What Is the Clinical Evidence? Steven D. Stovitz, MD; Robert J. Johnson, MD]

"Healing, the tissue response that can restore tissue structure and function after injury, results from a complex, interrelated series of cellular, humoral, and vascular events. Tissue damage and hemorrhage caused by injury or surgery initiate a response that includes inflammation (the cellular and vascular response to injury), repair (the replacement of necrotic or damaged tissue by new cells and matrix), and remodeling (the reshaping and reorganizing of repair tissue). This continuous sequence of events begins with the release of inflammatory mediators and ends when remodeling of the repair tissue reaches a homeostatic state."

[Journal of American Academy of Orthopedic Surgeons, Vol 7, No 5, September/October 1999: Loading of Healing Bone, Fibrous Tissue, and Muscle: Implications for Orthopedic Practice, by Joseph A. Buckwalter, MS, MD, and Alan J. Grodzinsky, PhD]

What about Swelling?

Swelling is good thing … not a bad thing. It is a necessary and fundamental component of phase one of the healing process. Additionally, and, contrary to popular belief, the amount of fluid sent to the damaged area is not an arbitrary or chaotic event. Instead, it is a vigilantly regulated process designed to help the body regain a homeostatic state; a process that ultimately depends on the lymphatic system to move the fluid and other waste away from the damaged area and back into general circulation (see next page for details).

Granted, sometimes trapped "waste" triggers the inflammatory response (which sends more fluid to the damaged area). But, generally, it's not because there is too much swelling … it's because there is too little lymphatic drainage. This issue is best settled by evacuating the waste, not stifling the healing process.

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Is Ice (cryotherapy) a Good Idea?

Yes, if the short-term goal is pain control and the prevention of the body's normal cellular and vascular response to injury.

However, if the goal is to help the lymphatic system evacuate trapped waste from the damaged area, the answer is … no.

Why? Because ice slows everything down. It abates, or worse, shuts off the signals between the nerves and the muscles … which basically stops lymphatic drainage (the lymphatic system works when the surrounding muscles contract and relax: no muscle action, no drainage). In fact, if ice is used beyond ten minutes or so, it actually increases waste in the involved area by causing the lymphatic vessels to backflow.

"The lymphatic system is a 'scavenger' system that removes excess fluid, protein molecules, debris, and other matter from the tissue spaces. When fluid enters the terminal lymphatic capillaries, any motion in the tissues that intermittently compresses the lymphatic capillaries propels the lymph forward through the lymphatic system, eventually emptying the lymph back into the circulation."

Textbook of Medical Physiology 10th Edition, Guyton and Hall

Here's what happens:
"When ice is applied to a body part for a prolonged period, nearby lymphatic vessels begin to dramatically increase their permeability (lymphatic vessels are 'dead-end' tubes which ordinarily help carry excess tissue fluids back into the cardiovascular system). As lymphatic permeability is enhanced, large amounts of fluid begin to pour from the lymphatics 'in the wrong direction' (into the injured area), increasing the amount of local swelling and pressure and potentially contributing to greater pain."
The use of Cryotherapy in Sports Injuries,' Sports Medicine, Vol. 3. pp. 398-414, 1986

And, if the goal is to improve outcome … the following abstract from the **Journal of Emergency Medicine** throws a significant amount of cold water on that idea.

"Is Ice Right? Does Cryotherapy Improve Outcome for Acute Soft Tissue Injury?"
JEM, 2008; Feb. 25; 65–68

Abstract:

*"**Aims:** The use of ice or cryotherapy in the management of acute soft tissue injuries is widely accepted and widely practiced. This review was conducted to examine the medical literature to investigate if there is evidence to support an improvement in clinical outcome following the use of ice or cryotherapy.*

***Methods:** A comprehensive literature search was performed and all human and animal trials or systematic reviews pertaining to soft tissue trauma, ice or cryotherapy were assessed. The clinically relevant outcome measures were:*
(1) a reduction in pain;
(2) a reduction in swelling or edema;
(3) improved function; or
(4) return to participation in normal activity.

***Results:** Six relevant trials in humans were identified, four of which lacked randomization and blinding. There were two well-conducted randomized controlled trials, one showing supportive evidence for the use of a cooling gel and the other not reaching statistical significance. Four animal studies showed that modest cooling reduced edema but excessive or prolonged cooling is damaging. There were two systematic reviews, one of which was inconclusive and the other suggested that ice may hasten return to participation."*

***Conclusion:** There is insufficient evidence to suggest that cryotherapy improves clinical outcome in the management of soft tissue injuries.*

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