

Healing And Repair

Stages of Repair And Recovery After An Injury

Most of us have experienced an occasional injury: The sprained ankle, a whiplash, the knee or shoulder injury, the shin bump on the corner of the coffee table, a sun burn, or a paper cut (ouch). Following the injury you begin to experience pain. Then inflammation begins. Pain occurs after your brain has sensed that there was an injury, that there was some level of tissue damage and something needs to be done.

Your body responds to tissue damage with inflammation followed by tissue repair and remodeling.

Eventually, you heal. But are you really done with the healing process?

Stage 1 - The Inflammatory Stage

0-5 days. Gradual reduction of inflammation occurs over three to six weeks. White blood cells move into injured tissues sealing off the sight of injury. In the first 24 hours, monocytes and macrophages predominate and phagocytosis of necrotic material occurs. In addition, there is increased vascular permeability, initiation of angiogenesis, stimulation of tenocyte proliferation in tendons and recruitment of more inflammatory cells (Murphy 1994).

Treatment Focus

- Use Pain as your guide, avoid it.
- Non-steroidal anti-inflammatories generally become ineffective after two weeks.
- No more than two days rest.
- M.I.C.E.: Motion, Ice, Compression, Elevation. Easy, gentle and pain-free movement in the middle range of motion.

Stage 2 – The Proliferative Stage

5 days – 6 weeks. Scar producing cells (fibroblasts, tenocytes). move into the injured area resulting in collagen and fibrous tissue formation (Oaks 2003). Initially, this scar tissue is very weak – 15% the strength of normal tissue.

Treatment Focus

- Use pain as your guide: movements just into stiffness and gentle pain. Pain should abate upon release of movement.
- Movements in mid range. Generally you can achieve full range by 3-4 weeks.
- Continuous Low Level Heat Therapy (CLHT). 2-4 hours a day to increase blood flow and improve healing rate (Thermocare).
- If pain persists, the inflammatory process has been retriggered and healing will be delayed. Return to M.I.C.E.

Stage 3 - The Remodeling Stage

About 6 weeks – 1 year or more based on the type of tissue injured and severity of original injury. Healing tissue is resized and reshaped and vascularization is reduced (Tillman 1996). Initially,

consolidation occurs: cellular tissue becomes more fibrous and fibers become aligned with in direction of stress. Addition of Type I collagen fibers predominates (Abrahamsson 1991). Finally, the tissue matures: fibrous tissue changes to scar tissue, and eventually contraction of scar tissue occurs, and tensile strength increases.

Despite remodeling, the properties of healed tendon tissue never match those of intact tendon (Burns 2000). In tendons, when extrinsic healing occurs as a result of disruption of surrounding sheath and synovium, epitenon tenoblasts initiate the repair process and results in adhesion formation which disrupts tendon gliding (Strikland 1999). This type of healing prevails in torn rotator cuffs (Uthoff 1991). However, when intrinsic healing occurs biomechanics are improved, there are fewer complications and normal gliding mechanism within the tendon sheath is preserved (Koob 2002).

Treatment Focus

- Goal: increase stress to scar tissue. Re-educate the new scar tissue of existing tissue properties and increase tissue strength to handle normal function. This is accomplished mainly through eccentric exercises.
- Pain is less of a guide, especially in more chronic conditions. Here the guide is "No Worse."
- Achieve end range of motion intermittently, not prolonged.
- Load, transition to unloading, and then unload joints and muscles.
- Changes of structural elements are accomplished with 10-12 reps, every 2-3 hours for 16-24 weeks.

Guidelines For The Use Of Ice and Heat

Ice reduces tissue temperature, blood flow, pain and metabolism (Hubbard 2004A). Ice reduces pain by slowing nerve activity. Ice reduces nerve conduction velocity and slows the stretch reflex (Lee 1978). The effect of cold on nerve conduction may last up to 30 minutes. Trauma to the surrounding tissue combined with inflammation can result in secondary injury. Secondary tissue death has been attributed to secondary enzymatic injury and secondary hypoxic injury (Knight 1995). By decreasing the amount of damaged and necrotic tissue, the healing process can be shortened. Ice slows this process and shortens the healing process, aids in recovery and return to activities (Hubbard 2004B).

Cold packs are more efficient when held with an elastic wrap to press the pack against the skin (Taber 1991). In addition, thickness of adipose tissue slows cooling (Lowden 1975). When the ice pack was removed, deep temperature continued to fall for 5 - 7 minutes at levels of 1-3 cm muscle depth while surface temperatures rewarmed at a much greater rate than intramuscular temperatures (Merrick 1993). After 40 minutes after treatment the deeper levels continued to remain cooler than the cutaneous and 1.0 cm levels (Enwemaka 2002). At rest, this deep tissue will not return to normal for at least 6 hours (Petajan 1962).

For best results, melting iced water applied through a wet towel for repeated periods of 10 minutes is most effective. Using repeated applications reduced muscle temperature without compromising the skin. Reflex activity and motor function are impaired following ice treatment increasing susceptibility to injury for up to 30 minutes after treatment (Mac Auley 2001).

- First, determine that the injury is minor and requires no further medical treatment. Otherwise, seek medical help immediately: The sooner you get medical help when necessary, the quicker your recovery.
- Use ice during the initial days after an injury to reduce pain and inflammation and speed recovery.
- Use a towel between you and the ice.
- Alternate 10 minutes on and 10 minutes off for several applications. At 13.5 minutes of cold gel pack application, mean blood volume flow reached its lowest point (Taber 1991)

Guidelines For The Use Of Heat

- Use heat after the initial inflammatory stage. Used too early heat will increase the inflammatory response.
- Use a very wrung-out towel between you and the heat source.
- Continuous Low Level Heat Therapy (CLHT). 2-4 hours a day can also be extremely helpful and is good for problems that are worse at night or in the morning: use patches at night.

Guidelines For Heat Versus Ice After The Initial Inflammatory Stage:

- ICE: If pain is constant and not relieved by position.
- ICE: If the end of the day is worse than the beginning.
- ICE for the day: If the morning of the next day is worse than the day before.
- Otherwise: HEAT.

Factors That Prolong Healing Time

- Lack of protection or not reducing the swelling in the first few days.
- Continued inflammation. This could be the direct result of mechanical injury or by thought patterns inappropriate for the condition.
- Lack of early mobilization. Gentle, painless, mid range movement in the first week results in stronger repair.
- Smoking, caffeine, diabetes, heart disease.
- Physical behavior: too much or too little activity based on the stage of healing.
- Inappropriate behaviors in dealing with pain and its consequences – fear avoidance, anxiety, catastrophising, depression, etc.

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