

# Management of Acute Sport Injuries

Yuli Chen, BSc<sup>1</sup>; Sitthiphon Bunman, MSc<sup>2</sup>; Palath Prakobsrikul, MD<sup>3</sup>



Yuli Chen, BSc

## Abstract

Acute sport injuries such as muscle strain, ankle sprain and muscle contusion are common injuries among sports' players. Inappropriate training results in damage of muscles and tendons. Diagnosis can be done by physical examination, x-ray, ultrasound, magnetic resonance imaging (MRI), and other clinical procedures. These injuries can be relieved by stretching, medication, physical therapy, and surgery. However, knowing what initial action to take during and after an accident contributes to the patients' rapid recovery from injuries and reduces further complications.

**Keywords :** sport injuries, muscle injury, muscle strain, muscle contusion, ankle sprain

Acute muscle injuries are the most common frequent cause of physical incapacity in sport players. It has been estimated that 30% to 50% of all sport players related injuries are caused by soft-tissue lesions.<sup>1-2</sup> Sports injury has a broad meaning. In general, it is defined as injury occurred while playing sports. Inappropriate training, lack of appropriate tools, and not having a warm-up exercise often leads to sports related injuries. These injuries cause varied damage to tissues. This article discusses common sport injury classified into two groups, namely acute sport and overuse injury:

Acute sport injury refers to pain ensuing immediately after an accident or getting hit by a strong force. Since swelling lasts about 2-3 hours, diagnosis should be done promptly after an injury otherwise subsequent swelling can hinder an accurate examination. Common findings are fracture, ruptured tendons, joint dislocation and bruises (bone and joint issues are not being discussed in this article).

Overuse injury refers to pain that sets in after an accident or after sustaining a repetitive trauma. Acute injury may depend on the intensity of each impact. Furthermore, the frequency of getting hit repeatedly can also stop complete healing. Therefore, the severity of the injury is associated with the amount of force and frequency of the strain. Other factors include muscle imbalance, and inappropriate training.

## Anatomy of muscle

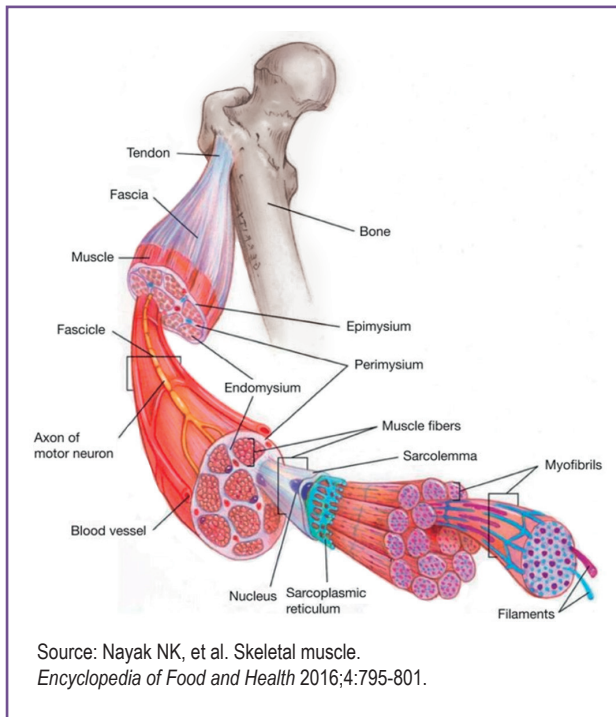
Most skeletal muscles are attached to two bones and tendons (Figure 1).<sup>3</sup> Tendons are tough bands of dense regular connective tissue whose strong collagen fiber attaches skeletal muscles to bones. Skeletal muscles move by shortening their length, pulling tendons and moving bones to each other. One of the bones is pulled toward another bone, which remains stationary. The place on the constant bone, which is connected via tendons to skeletal muscle, is called the origin. The place on the moving bone, which is connected to the skeletal muscle via tendons, is called the insertion. The tummy of the muscle is the part of the skeletal muscle in between tendons that performs the actual contraction (Figure 2).<sup>3</sup>

<sup>1</sup> Department of Physical Therapy, Chang Gung University, Taipei, Taiwan

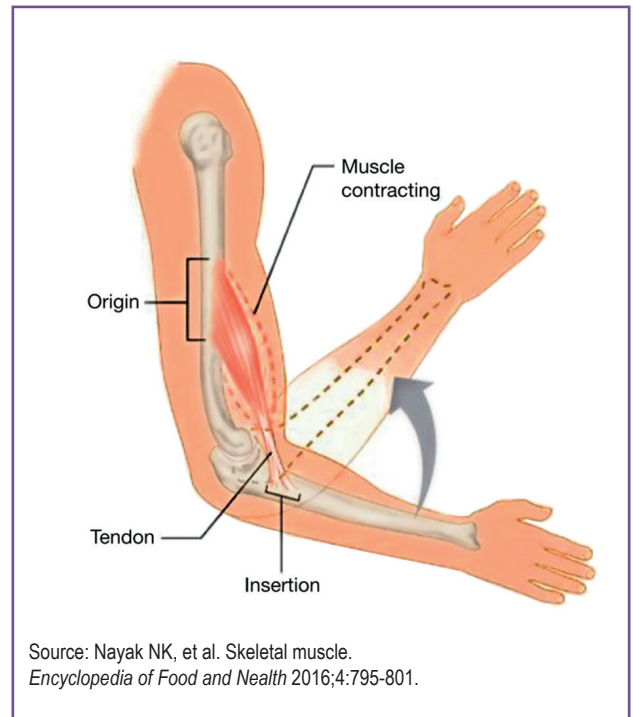
<sup>2</sup> Department of Community and Family Medicine, Faculty of Medicine Thammasat University, Bangkok, Thailand.

<sup>3</sup> Department of Emergency, Phra Nakhon Si Ayutthaya Hospital, Ayutthaya, Thailand.

\* Address Correspondence to author:  
Palath Prakobsrikul, MD  
Department of Emergency,  
Phra Nakhon Si Ayutthaya Hospital,  
Ayutthaya 13000, Thailand.  
email: Aqualuminoz@gmail.com



**Figure 1:** The connective tissue surrounding skeletal muscle.



**Figure 2 :** Isotonic muscle action

**Mechanism of injury**

Muscle injuries can be caused by spraining, lacerating, or bruising. More than 90% of all sports-related injuries are sprains or bruises. Moreover, muscle lacerations are the least frequent injuries resulting from sports.<sup>4</sup> The tensile force exerted pressure to muscle may lead to excessive stretching of the muscle fibers and accordingly a tear close to the muscle-tendon junction. Muscle sprains are commonly observed in the superficial muscles that work by traversing two joints, such as the gastrocnemius, semitendinosus and rectus femoris muscles.<sup>3</sup>

*1. Acute muscle injury*

Acute muscle injuries are defined as a common muscle injury that comes from external force or defects in function or normal muscle structure that result from perturbations that are applied over a brief period, such as contusions, lacerations, burning, freezing, or exposure to toxins.<sup>5</sup> Acute muscle injury is a common muscle injury that comes from external force. It can cause direct or indirect injury resulting in muscle strain. The common muscle injuries are as follows.

**Muscle strain**

Muscle strain, overstretched muscle, or even a muscle tear refers to damage to a muscle fiber or its attaching tendons.<sup>6</sup> Muscle strain is the most common muscle injury found while playing sports, vigorous training, and during sports competition. The high probability of recurrence and chronic pain further impose complexity.<sup>7</sup> Strains often occur at larger muscles groups such as Quadriceps, Hamstring, and Gastrocnemius.

**Symptoms and physical examination**

The characteristic of this injury is immediate pain. It can be potentially serious and can cause a lifetime disability deterring the patient from continued involvement in sports. If the injury occurs at the thigh, a lump will likely be present. Moreover, on physical examination, the point of tenderness is in the muscle, with reduced range of motion, muscle weakness in the damaged muscles, and ecchymosis. Normally, while using muscles, they shift from contraction to relaxation and vice versa. Besides, there are antagonist muscles whose actions are opposite from agonist muscles. In some conditions, however, such as muscle overuse, when stronger muscles have faster and more forceful contraction than muscle relaxation from antagonist ones, the weaker muscles will be pulled by pulling force resulting in muscle strains. Partial or complete muscle tear can occur and the position of strain is usually at the musculotendinous junction. Strains are possibly presented at the damaged muscles, and attachment of muscles.

**Risks of muscle strain**

**Muscle imbalance:** While playing sports, a number of muscles work simultaneously. Weak muscles which have slow relaxation are easily damaged. This risk is frequently found in specific muscle training. To illustrate, specific quadriceps training by sitting, putting weight on the ankle, and straightening the leg strengthen only the quadriceps. This training makes the hamstring, an antagonist muscle of the quadriceps, relatively weaker and increases the chance of hamstring injury.<sup>8</sup>

**Muscle inflexibility:** A muscle with low flexibility has fewer responses and slower contraction than normal ones. With inadequate contraction from agonist muscles, antagonist

muscles respond with incomplete relaxation bringing about muscle injury when being used strenuously.<sup>9-11</sup>

**Previous injury:** Once a muscle is damaged, it has lower contraction, decreased flexibility and a high probability of recurrence of having the same injury.

#### Laboratory investigation

Plain radiographs of injured muscles often reveal normal results. However, a soft tissue swelling might still be found and calcification at the attachment of the muscle can be observed. MRI is considered to be the imaging method of choice to confirm and evaluate the morphology of muscles, ligament, severity of muscle injuries and to differentiate between edema and tears.<sup>12</sup>

#### Treatment

General concept of muscle strain treatment is reducing pain and preventing additional injuries. It can be done by several methods stated below.

- **Rest:** reducing work on damage muscle by avoiding activities that can trigger pain.
- **Ice:** reduce swelling and pain by numbing the affected area. It can be administered ten to fifteen minutes or as long as the patient can tolerate. It should be applied immediately after sustaining injury or for a period of four hours.<sup>13,14</sup>
- **Compression:** Muscle compression by elastic bandage reduces swelling and movement of damaged muscle. Wrapping too tight is not recommended.
- **Elevation:** Lifting damaged muscle above the level of the heart can reduce swelling.
- **Nonsteroidal anti-inflammatory drug (NSAIDs):** Application of NSAIDs such as Ibuprofen, and Diclofenac reduces pain and inflammation of muscle improving muscle movement.<sup>15,16</sup> However, there are reports of delay of bone, tendon, and muscle repair in patients using NSAIDs.<sup>17,18</sup> As a result, NSAIDs are not recommended for long-term medication.
- **Surgery:** Most of muscle strains can be manage by conservative treatment. Nonetheless, grade III muscle strain and grade II muscle strain with more than 50% muscle tear necessitate surgery. These issues below have to be considered before allowing the patient to engage in sports again.
  - Range of motion should be within normal range.
  - Muscle power should be 90% or more of normal levels.
  - No pain should occur while performing jogging and running.

#### Prevention

- Warming up by stretching boosts muscle flexibility. Stretching should be done slowly until the muscle can fully be stretched and able to hold for a while before relaxing.<sup>19,20</sup>
- Practicing muscle balance by closed chain kinetic exercise. Eccentric and concentric muscle contraction alternate within this exercise practicing both agonist and antagonist muscles. Normally, other parts of body which are not affected from the training are fixed or weighted.

- Follow up checkup is recommended before allowing patient to participate in any sports activities.

#### Muscle contusion

Muscle contusion is a muscle injury resulting from a collision. While playing sports, muscles have more blood supply than when in a resting state. Therefore, following an accident, both muscle and blood vessels tear bring about hematoma. Using the tear of fascia as a criteria, hematoma can be classified into two groups.<sup>21</sup>

#### Intermuscular hematoma

When fascia is torn from a contusion, blood becomes congested between muscles. There is minimal change in the pressure of the muscle, despite excess accumulation of blood. Signs of this injury are swelling and petechiae on a skin which normally manifest within 24 to 48 hours. Muscle regeneration of this type of injury is rather quick.

#### Intramuscular hematoma

This kind of hematoma occurs when fascia is not damaged and blood fills inside the muscle increasing intramuscular pressure. Signs of this injury are painful swelling for more than 48 hours and uncomfortable movement. Muscle regeneration is relatively slow. Some reports claim that compartment syndrome is a possible complication.<sup>22,23</sup>

#### The three levels of muscle injuries

- **First degree:** Some myofibrils are torn. Despite feeling pain, the patient can move normally and have normal range of motion.
- **Second degree:** More myofibrils are torn. Muscle power and range of motion are reduced. Pain and swelling are minimal and increases when being tensed.
- **Third degree:** All myofibrils are torn. Muscle weakness and inability to tense the muscle is present. Space between muscle or swelling can be palpable.

#### 2. Delayed onset muscle soreness (DOMS)

**Muscle soreness after training** can occur after strenuous exercise due to lack of previous training leading to microscopic muscle tear, swelling, and ischemia. Pain remains about 24 to 76 hours post exercise or while doing exercise particularly when performing eccentric contraction.<sup>24,25</sup> Muscle soreness is usually relieved in 2 to 3 days. Patient doesn't necessarily need to stop doing exercise. However, the patient should lower the intensity and duration of exercise. It is recommended to massage the muscles pre and post exercise. Any attempt to work an injured muscle is an inappropriate approach might cause muscle strain.

**Muscle cramp** is an immediate and uncontrollable muscle contraction followed by severe but temporary pain. It

usually occurs at quadriceps and hamstrings. It can occur before or after a strenuous workout. The cause of muscle cramp is not fully known, however, it is believed that extreme temperature, dehydration, and mineral imbalance, such as hypomagnesemia and hypocalcemia, are associated with muscle cramp. Massage, stretching, and warm compression can alleviate pain. Warm-up by stretching and drinking an adequate amount of water can prevent muscle cramp. Moreover, having electrolyte drinks is suggested to correctly regulate the mineral level of the body while exercising.

### Symptoms

Patient has painful swelling after sustaining injury. In some severe cases, patients might not be able to bear their own weight.

### 3. Ankle sprain

Acute ankle injury is one of the most common musculoskeletal injuries among adults. Acute ankle injury was estimated to account for 20 percent of all sports injuries in the United States.<sup>26</sup> However, many patients with acute ankle injuries do not see a doctor.<sup>27</sup> The most common acute ankle injury is a lateral ankle inversion sprain.<sup>28</sup> Inadequate treatment of ankle sprains may lead to chronic problems such as pain, decreased range of motion, and joint instability.<sup>29</sup>

### Symptoms

Symptoms of ankle sprain depend on the level of severity injury such as pain when bearing weight on the affected foot, tenderness when touching the ankle, swelling, and bruising.

### Physical examination

**Observe** how the patient walks. If there is a bone fracture or ligament tear at the ankle, the patient feels severe pain or is unable to walk. Next, observe the location of swelling and ecchymosis. These can usually be found below the ankle whereas bruises can be found near or below ecchymosis.

**Palpate** point of tenderness. It is commonly found at tuberosity including ankle and 5<sup>th</sup> metatarsal bone. In case of ankle sprains in which the anterior talofibular ligament is damaged, points of tenderness are at 1 centimeter below and in front of lateral malleolus.

**Evaluate range of motion** by allowing patient to move the ankle. The patient usually has a lower range of motion. Moreover, plantar flexion which anterior talofibular ligament is tightening and can worsen the pain.

### Special tests

The **squeeze test** identifies syndesmosis injury which occurs along with external ligament injury. The examiner lets a patient sit on a bed with one leg hanging. Then, the examiner squeezes patient's calf trying to put tibia and fibula near and releases them immediately. If a patient feels more pain at syndesmosis, the test is positive. The examiner should not perform this test if a patient is suspected to have a bone fracture.<sup>30</sup>

The **anterior drawer test** checks the anterior talofibular ligament. The examiner lets a patient sit on a bed with one leg hanging and doing plantar flexion. Then, the examiner fixes patient's calf with one hand and uses another hand to hold the back of patient's foot and pushes it forward. If patient's foot can go more than usual, the test is positive. This test should not be done after getting injury since it can aggravate the pain.<sup>31,32</sup>

The **inversion stress test** checks the calcaneofibular ligament. The examiner instructs the patient to sit on a bed with one leg hanging off the side. Then, the examiner fixes the patient's calf with one hand and uses the other hand to hold the back of the patient's foot. The examiner's thumb has to be placed at the lateral malleolus. After that, the examiner inverts the patient's foot. The test is positive when the examiner's thumb palpates a space or a separation of foot bone. This test, as with the anterior drawer test, should not be performed after an injury.<sup>33</sup>

### Laboratory investigation

To investigate an ankle sprain, alongside a physical examination, a plain radiograph, an arthrogram, and a MRI can significantly assist diagnosis, however, these are expensive procedures. Dijk and group claimed that a 5-day physical examination delay, using both anterior drawer test and palpating point of tenderness, increases sensitivity and specificity of ankle sprain with a diagnosis of 84 and 96 percent respectively.<sup>34-36</sup> The position of the tenderness point will affect the diagnosis. To illustrate, if the point of tenderness is at the anterior talofibular ligament, sensitivity and specificity of the ankle sprain diagnosis is 90 and 100 percent respectively.<sup>36</sup> On the other hand, sensitivity and specificity of the anterior drawer test is 97 and 73 percent respectively.<sup>37</sup> Moreover, if the anterior drawer test is positive and the point of tenderness and hematoma is at the anterior talofibular ligament, sensitivity and specificity of the anterior drawer test is 77 and 100 percent respectively.<sup>38</sup> Therefore, a physical examination, especially when delayed, is a good prognosis of sprained ankle.

The **Ottawa Ankle Rules** acts as a guideline to evaluate if a patient with a foot or ankle injury should undergo x-ray to diagnose a possible bone fracture.<sup>39</sup> The patient should radiograph the ankle when:

- There's a pain and point of tenderness at the malleolus. Ankle x-ray should be done in anterior-posterior, lateral, and mortise postures.
- There's a pain and point of tenderness at navicular bone, mid foot, and base of fifth metatarsal bone. Foot x-ray should be done in a straight and oblique posture.
- A patient is unable to bear weight or walk more than four steps. If a patient can walk four steps or more, though hobbling, the patient is considered mobile.

Sensitivity, negative predictive value, and specificity of this rule is: 93 to 97; more than 99; and between 31 to 63 percent respectively.<sup>40,41</sup> Bachmann and group, studied the accuracy of The Ottawa Ankle Rule in a systematic review.<sup>42</sup> Their study revealed that sensitivity is nearly 100 percent and



a specificity, at a moderate level, is a necessary parameter to screen patients, thus, will reduce 30 to 40 percent of unnecessary exposure to x-ray.

Indication of plain radiograph or stress film is declining because of poor diagnosis, low accuracy, and it can be replaced by physical examination. On the other hand, MRI is used when an additional injury such as cartilage injury is suspected. Thus, MRI is usually performed alongside full term treatment in a patient with six to eight-week prolonged pain.

#### Grading of ankle sprain

**Grade I:** There is slight stretching of ligament fibers, ankle swelling, and point of tenderness at the ankle. No unstable position is found in stress film.

**Grade II:** There is a partial tear of ligament fibers. Signs of this grade are reduced range of motion, painful ankle swelling, point of tenderness at ankle, and enduring pain while bearing weight. Hematoma sometimes is found. Unstable position might be observed in stress film.

**Grade III:** There is a complete tear of ligament fibers. Signs of this grade are very painful ankle swelling, point of tenderness at ankle, hematoma, and unable to bear weight. Unstable position might be observed in stress film.

#### Treatment

It was believed that primary treatments for ankle sprain patient are conservative treatment and immobilization. Nowadays, early functional rehabilitation is considered as primary treatment. According to a systemic review, early functional rehabilitation is better than immobilization in many aspects such as indicated below.<sup>43</sup>

1. A patient has a higher chance of being able to play sports and walk again.
2. Shorter duration of treatment.
3. A minimal number of patients with swelling and loosened joint diagnosed by stress film.<sup>44</sup>
4. Higher satisfaction in grade III ankle sprain patients.

#### Early functional rehabilitation therapy has three phases.

**Phase I** is after the injury has occurred. The objective is to reduce painful swelling and to prevent further ligament injury. Generally, R.I.C.E method is recommended, prescription of anti-inflammatory drugs can alleviate painful swelling and reduce duration of treatment.<sup>45,46</sup>

**Phase II** The objective is to increase range of motion of the ankle and prevent ligament injury. A patient progresses to this phase when swelling is mitigated.

**Phase III** The objective is to prevent recurrent injury. In this phase, a patient does not feel pain while walking and has normal range of motion.

A patient with an ankle sprain has poor sensation in his lower extremity and a noted reduced muscle power around his ankle,<sup>47</sup> thus, the likelihood of recurrence is high. Therefore, patients should focus on an exercise around the ankle area with a proprioceptive exercise using a wobble board. There's a study comparing the efficacy of a wobble board with an orthotic device. Using a wobble board has a statistically lower risk of ankle sprain recurrence than any other approach,<sup>48</sup> additionally, Verhagen and group, claimed that proprioceptive exercise is the key factor in preventing ankle sprain recurrence.<sup>49,50</sup>

#### Surgery

Surgical treatment may be indicated when symptoms show a poor response to conservative treatment.<sup>51</sup> McGovern and Martin<sup>51</sup> reviewed 12 clinical trials comparing nonsurgical and surgical treatment. The overall data showed no significant evidence to recommend surgical or conservative treatments when treating an individual with an acute lateral ankle sprain.<sup>51-52</sup> However, Pihlajamaki et al,<sup>53</sup> studied long-term results of conservative treatment comparable to surgical treatment of acute lateral ankle sprains in physically active males. Overall, the study showed that surgery treatment decreases the risk and prevalence of re-injury but may increase the risk of subsequent development of osteoarthritis.

#### Conclusion

Common injuries from playing sports are muscle strain, muscle contusion, muscle soreness after training, and ankle sprain among others. Physical examination, ultrasound, and MRI play a key role in drawing up a definitive diagnosis. Limiting the use of an injured muscle proved to be effective, otherwise, surgery is opted for in more severe cases. Prompt and appropriate treatment after sustaining an injury increases rate of recovery, and reduces risk of recurrence.

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