

**Acute soft tissue injuries--a review of the literature**  
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FROM ABSTRACT:

The pathological processes [of soft tissue injury and repair] at a cellular level are described in three phases: acute inflammatory, repair, and remodelling.

The management of acute soft tissue trauma is embodied in the acronym RICE for rest, ice, compression, and elevation during the first 48 to 72 h.

Additional benefit from anti-prostaglandin medications has not been clearly demonstrated in clinical trials, and if used, these medications should be restricted to the first 3 days.

Cryotherapy (crushed ice) for 10 to 20 min, 2 to 4 times/day for the first 2 to 3 days is helpful in promoting early return to full activity.

Early mobilization, guided by the pain response, promotes a more rapid return to full activity.

Early mobilization, guided by the pain response, promotes a more rapid return to full functional recovery.

Progressive resistance exercises (isotonic, isokinetic, and isometric) are essential to restore full muscle and joint function.

Rehabilitation is complete when the injured and adjacent tissues are restored to full pain-free functional capacity under competitive conditions in association with the necessary level of cardiovascular respiratory fitness.

THIS AUTHOR ALSO NOTES:

A common classification of soft tissue injuries is based on severity:

- 1) Grade 1 (first degree)  
"Mild pain at the time of injury or within 24 h of injury, especially when stress is applied to the injury; local tenderness may or may not be present."
- 2) Grade 2 (second degree)  
"The person notices pain during activity and usually has to stop; pain and local tenderness are moderate to severe when the injury is stressed."
- 3) Grade 3 (third degree)  
"Complete or near complete rupture or avulsion of at least a portion of a ligament or tendon with severe pain or loss of function; a palpable defect may be present; stressing a ruptured ligament may, paradoxically, be painless due to the loss of continuity of the tissue."

In a third degree ligament sprain, "the ligament may appear intact macroscopically yet have complete loss of load-carrying ability."

Third degree ligament injury may require surgical management.

In **inter**-muscular hematoma, the blood tracks distally from the site of injury and appears as a bruise some distance from the site of injury, after some time.

**Intra**-muscular hematoma remains confined by epimysium and may take three times longer to heal than **inter**-muscular hematoma.

In ligaments, microscopic collagen fiber failure begins at 7 to 8% strain.

Ligament strain greater than 7 to 8% results in failure of the ligament to resume its original length after removal of the load (plastic deformation), and to more extensive collagen failure.

Ligaments strains as high as 20 to 40% can occur before signs of failure are apparent.

"Continuity of ligaments may be macroscopically apparent (e.g. arthroscopically) even with complete loss of the load-carrying capacity of the ligament."

"The micropathology of acute soft tissue trauma has been investigated. Healing of ligaments and soft tissue injuries in general has been shown to occur by fibrous repair (scar tissue) and not by regeneration of the damaged tissue."

### **[The Fibrosis Of Repair]**

The phases of soft tissue injury repair are:

#### Phase 1:

The Acute Inflammatory or Reaction Phase.

Lasts up to 72 hours.

Characterized by vasodilation, immune system activation of phagocytosis to remove debris, the release of prostaglandins and inflammation.

Prostaglandins play a prominent part in pain production and increased capillary permeability (swelling).

The wound is hypoxic, but macrophages can perform the phagocytosis duties anaerobically.

#### Phase 2:

The Repair or Regeneration Phase.

48 hours to 6 weeks.

Characterized by the synthesis and deposition of collagen.

The collagen that is deposited is "not fully oriented in the direction of tensile strength.

Collagen fibers tend to contract between 3 and 14 weeks after injury, and perhaps for as long as 6 months, decreasing tissue elasticity. **[This is probably why we note reduced range of motion during this phase.]**

This phase is "largely one of increasing the quantity of the collagen" but this collagen is not laid down in the direction of stress.

Phase 3:

The Remodeling Phase.

This phase may last up to "12 months or more."

"The collagen is remodeled to increase the functional capabilities of the tendon or ligament to withstand the stresses imposed upon it."

"It appears that the tensile strength of the collagen is quite specific to the forces imposed on it during the remodeling phase: i.e. the maximum strength will be in the direction of the forces imposed on the ligament." **[This could argue for the need for specific line-of-drive joint adjustments.]**

This phase is largely "an improvement of the quality" (orientation and tensile strength) of the collagen.

"Normal ligaments are composed of type I collagen, whereas damaged (and healed) ligaments contain a large proportion of immature type III collagen which is deficient in the number of cross-linkages between and within the tropocollagen subunits."

The remodeled scar is deficient in both content and quality 40 weeks after injury, as there is a plateau in scar collagen concentration at about 70% of normal.

Acute inflammation is beneficial when one has acute infection. However, the "acute inflammatory phase of the body's response to trauma is apparently of no benefit." **[Most Important]**

"Numerous studies have shown the effectiveness of ice therapy in reducing the pain and period of disability to soft tissue injuries."(4 references)**[Important]**

In contrast, "early heat treatment leads to an increase in the blood flow to the injured area with an exaggerated acute inflammatory response." **[Important]**

"The advantages of cryotherapy in treating soft tissue injuries have been well documented." Ice within 48 hours of injury reduces disability of ankle sprains from 15 days to 10 days.

Cryotherapy is superior to heat, especially when applied within 24 hours of injury.

Cryotherapy should be limited to a maximum duration of 30 minutes.

"The use of anti-prostaglandin medications or nonsteroidal anti-inflammatory drugs (NSAIDs) in the management of acute soft tissue injury has become increasingly common in recent years despite a lack of adequate clinical studies to support such a practice." **[Important]**

Prostaglandins, especially E2, are responsible for the acute inflammatory response to trauma. **[Very Important]**

The use of anti-prostaglandin medications or nonsteroidal anti-inflammatory drugs (NSAIDs) should be used for no more than 72 hours or they become detrimental to the second phase of healing. **[Important]**

"It is well to remember that all of these types of medications have adverse effects, some minor (e.g. gastrointestinal intolerance) and some major (e.g. fatalities from bone marrow suppression)." **[This is really important: common pain drugs suppress the bone marrow, the sole producer of immune system cells. In another context, taking these pain drugs when suffering from colds or flu would suppress the immune system's ability to neutralize the pathogens.]** The use of these drugs "should be restricted to a maximum of 3 days following injury."

Corticosteroids have been shown to cause destructive changes in articular cartilage. "Steroids have a deleterious effect on collagen and direct injection into collagen may produce a permanent decrease in tensile strength." The use of steroids for soft tissue injury has "no sound biological basis." Steroids delay collagen repair. Steroids "retard fibroblastic activity and may well delay healing." "Corticosteroids have little part to play in the management of soft tissue injuries."

#### BENEFITS OF EARLY MOBILIZATION

- 1) Improvement of bone and ligament strength, reducing recurrence of injury.
- 2) The strength of repaired ligaments is proportional to the mobility of the ligament, resulting in larger diameter collagen fiber bundles and more total collagen.
- 3) "Collagen fiber growth and realignment can be stimulated by early tensile loading of muscle, tendon, and ligament." **[Important]**
- 4) Collagen formation is not confined to the healing ligaments, but adheres to surrounding tissues. The formation of these adhesions between repairing tissues and adjacent structures is minimized by early movement.
- 5) With motion, "joint proprioception is maintained or develops earlier after injury, and this may be of importance in preventing recurrences of injuries and in hastening full recovery to competitive fitness." **[Important, especially for chiropractors]**

- 6) The nutrition to the cartilage is better maintained with early mobilization.

#### ADVERSENESS OF IMMOBILIZATION

- 1) A decrease in aerobic capacity.
- 2) Muscle wasting and loss of strength.
- 3) One study showed that 8 weeks of immobilization of the anterior cruciate ligament delayed the return to full tensile strength for more than one year.
- 4) "Immobilization leads to a higher incidence of avulsion fractures of bony attachments of ligaments rather than ligament failure." **[Important]**

#### MANAGEMENT RECOMMENDATIONS:

- 1) "The principles of management of acute soft tissue injuries have been embodied in the acronym RICE (for rest, ice, compression, and elevation) during the first 48 to 72 hours following injury."
- 2) Following this acute inflammatory phase and largely guided by the pain response of the patient, early mobilization is commenced, based upon the premise that the stress of movement on repairing collagen is largely responsible for the orientation and tensile strength of the tendons and ligaments.
- 3) The goal of stressing repairing tissues with controlled motion is to induce adaptive response of functionally stronger connective tissues. However, excessive stressing of the repairing tissues may result in further damage. Consequently, any sign or symptom which suggests a worsening of the injury (severe pain) is a clear indication to reduce the motion stress on the tissues.
- 4) "The masking of such symptoms by analgesics is contraindicated." **[Important]**
- 5) Drinking alcohol increases local hemorrhage and the acute inflammatory response, and should therefore be avoided.

#### KEY POINTS FROM DAN MURPHY

- 1) Ligaments collagen fibers begin to fail at 7 to 8% strain.
- 2) Ligament strains as high as 20 to 40% can occur before signs of failure are apparent.
- 3) The healing of ligaments and soft tissue injuries in general has been shown to occur by fibrous repair or scar tissue, **[The Fibrosis Of Repair]** and not by regeneration of the damaged tissue.

- 4) There are three primary phases of soft tissue injury repair:
- A) Phase 1, The Acute Inflammatory or Reaction Phase.  
Lasts up to 72 hours, is characterized by pain and swelling, and mediated primarily by prostaglandin E2.
  - B) Phase 2, The Repair or Regeneration Phase.  
48 hours to 6 weeks, characterized by the synthesis and deposition of collagen, but this collagen is not fully oriented in the direction of tensile strength.
  - C) Phase 3, The Remodeling Phase.  
This phase may last up to "12 months or more."  
"The collagen is remodeled to increase the functional capabilities to withstand the stresses imposed upon it;" this remodeling occurs in response to specific forces applied to the tissues.
- 5) Healed ligaments still have problems. There are residual weaknesses as compared to normal ligaments because of reduced cross-linkages and a plateau in scar collagen concentration at about 70% of normal.
- 6) When one has an infection, acute inflammation is beneficial because it helps the body neutralize the pathogen. However, the "acute inflammatory phase of the body's response to trauma is apparently of no benefit," and results in adverse fibrosis. Early management should therefore include ice, not heat.
- 7) The use of anti-prostaglandin medications or nonsteroidal anti-inflammatory drugs (NSAIDs) in the management of acute soft tissue injury should NOT be used for more than 72 hours or they become detrimental to the second phase of healing. **[Important]**
- 8) Common pain drugs suppress the bone marrow [production of immune system cells]. **[This is really important]**
- 9) Corticosteroids damage articular cartilage, weaken the collagen repair, delay collagen repair, produce a permanent decrease in collagen strength, and should therefore never be used in the management of soft tissue injuries.
- 10) Early mobilization of soft tissue injuries improves the healing of bone, cartilage, tendon, ligament; reduces the adverseness of adhesions, and restores joint proprioception.
- 11) Immobilization of soft tissue injures decreases aerobic capacity, causes muscle wasting and loss of strength that may delay full recovery for a year or more.