

Symposium on Muscle injuries

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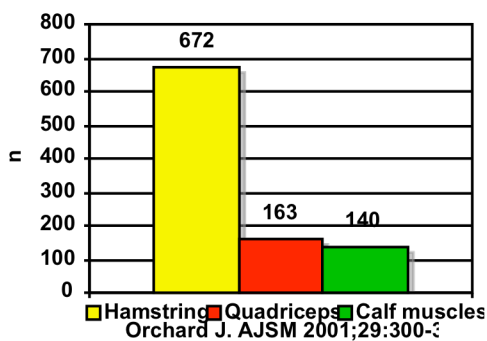
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Muscle injuries are one of the most common injuries seen after sports activity. The incidence varies between 10% and 55% of all sustained injuries.

Australian football, 1992-1999
85503 player-matches



consequently to a rupture near the musculo-tendinous junction.

More injuries are seen during matches compared to training sessions. A muscle contusion occurs when the muscle is hit by a direct blow common in contact sports.

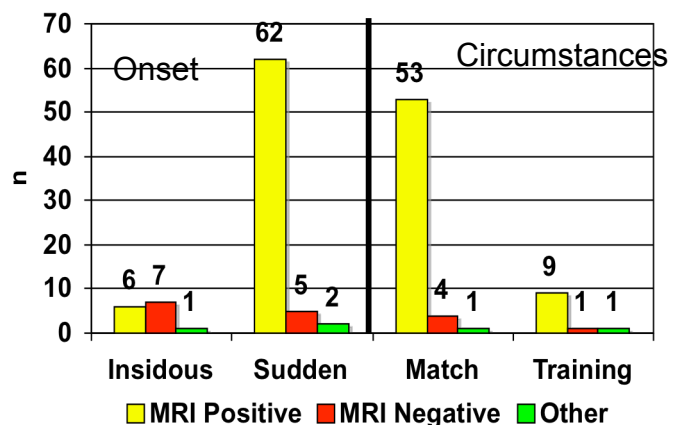
Lacerations are rare reasons for muscle injuries in the athletic population.

The current clinical classification is based on the clinical impairment.

Possible risk factors for muscle injuries are age, a recent or a past injury of the same muscle, low flexibility, and others.

Most injuries occur sudden after an extensive tensile force that leads to an overstraining of the myofibers and

American Football, 2 seasons, 3 teams



- 1 DOMS Delayed Onset Muscle Soreness: pain, swelling, and loss of strength and ROM after eccentric exercise, increase in intensity during first 24 h after exercise, peak intensity after 24 to 72 h

- 2 Mild (first-degree) strain/contusion : tear of only a few muscle fibers, minor swelling and discomfort, no or only minimal loss of strength and restriction of the movements.

- 3 Moderate (2nd-degree) strain/contusion: greater damage of the muscle, clear loss in function (ability to contract)

- 4 Severe (third-degree) strain/contusion: a tear extending across the entire cross section , virtually complete loss of muscle function

The clinical picture depends on the severity of the injury and the nature of the hematoma.

The intramuscular blood vessels are torn relatively easily, so we can see inter- and intramuscular hematomas.

CONSERVATIVE TREATMENT OF MUSCLE STRAINS

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Muscle injuries can be classified as:

- *Delayed Onset Muscle Soreness (DOMS)*
- *Strains*
 - I° DEGREE: local fibril and filament damage with no solution of continuity
 - II° DEGREE: interruption of a certain number of muscles fibres without involvement of a grossly recognisable portion of the belly
 - III° DEGREE: rupture of a large portion of the belly with clinically evident solution of continuity
- *Contusions*
 - intermuscular haematoma
 - intramuscular haematoma
- *Avulsions*
 - osseous
 - apophyseal
 - muscular

In the case of strains, the muscle-tendon junction is particularly at risk due to its lesser extensibility and the sudden reduction of the local circulation in the tendon compared with the muscle and the bi-articular muscles, especially the ones with greater number of type II, fast-contraction fibres.

Slight muscle injuries are repaired by mononuclear satellite cells that differentiate into myoblasts. More serious injuries are mainly repaired by the formation of scar tissue. The way in which recovery of function progresses is of fundamental importance because it guides the correct repair of the newly formed tissue.

An account will be given of the principles applicable during the rehabilitation of a subject with a stage II injury. Three time phases are distinguished: the acute phase, remodelling and recovery of function.

The first step requires application of a compressive elastic bandage and local cryotherapy (20 min/hr). This phase is marked by local haemorrhage, myofibrillar retraction and oedema due to enhanced capillar permeability. The goal of the RICE (rest, ice, compression and elevation) procedure is to limit the initial damage. Nonsteroidal anti-inflammatory drugs (NSAIDs), muscle relaxants and other drugs are not used. Pain, in fact, is not usually such as to require analgesic cover.

After 24-48 hr marked oedema is associated with mechanical muscle weakness due to massive macrophage invasion. An overaggressive approach at this stage may cause further tissue damage, prolong the inflammation and delay repair. The outstanding neuroreflex action of transcutaneous electric nerve stimulation (TENS) can be safely and effectively used to relieve pain. On the third day the bandage is removed for echography and magnetic resonance imaging (MRI) if required. Thanks to its hydrodynamic, hydrostatic, proprioceptive and thermal effects idrokinesitherapy allow the commencement of active mobilisation and reinstatement of the range of motion (ROM).

Initial remodelling starts on the 3rd-6th day when fibroblasts deposit collagen. Healing is

encouraged by the capillary neovascularization thus induced since it brings the oxygen and nutrients needed for regenerative and reparative metabolism. Biostimulation can be enhanced by the neodymium-YAG laser and the capacitive and resistive transfer biostimulation therapy (TECAR therapy), according to specific protocols and in the function of the echographic picture, though sufficient scientific evidence of their effectiveness is still lacking. Massage is not employed at this stage while isometric muscle contraction is begun in the form of submaximal exercise below the pain threshold.

During the advanced repair stage (7th-14th day), fibre regeneration is accompanied by an approximately 50% loss of muscle strength compared with the situation prior to the accident. This is thought to be more correctly attributable to the inflammatory nature of the repair process, as shown by oedema and pain, rather than a real reduction of contractility. There is a high risk of recurrence in this stage; pain and function improve but the patient is still vulnerable structurally.

When satisfactory elasticity is reached submaximal concentric and then eccentric muscle strengthening is begun against manual resistance. Recovery and maintenance of tissue elasticity are achieved by means of specific passive stretching exercises.

During functional recovery (15th-60th day), maturation of collagen and full recovery of voluntary muscle control mean rehabilitation must be directed to the total recovery of strength and functional efficiency. Normal movement, complete muscle elasticity and painless maximum isometric contraction are usually achieved by the 3rd or 4th week. The progress of fibre remodelling in the scar site is checked echographically at this time.

In case of muscle strains in the lower limb it is advisable commencement of running when the peak moment of force at 60°/sec. is not less than 70% of the other limb. This, however, requires the execution of a maximum isokinetic test that could itself result in a recurrence. In addition, the isokinetic dynamometer evaluates muscle strength in open kinetic chain and without loading. Joint kinematics in a close kinetic chain system and with loading, therefore, cannot be reproduced and this instrument cannot be used to evaluate the musculature's role as a dynamic joint stabiliser.

Initially submaximal eccentric isokinetic work at increasing speeds (starting from 60°/sec.) is carried out no more than three times a week. Overloads are avoided to prevent muscle fatigue. Work at high angular velocities is the hub around which the rehabilitation programme revolves.

Electrostimulation, in our opinion, is not appropriate and there is no evidence of its utility in the literature.

Unlimited training is commenced when the strength values are not less than 80% of those of the other limb and there is no muscle fatigue after protracted exercise.

Resumption of competitive sport is to be hoped when there has been a sufficient regaining of muscle force, strength and flexibility, and neuromuscular control.

Recurrence within two months from the resumption of sport is a clear indication of the inappropriateness of the rehabilitation programme employed.

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Operative treatment of muscle injuries

General indications for surgical treatment of muscle injuries are grade III-IV (total) tears and insertion or origin avulsions from bone. Several partial tears need surgery, too. The tear may recur, excessive scar tissue grows at the site of injury, adhesions to other tissues develop, especially around the near lying nerves, or tendinosis, degeneration and blood circulation disturbances follow. In some cases motoric or sensory nerves to muscles are injured (stretching, compression, tears) and consecutively weakness, elongation, atrophy and denervation of the muscle or part of it may occur. Entrapment neuropathies or neuromas may follow. Surgical complications may occur. Sometimes the lesion itself has been so severe that the end result is not good. The presentation is based on own experiences on muscle injury operations as well as on the literature.

Rupture of the long head of the biceps brachi muscle seldom requires surgery, but distal biceps tendon or muscle tears often need surgery. Usually there is an avulsion from radius, but sometimes the tear is at the tendon muscle junction distally, seldom in the middle of the muscle mass. Distal avulsions are repaired with sutures through holes in the radius or with bone anchors. More proximal muscle tears are treated with suturation or with plastic repair using palmaris tendon in chronic tears.

Tears of triceps brachi muscle are avulsion tears of the tendon from olecranon of more medially and proximally located intramuscular ruptures. Avulsion tear from scapula is very rare. Anchor and drill hole fixation is used as an operative method in addition to suturation of muscle and fascia.

Tears of lower arm muscles from lateral or medial epicondylus are seen mainly in athletes. Revision of the granulation tissue and fixation of the insertion to bone with anchors secures the original tension and muscle strength.

Pectoralis major muscle tears are seen after violent accidents or in power athletes doing bench press. Avulsion tears from humerus are fixed with suture anchors or through holes in the bone. More proximal or delayed tears are treated with suturation or with fascial augmentation.

In throwers, pole vaulters, wrestlers, judokas, ice hockey players and American football players tears in the trunk muscles may be total and need for surgery. These muscle tears have been repaired in the back, straight and oblique abdominal muscles and gluteus muscles.

Hamstring muscles may tear from ischial tuberosity. Surgical treatment is used in total avulsions from the bone or near it and partial recurrent tears causing chronic pain syndromes. Bone suture anchors have been used successfully in the repair. Distal hamstring tears can be total or partial. They often need to be repaired in athletes.

In anterior thigh vastus lateralis tear usually follows direct contusion trauma. Massive hematomas need to be evacuated surgically. Total or partial tears are most common in rectus femoris muscle. Depending on the activity and sport of the patients, decision for surgery is done. These muscle tears can be successfully corrected, even if some cosmetic gap and bulging may remain. Most severe are proximal avulsion tears from the anterior inferior iliac spine. Bone fragments are fixed with screws and muscle avulsions with anchors. Avulsion of the sartorius muscle insertion in young individuals sometimes need surgical treatment, if the bone fragment is avulsed more than 3 cm from the origin.

In lower leg the partial, subtotal and total tears of the medial head of gastrocnemius muscle are sometimes treated surgically. Partial myotendinous tears in the distal calf and proximal

achilles tendon are more frequent. Tibialis anterior and peroneal muscle tears are uncommon. On the medial side of the ankle medial flexor tendons are more often damaged than their muscles. Plantaris muscle may tear sometimes in athletes causing chronic problem as well as plantar muscles..

REHABILITATION AFTER MUSCLE INJURIES

Thomas Bochsansky

The goal of rehabilitation is a complete restoration of the function of the whole system movement. Rehabilitation according to WHO is a process including different domains as defined in the International Classification of Functioning Disability and Health (ICF) concept. Therefore rehabilitation has to be seen as a multidisciplinary work.

Rehabilitation after muscle injuries can be divided into different periods.

First period: restoration of muscle structure

Second period: restoration of muscle function

Third period: restoration of muscle activity

Fourth period: restoration of participation of the person in activities of daily living and sports

The length of these periods are depending on the grade of lesion (Ryan 1969).

First period:

The time needed to restore muscle structure after injuries grade 1 is only one or two days.

After acute therapy (Ice, Compression, Elevation) Lymphdrainage is one of the most important therapies. The main goal is a reduction of oedema and inflammation. In contrast time needed after grade 4 injury is much longer and depends whether an operation has been done.

Main goal is reduction of pain and immobilisation.

Second period:

Restoration of muscle function is a complex goal because the neural as well as the mechanical level has to be coordinated. This has to be done by starting with slow concentric contraction and then with increasing velocity of contraction. The intensity of contraction is limited by pain. In the next step eccentric contraction starts first with slowly increasing velocity. In a third step combination of concentric and eccentric contraction can be done. Pain is one of the most disturbing factors but in the same time an important protection.

Third period:

When the function of an isolated muscle is restored one has to improve muscle activities. An injured muscle is a so called weak link in a muscle chain. Therefore it is necessary to train in a muscle sling towards more and more complex movements. Therapy consists of improving the proprioceptive function, coordinative movements (balance training) and decreasing collagenous scar tissue (therapeutic ultrasound).

Fourth period:

Specific training with increasing intensity can be supported by massage and other forms of electrotherapy to improve the microvascularisation, vegetative system and the neuromuscular system. Medical training therapy and specific sports training is to proceed complementary. Physiotherapists, medical doctors and Trainers have to work closely together.

The central goal of muscle function after injury is an executable coordination of the afferent and efferent part of the sensorimotor system.