**SOFT TISSUE DYSFUNCTION**

**Differentiating soft tissue injuries and dysfunction**

**Soft tissue injury**
The soft tissues of the body include ligaments, tendons and muscles (not bone). A soft tissue injury is when the tissue has been damaged, as a result of a direct or indirect trauma, such as the impact of an external force, overload to the tissues, or repetitive overuse.
**Types of soft tissue injury**

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| **Muscle** | Injuries associated with the muscular system include:<br>• Strains: tearing of muscle fibres caused by excessive tensile stresses<br>• Contusions: caused by an external blow or impact to the muscle leading to disruption of the muscle fibres and their neurovascular supply, often observed as bruising (ecchymosis).<br>The bleeding and swelling associated with a contusion is usually referred to as a hematoma.<br>• Intramuscular hematomas are characterised by blood extravasation into the body of the muscle affected by the impact<br>• Intermuscular hematomas are characterised by extravasation of blood between the muscles and fascia<br>• Muscle cramps: sudden onset of pain and tightness in the muscle<br>• Delayed onset muscle soreness (DOMS): occurs 1-2 days after exercise (not an immediate effect) |
| **Ligament**s | The primary role of ligaments is to connect bone to bone and establish joint stability. Ligament injuries, or tears, usually occur as a result of high tensile loads placed on them and are referred to as sprains. |
| **Tendons** | **Tendons** are the structures responsible for force transfer from skeletal muscle to bone. Tendon injuries may result from direct trauma or repetitive overuse. Tears to the musculotendinous units are referred to as strains (see above), but repetitive overloading may result in degenerative or inflammatory response.<br>These tendon injuries can be referred to as:<br>• Tendinopathy: a generic description to describe overuse injuries to tendons characterised by a failed healing response, disorganised collagen and and pain associated with overuse of the tendon.<br>• Tendinosis - a mild degeneration of the tendon. May include ruptures and tearing (partial or complete).<br>• Tenovaginitis - roughening of the inner sheath, causing a sensation of grating (crepitus) Tendinitis: inflammation of the tendon and results from micro-tears when the tendon is<br>• acutely overloaded with a tensile force that is too heavy and/or too sudden.<br>• Tenosynovitis: an inflammation of the tendon sheath (synovium) that surrounds the tendon |
| **Skin** | Injuries to skin can take various forms and may involve many causal mechanisms such as friction and penetration.<br>Examples of injuries to skin include: Cuts, abrasions, friction burns and grazes, blisters |
| **Bursas** | A bursa is a small fluid-filled sac that provides cushioning between bones and tendons, helping to reduce the influence of friction between these structures.<br>Injuries to bursa include:<br>• Bursitis: swelling of a bursa due to overuse or direct trauma |

# Causes of soft tissue injury

## Primarily soft tissue injuries can be categorised into the following:

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| **Intrinsic injuries**<br><br>Which relate to individuals innate anatomical and physiological factors. | • Muscle weakness<br>• Muscle length / flexibility or inflexibility<br>• Joint laxity or stiffness<br>• Excessive Q-angle<br>• Muscle imbalances |
| **Extrinsic injuries**<br><br>Which relates to factors outside of an individual's control. | • Environmental factors, e.g. an uneven or unsprung floor surface<br>• Suitability of clothing, e.g. footwear<br>• Ineffective protective equipment<br>• Trauma from an external object or person, e.g. contact sports<br>• Poor coaching techniques |

### Soft tissue dysfunction

Soft tissue dysfunction describes impairments or imbalances of the soft tissues. Dysfunction is non-pathological; the tissue is not currently injured and there is no inflammation.
When soft tissues are placed under excessive stresses, compensatory movements, postures and muscle imbalances occur, which in turn can create further dysfunction within the soft tissues themselves. Soft tissue dysfunctions may either be the primary source of symptoms or secondary due to an altered structural and functional capacity.

## Causes of soft tissue dysfunction

### Primarily soft tissue injuries can be categorised into the following:

- Congenital factors such as short leg or small hemipelvis
- Postural stresses
- Overuse of soft tissues due to sport or over-activity
- Inappropriate patterns of activity at work or at home
- Alerted movement patterns as a result of injury

## Characteristics of soft tissue dysfunction

| | |
|---|---|
| **Adhesions** | Abnormal sticking together of soft tissues, often associated with the development of cross-links between collagen fibres. Scar tissue adhesions may also contribute to a lack of glide between tissues and reduced functional capacity following soft tissue injury. Adhesions can develop following periods of immobilisation and in adaptation to abnormal posture. |
| **Altered fluid dynamics** | Periods of immobilisation or postural adaptation may lead to a dehydration of ground substance within the connective tissue. Dehydration of the ground substance may result in an increase in tissue stiffness and rigidity. Fluid stagnation may also lead to a reduced cellular activity and an increase in the accumulation of waste products within the tissues. |
| **Muscle imbalances** | Postural dysfunctions may lead to muscle hypertonicity and inhibition around joints. This imbalance may affect the normal muscle/ joint co-ordination. |
| **Altered joint mechanics** | Adhesions, altered fluid dynamics and muscle imbalances may contribute to joint restrictions and misalignment leading to impaired movement. |

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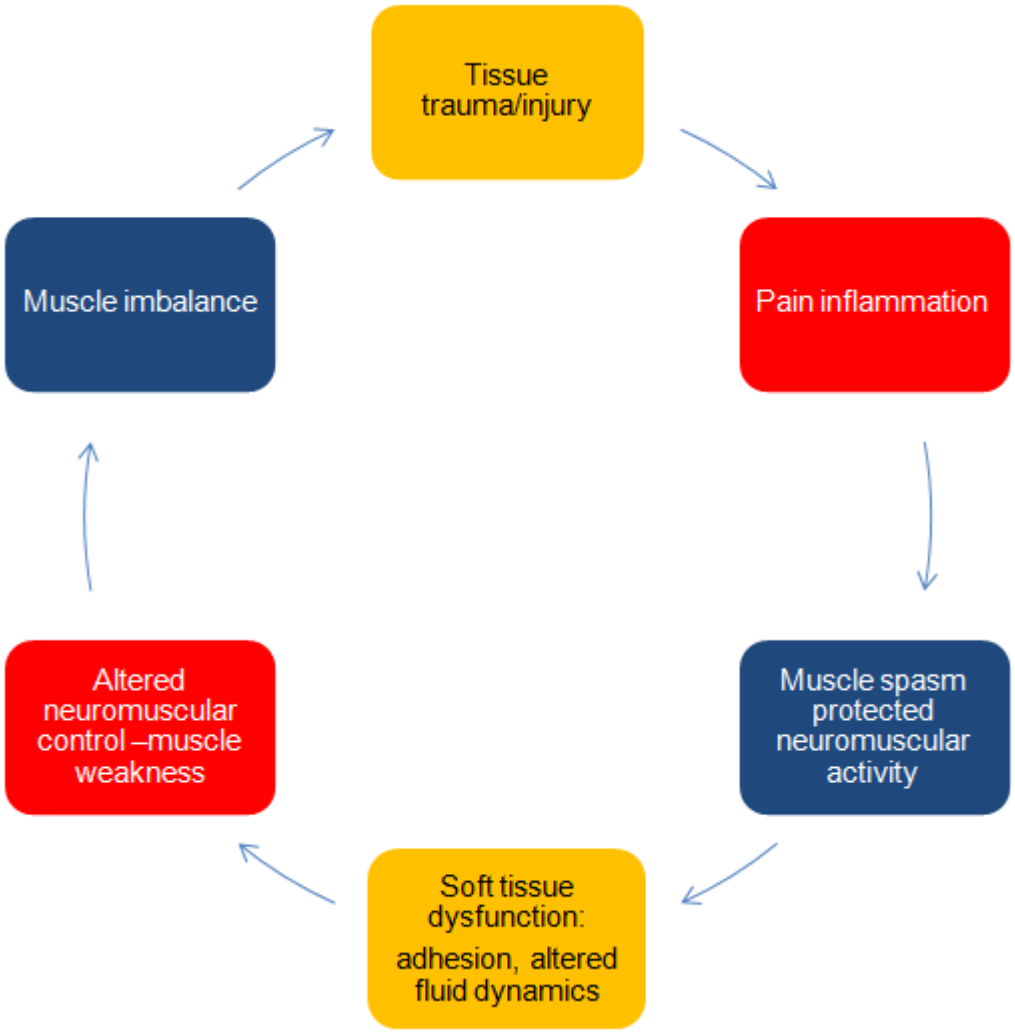
| **Abnormal neuromuscular activity** | Balanced joint mechanics lead to even pressures within the joints. Joint receptors are therefore able to provide information to the CNS that the joint is functioning correctly. Adhesions, tissue dehydration and muscle imbalances may cause disruptions to the sensory signals from the joints and alter the neuromuscular activity at the joint {e.g. muscle spasm) and contribute to changes in other joints and posture as a whole. |

## Soft tissue injury and dysfunction connection

It is important not to see soft tissue injury and dysfunction as two separate entities but an interconnecting series of events that are intimately related to each other. Any trauma will usually result in pain and inflammation, which in turn will initiate protective mechanisms such as altered motor activities and or muscle spasms. As a result of these protective mechanisms normal joint patterns and movements will be disrupted leading to the development of adhesions, dehydrated ground substance, altered neuromuscular activity and further tissue damage. This cycle of events is depicted in the diagram below. It is important for the massage therapist to identify those dysfunctions and muscle imbalances in order to restore normal function where possible.

**Injury and dysfunction cycle**



## Grades of injuries

**Muscle strains** are common within athletic and professional sportsmen/women, and are usually due to the individual overreaching the muscle tissue's normal capacity. The damage usually occurs within the musculotendinous junction (MJT), and has a subsequent grading that relates to the specific degree of damage that has occurred at that area.

| Grading | Characteristics | Symptoms for therapist |
|---|---|---|
| *I*<br>**strain** | Less than 5% of fibre disruption; grade I (mild) strains are minimal structural disruption and a rapid return to normal function. | • Minor weakness evident<br>• Minor muscle spasm<br>• Minor swelling possible<br>• Minor loss of function<br>• Minor pain on stretch<br>• Minor pain in resisted isometric contraction |
| *II*<br>**partial tear** | Grade II strains are accompanied by a partial tear in the muscle with greater fibre damage | • Weakness more pronounced<br>• Weakness due to reflex inhibition<br>• Moderate to major spasm in injured muscles<br>• Moderate to major spasm in nearby muscles<br>• Moderate to major swelling<br>• Moderate to major impaired function Pain likely during stretch<br>• Pain likely with resisted isometric contraction |
| *III*<br>**complete tear** | Complete discontinuity of muscle fibres, haematoma and retraction of the muscle ends | • Muscle may not function<br>• Spasm if muscle is intact<br>• Surrounding muscles in spasm<br>• Moderate to major swelling<br>• Loss of function due to reflex inhibition<br>• Pain severe at injury, but may recede |

**Ligamentous sprains** usually occur when joints are loaded excessively and can compromise the ligaments stabilisation role. The severity of the sprain is clinically specified according to the degree of damage that has occurred at the ligament.

| Grading | Characteristics | Signs and symptoms for therapist |
|---|---|---|
| *I* | In a grade ll (mild) sprain a few fibres are torn and there may be some stretching to the ligament that is not permanent | • Few ligament fibres torn<br>• Temporary ligament stretching possible<br>• Mild to moderate pain with stretch<br>• Minor swelling<br>• local muscle spasm likely |
| *II* | ln a grade ll (moderate) sprain more fibres are torn and the overstretched ligament may remain overstretched leading to some joint laxity. | • More ligament fibres torn<br>• Ligament overstretching likely<br>• Joint laxity likely<br>• Moderate to severe pain with stretch<br>• Moderate swelling likely<br>• Local muscle spasm likely |
| *III* | In a grade lll (severe) sprain most or all of the fibres are torn, leaving the joint unstable with possible long-term stability effects. | • Severe tear or rupture<br>• Fibres likely to need repair<br>• Permanent changes in joint stability likely<br>• Pain severe at injury site<br>• Pain may recede if ends detached<br>• Moderate to severe swelling likely<br>• Muscle spasm likely |

## PROCESS OF SOFT TISSUE REPAIR

Knowledge and understanding of the phases of tissue healing is essential to guide the effective management and rehabilitation of soft tissue injuries. Healing describes the recovery process. It refers to the various stages of repair, where the body replaces destroyed and damaged tissue with new living tissue. All connective tissue injuries, regardless of their severity, follow the same healing process.

### The four main stages of the healing process are:

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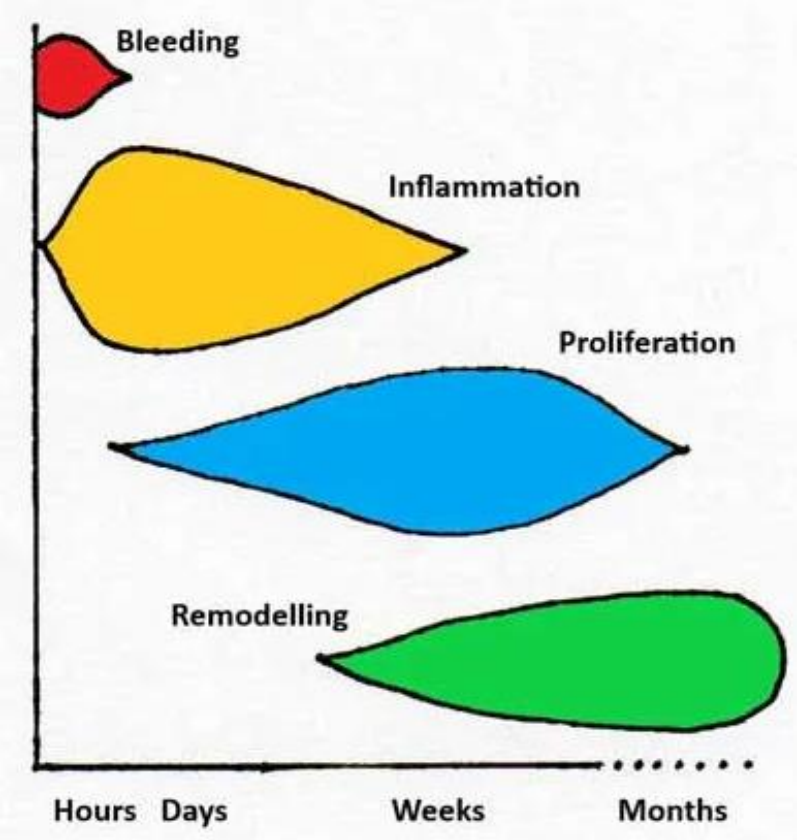
| **Stage 1** | ***Immediate stage***<br>Bleeding phase | Up to 4-6 hours (client specific) |
| **Stage 2** | ***Acute stage***<br>The Inflammatory phase | Up to 3 days post injury |
| **Stage 3** | **Sub-acute Stage**<br>Proliferation phase | 2 days to 3 weeks post injury |
| **Stage 4** | **Chronic Stage**<br>Remodelling phase | 3 weeks to 2 years post injury |

**Stages of Soft Tissue Repair**

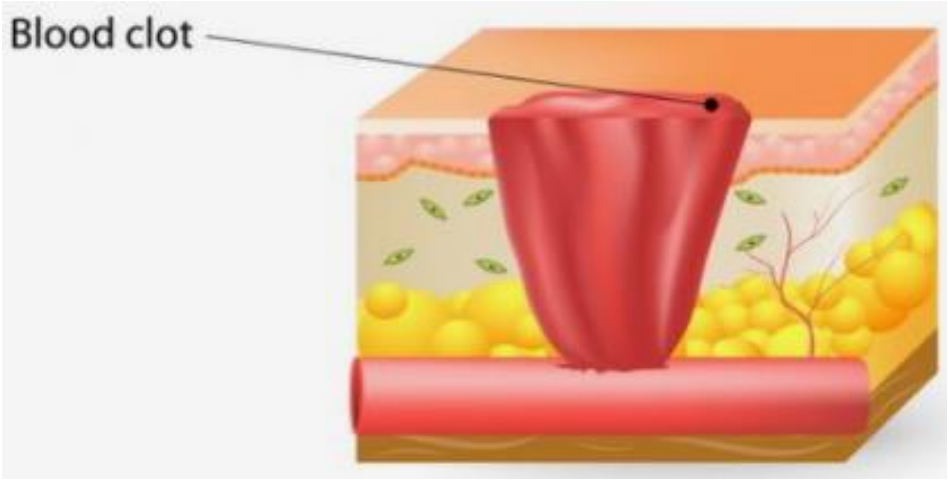



Clients will present with different types of injury and their injuries may be at different stages of the healing and recovery process. Massage therapists need to gather sufficient information from the client to assess their needs; they should also be sensitive to the worry, angst or pain the client is experiencing at the different stages. It is imperative to understand the healing process and what post therapy advice is essential to assist recovery and rehabilitation for soft tissue healing.

## Bleeding phase

This is a relatively short lived phase, and will occur following injury, trauma or other similar insult. If there has been no overt injury, this will be of little or no importance, but following soft tissue injury there will have been some bleeding. The normal time for bleeding to stop will vary with the nature of the injury, and the nature of the tissue in question.

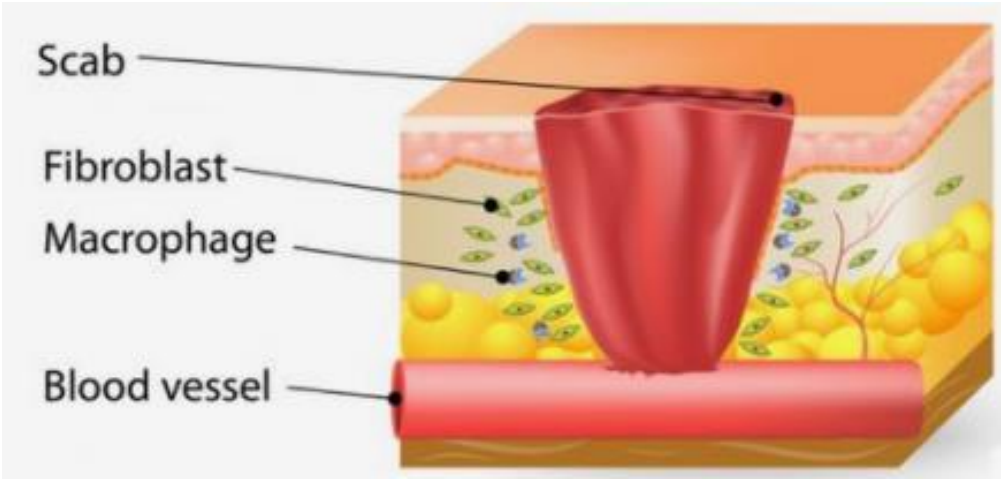
The more vascular tissues (e.g. muscle) will bleed for longer and there will be a greater escape of blood into the tissues. Other tissues (e.g. ligament) will bleed less (both in terms of duration and volume). It is normally cited that the interval between injury and end of bleeding is a matter of a few hours (4-6 hours). Some tissues may continue to bleed for a significantly longer period, albeit at a significantly reduced rate.




**Bleeding phase**

## Inflammation phase

The inflammatory phase is an essential component of the tissue repair process and is best regarded in this way rather than as an 'inappropriate reaction' to injury. There are, of course, numerous other initiators of the inflammatory process (e.g. repetitive minor trauma, mechanical irritation). The inflammatory phase has a rapid onset (few hours at most) and swiftly increases in magnitude to its maximal reaction (1-3 days) before gradually resolving (over the next couple of weeks). The onset and resolution are swifter in more vascular tissues and slower in the relatively poorly vascularised tissues.



**The inflammatory phase is often characterised by the following signs and symptoms:**

## Inflammatory indicators

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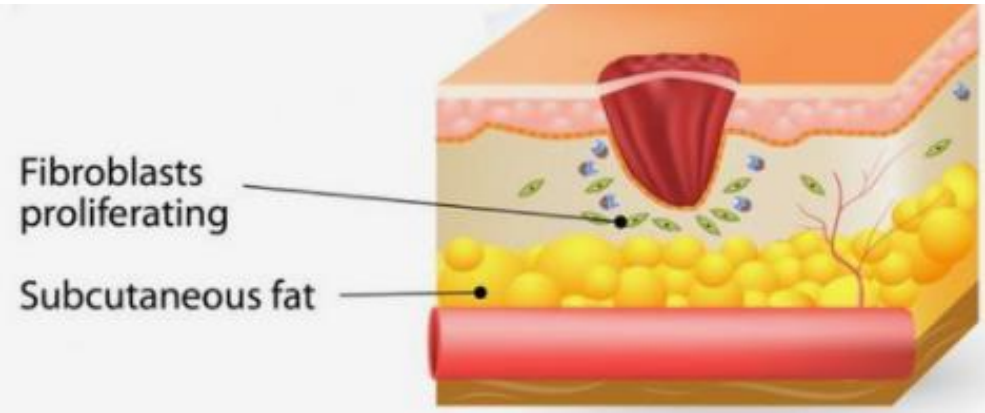
|---|---|
| ***Pain*** | • Damage to local nerve fibres<br>• Swelling |
| ***Swelling*** | • Damage of blood and lymphatic vessels |
| ***Heat*** | • Dilation of localised undamaged blood vessels |
| ***Redness*** | • Dilation of localised undamaged blood vessels (erythema) |
| ***Reduced ROM*** | • Pain<br>• Swelling<br>• Loss of optimal functioning |

Within the inflammatory phase swelling may occur due to the damaged blood vessels leaking blood into the tissues. The usual mechanism other than pain, and skin discoloration will be vasoconstriction, as the body needs to reduce the blood loss immediately. The physiological effect of this is subsequent cell death, as the cells become starved of oxygen. The death of the cells release histamine which then dilates the blood vessels, aiding in cell repair. The cell then develops a haematoma, which needs to be cleared as it is caused by dead cells and blood. At this stage the vessel becomes more permeable, and viscous. The pressure within the cells subsequently increases, which in turn forces plasma into the interstitial space, and white cells are mobilised to 'pick up' the dead cells, debris and fight infection. Within this stage a fibrin mesh is laid down which initiates the start of the healing process.

## Proliferation phase

The proliferative phase essentially involves the generation of the repair material, which for the majority of musculoskeletal injuries, involves the production of scar (collagen) material. The build-up of scar tissue is influenced by the tensile stresses the tissue is subject too.

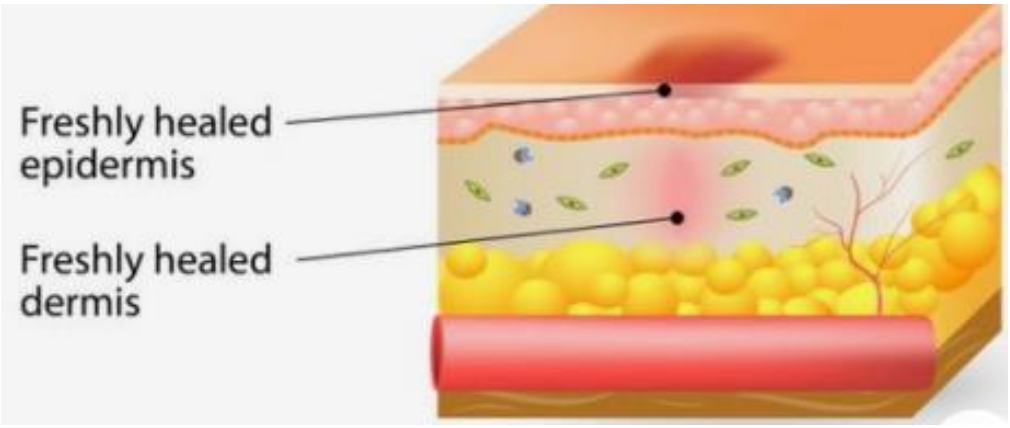



**Proliferation phase**

If there are no tensile stresses, then the collagen will be laid down in a non-directional cross sectional manner, resulting in extensive scar tissue, and reduced ROM. This is to protect the body from infections and to start the remodelling process, as the collagen will draw the wound together making it tightly compact. The proliferative phase has a rapid onset (24-48 hours) but takes considerably longer to reach its peak reactivity, which is usually between 2-3 weeks post injury (the more vascular the tissue, the shorter the time taken to reach peak proliferative production).

## Remodelling phase

The remodelling phase starts at around the same time as the peak of the proliferative phase (2-3 weeks post injury). After weeks 3, the weakened connective tissue gains more collagen fibres and become stronger, while losing its vascularity. The outcome of the remodelling phase is that the damaged tissue will be repaired with a scar which is not a 'like for like' replacement of the original, but does provide a functional, long term 'mend' which is capable of enabling quality recovery from injury. As the scar tissue develops it becomes fibrous and inelastic. When the collagen fibres start to align themselves with tensile stress, 20% of the tissue's original strength will be achieved within the 3 weeks, and reaches 80% maximal strength at full maturation.




**Remodelling phase**

## Treatment strategies

The objective of a successful treatment/rehabilitation program, should have the client's short and long term goals in mind. The overall programme and individual exercises should progress the client safely and effectively and return the client to their optimum functioning, while reducing the risk of re-injury. The therapist must ensure that they are competent at acknowledging the severity of the injury, they have the capability to assess the client status, they incorporate the correct therapeutic modalities, and exercises for the correct rehabilitation phase, have the ability to evaluate the outcome measures and re-assess to meet the client's overall goals.

The stages of soft tissue repair coincide with the treatment strategies that need to be applied to ensure the client meets their goals. The therapist needs to understand that therapeutic modalities will accelerate the client's rate of recovery; the use of medications can facilitate the stages of repair. Understanding human kinetic chains, and the functional units they encompass will ensure the client receives appropriate training to be biomechanically efficient. Finally therapists need to be aware of the psychological stress which occurs when dealing with a client who is injured.

**Treatment during the immediate and inflammatory phase**

The therapist's initial aim immediately post injury is to aid in narrowing the blood vessels, stem the flow of blood, aid in reducing swelling, minimise secondary cell death, reduce inflammation, and minimise pain.

The treatment strategy to support the healing process at this stage is the **PRICE** protocol, which is an acronym for the following;

| | | |
|---|---|---|
| **P** | **Protection** | Ensure first aid treatment is administered immediately. Remove the client from any further danger, and provide protection throughout the treatment until client is safe. |
| **R** | **Rest** | Allow the injured area to be rested immediately. Ceasing the activity is essential to ensure no further damage occurs to the client. |
| **I** | **Ice** | As soon as the injury has occurred, ice should be applied for around 10-12 mins initially. The application of ice reduces the skin temperature, causing vasoconstriction, so reduces blood flow. The reduction in temperature decreases metabolic activity, and subsequent pain. Never apply the ice directly to the skin, as it may result in 'burns'. The application of ice can be effective as it can be self-administered. |
| **C** | **Compression** | Apply a compression bandage to minimise the swelling. Ensure it is firmly applied, but not too tight to restrict blood flow indefinitely. Apply the compression bandage distal to proximal to aid in venous return. |
| **E** | **Elevation** | Elevate the injured area to reduce blood flow, and limit the use of any synergistic muscles. The capillary hydrostatic pressure is reduced, which decreases the amount of fluid forced into the interstitial space, and since the lack of movement will inhibit venous return and lymphatic circulation, gravity must assist in encouraging these mechanisms. |

**Treatment during the proliferation phase**

The inflammatory phase subsides usually after two days, the swelling starts to reduce, and the proliferation process starts to begin. The blood vessels start to repair, transporting nutrients and oxygen to the tissue. As muscle doesn't have the capabilities to regenerate new tissue, the body replaces the tissue with new scar tissue. The body produces a vascular mass of cells, and lays down collagen. Over the coming weeks, the collagen fibres become more tensile, however only reach a tensile strength peak of 70%, in comparison to the healthy tissue. This makes the tissue susceptible to further injury, as it is weakened over this period, and the tissue loses its vascularity. Over this period the subsequent scar tissue becomes more fibrous and inelastic and is also non-functional.

**Aims of treatment during this phase are to:**

- Develop mobility
- Restore tensile strength
- Minimise swelling
- Minimise excessive scar tissue
- Minimise pain

**Appropriate treatment strategies during this phase:**

- Mobility exercises
- Mid-range isometric muscle contraction exercises
- General massage techniques, specifically effleurage, frictions and petrissage
- Heat and ice
- General stretches - controlled dynamic stretching (range of motion and speed of movement) and developmental static stretching
- Progressive weight training program
- Alternative exercises such as: swimming, yoga, Pilates

**Treatment during the remodelling phase**

Once the proliferation phase is completed, the therapist's main goals should be to get the client back to their previous daily function, or above that level, with progressive planning.
The goals of the client will vary depending on specific damage but the overall aims will encompass these elements within them;

- Regain daily living function
- Regain/develop strength
- Regain/develop mobility
- Regain/develop flexibility
- Regain/develop cardio/respiratory fitness to optimise cell function

**Appropriate treatment strategies during this phase:**

- Progression of proliferation treatment strategies, e.g. massage techniques
- Progressive flexibility program
- Progressive strength program
- Progressive muscular endurance and cardio-respiratory program
- Functional daily activities

**Flexibility**

A progressive flexibility program will ensure the client has an optimal range of movement. This ensures the muscle is working within their limitations and will not be further damaged. The flexibility program should coincide, and be an addition to the proliferation treatment strategies.

Passive stretching is extremely productive within the initial stage of the remodelling phase, as the therapist can control the timings, and how to elicit the stretch. As the therapist stretches the client they can gain biofeedback for the tissue degradation, and also from the client themselves. This can be performed post massage, as the muscles will have been optimally manipulated.

Dynamic stretching can be performed, provided the client can work through the range of motion using a controlled tempo (to minimise the risk of injury). The therapist can progress this, by encouraging the client to start working within a small range of movement and working towards a more gross/high range of movement when the tissue is ready. The aim should be to get the client back to their full range of movement (prior to the injury).

**Strength**

Muscles, ligaments, and tendons have varied healing processes and respond to different stimuli. If they do not get the correct stimuli they will atrophy and become weak, so strengthening exercises should be implemented as soon as possible to aid the healing process, and for muscular hypertrophy.

- Initially isometric exercises should be implemented especially if the client is non-weight bearing, as this will help with strengthening the muscles within the targeted area. Once the isometric exercises are being performed, some passive or active range of motion (ROM) exercises can be included.
- Eccentric exercises are a logical progression as they will help strengthen the muscles and improve ROM.
- Concentric exercises either performed partially, or through full weight bearing to strengthen the joint and muscle.
- The therapist needs to ensure while performing these exercises that they are not provoking any compensatory movements, and/or mechanical dysfunction, as long term rehabilitation will be hindered.
- Daily living activities should be performed to ensure the client can perform regular, daily tasks, e.g. squats, lunges, rolling over in bed, side lying, rotation twists. Once these movements have been performed exercises can be progressed to multi-planar movements that work on myofascial slings and anterior and posterior chain movements that ensure the client is mechanically stable.

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