Tissue Healing Timelines: The Stages & Phases of Healing

Speaker: Zak Kaylor, DPT

Objectives

- Discuss types of injuries affecting the musculoskeletal system, the inflammatory process and stages of healing.
- Apply the stages of healing to various tissues including muscle, tendon, ligament, cartilage, and bone.
- Describe factors that enhance and impede the healing process and the role of physical therapy in the healing process.
- List and describe the phases of rehabilitation and relate the clinical presentation in each phase to the stages of healing.
- Discuss the goals and interventions appropriate in each phase.

Classification of Injuries

Classification of Injuries

Primary

- Acute - 0 days to 7-10 days from onset of injury
- Subacute - 7-10 days to 12-20 days from onset of injury
- Chronic - anytime after 20 days from onset of injury
    - Any persistent inflammatory state
    - Adhesions, degenerative changes, etc.

Classification of Injuries cont.

Secondary

- Inflammatory response that occurs at time of primary injury
  - Examples: tendinitis, bursitis, etc.

Classification of Injuries cont.

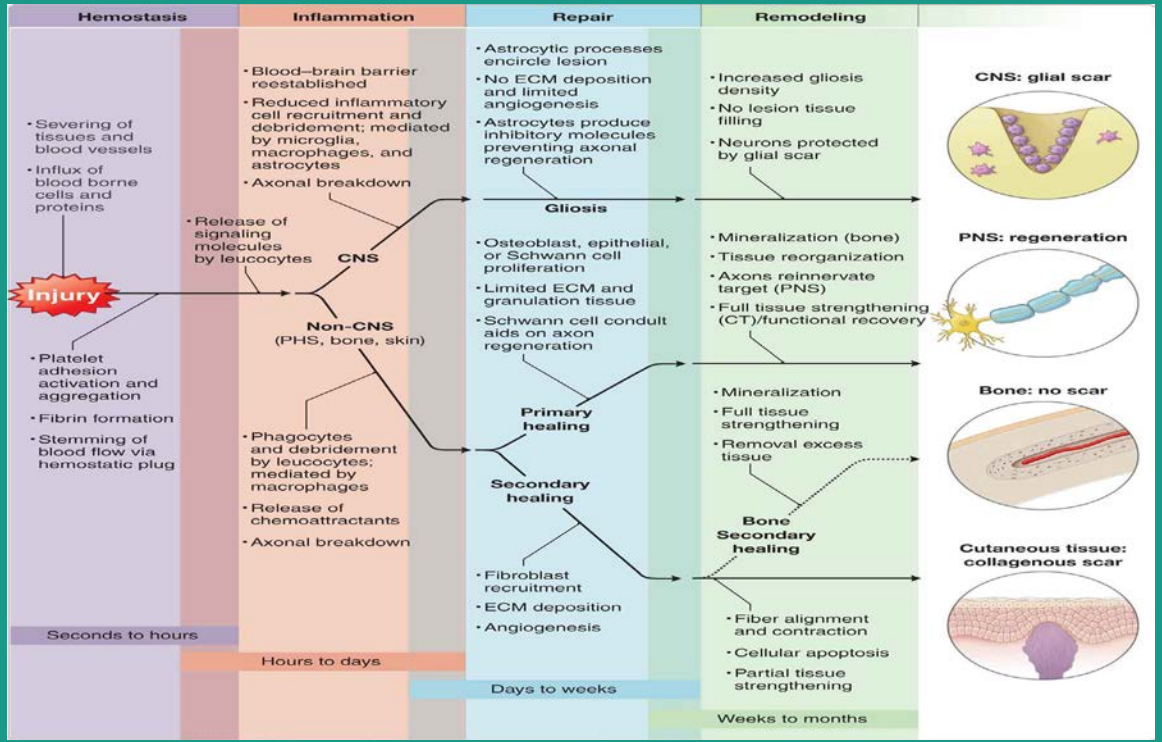
What is the mechanism of injury that creates a tissue injury?

- Infection
- Chemical agents
- Physical agents
- Aging
- Nutritional imbalance or deficiency
- Oxygen deprivation
- Immunological reactions
- Genetic defects
- Surgery


SORE KNEE, HUH? HAVE YOU TRIED ICING IT ?

Stages of Tissue Healing

Stages of Tissue Healing



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Stages of Healing - Homeostasis and Inflammation Stage

Acute stage of healing

Can be up to 10 days

Main goals

- Clot formation (Homeostasis)
- Remove debris
- Prevent infection
- Set the stage for the migration and proliferation stage

Stages of Healing - Homeostasis and Inflammation Stage cont.

Processes

- Vascular changes
- Cellular events
  - Leukocytes
  - Chemical mediators

Stages of Healing - Homeostasis and Inflammation Stage cont.

Clinical Presentation

- Edema/swelling
- Erythema/redness
- Heat
- Impairment
- Pain
    - At rest or with active motion
    - With any stress to affected tissue
    - Possible guarding

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Stages of Healing - Migration and Proliferation Stage

Subacute stage of healing

Overlaps with inflammatory stage (5-15 days to 10 weeks)

Main goals

- Wound closure

Stages of Healing - Migration and Proliferation Stage cont.

Processes

- Neovascularization
- Angiogenesis
- Increased tensile strength of wound
- Collagen Proliferation

Stages of Healing - Migration and Proliferation Stage cont.

Clinical Presentation

- Edema may still be present
- Joint effusion improved but is often still present
- Muscle weakness
- Intermittent pain
- Pain at the end of available ROM
- Contractures could be developing
- Limited functional use

Stages of Healing - Remodeling Stage

Chronic stage of healing

Can last a year or more.

Main Goals

- Conversion to scar tissue
- Increase tensile strength

Van der Mueulin

Stages of Healing - Remodeling Stage cont.

Processes

- Wound contraction
- Scar formation

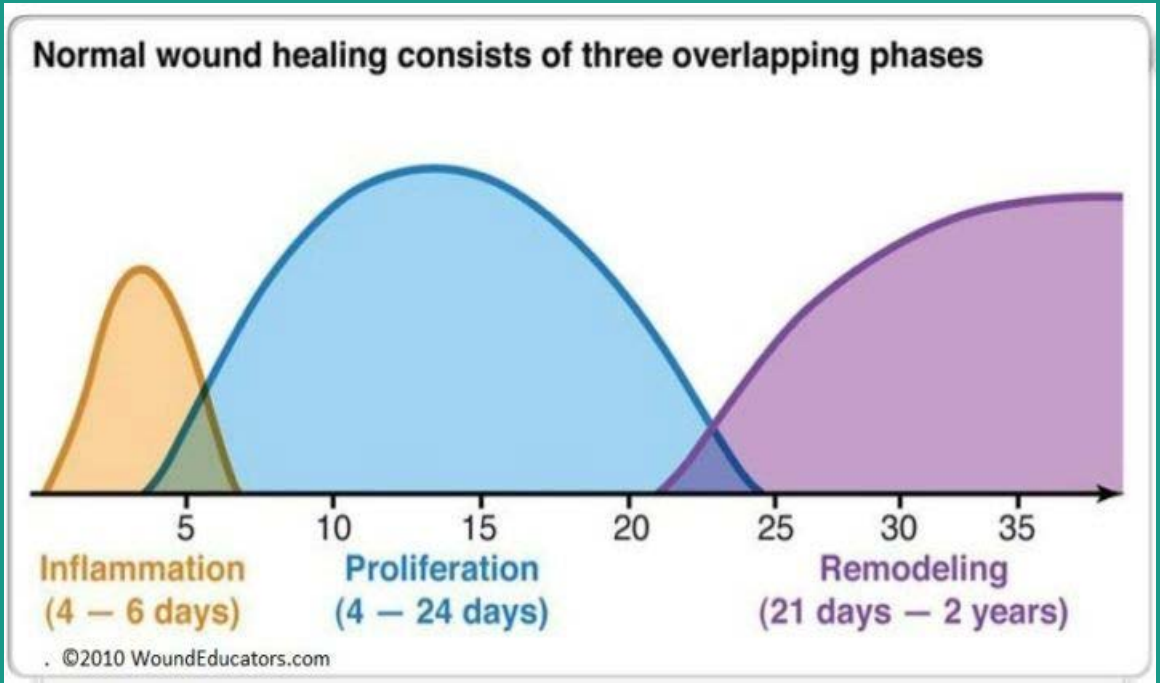
Stages of Healing - Remodeling Stage cont.

Clinical Presentation

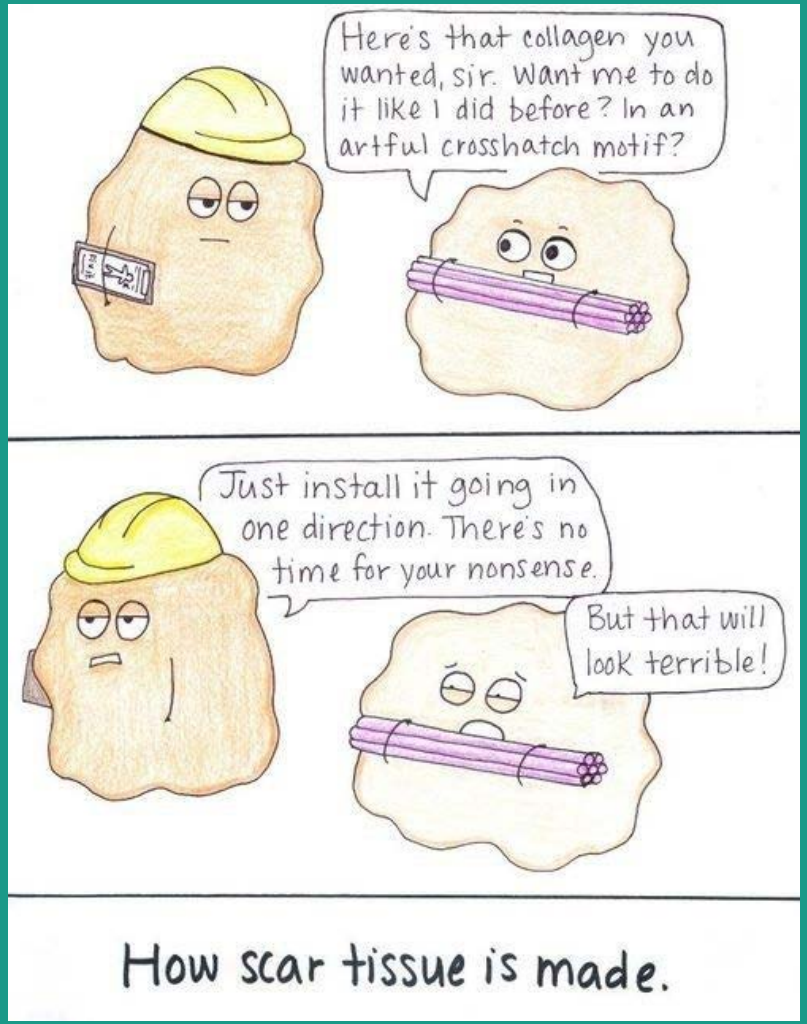
- No signs of inflammation
- Contractures or adhesions limiting ROM or joint play
- Decreased muscle performance
    - Pain during stretching
- Decreased function
    - Home or social activities
    - Work
- Progression to pain free functional activity

Van der Mueulin

Stages of Tissue Healing



Kevin Weiss


Here's that collagen you wanted, sir. Want me to do it like I did before? In an artful crosshatch motif?
Just install it going in one direction. There's no time for your nonsense.
But that will look terrible!
How scar tissue is made.

Chronic Inflammation and Pain

Chronic Inflammation

Tissue undergoes continuous stress that is beyond the body's ability to heal.

Inflammatory process persists

Leads to continued collagen production with degradation of mature collagen

- I.e. weaker tissue

Myofibroblast activity persists

- I.e. leads to limited motion

Ferrucci L, Fabbri E

Chronic Inflammation cont.

Tendinosis versus tendonitis

- Tendinosis is chronic whereas tendonitis is acute
- Be aware of the acute on chronic nature of injuries and the need for slower progressions due to the weaker nature of tissues with chronic inflammation

Chronic Inflammation cont.

Clinical presentation

Pain varies

- During and after repetitive activity
- Attempting provocative activities
- Continued and unremitting

Others include, but are not limited to: swelling, muscle guarding, contractures or adhesions, faulty postures, movement patterns, and biomechanical dysfunction, muscle weakness or imbalance, decreased function, stiffness after rest and progresses with irritation, and loss of ROM 24 hours after activity.

Ferrucci L, Fabbri E

Chronic Inflammation cont.

Goals

- Control inflammation
  - Treat as if in acute stage
- Improve impairments and biomechanical dysfunction
- Restore functional mobility

Ferrucci L, Fabbri E

Chronic Inflammation cont.

Chronic inflammation causes

- Overuse or cumulative trauma
  - Over time inflammation will lessen when condition turns degenerative
  - Repetitive trauma prevents healing
  - Progressing too quickly
- Reinjury of old scar tissue
  - Scar tissue is weaker than previous tissue
- Contractures or poor mobility

Ferrucci L, Fabbri E

Chronic Inflammation cont.

Chronic inflammation contributing factors

- Muscle imbalance (length or strength)
- Muscle weakness
- Sustained postures
- Inappropriate eccentric activity
- Change in activity
- Malalignment
- Training errors
- Environmental factors
- Combination of factors

Ferrucci L, Fabbri E

Chronic Pain

Chronic Pain Syndrome

- Persists longer than 3 months
- No clear source of symptoms
- Clinical presentation
    - Physical, emotional, and psychological

Raffaeli, William, et al.

Tissue Healing Timelines

Tissue Healing Timelines

Muscle strain

- Overstretching or overuse of the muscle
- Some degree of disruption of the musculotendinous unit
  - Tear will have pain but some muscle activity
  - Rupture will have no pain and no muscle activity
- Grade 1 (2-8 weeks)
- Grade 2 (2-4 months)
- Grade 3 (9-12 months)

Tissue Healing Timelines cont.

Ligament sprain

- Overstretching or tearing of a ligament or joint capsule
  - Tear will have pain with PROM
  - Rupture will have no pain with PROM
- Grade 1 (2-8 weeks)
- Grade 2 (2-6 months)
- Grade 3 (6-12 months)

Tissue Healing Timelines cont.

Tendon injury

- Overstretching or tearing of a tendon
  - Tear will have pain but some muscle activity
  - Rupture will have no pain and no muscle activity
- Acute (2-6 weeks)
- Subacute (2-4 months)
- Chronic (3-9 months)
- Tear or rupture requiring surgery (4-12+ months)

Tissue Healing Timelines cont.

Others

- Dislocation (1-4 months)
  - Displacement of joint causing soft tissue damage, inflammation, pain, or spasms
    - Subluxation is an incomplete dislocation
  - Timelines can change depending on number, frequency, and severity of dislocations
- Synovitis (3-4 days to 5 weeks)
  - Inflammation of a synovial membrane creating excess fluid
- Hemarthrosis (3-4 days to 5 weeks)
  - Bleeding into a joint

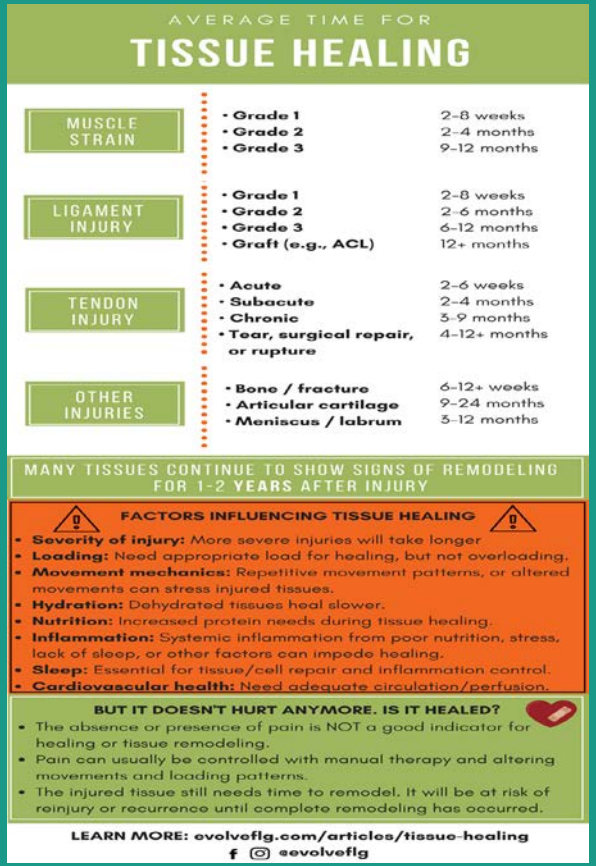
Kinslow, Brian

Tissue Healing Timelines cont.

Others cont.

- Bone (6-12+ weeks)
- Articular cartilage (9-24 months)
- Meniscus or labrum (3-12 months)
- Nerve (12 months)

Tissue Healing Timelines



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Tissue Healing Timelines cont.

Other factors that affect tissue healing

- Comorbidities
- Severity - more severe injuries take longer to heal
- Loading - appropriate loading (not over but not under)
- Movement mechanics - repetitive or altered movements can stress tissue
- Hydration - dehydrated tissue heals slowly
- Nutrition - increased protein needs during tissue healing
- Inflammation - systemic inflammation from poor nutrition, stress, lack of sleep, or other factors can impede healing
- Sleep - essential for tissue/cell repair and inflammation control
- Cardiovascular health - need adequate circulation and perfusion of tissue

Tissue Healing Timelines cont.

Does no pain mean a tissue is healed?

- No pain does not mean a tissue is healed
- The absence or presence of pain is not a good indicator for tissue healing or tissue remodeling
- Pain can usually be controlled with manual therapy and altered movement and loading patterns.
- The injured tissue still needs time to remodel. It will be at risk of reinjury or recurrence until complete remodeling has occurred.

Phases of Healing

Phase 1 - The Protection Phase

Goals

- Control inflammation
- Facilitate healing
- Maintain normal mobility in adjacent structure

Phase 1 - The Protection Phase cont.

Interventions

- Patient education
- Protection
- “Relative rest”
- Minimize effects of immobility
- PROM
- Setting or isometric activity
- Manual treatment
    - Myofascial release or soft tissue mobilizations
    - Grade 1-2 joint mobilizations when appropriate

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Phase 2 - The Controlled Motion Phase

Goals

- Facilitate healing process
- Improve mobility of tissues and neuromuscular control
- Maintain function of adjacent areas

Phase 2 - The Controlled Motion Phase cont.

Interventions

- Patient education
- Initiate AROM
- Multi-angle isometrics
- Protected weight bearing
- Initiate or progress stretching

Phase 3 - The Return to Function Phase

Goals

- Facilitate return to previous functional level, work, or sport
- Improve strength, endurance, and neuromuscular control
- Improve or restore cardiopulmonary function
- Prevent re-injury

Phase 3 - The Return to Function Phase cont.

Interventions

- Patient education
- Exercise progression
  - Activity or work and goal specific
  - Functional activities
  - Developing a home exercise plan that can be performed to prevent re-injury

How Stages and Phases Align

Stage 1 = Phase 1

Stage 2 = Phase 2

Stage 3 = Phase 3

However, depending on the patient or client an aspect of a phase might be used during a different stage i.e. performing phase 2 neuromuscular reeducation to improve quad activation after an ACL reconstruction.

Surgical Considerations

Surgery acts as a trauma, and as such marks the start of the stages of healing.

Things to consider that will have an effect on the healing timelines post-op include:

- What tissues are affected?
  - Contractile vs.non-contractile, healing timelines of each tissue, and cumulative effect of multiple traumas
- Was there a graft?
  - What was used?
    - Allograft vs. autograft, where was graft gathered from (hamstring vs. patellar tendon for ACL reconstruction)

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Surgical Considerations cont.

Were there complications with surgery?

- Operatively and post-operatively

Does the patient/client have comorbidities?

- General health of patients, age of patients, etc.

Is the patient/client compliant?

Surgical Protocols

Protocols should reflect the aforementioned stages of healing and surgical considerations.

With the stages of healing and surgical considerations in mind a timeline for the phases of rehabilitation process should be determined.

Protocols should be guidelines for a physical therapist to follow with the understanding that every patient, and thus every recovery, is different.

Protocols should be written with a collaboration between MDs/DOs and PTs to create the best outcomes for patients.

- MD/DO have more familiarity of the intricacies of the surgery that was performed.
- PTs have more practice with the intricacies of the rehabilitation process.


PHYSICAL
THERAPY
TODAY
IT HURTS
TOMORROW
IT WORKS

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Questions?