Physical Therapy For
Sports Injuries

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Prof. Shehab M. Abd El-Kader
Professor of Physical Therapy
Lesions of shoulder rotator cuff

Rotator Cuff Muscles

Supraspinatus, infraspinatus, subscapularis and teres minor muscles constitute the rotator cuff of the shoulder joint. The supraspinatus is located at the top of the shoulder and abducts the shoulder - it raises the upper arm and moves it away from the body. The subscapularis is at the front of the shoulder - it internally rotates the shoulder. The infraspinatus and teres minor are in the back of the shoulder - they externally rotate the shoulder. Though each rotator cuff muscle moves the shoulder in a separate direction, though they all work together to stabilize the shoulder joint.

N.B.

In the range of abduction between 60 and 120 degrees, the rotator cuff impinges on the acromion. This constitutes a form of repeated minor trauma, which predisposes to degeneration of the cuff, especially in hard workers.

Sports related lesion

Overhead sports such as throwing, swimming, or tennis, can lead to tendinitis.

Clinical syndromes

The majority of rotator cuff injuries occur gradually and symptoms appear gradually.

I. Acute tendonitis (acute calcification)

1. If the space between the rotator cuff and the bone above it is narrowed, the rotator cuff tendons and the overlying bursa can get squeezed. This will lead to bursitis and tendinitis. This is called impingement.
2. Occasionally a calcium deposit may form in the rotator cuff and cause acute inflammation of the tendon and bursa. This is called calcific tendinitis.
3. There is intense shoulder pain with limitation of all shoulder movements.
4. After few days, pain may subside once the calcified substance has erupted into the subacrominal bursa, reliving the tension.

II. Painful arc syndrome (Supraspinatus syndrome):
1. The syndrome is produced by degeneration of the cuff with or without calcification and by partial tears.
2. There is pain in the shoulder and upper arm during the mid range of the glenohumeral abduction (between 45 and 160 degrees), with a relative freedom from pain at the extremes of the range.
3. There is tenderness over the greater tuberosity.
4. X-Ray may show a calcified deposit.
5. Treatment: most cases are relived by
   - Exercise within the limit of pain.
   - Heating.

III. Complete rupture of the Supraspinatus tendon
1. A rotator cuff tear can occur due to degeneration alone, or when the weakened tendons are stressed during activities or accidents
2. Pain is felt in the shoulder which radiates down the outer side of the arm to the deltoid insertion.
3. Active shoulder abduction is impossible and when attempted, it produces a shrug entirely due to scapular movement.
4. Passive abduction is full and painless.
5. Once the arm has been passively lifted, the patient can hold it vertical with the deltoid.
6. When the patient lowers it sideway, it suddenly drops.
7. Treatment: repair is occasionally done in early cases in young adults.

Repair of complete tears of the rotator cuff

Indications for surgery
  Surgery is indicated for most complete cuff tears, some of which may be associated with an avulsion fracture of the tuberosity.
**Postoperative management**

1. Begin active exercise of the hand and wrist immediately after surgery to maintain range of motion.

2. At 2 to 4 weeks postoperatively, when the immobilization has been removed
   A. Begin gentle passive and active-assistive motion at the shoulder in the pain free range. Forward flexion should precede abduction.
   B. Begin exercise to restore antigravity abduction
   C. Begin gentle manual resistive exercise only after the patient can actively abduct the arm against gravity. This may be as long as 12 weeks after the surgery.
   D. Increase resistance very gradually and conservatively.
Tennis Elbow Syndrome
(Lateral Epicondylitis, Lateral Stress Syndrome)

Definition
Tennis elbow is a lesion affecting the tendinous origin of the wrist extensors. It includes local tenderness over the common extensor origin, at the lateral epicondyle, exacerbated by continual use and restricted elbow extension, and frequently producing aching and pain down the back of the forearm into extensor muscle mass.

Incidence
- Both sexes are affected equally.
- Lateral epicondylitis most often occurs between the third and fifth decades of life.
- It rarely occurs under the age of 20 years.
- There are more than 20 million tennis players in North America, and as many as one-third, or possibly more, suffer from elbow problems at some time, particularly if they are over age 35.

Pathophysiology
Tendonitis is usually seen after excessive repetitive movement with which the tendon gradually becomes tighter until the fibers start to tear. For example, a person who plays tennis may over-use the muscles of the elbow through hitting the ball repetitively and cause tendonitis to the area. Lateral epicondylitis is a result of inflammation at the muscular origin of the extensor carpi radialis brevis (ECRB). This inflammation leads to microtears of the tendon with subsequent fibrosis and, ultimately, tissue failure. Less commonly, the attachments of the extensor carpi radialis longus (ECRL), extensor digitorum communis (EDC), or extensor carpi ulnaris (ECU) are involved.

Etiology
- Whatever the etiology, there is generally an element of overuse or overstress, and 45% of tennis players with daily games or practices experience problems.
- Furthermore, the tennis elbow syndrome is a frequent occupational hazard in individuals carrying out forceful pronation and supination motions, heavy lifting, or repetitive hammering type activities.
Stages
Stage 1: Inflammatory changes those are reversible
Stage 2: Nonreversible pathologic changes to origin of the ECRB muscle
Stage 3: Rupture of ECRB muscle origin
Stage 4: Secondary changes such as fibrosis or calcification

Symptoms

A. Pain
It mainly affects the outer aspects of the elbow. It may radiate upwards along the upper arm and downwards along the outside of the forearm.

B. Weakness in the wrist
Decreased grip strength, limited by pain. This can cause difficulty in carrying out such simple movements as lifting a plate or a coffee-cup, opening a car door, wringing wet dishcloths and shaking hands. Using a hammer, turning a screw driver, shuffling papers or playing a percussion instrument.

X-ray: To exclude other diagnosis such as a loose body in the joint or fracture.

N.B.

Player who are at risk of developing tennis elbow
- Novice in tennis
- Playing multiple games per week.
- Over 35 years of age: Average age is 40 years.
- Less experienced players with poor stroke techniques, but who play frequently, are in the high risk group.

Management
1) Medical treatment
2) Rest and splinting
3) Occupational Therapy: Job and recreational tools and/or equipment may need modifications, especially if repetitive gripping is required. Gradual resumption of activities is recommended to improve tolerance and prevent recurrence.
4) A steroid injection about the lateral epicondyle using local anesthetic can be performed but complications may be present.
5) **Surgical Intervention:** For those cases of refractory lateral epicondylitis, surgical resection of the lateral extensor aponeurosis might be considered.

6) **Physical Therapy**
   
   **A) Acute stage**
   - The goals of treatment are to reduce pain and inflammation.
   - Anti-inflammatory modalities include ice, ultrasound, and phonophoresis.
   - Use of a wrist splint can be helpful because it places the extensor muscles in a position of rest and prevents maximal muscle contraction.
   - Counterforce bracing (tennis elbow strap) is another orthotic alternative that can be used during activity to unload the area of muscle origin at the elbow.
   - Deep tissue and friction massage helps release underlying adhesions and promotes improved circulation to the area.

   **B) Subacute stage:**
   - Emphasis is placed on the restoration of function of the involved muscle group.
   - Flexibility, strength, and endurance of the wrist extensor muscle group can be achieved through a graded program.
   - ROM for wrist flexion/extension and pronation/supination should be achieved prior to proceeding with a strengthening program.
   - Strength and grip training should progress from isometric to concentric to eccentric contractions of the forearm muscles, especially the wrist extensors.
   - Stretching can help relax and lengthen a tendon, but never stretch the painful and inflamed area, as this can worsen the tendonitis.

**Prognosis**
- Patients who present acutely (< 3 months) generally respond well to treatment.
- Chronic cases that are refractory to treatment may take months to resolve.

**Patient Education**
- Education regarding proper use of tools, good body mechanics, and the importance of flexibility and strength of the involved musculature should be emphasized to the patient.
Golfer’s Elbow
(Thrower’s Elbow, Medial Epicondylitis)

Definition
Medial epicondylitis (ME) is an overuse injury affecting the flexor-pronators muscle origin at the anterior medial epicondyle of the humerus.

Incidence
Frequency: Medial epicondylitis often is discussed in conjunction with lateral epicondylitis (LE), which occurs much more frequently. Medial epicondylitis is the most common cause of medial elbow pain, though the clinician is likely to see at least 5 cases of LE for every case of ME.
Sex: A male-to-female ratio of 2:1 has been reported.
Age: Peak incidence is in patients aged 20-49 years, but ME certainly is seen in teens and older adults, especially if they have hobbies, jobs, or sports activities that make them prone to overuse injuries.

Pathophysiology
Medial epicondylitis involves primarily the flexor/pronator muscles (pronator teres, flexor carpi radialis, and palmaris longus) at their origin on the anterior medial epicondyle. Less often, it also affects the flexor carpi ulnaris and flexor digitorum superficialis. Repetitive stress at the musculotendinous junction and its origin at the epicondyle lead to tendonitis in its most acute form and tendinosis in its more chronic form. In addition, an ulnar neuropraxia due to compression of the ulnar nerve in or around the medial epicondylar groove has been estimated to occur in up to 50% of ME cases.

Causes
Medial epicondylitis is caused by repetitive use of flexor/pronator muscles, especially with valgus stress at the medial epicondyle.
• Onset can accompany acute injury.
• Excessive grip tension, improper pitching techniques in baseball, and improper golf swing are common sports-related causes of ME.
• Causes also may be related to the patient's occupation (e.g. those requiring repetitive actions like using a screwdriver or hammer).
Clinical picture

- Pain over the medial epicondyle. Pain worsens with wrist flexion and pronation activities. Patients may report discomfort even when simply shaking hands with someone. Typically, pain is reproduced with resisted pronation or wrist flexion.
- Tenderness with palpation over the anterior aspect of the medial epicondyle is the most consistent finding. Occasionally, the area of tenderness extends toward the proximal flexor pronator muscle mass just distal to the epicondyle for approximately 1 inch.
- Up to 50% of patients with ME complain of occasional or constant numbness and/or tingling sensation that radiates into their fourth and fifth fingers, suggesting involvement of the ulnar nerve (ulnar neuropathy). Patients may have a positive elbow flexion test, and a positive Tinel sign. In more severe cases, decreased sensation is associated with intrinsic weakness and even intrinsic muscle atrophy.
- Range of motion of the elbow and wrist usually is within normal limits.

Treatment

As Tennis elbow

Prognosis

Overall prognosis is good, with few patients needing to progress to steroid injection and even fewer (typically less than 10%), to surgical intervention to find relief.
Bursitis

Definition

Bursitis is inflammation of a bursa. A bursa is a membranous sac lined with endothelial cells. It may or may not communicate with the synovial membrane of joints.

Function of a bursa

The function of a bursa is to:

- prevent friction between two structures (e.g. tendon and bone or tendon and muscle) or to
- Protect bony points.

Common sites of bursitis

1. Prepatellar bursitis (‘housemaid’s knee’).
2. Suprapatellar bursitis.
3. Subdeltoid bursitis.
4. Miner’s or student’s elbow (olecranon bursitis).
5. Achillodynia (inflammation of one of the bursae around the Achilles tendon).

Causes

1- Trauma: one episode, or, more often, repeated minor episodes.
2- Associated disease, e.g. rheumatoid arthritis, gout.

Pathology

Acute inflammatory changes occur. Chronic inflammation may arise with repeated minor trauma.

Clinical features

- Pain: Over the bursa especially on compression.
- Swelling: A large fluctuating swelling may be present.
Treatment

- Aspiration: Where the bursa is a problem, the fluid may be aspirated.
- A cortisone injection: may be appropriate to reduce inflammation.
- Physiotherapy: is not generally appropriate, but may be for suprapatellar and subdeltoid bursitis especially if the condition has become chronic.

1) Trochanteric bursitis

Pathomechanics

It is the most common hip bursitis. The greater trochanter bursa lies between the gluteus maximus and the surface of greater trochanter. The bursa produces the fluid that lubricates the surfaces between which it lies. Hemorrhagic bursitis and infected bursa may occur.

Mechanism of injury

- Direct trauma
- Overuse stress
- Repetitive irritation as running with one leg slightly adducted.

Physical examination

- Palpation: produces pain over greater trochanter.
- Gait cycle may be slightly abducted to relieve pressure on the bursa with shortened weight bearing phase
- Active resistive hip abduction may reproduce pain.

Treatment

- Medical: Oral anti-inflammatory drugs to relieve pain and inflammation.
- Ice and compression
- Therapeutic modalities & Stretching exercises
- Progressive resistive strengthening exercises in hip abduction when pain free.
- The patient may require 3 to 5 days for rehabilitation.
- For contact sports a protective pad should be worn.
2) Ischial Bursitis

Pathomechanics
- The ischeal bursa lies between the ischial tuberosity and gluteus maximus.
- Ischial bursitis is often seen in people who sit for long periods.
- It may be caused by direct trauma such as falling with hip flexed.

Physical examination
- Palpation: over the ischial tuberosity may reproduce pain.
- Pain during walking when hip is flexed.
- Stair climbing, uphill walking may reproduce pain.

Treatment
- Anti inflammatory medication
- Ice,
- Pain free stretching exercises
- Healing occur within 3 to 5 days
- For contact sports a protective pad should be worn

3) Suprapatellar bursitis

In the acute stage
- Ice and a support bandage may be applied, until the swelling goes down.
- The quadriceps may require progressive strengthening.

In the chronic stage
The principal clinical features are:
1. Dull pain over the knee.
2. Limited knee flexion: particularly weight-bearing crouching.
3. Thickened palpable swelling with adhesions above the patella.
Physiotherapy
1- Ultrasound to the suprapatellar bursa with the knee in flexion (to just short of the limit) usually 0.8 or 1 W cm\(^{-2}\) continuous applied.
2- Frictions and finger kneading are applied to soften the thickened swelling.
3- Mobilizations (knee in flexion): longitudinal oscillations applied to the patella – directed distally – will stretch the adhesions in the bursa.
4- Later oscillatory flexion is applied at the limit of flexion to regain the last few degrees of movement.
5- Progressive quadriceps strengthening is then required.

4) Subdeltoid bursitis (subacromial bursitis)

- This condition is characterized by a painful area on shoulder abduction.
- It is present between 60° and 120° on both active and passive movements when the bursa is passing underneath the acromion process together with supraspinatus tendon, the long head of biceps and the capsule of the glenohumeral joints.

Treatment
- Methods of pain relief.
- Mobilizations.
- Longitudinal oscillations or distraction of the glenohumeral joint mobilize adhesions and restore pain-free movement.

5) Calcaneal bursitis

The insertion of the Achilles tendon is protected by two synovial bursae: the subcutaneous bursa and the retrocalcaneal bursa. They may be inflamed and hypertrophied in sports activities due to excessive impact loading, exaggerated friction of the shoe counter on the outside heel, poorly constructed shoes, or training errors.
Treatment

Aims

- Reduction of the inflammation
- Pain control
- Return to normal ROM
- Recovery of muscle power.
- Return to full activities and sports.
- Modification of shoes and causes of stress.
Muscle Strains

Definition
A muscle strain injury is a disruption of the muscle tendon units. It is called stretch-induced injuries.

Incidence
- Stretch-induced injuries are about 30% of the typical sports medicine injuries.
- In athletics, muscle strain injuries occur to speed athletes such as sprinters and participants in American football, basketball, soccer and rugby.
- Certain muscles are more susceptible to injury as adductors of the hip, hamstring, and quadriceps muscles.
- Previously strained muscle appears to be a risk factor for re-injury.

Mechanism of injury
Muscle strain injuries occur when the muscle is passively stretched or activated during stretch. Occurrence during eccentric contraction of the muscle is frequent.

Classification
Strains can be classified by the degree of rupture:

Grade I (1st Degree or mild strain):
- Rupture of less than 5% of muscle fibers.
- Slight discomfort
- Minimal swelling
- Little loss of function
- Full ROM

Grade II: (2nd Degree or moderate strain):
- Incomplete tear of the muscle.
- Pain aggravated by muscle contraction.
- Tenderness
- Small to moderate defect
- Moderate swelling
- Impaired gait
- Restricted ROM

**Grade III:** (3rd Degree or severe strain):
- Complete muscle disruption.
- Moderate to extensive defect
- ROM is extremely limited
- Intense pain and tenderness.
- Resisted ROM may not be endured.

**Treatment**

1) **Treatment during acute phase:** the 1st 72 hours
   - Immediate treatment is rest, ice, compression, and elevation (RICE).
   - Rest may mean lying in bed. Crutches are necessary to avoid weight bearing on lower limbs.
   - Ice is applied for 20 – 30 minutes.
   - Compression is applied by crepe bandaging with cotton wool to prevent edema. It should start distally and progress proximally with decreasing pressure.
   - Elevation is important to facilitate drainage of exudates for 48 hours.
   - Isometric contractions should be performed five times/hour.

2) **Treatment over 7 – 21 days after injury:**
   - Exercises are gradually progressed:
     1. Static exercises without load: inner range to middle range to outer range work.
     2. Isometric exercises with light load.
     3. Active pain free dynamic training.
     4. Dynamic training with ↑ of Load.
     5. Stretching to ↑ ROM.
7. Sport specific training.

3) Criteria for progressing exercises

- Pain
- Swelling

Groin and Hip flexor Injuries

Anatomical considerations

The muscles that adduct the hip joint are primarily the adductor longus, the adductor magnus, the adductor brevis, and the pectineus muscles. The gracilis muscle and the lower fibers of the gluteus maximus also work as adductors. However, it is usually the adductor longus that is damaged during sporting activity. The adductor longus muscle tendon arises from the pubic bone and is inserted into the back of the mid-shaft of the femur.

Mechanism of injury

Overloading can be caused by sideways kicks in soccer, hard track training, and drawing the free leg inwards when skating. It is also common in team handball and ice hockey players, skiers, weightlifters and high-jumpers (Figure 1). The symptoms may begin suddenly perhaps at a training camp or during other intensive training periods.

Symptoms

1. Pain can often be located in the origin or at the junction of the muscle-tendon unit and may radiate downwards into the groin.
2. Tenderness is felt at one particular point on the pubic bone over the origin of the muscle (Figure 2).
3. The pain can be triggered by pressing the legs towards each other against resistance (Figure 2).
4. Functional impairment is common, sometimes the athlete cannot run. The athlete should not participate in explosive sports.

![Figure 1: A sudden strain on the abductor muscles may occur in many sports (by courtesy of All Sport).](image)

**Diagnosis**
- X-ray examination may show calcification around the origin of the muscle on the pubic bone.
- MRI or ultrasound can be helpful.

**Treatment**

Treatment of adductor stain is carried out according to grade of injury.
Figure 2: Left: Tenderness in one area over the origin of the muscle in the pubic bone. Right: Pain can be triggered in the injured area by pressing the leg inwards against resistance.

**Grade I:**
- The athlete may complain only of a mild discomfort with no loss of function and full ROM.
- There may be some local tenderness, little swelling and normal gait.

**Physical therapy**
- Rest from painful activities as soon as pain in the groin is felt; the condition will then resolve relatively quickly without any other treatment. The injured athlete should not return to training and competition until there is no tenderness or pain when making movements with the leg under load.
- Therapeutic modalities: Use general heat treatment in the form of hot baths.
- Pain free stretching of hip flexors, adductors, and internal and external rotators of the hip.
- Strengthening exercise when pain free, graduated using weights, and from sitting to standing.
- Plyometrics.
- Functional activities.

**Grade II**
- There is tenderness, swelling, alteration of normal gait.
Physical therapy
- Immediate very mild, pain free active ROM.
- Electrical stimulation to limit pain, and muscle spasm.
- Isometric exercises with the limit of pain.
- Stretching exercises.
- Strengthening exercises.
- Training and competition can be resumed after 2 weeks.

Grade III
- The athlete will need crutches to ambulate.
- Tenderness and swelling.
- ROM is severely restricted.
- Abduction is difficult.
- Resistance to adduction movement will not be tolerated.

Physical Therapy
- Complete rest.
- Compression for up to 3 days.
- Low intensity isometric exercises and pain-free active ROM on day three.
- Crutches should be used until normal gait has been regained.
- After 7 – 10 days, begin stretching and strengthening exercises gradually.
- Functional training.
- Maintain basic fitness by cycling on bicycle ergometer or swimming but only if these activities are pain-free.
- Plyometrics
- The athlete will be out of training and competition for 3 weeks to 3 months.

Surgery
Surgery in cases of delayed resolution. It is often consists of tendon release and/or local removal of damaged tendon tissue.
Preventive measures

Preventive training with specially designed strength and flexibility exercises is essential and should be included in every training program as an integral part of the warm-up and cool-down. Athletes who undergo good basic fitness training are injured less often than others.

The training program for the injured adductor longus muscle.

1. **Warm-up:** a light dynamic training program, such as using an exercise bicycle, for 5-10 minutes.
2. **Static training** without loading the adductor muscle, at different joint angles up to the pain threshold.
3. **Dynamic training** without resistance.
4. **Isometric training,** gradually increasing the external load.
5. **Stretching.**
6. **Dynamic training** with gradually increasing load.

Quadriceps strain

Anatomical considerations

The quadriceps muscle group consists of four muscles on the anterior aspect of the femur: rectus femoris, vastus medialis, vastus lateralis and vastus intermedius. These muscles contain predominantly type II muscle fibers and are best suited to rapid, forceful activity. In cases of rupture caused by external impact (contusion ruptures), the muscles lying close to the bone are most commonly affected. Superficial muscle ruptures are usually caused by overload and are usually located in the muscle-tendon junction.

Symptoms and diagnosis

1. A sudden intense pain as the injury occurs.
2. The muscle may go into spasm.
3. There is intense tenderness over the injured area.
3. Increasing pain and swelling occur.
4. Loss of flexion ROM.
5. Pain can be elicited by contracting the muscle against resistance.
6. In complete or major partial rupture a defect can be felt in the muscle.
7. A rectus femorus strain can be confirmed by eliciting pain when the athlete is lying prone extends his hip and the knee is flexed.

Healing and complications
1. The healing time is 2-12 weeks depending on the extent of the bleeding and whether the rupture is partial or complete.
2. Scar tissue in the muscles adds to the risk of a further hemorrhage or rupture.
3. Significant haematoma inappropriately treated can result in heterotopic bone formation (myositis ossificans).

Treatment
Strain of the muscles of the thigh is treated according to grades of injury and the guidelines as described before.

Physical Therapy
A. Acute phase: Therapy includes rest, ice, compression and immobilization. Stretching of the hamstrings, quadriceps, Achilles, and iliotibial band should be started gently and then become more aggressive as pain permits.

B. Recovery Phase: Patient should continue to be monitored and work on stretching, range of motion exercises, and quadriceps and hamstring strengthening.

Recreational Therapy:
When the player returns to activity, a protective pad larger than the injury site should be worn over the contused area for the duration of the season.
Iliotibial tract syndrome

Anatomy

The iliotibial tract is a thickened band of fascia on the lateral aspect of the thigh. Proximally, the gluteus maximus and tensor fasciae latae are inserted into it. Distally it is attached to the lateral condyle of the tibia.

Pathology

The tract can become thickened and tight. The deep surface can become inflamed.

Cause

Excessive use in patients who participate in long-distance sport (running, walking) gives rise to this syndrome. It can also occur in people who habitually stand on one leg more than the other, e.g. a person who favours the left leg has a lengthened left tract and a tightened right tract.

Clinical features

- Pain: Usually comes on gradually, over the lateral side of the thigh. It increases in intensity and comes on more readily until the patient decides to seek help.
- Tenderness: The tract is tender on palpation, especially in the lower third.
- Movements: Hip adduction is slightly limited.

Physical therapy

1. Rest from the aggravating activity is necessary until the condition clears.
2. Ultrasound applied over the tender or thickened area reduces pain and inflammation.
3. Passive stretching can be applied in the following ways:
   a) Stride standing: trunk and pelvis bend sideways away from tight side.
   b) Lying: Carry both legs to the left, bend trunk to left sliding left hand down left thigh (stretches right iliotibial tract).
c) Lying on right side: Trunk supported on right hand, place left foot with knee bent behind right leg. Lift right leg off floor-active adduction which lengthens right tract.

d) Lying: Both legs held up, hips flexed to right angle, knees straight; lower both legs to left (stretch right iliotibial tract).

4. Mobilizing: May be required for hip, knee, ankle and foot. The tight tract can cause joint stiffness and vice versa.

5. Posture: The patient may require education on posture of the pelvis, legs and feet.
Ligament injuries of the knee joint

Knee joint is stabilized by four strong ligaments: the medial collateral ligament (MCL); the lateral collateral ligament (LCL); the anterior cruciate ligament (ACL), and the posterior cruciate ligament (PCL). The MCL and LCL prevent side-to-side motion, while the ACL and PCL limit abnormal front and back motion. Twisting injuries that cause excess forces in these ligaments can tear the ligaments.

Grading of ligament injuries

Ligament injuries can be graded according to the severity of the injury, most commonly into three grades:

**Grade I:** there is tearing within the microstructure but no obvious stretching of the ligament.

**Grade II:** the ligament is stretched and there is a partial tear.

**Grade III:** a complete tear causing the ligament to separate into two parts.

History and clinical examination

A thorough history and examination of a knee injury is the basis for its diagnosis.

History

The history should include an analysis of the injury mechanism. The magnitude and the direction of the energy are important pointers to the severity and type of injury.

Inspection of the injured area

There may be swelling around as well as within the joint. Bruising over or around the knee indicates bleeding and a ligament injury.


**Palpation**

The examiner should palpate the joint lines for tenderness or effusion of the knee joint.

**Testing the range of movement**

A restriction of extension and flexion of the knee should be looked for pain on movement or a decreased range of motion can be a sign of meniscus injury as well as ligament injury.

**Stability examination**

4. Lateral collateral ligament: varus, valgus stress tests.
5. Examination following posterior lateral instability uses the reverse pivot shift test.

**Radiology**

1. Plain X-rays are essential in any serious knee injury, to exclude fractures or avulsions or to show defects of the bone lying beneath the articular cartilage.
2. Magnetic resonance imaging is useful for evaluating the soft tissues. (Ligaments, tendons, muscles, capsule, meniscus). It is sometimes difficult to decide whether the injury is complete or partial.

**Arthroscopy**

When clinical examination and other tests are inconclusive, arthroscopy gives the best examination of the structures within the knee joint. It will not evaluate injury to structures outside the joint (skin, nerves, muscles, tendons). Arthroscopy is performed under local, spinal, or general anesthesia.
1. Anterior cruciate ligament injuries

ACL injuries of the knee are the most common injuries to the knee; the loss of an ACL not only produces abnormal kinematics but also frequently results in major degenerative changes in the knee.

Anatomy

The ACL is an intra-articular ligament surrounded by synovium. It is well vascularized and contains nerve endings which may have a proprioceptive function. The ACL prevents the anterior movement of the tibia in relation to the femur.

Figure 1: Anatomic diagram of the anterior right knee joint.
Mechanism of injury

- Hyperextension or severe abduction of the knee.
- The lesion may occur as an isolated injury or may associate tears of the medial semilunar cartilage, injuries of the medial collateral ligament or both.

Symptoms and diagnosis

1) Several clinical signs and tests indicate an ACL injury.
2) A careful history is important. An ACL injury should always be suspected if there is a history of any kind of rotation or flexion injury, direct trauma, or rapid deceleration.
3) The patient may have sudden pain or hear a 'pop'.
4) The knee may give way. After the initial trauma, the athlete can often walk off the field.
5) The patient may with time develop a recurrent "giving way" problem (the patient feels about to fall because of instability). This often indicates a serious ACL injury requiring surgery.
6) Swelling may develop within a few hours, causing discomfort and pain. The swelling is always a result of hemoarthrosis (blood in the knee). Any patient with traumatic hemoarthrosis should be suspected of having an ACL injury, the cause of hemoarthrosis in 70% of cases.
7) Sometimes a doctor can aspirate fluid, and if blood is present, an ACL injury is most likely. Aspiration of the blood also gives pain relief.
8) The active and passive ranges of motion are limited.
9) An anterior drawer test with the knee in 20-30° of flexion and the tibia in neutral rotation (Lachman's test) is positive (Figure 2).

N.B.

An anterior drawer test in 70-90° of flexion (Figure 3), with the knee in neutral or internal rotation, is positive. This test is, however, not as reliable as the Lachman’s test, because the hamstrings and the medial posterior horn of the meniscus can resist this drawer.
10) Valgus and varus (side) stability of the knee at 20-30° of flexion and extension should be assessed to exclude injuries to the MCL and LCL.
11) An X-ray examination is needed to exclude any bony injury.
12) Arthroscopy will give the definite diagnosis, also MRI is used by many; however, it is rarely needed as the diagnosis can be made from the history and clinical findings.

Figure 2: Lachman's test                          Figure 3: Anterior drawer test

Treatment

1) Non-operative treatment

Candidates for non-operative treatment include:
1. Very young and very old patients.
2. Patients who are not very active and do not participate in sports activities.

Non-operative treatments include:
1. Acute management of the injury with swelling and pain control, bracing, a gradual increase in range-of-motion exercises, ice and anti-inflammatory medication.
2. Rehabilitation of the muscles should be advanced as rapidly as tolerated.
3. Any immobilization splints needed for the first day or two should be removed as soon as possible.
4. Functional exercises as cycling, swimming, and jogging can be started when there is full range of motion and no effusion in the joint.

5. High-risk activities with cutting or pivoting should be avoided for 6 -12 weeks after an ACL tear.

6. A brace may be used if the athlete returns to sports (Figure 4). Bracing may give the patient confidence and may prevent hyperextension. It may also protect the tibia from forward translation in relation to the femur at low levels of load.

**N.B.**

If there are signs of 'giving way' episodes, knee buckling, or recurrent pain or swelling, there may be a need for surgery.

![Figure 4: Functional knee brace](image)

### 2) Operative treatment

Following acute trauma it is now considered advisable to delay surgery until the knee has settled down and the swelling and pain have resolved. The optimal time for the procedure is about 2 - 8 weeks after injury, although further delay does not
significantly affect the results although the chances of a successful end result may decrease slightly.

**Indications for surgery**

1. Very active persons have the greatest need for surgery.
2. Knees that have marked instability give recurrent effusion and pain, have large meniscal injuries that can be repaired, or have other articular cartilage injuries.

**Surgical technique**

The graft selection is either from the patellar tendon or the hamstring tendons, for the reconstruction; both are very good grafts. Occasionally, especially in re-operations, allograft (tissue from cadavers) can be used, but it should not be the first choice in athletes. Synthetic ligaments should be avoided because of their stiffness and historically poor outcomes.

**Postoperative management**

**I. During Immobilization:** 6 - 8 weeks.

1. The patient must ambulate with crutches (non-weight bearing).
2. Regular setting exercises for quadriceps and hamstrings and SLR while in the cast.
3. Electrical stimulation to muscles can be done through specific window in the cast.
4. Early active hip extension and abduction exercises are done as soon as the patient can lift his leg.

**II. When the cast is removed** after 6- 8 weeks, slow and cautious progression of exercise and weight bearing.

1. Too vigorous exercises and too rapid weight bearing after the cast has been removed will stress and damage the repaired structures.
2. This period of protected motion and weight bearing is necessary so that proper
vascularization and organization of the collagen fibers can occur during healing and so that the tensile strength of the collagen fibers of the ligament can increase.

III. Specific exercises after the immobilization device has been removed include:
1. Continue setting exercises for the knee, SLR and hip exercises.
2. Active knee flexion and extension progressed very slowly.
3. Gradual active-assistive and active anti-gravity knee extension should be emphasized for anteromedial and anterolateral instability. This should be carried out with the control from the therapist so the patient does not fully extend the knee for several weeks.
4. Adding 5-10 bound of weight during SLR exercises when the patient has between 10 degrees to full active knee extension.
5. Bicycle activities on a stationary bicycle, started after 12–16 weeks. 6. Very low progressive resistance exercise, started at 12-24 weeks after surgery, to increase the strength of the quadriceps and hamstrings. Full ROM of knee extension may be done against resistance if it does not cause discomfort in the knee.

IV. Progressive ambulation without crutches may be started between 18-24 weeks after surgery if a patient has 10 degrees of extension and 80-90 degrees of flexion and can actively lift 15% of his body weight with the quadriceps and hamstrings.

V. Return to full activity will take at least 9-12 months.

Results and prognosis

The results of ACL reconstructive surgery are good: active people can return to the preoperative level in their sport after an acute ACL injury in around 80-90% of cases, and in about 70-80% of chronic cases.
2) Medial collateral ligament injuries

Symptoms and diagnosis
1. Injuries of the MCL are result from an abduction strain on the extended knee.
2. Pain occurs at the time of injury. Absence of severe pain does not exclude a severe injury; minor injuries may be more painful than more severe injuries.
3. The ability to walk can be impaired after an MCL injury: 50% of athletes with severe (grade III) injuries cannot walk unaided by external support after the injury.
4. Swelling of the joint is unusual; it indicates a more severe injury in the joint itself.
5. Tenderness is usually present over the site of injury. The most common location for tenderness is the medial femoral condyle.
6. Testing the laxity with valgus stress tests is important (Figure 5).

The Grading is as follows:
- Grade 0: Normal, i.e. no joint opening
- Grade I: 0.2 in (1-4 mm) joint opening
- Grade II: 0.2-0.4 in (5-10 mm) joint opening
- Grade III: 0.4-0.6 in (10-15 mm) joint opening.
7. Grade I and II injuries have well-defined end points, but a grade III tear occurs only with the soft end point with valgus stress testing.
8. It should be pointed out that even with a complete medial injury; there will be no valgus instability with the knee in full extension if the posterior cruciate ligament and the posterior capsule are intact.
9. Lachman's test for ACL stability should be carried out when gross medial instability is present (Figure 2). A grade III MCL injury is associated with an ACL injury in 95% of cases.
Figure 5: Valgus stress test: (left) in flexion; (middle) in extension; (right) alternative method.

**Treatment**

I. **Acute grade I and II isolated MCL injuries**
1. Weight-bearing and early motion can start as early as possible. A brace can be beneficial.
2. If by the end of the first week there is satisfactory progress with full extension, no effusion, and decreased tenderness, the athlete will do well and may return to full activity (including contact sports) within 3 - 8 weeks.

II. **Grade III injuries depend on the associated injuries**
1. Many believe that a significant MCL tear cannot exist without ACL tear.
2. A combined MCL and ACL reconstruction should be carried out.
3. The rehabilitation is the same as for isolated ACL injuries.
4. Early motion is important as surgery of the MCL structures can make the knee stiff.

**Return to sports**

Return to sports is permitted as soon as the athlete is comfortable with it. In a grade I sprain this may be within 1-2 weeks. Grade II sprains need a little longer about 2 - 4 weeks. Grade III injuries are the problem. Functional activities can be well tolerated. Sometimes these athletes need a brace.
3) **Posterior cruciate ligament injuries**

PCL tears of the knee are not very common; they constitute only 5-10% of all major knee ligament tears. The PCL provides 95% of the strength to prevent the posterior movement of the tibia in relation to the femur.

**Mechanism of injury**

A posteriorly directed force on the upper front of a flexed knee, such as a dashboard injury in a motor vehicle accident, is the most common cause of a PCL injury. In soccer, a player may receive a blow to the anterior proximal surface of the tibia and thereby force the tibia posteriorly to cause a PCL tear.

**Diagnosis**

1. There is only a mild hemoarthrosis and swelling.
2. Typically there is an increase in pain with flexion beyond 90°.
3. There is often patellofemoral pain and recurrent instability.
4. The posterior sag sign is a straight posterior increased displacement of the tibia when the knee is flexed 70 - 90° (Figure 6).
5. The posterior drawer test is the classic test reveals PCL tear (figure 7).
6. In the quadriceps active test, the patient is supine and the knees are flexed to 90°. In this position, the tibia translates posteriorly if there is PCL insufficiency (Figure 8).

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**Figure 6: Posterior sag sign.**  **Figure 7: Posterior drawer test**
Imaging can support the diagnosis
1. Plain X-rays will exclude major fractures and bony avulsions.
2. Magnetic resonance imaging is a useful diagnostic tool, but it is expensive.

Treatment
1) PCL injuries with bony avulsion
   In dislocated PCL bone avulsions, open reduction and internal fixation is the method of choice. Excellent results can be achieved after reattachment with sutures through drill holes or by fixation with screws. Early controlled mobilization in a knee brace is usually possible.

2) Isolated PCL tears
   Non-operative treatment with aggressive rehabilitation is often used for isolated PCL injuries.

Conservative treatment includes:
1. A brace or splint for comfort for up to 2 weeks.
2. Quadriceps strengthening is important and can compensate for functional PCL disability.
3. Return to full activity following an isolated PCL injury is possible within 2 - 8 weeks of injury.
Meniscus injuries

Gross anatomy

The medial and lateral menisci are C-shaped wedges of fibrocartilage located between the condyles of the femur and tibia (figure 1). The vascular supply of the menisci originates predominately from the inferior and superior lateral and medial genicular arteries. In adult menisci, the degree of peripheral vascular penetration is 10 - 30% of the width of the medial meniscus and 10 - 25% of the width of the lateral meniscus. With age, there is decline in meniscus vascularity which may be associated with weight-bearing. Cells within the central and inner regions of the menisci are dependent on diffusion of synovial fluid for their nutrition.

![Figure 1: Anatomic diagram of the anterior relationship between menisci, cruciate ligaments and MCL.](image-url)

Meniscal functions:
1. The meniscus transmits 30 - 70% of the load applied across the joint.
2. The menisci apparently play an important part in preventing an increase in anterior laxity when cruciate function has been lost.
3. The menisci may contribute to joint lubrication by spreading nutrient synovial fluid over the articular surfaces.
4. During weight-bearing the menisci serve to compress the nourishing synovial fluid into the articular cartilage.

**Mechanism of meniscus injury**

- The person usually injures himself.
- While standing on one leg with the knee flexed, forcible rotation of the body pushes the semilunar cartilage into the center of the joint, when the joint is extended the semilunar cartilage is crushed between the femur and the tibia.
- A combination with ligament injuries, particularly when the medial meniscus is involved.
- Injury to the medial meniscus is about 5 times more common than injury to the lateral meniscus.
- In elderly individuals, a meniscus injury can occur during a normal body movement such as deep knee bends, because of decreased strength due to degenerative changes.

Figure 2: (Top left) Injury to the medial meniscus: tenderness can occur over the inner synovial cavity (see arrow). (Top right) Injury to the lateral meniscus: pain can occur if the knee joint is over-extended. (Bottom left) Injury to the medial or lateral meniscus: pain can occur if the knee joint is over-extended. (Bottom right) Injury to the medial meniscus: pain can occur when foot and lower leg are rotated externally with knee bent at 90°. Injury to the external meniscus: pain can occur when foot and lower leg are rotated internally with knee bent at 90°.
**Clinical picture**
1. The history of the first injury is typical.
2. While playing a game the patient twists the bent knee while it is bearing weight.
3. The patient falls and feeling pain in the knee.
4. The patient cannot resume the game but can walk home with a limp.
5. Swelling of the knee joint because of effusion appears the next day and usually lasts for ten days.

**Physical examination**
1. There may be effusion.
2. Limitation of complete extension is present when the knee is locked.
3. Atrophy of the quadriceps muscle is noticed.
4. There is tenderness on the joint line over the torn meniscus (Figure2).
5. A click may be elicited when the knee is rotated in certain degree of flexion (McMurrays sign).
6. There may be associated injury of the knee as ACL injury.
Menisectomy

I. Indications for surgery
1. A tear or rupture of the medial or lateral meniscus.
2. Displacement of the meniscus, associated with locking of the knee.

II. Procedures
1. An arthrotomy of the knee is done through a longitudinal incision along the anterior aspect of the knee.
2. Complete removal of the meniscus or removal of the torn fibers is done.

III. Physical Therapy after Menisectomy
A. During Immobilization
   The knee is initially immobilized in a bulky compression dressing and the later in a splint for a total of 10 - 14 days.
1. Setting exercises to the knee and hip muscles as well as isotonic ankle exercises are begun the day after surgery.
2. Straight leg raising (SLR) is begun as soon as the patient can tolerate it.
3. Weight is added to the leg during SLR exercises at 7 - 14 days.
4. Ambulation with crutches, with partial weight bearing, is begun the day after surgery.

B. After removal of immobilization
   The immobilization device is removed by 10 - 14 day postoperatively, and active knee flexion and extension are begun to restore range of motion. As, the patient may lie supine, with the involved leg up against a wall, and slowly slide the foot down the wall to increase knee flexion.

C. Strength and stability of the knee (must be increased with resistance exercises)
1. Continued SLR without a splint using up to 25 bound of weight for resistance.
2. Isometric resistance exercise of the knee flexors.
3. Active and then active-resistive exercise of knee flexion and extension through the full range of motion, emphasizing a high number of repetitions against low resistance.

N.B. Most of patients tend to regain normal strength of knee flexors before the knee extensors.

D. Hip strengthening exercises
Exercises must also be continued and progressed so the patient will regain maximum strength and stability in the entire lower limb.

E. Return to full activity
A. Bicycling may be done routinely after one month.
B. The patient may return to jogging if he is symptoms free.

IV. Arthroscopic menisectomy
If an arthroscopic menisectomy has been done, exercises are be progressed much more rapidly. This is because an arthrotomy and significant disturbance of soft tissues are not necessary. As a result:
1. There is no extended period of immobilization.
2. Active ROM exercises may be started just 2 - 3 days after surgery.
3. Ambulation and weight bearing are progressed very rapidly.
4. The patient may ride a bicycle for short distances one week after surgery.
Chondromalacia Patellae

(Anterior knee pain or Patellofemoral Pain syndrome)

Definition
This is a softening and degenerative condition of the articular cartilage on the back of the patella. It is frequent finding in young adult. The medial surface is often found more affected than the lateral.

Pathomechanics
The cartilage is roughened and fibrillated. In most cases these changes are reversible and symptoms disappear. In few cases the disease progresses to osteoarthritis. Degeneration first occurs in the deeper portions of the articular cartilage, followed by blistering and fissuring that stems from the subchondral bone and appears on the surface of the patella.

Causes
Chondromalacia patellae may occur either as a consequence of patellofemoral stress syndrome or from a direct impact to the patella.
abnormal patellar tracking.

Stages of Chondromalacia patellae
Stage 1: Articular cartilage shows only swelling and softening.
Stage 2: Fissures appear in the softened articular cartilage.
Stage 3: Fibrillation of cartilage occurs, causing a "crab-meat" appearance.
Stage 4: Full cartilage defects are present, subchondral bone is exposed.
Clinical picture
1. There is pain in the anterior aspect of the knee and a sense of stiffness of the knee especially felt on starting movement after rest or on going up or down the stairs, and while walking, running, or squatting.
2. There is pain over the margin of the patella or when it is compressed or rubbed against the femur.
3. There may be effusion and recurrent swelling around the kneecap.
4. There may be crepitation and pain during a patellar grind test.
5. During palpation, there may be pain on the inferior border of the patella or when the patella is compressed within the femoral groove while the knee is passively flexed and extended.

Treatment
A. Medications
1. NSAIDs.
2. Iontophoresis.

B. Physical Therapy for patellofemoral disorders
I. Strengthening exercises
1. Isometric exercises such as quadriceps setting (QS) and straight leg raises are most frequently used for strengthening.
2. Terminal knee extension exercises.
3. Eccentric ankle dorsiflexion exercises have been reported to reduce patellar tendonitis symptoms.
4. Open kinetic chain exercises.
5. Regaining optimal patellar positioning and tracking through stretching the tight lateral structures and improving the vastus medialis oblique, which acts as dynamic stabilizer for the patella.

II. Flexibility
1. Hamstring stretching exercises.
2. Gastrocnemius-soleus stretching exercises.
III. Endurance
1. Bicycling and swimming are used most often because of their low-impact force on the lower extremities.
2. Stair-climber machines can be used to increase endurance, but caution must be taken to avoid increasing symptoms with this method.

IV. Modalities
Electrical muscle stimulation (EMS) to increase muscles strength.

V. External support
Knee brace have been reported for externally supporting the patella in patients with patellofemoral disorder. Taping with highly adhesive straps to correct patellar orientation.

VI. Avoid activities that exacerbate pain: As squatting and stair climbing and long times of sitting.
Osgood-Schlatter’s disease

In Osgood-Schlatter’s disease the tibial tuberosity in which the attachment of the patellar tendon becomes a seat of inflammation the cause of this injury is unclear; possibly it is repeated traction micro-trauma. Very active boys between 10-16 are primarily affected; it heals spontaneously at 17-19 years. The only remnant is enlarged tibial tubercle.

Symptoms and diagnosis

1. Pain at the attachment of the tendon to the tibia during and after physical activity.
2. Pain can be triggered by quadriceps muscle contraction.
3. Severe pain with kneeling, jumping, and running.
4. Localized tenderness and soft tissue swelling of the attachment of the patellar tendon.
5. The skin may be hot and red, with a prominence at the affected area.
6. Tightness of the muscles is often present.
7. An X-ray may show fragmentation of the bone; soft tissue swelling and thickening of the distal portion of the patellar tendon may also be seen.
**Treatment**

1. Stressful activities should be decreased until the appophyseal union occurs, usually within 6-12 months. Activity modification is recommended.
2. Pain free quadriceps muscle strengthening and stretching exercises.
3. Isometric progressive resistance exercises for quadriceps and hamstring muscles.
4. Hamstring stretching
5. Ice application before and after activity, and sometimes heat before activity.
6. Brace or cast immobilization for 2 weeks if pain is extremely severe.
Role of Physical Therapy for Ankle Sprain

The ankle is the most frequently injured joint in athletes and more than half of the injuries at the ankle are sprains. Most ankle sprains affect the lateral ligament. Of the ankle sprain injuries, 31% complain of chronic recurrent sprains. So the need for correct assessment followed by a comprehensive rehabilitation program is apparent.

![Figure (1): The lateral ligament complex of the ankle joint](image1)

![Figure (2): Posterior view of the ankle ligaments](image2)

Role and function of the collateral ligaments

Ligaments of the ankle serve three major functions:

**First**, they provide proprioceptive information for joint function. Joint capsules and ligaments are richly innervated and have many proprioceptive end organs. Disruption of ligaments may disturb this proprioceptive function.

**Second**, ligaments contribute to the static stability of joint function thereby preventing excessive motion. As the ankle moves from dorsiflexion to plantar flexion the contribution of bony anatomy to ankle stability decreases whereas the ligamentous contribution to ankle stability proportionally increases.

**Third**, ankle ligaments act as guides to direct motion.

The ATFL and PTFL resist anterior/posterior displacement of the talus in the ankle mortise. The CFL resists inversion stress and stabilizes the subtalar joint.
Ankle Sprain Injury

Definition

Ankle sprain injury was defined as acute trauma to the ankle ligaments that resulted in an inability to participate in activities one day after the injury.

Incidence of ankle sprain

- The three lateral ligaments account for 85% of all ankle injuries, whereas only 3% to 5% are deltoid ligaments sprains.
- In 70% of ankle ligament ruptures, the ATFL is the only ligament involved.
- Combined rupture of the ATFL and CFL is seen in 20% of cases.
- It is very rare that the PTFL is ruptured.
- In the remaining 9% of acute ankle ligament ruptures, the deltoid ligament at the medial aspect of the ankle is involved.

Etiology of ankle sprain

1- Potential muscle coordination deficiencies.
2- Cutting movements.
3- Inadequate foot position.
4- Training on the apparatus for long period of time.
5- Loss of concentration.

General symptoms of ankle sprain

The general symptoms of ankle sprain injury are pain, swelling, ecchymosis, and inability to bear stress. Bruising may be severe (suggesting a complete tear of the ligament), or may be faint and appear day or two after the injury (more likely with a sprain). Tenderness is usually maximal on the lateral aspect of the joint. Passive inversion is painful, but only with a complete tear the movement is excessive.

Grades of ankle sprain

A. Grade I injury (Mild)

Grade I injuries have stretching of the ligament without macroscopic tear, and the
Joint is considered stable on testing (negative anterior drawer and talar tilt tests). A mild sprain may be associated with mild swelling, mild tenderness, no discoloration (ecchymosis), a small amount of pain, and no loss of range of motion, no loss of function, no loss of ligamentous stability and full function and strength are maintained.

B. Grade II injury (Moderate)

Grade II, a moderate injury, consists of a partial macroscopic tear and allows some excess range of motion and mild to moderate laxity and instability. There is moderate swelling, tenderness, discoloration, pain and possible decrease in strength, and the potential for loss of proprioception. The patient’s functional ability is compromised.

C. Grade III injury (Severe)

Grade III sprain is a severe injury due to complete rupture of the ligament, resulting in marked and diffuse swelling, extreme point tenderness, and ecchymosis and gross instability and laxity of the joint. There is potentially complete loss of full function, and proprioception. Grade III injuries had a positive anterior drawer and talar tilt test (the ankle mortise opened with applied inversion stress).

Residual symptoms and complications

Ankle sprains are not always simple injuries and residual symptoms result in 33 - 40 % of patients.

- The incidence of residual complaints is greater in athletes than in patients who undertake less strenuous activities.
- The residual complaints include mechanical, functional instability, intermittent swelling, stiffness and pain, which is the most frequent residual problem.

Recurrent ankle sprain

Three-fourths of ankle sprains of professional players were in ankles with previous sprain and/or clinical instability.

Prognosis of ankle sprain

Prognosis is proportional to the severity and grade of the injury. Grade I sprains
require an average 11.7 days before the full resumption of athletic activities. Grade II ankle sprains require approximately 2-6 weeks for return to full athletic function. Generally, for grade I and II sprains, patients are completely asymptomatic and functionally stable at follow-up. For acute grade III ankle sprains, the average duration of disability has been reported from 4.5-26 weeks, and only 25-60 % of the patients are symptom-free 1 to 4 years after injury.

**Management of ankle sprain**

For many years, treatment for ankle sprains varied greatly and was a controversial topic. An adequate treatment of any ankle sprain is necessary to restore the mechanical interplay of the ankle joint complex.

**Methods of treatment of ankle sprain**

- Anti-inflammatory medications
- Plaster cast immobilization,
- Early mobilization with brace protection,
- Taping, elastic bandaging, and adhesive strapping.
- Rehabilitation programs.
- Injection of steroids,
- Primary surgical repair.

(1) **Conservative treatment of ankle sprain**

Treatment of acute ankle sprains depends on the severity of the injury. Conservative therapy is effective in treating grade I and II ankle sprains. Early use of RICE (rest, ice, compression and elevation), maintenance of range of motion and use of an ankle support should be emphasized. Some controversy exists regarding the appropriate treatment of grade III injuries, particularly in high-level athletes. The majority of these patients may also be treated well with conservative management. The impact of the injury on the patient’s personal life, work, and athletic demands will largely direct the initial therapeutic efforts. If painless mobility is essential then rigid immobilization (i.e. cast) may be appropriate. If rapid return to sports competition is of importance, functional immobilization is preferred.
(2) Surgical treatment of ankle sprain

Most injuries to a single ligament are not treated surgically. Some orthopedic surgeons have advocated operative repair of severe injuries, especially in young athletes and physically active individuals. The surgeon may select from a number of non-anatomic ligament reconstructions or anatomic ligament repair.

**Arthroscopy:** Arthroscopy can be used for diagnosis and treatment.

**The functional rehabilitation program**

**Goals**

1. Facilitation of healing via protection of the damaged ligament to provide dynamic stabilization to the affected joint.
2. Prevention of swelling and maintain range of motion
3. Muscle strengthening as soon as possible
4. Restoration of a responsive proprioceptive system.
5. Reduced time loss from work and daily activities
6. Promotion of a timely return to prior sports participation,
7. Prevention of long-term functional instability
8. Prevention of recurrent sprains

**Phases of the functional rehabilitation program**

Phase I is the acute phase in which the control of pain, edema, and joint stability are emphasized. Phase II is the early rehabilitation (subacute) phase in which the return of normal motion and arthrokinematics are promoted. Phase III is the late rehabilitation (chronic) phase during which stretching, strengthening, and proprioceptive training are all of almost importance. Phase IV addresses a functional progression of activities aimed to full sports participation.

**Phase I (acute phase) of the rehabilitation program:**

Stability of the injured ligament must be provided; therefore, phase I (initial management) consist of protection, rest, ice, compression, and elevation (PRICE).
1- Control of edema

The control of edema is essential in the early stages of an acute injury. Fluid that has accumulated in the tissue spaces around the injured ligament must be mobilized back into the lymphatic system if optimal healing is to occur. Effusion and hemorrhage distend the joint and overstretch the ligaments. Tissue swelling increases the adhesion formation that can delay healing and decrease range of motion following ankle sprains. Sprains treated by PRICE, to diminish the edema and haematoma in the acute phase following the sprain.

A) Protection

Controlled stress and protected function have been found to enhance the strength, thickness, and functional integrity of the healing ligaments. Protected early mobility can be accomplished using a variety of bracing and taping techniques.

B) Rest

Rest from bearing full weight can be achieved by using crutches during the initial, most painful period after injury, until the patient is able to bear weight without any discomfort. Protected weight bearing should be initiated as tolerated, but early bearing of weight should be encouraged as soon as possible to minimize proprioceptive loss.

C) Ice (cold application)

Cryotherapy should be used immediately after the injury. Heat should not be applied to an acutely injured ankle joint because it encourages swelling and inflammation through hyperemia. Ice is useful for treating pain, hemorrhage and edema. Cryotherapy induces vasoconstriction, which affects a decrease in local blood flow. Cryotherapy acts as an anesthetic to control pain and decrease reflex muscle spasms by reducing the conduction velocity in peripheral nerves. Cold can be applied to the medial and lateral ankle over a thin layer of cloth, using bags of crushed ice or cold gel packs. A 20 minutes treatment time is recommended every two to three hours for the first 48 hours, or until edema and inflammation have subsided for treatment of ankle sprains. While cold therapy is being used, exercises should be initiated to maintain range of motion and assist lymphatic drainage.
D) Compression

Cold-compression pumps are most efficient in reducing acute edema because the benefits of ice are augmented by those of a compression device. The bandaging should start just proximal to the toes and extend above the level of maximal calf circumference.

E) Elevation

The patient is encouraged to elevate the injured extremity 15 to 25 cm. above the level of the heart as much as possible during the day and while sleeping at night to facilitate venous and lymphatic drainage until the swelling has begun to resolve.

2- Exercises in the acute phase

Gentle isometric exercises are appropriate in all planes of motion to limit the amount of secondary muscle atrophy. The use of a single-planer tilt board for active-assisted dorsiflexion is recommended in the acute phase, with the patient is seated and motion is limited to a painless range.

Phase II (subacute or early rehabilitation phase)

When swelling has stabilized and pain and tenderness markedly have decreased, and the patient is able to bear weight comfortably, the patient can progress to the second phase of rehabilitation program which consists of:

- Peroneal and dorsiflexor strengthening exercises
- Achilles tendon stretching exercises.
- Electric modalities continue to play a role for pain and swelling.
- Cryotherapy to decrease ankle swelling in the subacute phase.

Phase III (chronic or late rehabilitation phase)

The third phase of rehabilitation can begin when the patient is able to tolerate bearing full weight and demonstrates normal ambulation. ROM of dorsiflexion is near normal and soft tissue palpation should be painless and swelling is mild to absent after the exercise sessions. Goals to be achieved in the late rehabilitation phase include full active range of motion, a progressive increase in muscle strength and endurance training.
The stretching and strengthening exercises are continued throughout the rehabilitation program. Active range of motion in all planes should now be stressed and aggressive techniques that increase both inversion and eversion are appropriate.

Phase IV (Return to activity or functional phase)

When the athlete has achieved full range of motion and has regained at least 80% of pre injury strength, preparation begins for a return to activity. A progressive program of functional rehabilitation based on the specific demands of the individual’s sport must precede this return. Sports activity should be broken down into a series of skills that gradually increase in difficulty. The patient is progressed through functional activities, beginning with brisk walking, light jogging, running in a straight line, the progressive figure eight running, jumping and cutting. Progression through these activities occurs as confidence in the ankle increases.
Achilles Tendinitis

Introduction

The Achilles tendon is the tendon common to the gastrocnemius and soleus muscles. The tendon is surrounded by a structure called the paratenon, which functions like an elastic sleeve and increases freedom of movement against surrounding tissues. The paratenon also provides the major blood supply to the Achilles tendon. There is a zone of hypovascularity 2 - 6 cm proximal to the insertion at the calcaneus, and it is though this predisposes the tendon to injury at this area. Either the tendon or paratenon (or both) can become inflamed from excessive friction by ill-fitting boots, particularly in soldiers and policemen. Occasionally, the inflammation is a rheumatoid or tuberculous origin.

Signs and symptoms

1) Dull aching pain in the area of the Achilles tendon, usually proximal to its insertion into the calcaneus.
2) Pain may be present at rest but most often occurs with activity.
3) Observable, palpable edema and thickening of the Achilles tendon.
4) Crepitus may be felt on repeated plantar flexion and dorsiflexion.
5) There is usually pain with passive dorsiflexion and on active and resisted planter flexion.

Diagnosis

1. There are no routine diagnostic tests for Achilles tendinitis.
2. MRI examination will show soft tissue changes in the patient with Achilles tendonitis or with a tear.

Clinical picture

1. Achilles tendon pain with weight bearing.
2. Crepitus on palpation.
3. Swelling around the tendon.
4. Pain on palpation.

**Treatment**

1) **Medical Treatment**

1. The physician may prescribe drugs to decrease inflammation and pain. Avoid cortisone injections (weakening and possible rupture of tendon).
2. Foot orthotics may be needed if abnormal mechanics at the foot and ankle contribute to the onset or recurrence.
3. In many cases relief is obtained by resting the ankle in a below knee walking Plaster-of-Paris cast for few weeks. If this is not effective the diseased sheath is excised.

2) **Physical Therapy**

1. Treatment is initially geared toward controlling the symptoms, edema, and inflammation using PRICE.
2. Physical agents can control symptoms and promote healing as iontophoresis or phonophoresis.
3. Transverse friction massage may promote healing.
4. Daily activities should be modified according to the severity of the tendonitis.
5. The program should eventually include active stretching to improve tendon extensibility and strength.
6. Gastrocnemius-soleus strengthening exercises should include eccentric exercises to improve the tendon's tension resistance.
7. Pool exercise can be appropriate adjunct to promote progression in weight bearing activities.
8. The patient should ice the tendon area after activities until he or she has returned to normal activities.
9. Prevention can be facilitated with appropriate footwear; maintenance of strength and flexibility; monitoring activities; and treating any mechanical abnormalities at the foot and ankle.
Sports injuries of the foot injuries

Introduction

The foot is a complex anatomical structure subdivided into several bones and different articulations, which change their spatial orientation instantly. The foot is able to provide both stability and flexibility. Most sports involve some sort of running or jumping, and so the foot is continually called upon to provide both stability and shock attenuation.

The foot is the athlete’s main contact area with the ground, which accounts for the very high number of injuries affecting this area in sport. An athlete’s foot may have to withstand forces two or three times greater than body weight, and this may be repeated more than 500 times every hour when running.

Different injuries of the foot among athletes

1) Turf toe

Definition

Turf toe is a sprain involving the plantar aspect of the capsule of the first MTP joint.

Incidence

Athletes who play regularly on synthetic surface.

Cause

Forced hyperextension of first MTPJ, which causes capsular tearing, and sometimes disruption of the components of the medial sesamoid.

Predisposing factors for turf toe

1- Artificial playing surface than with grass.
2- Sports shoes:
- Lighter shoes tend to be used with artificial playing surfaces.
- Shoes which are fitted by length alone, rather than width.

3- Increased ROM of ankle dorsiflexion.

Examination
- Hyperaemic swollen joint
- Tenderness over planter surface of metatarsal head.
- Local bruising within 24 hours.

Treatment
Reducing pain and inflammation is the initial aim of treatment.
- Rest, ice, elevation, and TENS are used to control pain.
- Compression and support of the joint by raping:
The first MTPJ is held in neutral position and strips of 2.5 cm inelastic tape are applied in a figure-of-eight fashion crossing over the joint. The strips begin on the plantar aspect of the foot; go over the top and around the toe to finish on the dorsum of the foot.
- An oval piece of felt or foam with a hole in the middle is placed beneath the toe, the hole corresponding to the metatarsal head.
- When the pain subsides, active and passive motion of the joint is encouraged.
- Hard solid shoes.
- No activity until full ROM is reached.

Preventive measures
Wearing shoes with more rigid soles to avoid hyperextension of the injured joint. Semi-rigid or rigid insoles may be used.

2) Hallux valgus (Bunion)

Definition
Hallux valgus is the outward angulation of the big toe with an angle more than 10 degrees.

Incidence
Hallux valgus occurs when the first MTPJ is hypermobile, and the first ray is shorter than second.

Cause
• It is more common in athletes who hyperpronate.
• As the first MTPJ dorsiflexes during the propulsive phase of running, the instability allows the hallux to deviate from its normal plane.
• Adduction and axial rotation occur.
• The long flexors, which normally stabilize the joint, now deforming.
• As the metatarsal head adducts the sesamoids sublux and eventually erode the plantar aspect of the first metatarsal head, which lead to pain.

Pathology
Compensatory stress is placed on the joints proximal and distal to the first MTPJ, which lead to synovial inflammation, capsular distraction and pain over the medial exostosis of the 1st metatarsal head which forms where the angle is greatest. Secondary osteoarthritis occurs in the first MTPJ and sesamoids. The outgrowth is covered by bursa which may be inflamed and extremely sore as a result of exposure to pressure (a bunion). Bunion formation to the side of the first metatarsal head is common.

Management
The aim is to stabilize the first MTPJ by correcting faulty foot mechanics (hyperpronation – footwear).
• Pad between 1st and 2nd toes and
• Supportive strapping may be used.
• Obtain adequate width of foot wear.

If conservative III fails, surgery may be required:
• Soft tissue deformity: removal of the bunion.
• Bony deformity:
  - Osteotomy.
  - Arthroplasty.

3) Hallux rigidus

Definition
A reduction in movement of the first MTPJ. A hallux limitus may progress to complete immobility of hallux rigidus.

Incidence
The condition is more common when the first metatarsal is longer than the second.
Symptoms
Pain is generally worse during sporting activities especially during pushing off.

Examination
• End feel: firm.
• Limitation of movement of dorsiflexion.

Treatment
• Joint mobilization:
  - Distal distraction
  - Gliding mobilizations with metatarsal head stabilized
• Surgical treatment is recommended for bony deformity.

4) Morton’s Neuroma

Morton’s neuroma affects the plantar interdigital nerve between the 3rd & 4th metatarsal heads.

Incidence
• Runners, dancers
• The condition is aggravated by wearing narrow, high-heeled shoes.

Cause
The sustained dorsiflexion position of these activities stretches the digital nerve causing inflammation.
Once the nerve is swollen, it is open to entrapment between the metatarsal heads, and the nerve is scared and permanently enlarged to form a neuroma.

Symptoms
• It may occur spontaneously.
• Feeling like “electric shocks” along the sensory nerve distribution.

N.B.
Pain may be reproduced by direct pressure over the neuroma while compressing the forefoot medially and laterally.
Treatment
A) Edematous stage
• Alteration of footwear
• Felt metatarsal pad
• Ice
• US
• Injection with corticosteroid and local anesthetic
B) Stage of Neuroma
Surgical excision under local anesthesia. There may be a permanent loss of sensation over the plantar aspect of the foot supplied by the plantar aspect of the foot supplied by the digital nerve, but in some cases regeneration occurs between 8-12 months after surgery.

5) Tarsal Tunnel Syndrome

Definition
Entrapment of the medial and lateral plantar nerves.

Pathology
Just below the medial malleolus lies a passage through which pass the medial and lateral plantar nerves. In case of excessive pronation of the foot the load increases on the tissues that surround the flexor tendons, and inflammation occur and cause swelling which results in trapping of these nerves.

Symptoms
• The affected athlete feels pain arising from the area of entrapment.
• It radiates distally along the inside of the foot and along the sole of the foot towards the toes (the area the nerves supply).

Management
• Rest
• Ice massage for pain control
• TENS
• Medial arch support is prescribed.
• Compression of the abductor hallucis must be avoided.
6) Metatarsal arch strains

Introduction
The soft tissue of the longitudinal arch of the foot may be injured due to:
• An excessive foot pronation and
• A valgus heel posture.

Rehabilitation
Therapeutic modalities for pain and swelling control.
• Strengthening the muscles which raise the arch of the foot (toe flexors & posterior tibialis tendon).
• The heel cord is also important because a tight heel cord exaggerates pronation during running.
• Taping the longitudinal arch is performed while the toes are flexed and the ankle is extended.
• The use of orthosis is necessary to control hyperpronation.

7) Stress fractures of calcaneus, navicular and metatarsal bones

Cause
Stress fractures can occur as a result of prolonged and repeated load on the legs.

Incidence
Long distance runners and athletes who train intensively or badly are susceptible to stress fractures.

Symptoms
• Pain during activity.
• Local tenderness and swelling.
• X-ray shows no fracture. After 2-3 weeks healing by callus can be seen around the fracture site.
• Bone scanning can confirm the diagnosis.

Treatment
Use crutches to avoid weight bearing, rest, orthosis and Activity can be resumed after the athlete is free of symptoms (6-8 weeks).

8) Calcaneal spur

Definition
It is a condition characterized by pain beneath the hind part of the heel on standing or walking.

Cause
There may be an inflammation of uncertain origin.

Symptoms
Pain beneath the heel on standing or walking is the only symptom.

Examination
There is well marked local tenderness on firm palpation over the heel pad.

Management
• A soft calcaneal orthotic: a rubber heel cushion on the insole.
• Correction (review, elimination) of abnormal shoe wear, hyperpronation, limited ankle extension, technical or training errors.
• Running on soft surfaces or grass should be advised.

N.B.
It is not unusual for the condition to take 2-3 months or longer to improve, even when overuse is removed.

9) Plantar fasciitis

Definition
Inflammation of the plantar fascia.

Incidence
Sports which involve repeated jumping an with hill running.

Pathology
• The fascia consists of a dense fibrous band running forwards from the calcaneal tuberosity to the metatarsal heads.
• Overuse may cause microtears and inflammation of the fascial insertion, and nodules from the fascial granuloma can be felt.
• Normally, during midstance, the foot is flattened, stretching the plantar fascia and enabling it to store elastic energy to be released at toe off.
• A variety of malalignment faults may increase stress on the fascia.

Predisposing factors for plantar fasciitis
1- Excessive pronation.
2- Weak peronei after ankle sprain.
3- Pes cavus.

Plantar fasciitis is exacerbated if the Achilles tendon is tight, or if high-heeled shoes are worn. Sports shoes play an important role in the course of the plantar fasciitis. The shock absorbing qualities of the shoe are important.

Symptoms
• Pain is often worse when taking the first few steps in the morning until the Achilles tendon is stretched.
• Pain usually occurs over the calcaneal attachment of the fascia or its medial edge.
• Pain may be localized to the heel as though the athlete is “stepping on a stone” or may present as a burning pain over the arch.
• The site of pain and tenderness is more forward than it is in tender heel spur.

Radiologically
Radiographs usually do not show any abnormality. A sharp spur projecting forwards from the tuberosity of the calcaneus is sometimes found, but it may be present without heel symptoms.

Treatment
1- Rest.
2- Anti-inflammatory drugs, local injection with hydrocortisone into the tender area.
3- Ice massage.
4- Massage with anti-inflammatory products.
5- Contrast baths to relief pain.
6- US to the medial arch of the foot.
7- Taping the foot give rapid relief.
8- Shoe modification is critical for successful treatment.
9- Progressive resistive exercises for strengthening the intrinsic muscles of the foot.
12- Stretching exercises are used when pain subsides, since extension of the toes and of the ankle stretches the plantar fascia. Stretching exercises of the gastrosoleus complex are recommended in order to restore flexibility of the heel cord.
13- Walking program to gradually introduce stress.
14- Running also can be introduced gradually.

7) Metatarsalgia

Definition
Metatarsalgia is pain in the forefoot.

Cause
Altered foot function causes abnormal mechanical stress in the forefoot leading to symptomatic functional metatarsalgia.

Symptoms
- Metatarsophalangeal (MTP) joint subluxation,
- Oedema of the surrounding tissues,
- Extensor tendon tightness and
- Painful callosities under the metatarsal head are usually observed in metatarsalgia.

Management
- Reducing the load on the metatarsals by correction of foot wear is important.
- Anti-inflammatory modalities: NSAIDs.
- Period of rest.
- Ultrasound can provide some symptomatic relief.
- Use of orthotics: padding and strapping to relieve the stress on the forefoot tissues.
- Strengthening of intrinsic muscles is essential simple exercises, such as “shortening” the foot in bare foot, are effective at building isometric strength and endurance of the intrinsic muscles.
• Distal osteotomy of metatarsals is the treatment considered when conservative treatment failed.