CHAPTER 2: Injury prevention and the rehabilitation of injury

Types of injury

A sports injury is any kind of injury, pain or physical damage that occurs as a result of sport, exercise or physical activity.

Sports injuries are unfortunately inevitable, and are dependent on a performer’s intensity of training, the preparation he or she makes to avoid injury, and the ways in which rest and recovery are planned into a training and competitive programme. Figure 2.1 outlines the factors influencing how injuries are caused and can be dealt with.

Sports injuries are:
• Most commonly associated with the musculo-skeletal system, which includes muscles, joints and their associated tissues such as ligaments and tendons.
• Commonly classified as acute or chronic.
• Mild, moderate or severe.
• Characterised by pain, swelling, tenderness, weakness and the inability to use or place weight on the injured area.
• Acute injuries refer to sports injuries that happen in a moment.
• Chronic injuries are characterised by a slow, sustained development of symptoms, that culminate in a painful inflammatory condition.

Acute injuries

Common symptoms associated with acute sports injuries:
• Acute injuries require immediate first aid treatment at the scene of the injury.
• Sudden severe pain.
• Stretching painful in the case of a muscle strain.
• Swelling, inflammation, bruising or tenderness over injured area.
• Restricted mobility above and below injured area.
• Loss of stability in the case of leg injuries.
• Loss of function in the injured area.
• Protruding bone from the skin in the case of a compound fracture.
• Deformity around injured area.
• Cold purple colouration of skin indicating a lack of proper blood circulation in that injured part.

Fractures

A bone fracture is a break in the bone and is caused by excessive external forces and so is classified as traumatic fracture. There are two major classes:
• Simple fractures (figure 2.2) are broken bones that remain within the body and do not penetrate the skin.
• Compound fractures are broken bones that penetrate through the skin and expose the bone and deep tissues to the exterior environment, creating an open wound with a risk of infection.

Dislocations

A dislocation occurs when the bones which meet at a joint, are separated by a violent action so that the joint no longer functions.
• For example, a shoulder dislocation occurs when a player’s arm is forced outwards and upwards by a tackle or heavy landing and the shoulder joint pops out.
• Injuries can occur quite easily because the shoulder joint is a shallow ball and socket when compared to the hip joint.
• A dislocation is usually accompanied by a sprain (page 31).
• Repeat dislocations of the same joint are common because the initial dislocation stretches the joint capsule and ligaments, and results in joint hypermobility.
Common soft tissue injuries

A soft tissue injury occurs when muscles, ligaments and tendons are damaged. Common soft tissue injuries usually occur from a sprain, a strain or a one off blow resulting in a contusion or bruise (caused when blood vessels are damaged or broken as the result of a blow to the skin). Contusions are common in contact sports such as rugby and boxing. Soft tissue injuries can result in pain, swelling, bruising and loss of function.

Strains

- Muscles can be damaged both by direct trauma (impact) or indirect trauma (overloading).
- A strain (pull or tear) refers to damage to muscle fibres or its attaching tendons caused by a sudden stretching force or a very forceful contraction of the muscle.
- The tearing of the muscle can also damage small blood vessels, causing local bleeding, or bruising (known as a haematoma), and pain caused by irritation of the nerve endings in the area.
- The most common muscle injuries occur in high speed activities such as sprinting and weight lifting, which load muscles such as the hamstrings, quadriceps, calf, back and biceps.
- Muscle tears range from a mild to moderate to severe strains or complete rupture.

Sprains and tears of ligaments

- A ligament is an extension of a joint capsule consisting of tough, fibrous connective tissue that provides stability by joining bone to bone positioned inside a joint (intrascapular) and outside of a joint (extracapsular).
- In a sprain, ligaments reinforcing a joint are stretched or torn.
- One of the most common knee injuries is an anterior cruciate ligament (ACL) sprain or rupture. The ACL runs diagonally across the middle of the knee and prevents the tibia from sliding out in front of the femur, as well as providing rotational stability to the knee.
- Athletes who participate in high demand sports like soccer and basketball, are more likely to injure their ACLs.
- About half of all injuries to the ACL occur along with damage to other structures in the knee, such as articular cartilage, meniscus or other ligaments.

Ligament injuries

There are three graded categories for all ligament injuries:

**Grade 1 sprain:** the ligament is mildly damaged as it has been slightly stretched, but is still able to help keep the knee joint stable.

**Grade 2 sprain:** the ligament is stretched to a point where it becomes loose, and is commonly known as a partial tear of the ligament.

**Grade 3 sprain:** a complete tear of the ligament into two pieces. For example, a complete tear of the ACL creating an unstable knee joint (figure 2.3).

A complete rupture leads to mechanical instability, whilst tearing may damage the proprioceptive feedback mechanism.

The ACL can be injured in several ways:

- Changing direction rapidly.
- Stopping suddenly.
- Slowing down while running.
- Landing from a jump incorrectly.
- Direct contact or collision, such as a football tackle.
Symptoms of cruciate ligament injuries
• A ‘popping’ noise is associated with a ruptured ACL.
• The knee gives way and becomes unstable.
• Causing further damage to the cushioning cartilage (meniscus) of the knee.
• Pain and swelling within 24 hours.
• Loss of full range of motion.
• Tenderness along the joint line.
• Discomfort whilst walking.

When a ligament is torn completely, it can be replaced with a graft, for example, the anterior cruciate ligament of the knee joint can be replaced using a hamstring tendon graft (page 43).

Achilles tendon injuries
• A tendon is a tough cord or band of dense white fibrous connective tissue which contacts a muscle to a bone and transmits the force which the muscle exerts.
• The Achilles tendon is located at the back of the ankle and connects the powerful calf muscles to the heel bone (calcaneus).
  • When the calf muscles contract, the Achilles tendon is tightened, pulling the heel.
  • This allows the foot to point and stand on tiptoe, vital to such activities as walking, running, and jumping.

• Tears of the Achilles tendon can be tiny (microtears), or large (macrotears), causing pain, swelling, and impaired movement.
  • Tears may occur suddenly (acute), during activity or gradually over time (chronic).
  • A complete tear through the tendon, which usually occurs about 2 inches above the heel bone, is called an Achilles tendon rupture.
  • A rupture can occur when a significant load has been applied quickly and sustained without adequate warm-up.
• An Achilles tendon rupture is more common in those with pre-existing tendinitis of the Achilles tendon.
• By the age of thirty, tendons begin to lose their elasticity with increasing degenerative changes, but the process can be delayed by regular exercise.

• Total tendon ruptures often occur in a degenerated tendon and is especially common in older athletes who return to sport after some years’ absence from training, and middle-aged men and women participating in recreational sports that require bursts of jumping, pivoting, and running. Most often these are in sports such as tennis, squash, basketball, and badminton.
  • A rupture is most likely to occur when an individual makes a forceful push-off by the thigh muscles whilst the knee is extended. One example might be preparing for a overhead shot during a badminton rally.
  • Other common causes for a rupture can occur as a result of a sudden trip or stumble when the foot is thrust in front to break a fall, forcefully overstretching the tendon, or abruptly stepping into a hole.
  • A complete rupture of the Achilles tendon may make a ‘popping’ sound, followed by pain and swelling of the lower leg.
• Figure 2.4 compares a ruptured and normal Achilles tendon.
• Treating an Achilles tendon rupture requires surgery or long-term immobilisation of the ankle.
Sprains and tears within joints

- Common sites of sprains are the ankle, knee and thumb joints.
- Sprains happen most often in the ankle (figure 2.5) in sports that involve twisting and turning movements, such as in netball.
- Knee sprains are common football injuries.
- Thumb sprains are common in skiing and contact sports such as judo.

Ice therapy is a common method used for acute joint and muscle injuries and is part of the RICE First Aid procedure as follows:
- **Rest** - stop the activity as soon as the injury occurs to prevent making it any worse.
- **Ice** - apply to injured area for 10-15 minutes then remove for 20 minutes (and repeat) to reduce internal bleeding and swelling.
- **Compression** - reduces swelling, supports soft tissues, minimising further damage, and so speeds recovery.
- **Elevation** - elevating the injured area above the heart aids the drainage of any liquid/leakage caused by the injury thereby reducing swelling and inflammation.

Chronic or overuse injuries

Common symptoms associated with chronic overuse sports injuries:
- Chronic injuries start off with **mild symptoms** that enable performer to ignore the injury and carry on with his or her activities.
- Followed by a gradual **increase of pain** and inflammation over a period of time resulting from continued **overuse**.
- Increase in pain during sporting activity.
- Mild swelling after completion of sporting activity.
- Constant **aching** at rest.
- Chronic injuries are also associated with fatigue.

Shin splints (periostitis)

Shin splints are a type of **soft tissue injury** due to **inflammation** of the periosteum (a layer of connective tissue that surrounds bone), usually caused by repeated stress on the tibia. Shin splints are common in people who do a lot of running or other activities that involve repeatedly putting weight on the legs, such as tennis or basketball.

Shin splints can usually be treated at home as follows:
- **Rest**: stop the activity that causes shin splints for at least two to three weeks, then gradually resume normal activities
- **Ice**: for around 10 minutes every few hours for the first few days. This helps to relieve pain and swelling
- **Pain relief**: such as paracetamol and ibuprofen help to relieve the pain.
- **Switch to low-impact activities**: such as cycling, swimming and yoga.

Tendinopathy

Tendinopathy refers to a disease of a tendon including tenderness on palpation and pain, often felt when exercising. Tendonitis is an acute tendon injury accompanied by swelling (‘itis’), resulting from **excessive overuse**, and describes common elbow injuries, experienced by tennis players, golfers and throwers.

The elbow joint

The **elbow joint** is surrounded by muscles that move the elbow, wrist and fingers. The tendons in the elbow join the bones and muscles together, and control the muscles of the forearm. **Golfer’s elbow** is not as well known as its cousin, **tennis elbow**. Both are forms of tendinopathy. The difference is that **tennis elbow** stems from overusing tendon attachments to the **outside** of the elbow, while **golfer’s elbow** is caused by overusing tendons on the **inside** of the elbow.
Elbow

Golfer’s elbow is a common overuse injury associated with playing golf and throwing activities such as javelin and bowling in cricket. It is caused by overusing the muscles in the forearm that allow the individual to grip, rotate the arm, and flex the wrist.

Repetitive flexing, gripping, or swinging can cause irritations to the tendons creating pronounced tenderness and pain when the medial epicondyle is subjected to pressure, and when the hand is flexed downwards (palmer flexion) at the wrist joint against a resistance.

Tennis elbow is a common overuse injury associated with racket sports such as squash, badminton and tennis. For example, in tennis it can be caused by repetitive faulty stroke technique, such as hitting backhand balls by using wrist movements instead of hitting backhand balls with a firm wrist and a movement of the whole arm and shoulder.

Top level tennis players (figure 2.6) may develop lateral epicondylitis despite having good playing technique and is usually caused by the serving action during which the wrist is bent at the same time as the forearm is turned inwards.

Those who hit an exaggerated ‘top spin’ and in so doing rotate the forearm vigorously inwards (excessive pronation) can also be affected. This was the injury sustained by Andy Murray at the beginning of the 2017 tennis season. The flexor muscles, that are principally responsible for these movements, have their origins at the medial epicondyle of the elbow.

The symptoms are similar to those of golfer’s elbow, but are located on the outer aspect of the elbow joint. If the muscles and tendons are irritated, it can cause thickening of the tendon and pain near the bony lump (the lateral epicondyle) on the outside of the joint.

General tendonitis symptoms include:

• Pain which mainly affects the outside aspect of the elbow (tennis elbow) or inside of the elbow (golfer’s elbow) that can radiate along the upper and lower arm.
• Weakness in the wrist.
• A tender local hot spot over the epicondyle.

Stress fractures

A stress fracture is a small crack in a bone resulting from overuse. There are two theories about the origin of stress fractures:

• The fatigue theory states that during repeated protracted effort, such as running, the muscles pass their peak of endurance and are no longer able to support the skeleton during impact applied as the foot strikes the ground. The load is therefore transferred directly to the skeleton. Its tolerance is eventually exceeded causing a tiny crack or stress fracture.

• The overload theory is based on the fact that certain muscle groups contract in such a way that they cause the bones to which they are attached, to bend. For example, the contraction of the calf muscles causes the tibia to bend forward like a drawn bow. After repeated contractions the innate strength of the tibia is exceeded and it cracks.

More than 50 percent of all stress fractures occur in the weight-bearing bones of the foot and lower leg because of the repetitive forces they must absorb. Typically, runners sustain stress fractures of the lower third of the fibula and high jumpers of the upper third of the fibula.
Symptoms and diagnosis

- Pain is felt during training as intensity increase and eventually a dull ache which persists after the exercise period.
- Local swelling and tenderness can be felt over the fracture area.
- Stress fractures affect people of all ages who participate in repetitive sporting activities and are especially common in tennis players, runners, gymnasts and basketball players.
- Repeated use of X-ray examination is used to check the process of healing, whilst the athlete is resting and using prescribed crutches to relieve the injured part.
- If stress fractures are to be avoided, the athlete should pay particular attention to selecting appropriate footwear, equipment (page 40) and periodisation of training or load.

Overuse or chronic injuries are particularly difficult to diagnose and treat. Recovery from chronic injuries takes time and needs careful programming to restore the individual back to pre-injury levels using many of the rehabilitation methods discussed on page 42 onwards.

Prevention of injuries

Extrinsic and intrinsic risk factors affecting sports injuries

Table 2.1 outlines the intrinsic and extrinsic risk factors which affect sport injury. Intrinsic risk factors are those within the performer, and extrinsic risk factors are those derived outside the performer.

Table 2.1 – intrinsic and extrinsic risk factors in sport injuries

<table>
<thead>
<tr>
<th>intrinsic risk factors</th>
<th>extrinsic risk factors</th>
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<tbody>
<tr>
<td>gender</td>
<td>training volume, overtraining</td>
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<tr>
<td>age increases injury risk as bone tissue</td>
<td>sport technique</td>
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<tr>
<td>loses strength</td>
<td></td>
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<tr>
<td>body mass and body composition</td>
<td>playing surfaces</td>
</tr>
<tr>
<td>muscle balance/imbalance</td>
<td>equipment difficulties, e.g. selecting the perfect ski boots, skis and poles</td>
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<tr>
<td>joint flexibility (or lack of it)</td>
<td>clothing/footwear/equipment</td>
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<tr>
<td>orthopaedic and skeletal features</td>
<td>environmental conditions</td>
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<tr>
<td>conditioning</td>
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</table>

Although the chances of injury in sport can never be fully eradicated, preventative measures and procedures can be put into place to minimise the risk of getting injured, as discussed in managing risks (page 41).

Intrinsic risk factor variables

Conditioning

Regardless of the sport involved, most athletes need general muscle fitness to reduce the risk of injury to the muscle-tendon unit itself and to the joints protected by muscle activity. Weight training and circuit training are common training methods that are used improve the general strength and conditioning of muscles.

Athletes must be fit enough to be able to perform the skills needed to compete in their sport and so long-term preparation is needed in training for many activities, for example, running a marathon for which preparation can take several months.

When athletes become tired, performance levels can drop and injuries are more likely to occur due to fatigue.
Conditioning

A core stability conditioning programme benefits good muscle balance and coordination (figure 2.7). Good core stability involves the effective recruitment of the muscles that stabilise the lumbo-pelvic-hip complex, together with those that stabilise the shoulder girdle. Many athletes attend pilates, a body-conditioning technique that concentrates on strengthening the core postural muscles needed by all active sportspersons.

Variance in training avoids the overuse injuries associated with using the same exercises and movements year round, and builds the right foundation for achieving peak performance at the right time.

All training/competitive activities should begin with a warm-up. A warm-up takes the body from a non-active state to one ready for exercise. The absence of a warm-up or an inadequate warm-up is a common cause of injury.

Lack of flexibility can limit range of movement (ROM) and lead to sprain and strain injuries. Hyper-mobility enables joints to move beyond the normal range expected for that particular joint and can lead to poor joint stability and dislocations.

A cool-down gradually returns the body to its former resting state with reduced injury risk. A major physiological value of an active cool-down is to flush out lactic acid thereby preventing muscle soreness (DOMS).

Sport performers require sports specific training programmes aimed at developing those muscle fibres which are used most intensively in competition. These programmes should include a variety of skills, drills and techniques that should mimic the desired sporting action as closely as possible.

STUDENT NOTE

For reviews of antagonistic muscle action, warm-up, cool-down and preparation and training methods refer to AS/A1 Edexcel ISBN 978190142488, Chapter 1, page 25, Chapter 2, page 32, Chapter 8, page 121 and Chapter 7, page 87 respectively.

Muscle balance

Human movement and function requires a balance of muscle length and strength between opposing muscles surrounding a joint. Normal amounts of opposing force between muscles are necessary to keep the bones centred in the joint during motion, to create muscle balance.

Muscle imbalance occurs when opposing muscles provide different directions of tension due to tightness and/or weakness. When a muscle is too tight, the joint tends to move in that direction and is limited in the opposite direction since this is typically the path of least resistance.

There are also two recognised causes of muscle imbalance:

- Neuromuscular imbalance due to the predisposition of certain muscle groups to be either tight or weak.
- Biomechanical imbalance resulting from poor technique.

Muscle imbalances can be characterised by either side-to-side (right versus left) or front-to-back (agonist versus antagonist) differences in muscle length or strength. Most musculoskeletal pain syndromes are caused by front-to-back differences, or imbalances of muscles surrounding a joint, rather than side-to-side differences (in the frontal plane).

For example, the quadriceps and hamstrings of the knee joint perform opposite motion (antagonistic pairing), and so an imbalance between the two could put undue stress on the knee joint. A tight hamstring would not allow the joint to glide normally or fully extend, which could put extra stress on the quadriceps muscle and patella (knee cap) tendon.
Muscle balance

Muscle imbalance can be the result of poor weight training techniques, or playing intense sports where one side of the body is used slightly more than the other as in the repetitive action of kicking in football.

When muscles are balanced the human body moves efficiently, requiring less energy and preventing unnecessary stress on the muscles, nerves, ligaments and joints. This synergy is known as neuromuscular efficiency, requiring the interaction of the neuromuscular systems.

It is important to know which muscles need to be strengthened and which muscles need to be stretched in order to create good muscle balance.

Good posture ensures that movements can be performed with minimal strain. For example, when the body leans slightly to one side, the nerves associated with the muscles and ligaments send messages to other muscles to help correct this movement by telling muscles to contract to regain muscle balance. If there are imbalances within this unit, problems can occur, such as decreased performance, muscle trauma and injury.

Running posture is an important technical aspect for both enhancing performance and minimising injury risk. Runners who lean forward (figure 2.8) to a greater extent are more economical (run faster for a given oxygen uptake) and less likely to suffer from knee injuries, the most common of which occurs at the patellofemoral joint (PFJ) - a joint between the patella and femur.

PFJ pain syndrome is often caused by imbalances in the muscles surrounding the knee, which affect the kneecap (patella) and cartilage within the joint. Symptoms include a scratching, grinding or clicking sensation in the knee, and non-specific knee pain.

Maintaining a forward lean without losing straight alignment over long distances requires certain level of torso strength, which is why strength and mobility exercises are fundamental in improving running performance and reducing injury risk.

Muscle balance assessment

A muscle balance assessment is a series of tests and observations that evaluate joint ROM, strength and coordination, and muscle flexibility. Such assessments can establish what is working well or not so well.

For example, an isokinetic lido leg strength test can assess the strength ratio between the quadriceps and hamstring muscle groups. For good muscle balance the ideal ratio should be 2:1. If it is greater that this value, the hamstring muscle group becomes susceptible to injury.

Student note

Proprioceptors, such as Golgi tendon organs and muscle spindles, are specialised sensory receptors sensitive to stretch, tension and pressure located in tendon, joints and muscles. They relay information about muscular dynamics, limb position and kinaesthesia (movement sense) to conscious and subconscious portions of the CNS.

Proprioceptive training methods

Proprioceptive training methods can improve muscle balance, as is the case with plyometric training. The emphasis is placed on making the ROM more stable, in particular in single limb tasks.
**Proprioceptive training methods**

Proprioception is the ability to sense stimuli arising within the body regarding position, motion, and equilibrium.

For example, in an ideal *long-term athlete development* plan (LTAD) a coach could teach a young athlete to land bilaterally off low level drops, from horizontal jumps/bounding (figure 2.9) and jumps using a multi-directional approach.

To achieve a *softer landing*, the coach could tell the athlete that they need to land on the front of the foot, and then flex the knees into a squat position in order to dissipate the ground reaction force effectively.

This would *avoid* such *high peak forces* in shorter time frames on landing, which has been demonstrated as a most likely cause of knee and muscle/tendon injuries.

The aim is to be able to absorb and handle the impact of *eccentric loads* on landing and ground stroke in high velocity running.

The progression within single leg landings would ensure the athlete can land softly to begin with, promoting good landing mechanics of holding and maintaining good *postural balance* by controlling the alignment of the knee and effective position of the trunk in a neutral position.

The proprioceptors therefore have to *adapt* to control these movements and keep a balanced athletic position on landing. Once achieved, the young athlete is ready to progress from low level muscle balance work through to *greater training loads*, thereby increasing the muscular strength and balance.

By improving an athlete’s proprioceptive ability, he or she can gain the balance skills necessary to maintain stability for their sporting needs.

Muscle balance is enhanced by having a *strong core* as discussed above.

**Extrinsic risk factor variables**

**Technique**

If an athlete does not have a good technique he or she is more likely to sustain a sports injury. *Poor technique* can expose players to the risk of acute injury.

For example, rugby tackling with the head in front of the ball carrier’s leg rather than behind it.

Injuries are not the only by-product of poor technique, *performance levels* will also be decreased by *poor technique* as this will prevent optimum strength, power and speed in the particular movement or shot.

In injury prevention, *good technique training* from a *coach* is vital and should start when athletes are young. *Movement patterns* in technique training must be performed correctly right from the start as it can be difficult to correct a faulty pattern later (as illustrated in the example within the proprioceptive training methods).

Achieving optimal coordination requires *constant repetition* of the various elements of the movement. This is achieved by establishing good interaction between the muscles and the nervous system to produce *good muscular coordination*. 
Technique

Technique training should be assigned to the beginning of the training session when it is easier to concentrate and the body is well-rested. All athletes should have a solid technical foundation before taking part in competition.

The coach is responsible for planning appropriate levels of intensity, duration, frequency and variance within a training programme to prevent overtraining.

Overuse injuries refer to injuries sustained from repeated action. For example, repetitive, excessive overload can cause microscopic injuries, leading to inflammation, which is the body’s response to injury.

Repeated low level impacts can cause chronic injury, for example, Achilles tendinopathy if long-term measures, such as rest and strengthening are not taken.

Protective equipment and clothing

For some sports, protective equipment is important to prevent damage to participants. This is particularly relevant when the sport or activity involves physical contact with other players.

Equipment in any sport may be inadequate, poorly designed or ineffective and not suitable for age, stature or ability. For example, generic trainers (footwear) will not provide the support and grip needed for throwing events.

Protective clothing can be faulty or insufficient to meet the needs of the sporting activity. Specialised protective clothing (figure 2.10) has been developed for many sports with well known examples from fencing, field hockey, cricket, baseball, American football and equestrianism.

Boxing and other martial arts require helmets (with or without face guards), padding, boxes, strapping, gloves, mouth guards and so on, depending on the rules of the sport, and the damage allowed to be inflicted within the rules of the sport. All these pieces of equipment are designed to prevent injury to vulnerable parts of the body.

Specialist clothing is also required for low and high temperatures to maintain body temperature within a safe range.

Wicking fabrics (a mixture of cotton and man-made light and stretchy fibres) are used in a range of sports clothing. The wicking properties have the ability to soak up sweat then move it away from the body, thus saving energy on maintaining skin temperature, and preventing hyperthermia (heat exhaustion). In cold conditions such fabrics insulate the body thereby reducing hypothermia.

Energy absorbing plastics (also known as shear-thickening, energy absorbing materials, for example D30) are used as materials to create foam-filled clothes that cushion, absorb and dissipate the energy resulting from a high impact blows. The shear-thickening property means that greater the force acting on it, the more solid the material becomes. This material is used in ski clothing and sports such as motor racing clothing to provide significant protection from injury against high impact incidents.

Compression clothing (page 46) works by supporting and protecting body tissues, increasing circulation, assisting in the removal of lactic acid and thereby reducing DOMS.
Footwear, braces and strapping

Sports footwear is the most important item of equipment for most sports. When choosing sports footwear, several factors must be taken into consideration including the sport involved and the surface used.

For example, in long-distance running the weight of the shoes can be of importance. They should not, however, be so light that their stability is impaired.

Elite athletes are often provided with bespoke footwear. The foot is scanned to capture its shape, then footfall is analysed (using forceplate technology). This indicates how the foot lands and moves and leads to the development of personalised footwear, whose aim is to make movement more efficient, improve performance and reduce the likelihood of injury (figure 2.11).

Proper fitting and sport-specific footwear reduce the risk of injury to the soft tissues, bones or joints of the lower limb.

The risk of a sprained ankle and other such injuries has been shown to significantly be reduced by wearing braces such as ankle supports (as worn by tennis star Andy Murray - figure 2.12).

There are a few items that can be used in training, but not allowed in competitive situations. For example, strapping a shot putter’s fingers or hand helps prevent finger knuckle sprains, but is not allowed in competition.

There are many other examples of protective equipment, all of which contribute in the prevention of sports injuries.

The environment and safety hazards

A hazard is something that is potentially dangerous to an individual or activity or both. For example, if a sports hall roof leaks the floor may become wet and so it will need to be coned off and dried to prevent people slipping during a physical activity.

Temperature, wet and windy conditions can also be responsible for injury, and particularly cyclists should take care when cycling on wet, greasy roads.

The ability to perform vigorous exercise for long periods is limited by hyperthermia (over heating) and loss of water and salt in sweating. Athletes should know the hazards of vigorous exercise in hot, humid conditions particularly in ultra endurance events, and should be able to recognise the early warning symptoms that precede heat injury.

Managing risks

Managing risks refers to the practice of identifying potential risks in advance, analysing them and taking precautionary steps to reduce/curb the risk. This is known as a risk assessment.

Injury prevention and management is an important component of a coaching programme for participants in many sports and activities. An important function of a coach is to identify, evaluate and refine an injury risk coaching strategy programme for everyone in the coaching group, in addition to managing injury recovery strategies.

Coaches must also take account of guidelines and assessment opportunities from national governing bodies, experts and their own prior experience when designing and delivering injury prevention and management strategies.
Managing risks

Scientific experts at Loughborough University Sport and Technology Institute have developed a running kinematics assessment facility that uses motion analysis technology (figure 2.13).

This technology objectively assesses the running efficiency of the athlete and so can identify poor running technical elements that could potentially injure the athlete.

Another example of risk management, is that of physiotherapy screening services which are designed for sports persons of all ability. Standard tests are used to assess strengths and weaknesses in key areas, such as strength, flexibility (figure 2.14), core control and balance. This information can be used in exercise prescription for musculoskeletal conditioning, thereby decreasing the risk of getting injured.

To be effective, injury prevention management has to be properly integrated into the participants’ programme.

In summary there are several key progressive stages that will assist a coach and athlete to minimise the risk of injury as outlined in table 2.2

<table>
<thead>
<tr>
<th>progressive stages for injury prevention</th>
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</thead>
<tbody>
<tr>
<td>1 analyse the athletes’ current risk of injury in relation to their level of development, previous history and the demands of the sport</td>
</tr>
<tr>
<td>2 select and plan activities, information and advice that will help the athletes minimise the risk of injury</td>
</tr>
<tr>
<td>3 where necessary, seek the support of other specialist staff</td>
</tr>
<tr>
<td>4 ensure that the strategy for injury prevention effectively supports and integrates with other training programme components</td>
</tr>
<tr>
<td>5 provide planned activities, information and advice to minimise the risk of injury</td>
</tr>
<tr>
<td>6 evaluate and review the success of the strategy for injury prevention</td>
</tr>
<tr>
<td>7 monitor and refine the strategy for injury prevention as part of the athletes’ programme</td>
</tr>
</tbody>
</table>

Safety measures

Safety measures, which are intrinsic to sports coaching and teaching, include understanding the rules, having the kit and equipment appropriate to the sport and making use of technologies as illustrated in figure 2.13.

Coaches, athletes, teachers and officials must abide by set rules that are intended to minimise the chances of getting hurt or injured, by taking precautionary measures.
Safety measures

For example, in throwing activities, such as javelin, hammer and discus a risk assessment would include:

- Correct age-related, type, weight and dimensions of throwing equipment is selected by staff.
- Athletes wear appropriate clothing and footwear.
- The athlete should always check that the predicted line of flight and adjacent area are clear of individuals.
- Implements should not be retrieved until supervising staff directly instructs the thrower (or field official) to do so.

Although the chances of injury in sport can never be fully eradicated, preventative measures and procedures can minimise the risk of injury for sports’ performers.

Rehabilitation from injuries

Rehabilitation programmes

Rehabilitation is the process of restoring full physical function after injury.

A rehabilitation programme should be designed with individual short-term and long-term goals in mind. The overall programme and individual exercises should progress safely and effectively (figure 2.15).

Traditional treatments of muscle/joint and ligaments injuries include rest, ice, elevation, compression (RICE), rehabilitation exercises, and anti-inflammatory medications. In recent years, advances in understanding of muscle injury physiology and healing, have led to the development of contemporary recovery methods.

The timescales and treatment options involved in rehabilitation from injury depend upon the age of the person, severity of the injury, fitness levels and active daily lifestyles.

Immediately following an acute injury, the injured person should cease activity and the injured area must be immobilised to prevent further injury. The most important physical therapy used at this stage is cryotherapy (cold therapy) usually accompanied by protection, optimal loading, rest, ice, compression and elevation. This combination is known as POLICE (page 51).

An acute, inflammatory phase can last several days. The use of compression, elevation, alternating hot and cold therapies, and treatments such as hyperbaric oxygen therapy HBOT (page 47) and light massage can be used to stimulate the growth of new blood vessels and begin the stretching and strengthening of the damaged body part. Therapeutic exercise may be beneficial during this early stage to minimise de-conditioning. For example, isometric exercises assist in the increase in ROM and minimise strength loss in the injured part and related muscles.

The repair and healing process of the injured area takes place from anywhere between 3 weeks to a year after injury, but could be less depending on the extent of the injury.

Example 1: healing of a ligament in a sprained ankle

- The healing of a ligament in a sprained ankle joint can take between 2-8 weeks, depending on the severity of the impact and the extent of the injury.
- When the injured athlete can tolerate pain on moving the ankle joint, rehabilitation training can start.
- Proprioceptive training is very important, otherwise the ligament is likely to be stretched again, and strengthening of the peroneus longus and brevis muscles will reattain pre-injury strength levels.
**Example 1: healing of a ligament in a sprained ankle**

- During this recovery period the ankle joint should be **protected** from further overstretching with the help of adhesive strapping, an elastic bandage or tape or an ankle brace.
- Proprioceptive ability can be trained through specific exercises, such as the use of a **wobble board** (figure 2.16) most commonly used in the rehabilitation of ankle injuries, such as ankle sprains.
- In the case of the injured athlete, the improvement can compensate for the loss caused by injury.
- This has the effect of decreasing the chances of re-injury.
- It is recommended to start balancing on two legs, before progressing to one leg wobble board balances.
- Wobble board training can be introduced to the rehabilitation programme once swelling and bruising have disappeared and the injured athlete has regained bipedal balance.

**Example 2, recovering from anterior cruciate ligament (ACL) surgery**

The ACL is one of the **restraining** ligaments in the knee, as it prevents excessive forward movement of the tibia. It provides important information about **balance** to the joint and surrounding muscles, and gives the knee stability during rotational movements like twisting, turning and sidestepping.

A ruptured ACL is a common injury sustained in team sports such as soccer, rugby, netball, hockey and basketball. When it has been torn it is unable to heal and the **balance information** it carries is also lost.

- A **reconstructed** ligament involves replacing it with a **graft** taken from one of the hamstring tendons.
- Following the immediate surgical reconstruction of the ACL, rest, regular application of a **cryocuff** (figure 2.17) on the knee provides iced water compression to help reduce pain and swelling.
- **Within 24 to 48 hours** following the operation the patient is encouraged to walk with the aid of crutches (used to off-load weight bearing on the injured leg) and a fully supporting **leg brace** (figure 2.18) and is discharged as an outpatient for regular outpatient physiotherapy appointments.
- **Between 5-7 days** after discharge the patient should be able to flex the knee 60-90 degrees at the first physiotherapy appointment.
- For the **next 2 weeks** the aim is to regain **ROM** and start balance re-education by working through a series of exercises.
  - For example, in a lying position lift the leg 2-3 inches only keeping the knee straight.
  - Hold for 5 seconds and repeat 10 times, 4 times per day, after any sutures/ clips have been removed.
- **After 2 weeks**, the wound should be healed, swelling reduced, walking with a limp and flexion improved to 110 degrees.
- **Between 2-6 weeks**, the aim is to continue the balance activities and commence light strength and endurance training.
- Goals include working on full range of movement, **balancing** on one leg, single leg squats and step ups, minimal activity related to swelling and clinical review.
- **Between 6-12 weeks**, the quadriceps/hamstring tone and definition will be poor. The graft fixation will be more secure within the femur and tibia enabling more vigorous strength training to commence. The goal during this phase of recovery is to improve strength in all leg muscles, so that equality between limbs is near.
- **Between 3 to 6 months**, **running and twisting** manoeuvres are introduced, building up to light sports. Gym work is encouraged until leg strength is equal (between limbs).
- The **6 month goal** aims to have rehabilitated the knee to near normal function, to be able to return to **non-contact sport/training** and have a final review at the clinic if all is good. Return to contact sport is recommended when the leg is at least 85% the strength of the other.
Physiotherapy

The role of physiotherapy in sports medicine is one of participation in both prevention and treatment of injuries. The aim during injury rehab is to restore original function to the affected part.

Physiotherapy uses a range of physical recovery methods for musculoskeletal injuries that includes heat treatment, massage and exercise prescription. This is a big section to cover and so a restricted number of contemporary recovery methods are discussed.

Ultrasound therapy

Ultrasound is a deep heating process that uses acoustic sound waves to generate mechanical disruption of tissues. A gel is used on the surface of the skin to reduce friction and assist transmission of the ultrasonic waves. The treatment head is then moved over the surface of the skin, in the region of the injury, providing gentle massage as it transmits the energy into the tissue with no added strain to the injured area. Although ultrasound therapy was a popular treatment used by physiotherapists up to 10 years ago, it is used more sparingly within modern sports’ recovery methods.

Ultrasound also acts as a pro-inflammatory process to stimulate the presence of macrophages (a type of white blood cell that engulfs and digests cellular debris). Macrophages also play an important anti-inflammatory role and can decrease immune reactions through the release of pro-inflammatory cytokines (small proteins, such as interferon, that are important in cell signalling). Their release has an effect on the behaviour of cells around them.

Ultrasound therapy increases the extensibility of structures such as ligaments, tendons and fibrous scar tissue inside and outside the joint capsule, resulting from the build up of mature collagen fibres which may form after the injury. This softens any scar tissue, within muscle tendons and/or ligaments, without any strain.

Ultrasound therapy is beneficial immediately following the acute stage of an injury and should be discontinued when pro-inflammatory agents are no longer needed. There is a possibility that the ill-advised use of ultrasound can damage nervous tissue.

Joint mobilisation and massage of soft tissue

Sports massage is defined as a collection of massage techniques performed on athletes or active individuals for the purpose of aiding recovery from exercise sessions or rehab from injury.

• Massage techniques assist in soft tissue mobilisation, muscle function and reduce local pain (figure 2.19).
• Muscle and joints can be passively moved to full range.
• In addition sports massage reduces DOMS symptoms following intense anaerobic training.
• Sports massage needs to be regular and can be expensive.
• There are much cheaper ways of gaining the above benefits. For example, a foam roller massage has many of the same benefits as a sports massage done by a practitioner, including reduced inflammation, scar tissue and joint stress, as well as improved circulation and improved flexibility (figure 2.20).
• Rolling preps muscles for stretching and so is a valuable part of a warm-up and cool-down for both rehab and regular schedules.
• Sports massage can only be used for treatment during the acute stage in terms of lymphatic drainage in order to reduce swelling.
• However sport massage treatments are mainly carried out at the repair stage.
• Care should be taken that excessive forces are not applied to traumatised tissue.
**Electro stimulation**

Electro stimulation (ES) also known as neuromuscular electrical stimulation (NMES), is a training technique used for injury prevention, injury treatment, toning, pain relief, muscular recovery and physical preparation.

Electrodes are placed on the muscle groups such as the abdominal muscles, hamstrings (figure 2.21), calf muscles, plantar arch muscles and lower back muscles. An electric current is produced which is sent to the nerve fibres causing a mechanical response in the muscle. The current settings can vary depending on the clinical pathology requirements.

ES is thought to affect the body with associated therapeutic benefits that:

- Stimulate muscles to **contract**, by stimulating muscle fibre recruitment.
- Stimulate nerves to **decrease pain** by stimulating larger nerve fibres that can override the smaller nerve fibres that produce pain.
- Increase **blood flow** to speed healing.
- Reduce **inflammation**.
- Stimulate cells to reproduce and speed **healing**.
- Assist the **removal of lactic acid** following a training session or competition and hence reduce **DOMS**.
- ES can be used early on in the recovery process when a wound has healed but the injured body part is not ready for loading.
- ES in combination with physical activity, serves is to stimulate weaker muscles to contract and improve strength more quickly.

**Exercise programmes to strengthen weakened muscles/joints.**

- In the case of a planned surgical procedure, the physiotherapist can be valuable both before and after.
- For example, prior to an ACL or meniscus operation, it is essential for the patient to exercise his or her thigh muscles as they are responsible for stabilising the knee, and if they are well-trained before the operation, subsequent rehabilitation is facilitated.
- Assessing an individual’s functional state is part of the physiotherapist’s work. By analysing the causes and consequences of a functional impairment, the physiotherapist can draw up a programme for the treatment of muscles, joints and ligaments.
- The treatment methods used are flexibility, strength and coordination in prescribed portions, together with encouragement, rest and pain relief.

**Strength training**

One of the major detraining effects that occur during long-term injuries is **muscular atrophy** of the unused limb. It is therefore essential that these particular muscles increase their size back to normal. Within the early stages of muscle rehabilitation, muscular size can be increased by effective electrical stimulation to the muscle.

**Core stability exercises** should not be neglected and can be combined with the start of performing some more traditional weight training exercises. The **plank** (figure 2.22 and figure 2.7, page 36) is one of the best body weight training exercises for improving core conditioning (which is often compromised following injury) but it also works gluteal and hamstring muscle groups, supports posture and improves balance.

As soon as the injured athlete can tolerate increased loading, he can progress through his rehab process back into more traditional strength and conditioning training programmes. For example, free squats can progress to single leg squats.
Strength training

Strengthening the quadriceps and hamstrings will directly result in increased stability of the knee joint and in turn further reduce the reoccurrence of hamstring injuries such as tears. During this period, the injured athlete will start to benefit from anatomical adaptations, such as muscular hypertrophy as he or she gradually progresses to pre-injury strength levels.

Elastic band training and tubing

Elastic resistance is a unique type of resistance training that can be safely used in injury rehabilitation. The resistance provided by the latex elastic band or tubing is based on the amount that the band or tubing is stretched. Thera Band (a brand name for a type of elastic band of varying strength) elastic resistance training increases strength, mobility and muscle function, as well as reducing joint pain.

For example, following a shoulder injury, the main focus is to increase the range of movement and muscle strength, especially the rotator cuff which is a group of muscles that rotate the arm (figure 2.23).

Note that in this example the resistance is light, but sufficient to create the required adaptive physiological response.

Rest and active rest

The physiotherapist will include rest and active rest to give stressed body parts time to recover prior to the next part of the rehabilitation programme.

- Modern rehab includes rest as essential recovery time after trauma. Active rest means that low level exercises are undertaken in order to improve the blood flow through affected areas without physical stress, and therefore to promote healing via blood carried nutrients, particularly oxygen.
- Cell to cell activation is really important, since it stimulates the healing process.
- This also has the effect of preventing a muscle or other soft tissue from healing at a shorter length than it was before the injury. This is because post-trauma muscle length is unpredictable depending on joint flexibility and nutrition.
- Low level activity also has the effect of keeping muscle fit enough to exert force once an injury is healed.

Compression clothing

Compression clothing works by applying a constant pressure on the body part, which adds external pressure to the veins.

- By squeezing the muscle, venous return is enhanced, which may reduce the potential for venous pooling.
- And a reduction in post-exercise symptoms such as light headedness/dizziness.
- Increased venous return facilitates an increase in cardiac output (Starling’s Law of the heart), resulting in increased transportation of oxygenated blood to recovering tissues.
- An increased blood supply will carry nutrients to the muscles and help remove waste materials more quickly.
- Recovery is improved and DOMS is reduced.

Compression clothing is also said to potentially enhance sporting performance by:

- Reducing muscle oscillation (vibration of leg muscles due to the repetitive impact loading).
- Increasing proprioception.
- Improving body aerodynamics.

Products include socks, short and long tights and short-sleeve and long-sleeve tops. Compression stockings are worn by runners, basketball players and other athletes hoping the socks will boost their performance and reduce the risk of muscle soreness, injuries and muscle cramps.
Compression clothing

Compression stockings are known to decrease post-exercise soreness, by increasing circulation and reducing the lactic acid build-up during the exercise period, thereby reducing DOMS and preventing medical conditions such as deep vein thrombosis (DVT).

Compression tights (figure 2.24) may be useful for people with certain existing injuries, by providing support to minimise undesired movement of underlying tissues. Faster recovery means being able to train for longer periods sooner, and basically doing more of it. But to get the full benefits for recovery associated with compression tights, they must be worn during and after exercise for up to 24 hours. When the compression clothing is too tight it can cause tissue damage by restricting blood flow and ROM. It is recommended to seek specialist guidance on fabric specifications.

The rationale for wearing compression sportswear is solid, but the evidence is weak.

Climate chambers

Environmental chambers replicate different climates at the press of a button with precise and harmonious control of altitude, temperature and humidity.

Hyperbaric chamber

A hyperbaric oxygen chamber is an example of a chamber that provides a controlled climate in which sporting injuries can be treated.

Research has found that healing is promoted by increasing the oxygen partial pressure surrounding affected areas. The various techniques employed to promote this are:

- Oxygen tents.
- Sleeping in a greater than normal proportion of oxygen in breathed air.
- Hyperbaric (meaning high pressure) chambers (figure 2.25), in which an injured athlete will spend periods of time in a zone in which the air pressure is above normal.
- Therefore forcing oxygen above normal pressure into the body. This is called hyperbaric oxygen therapy (HBOT).

HBOT is a treatment which enhances the body’s natural healing process by inhalation of 100% oxygen in a total body chamber, where atmospheric pressure is increased and controlled. Initially HBOT served to provide a means of therapy to facilitate a speedier resumption to pre-injury activity levels as well as improve the short and long-term prognosis of the injury.

HBOT sessions can commence as soon as the injured athlete has recovered from the initial treatment phase.

HBOT is now commonly used as a regular therapy within professional sports such as rugby, soccer and cricket, with its known benefits listed below. Such benefits allow athletes of every level to recover faster, perform sharper, and train longer.

**HBOT benefits**

- Delivers up to 25 times normal levels of oxygen to body tissues.
- Stimulates the growth of new blood vessels, thus improving blood flow to areas with an arterial blockage that may have resulted from an impact injury.
- Reduces fatigue from inadequate oxygen supply to body tissues.
- Speeds up recovery from fatigue such as DOMS.
- Boosts immune system function by stimulating white blood cell activity, thereby controlling infection.
- Decreases swelling and inflammation.
- Promotes regeneration of injured tissues.
- Decreases ligament and tissue healing time.
- Aids the repair of stress fractures and breaks.
HBOT benefits
HBOT is an example of a secondary therapy used to treat sports injuries and its purpose is to assist the primary treatment received, for example, from a physiotherapist or doctor. HBOT assists in the recovery of acute traumatic injury to muscle contusions and sprains and strains thereby reducing recovery time.

Hypobaric chambers
A hypobaric chamber or an hypoxic tent (low oxygen tent, figure 2.26), provide a hypoxic environment that contains a reduced amount of oxygen in the air compared with sea level atmospheric pressure (hypobaric means low pressure).

Hypoxic simulation occurs in cells and tissues that are in a hypoxic state and so is responsible for a number of adaptive responses that enable the body to make better use of the limited oxygen available. The main adaptive response is an increase in manufacture of red blood cells (erythropoietin production), alongside increases in myoglobin, mitochondria and oxidative enzymes levels.

These responses support an increased oxygen and nutrient delivery to body tissues undergoing repair, such as the healing of bone fractures. This is of great value to the process of rehabilitation from injury, particularly when the athlete is exercising within the hypobaric environment during the active phase of rehab.

In addition, this hypoxic microenvironment acts as a protective mechanism for recovery by stimulating the repair of a variety of proteins, fibroblasts, endothelial cells and osteoblasts used in the healing of fractures.

As with the HBOT recovery method, hypoxic sessions can commence as soon as the injured athlete has recovered from the initial sedentary treatment phase to the active recovery phase of rehab.

Sauna and steam heat room therapies
- Heat therapies should not be used immediately after an injury as this will increase body temperature and increase bleeding in the surrounding area and so will not be beneficial until after 48 hours after the injury and during rehabilitation.
- Within a climate chamber, such as a sauna or steam room, depending on the heat and humidity, core temperature starts to increase within 5-15 minutes.
- It is important to limit the time spent in heat chambers (hot or cold) otherwise body tissues become damaged.
- Heat creates a stress response in the body.
- As temperature rises, the body responds by rerouting blood flow to increase blood vessel dilation and secreting a number of hormones, including the growth hormone (GH, or somatotropin) which assists in increasing the rate of musculoskeletal tissue repair.
- Heat therapy reduces cellular oxidation rates (high rates of oxidation may compromise the recovery rate and cause damage to cell membranes).
- Heat therapy also stimulates heat-shock proteins, which play a role in organising other proteins that are thought to play a role in the growth/repair of muscle tissue.
- Heat therapy provides an ideal environment for regaining the ROM of joints and muscles.
- With heat therapy’s ability to enhance muscle growth and limit oxidation, it should also enhance the injury recovery processes alongside other contemporary recovery methods.

Cryotherapy
Cryotherapy is the treatment by means of applications of cold temperatures, and can be used as soon as the wound has healed (i.e. no broken skin). Cryotherapy treatment decreases skin, subcutaneous and muscle temperature, causing narrowing of the blood vessels (vasoconstriction). Its goal is to decrease cellular metabolism, decrease inflammation, pain and muscle spasm.
A variety of cold applications can be used to treat sports injuries.
**Whole body cryotherapy (WBC)**

WBC involves exposing individuals to extremely cold dry air (below -100°C) for two to four minutes in a cryogenic chamber. Reduction in skin and muscle tissue temperatures reduces blood flow to the arms and legs (vasoconstriction) and divert blood flow to the body’s central core.

On leaving the chamber, blood flow returns to the arms and legs (vasodilation) reinstating normal oxygen levels, thus aiding the healing process. WBC relieves muscle soreness and inflammation following high intensity training, as a result of reduced muscle metabolism, and is a popular recovery method used by professional sportspeople. WBC is a much quicker alternative to ice baths, but does require specialist expensive equipment.

**Alternative cold therapy methods**

Various alternative and cheaper cooling therapies are used in acute sports injuries as well as rehabilitation of the injured athlete, injury prevention and recovery from training and competitions. For example, ice packs, ice towels, ice massage and frozen gel packs.

**Ice baths**

Ice baths (figure 2.27) use the fact that chilling the affected area can reduce local inflammation. The ice bath is thought to constrict blood vessels, flush waste products such as lactic acid and reduce swelling and tissue breakdown.

**Total cold water immersion**

Studies have shown that total cold water upright immersion (at an optimal temperature of 10 degrees and up to 10 minutes immersion) decreases inflammation following injury and aids recovery from training. The effect is best when the water pressure is greatest. In addition, it gives the athlete a feeling of perceived freshness.

Precautions should be taken because prolonged application of very low temperatures could have detrimental effects.

**Contrast therapy**

This is the alternating use of hot and cold application to an injured muscle or body part for therapeutic effect (for example, increasing blood flow to speed up the recovery process).

**Hydrotherapy**

Hydrotherapy is a therapeutic whole-body treatment that involves moving and exercising in a warm water pool. The temperature, pressure and movement of water are controlled and changed according to who’s using the pool.

For example, aquajogging (figure 2.28) has proven to be a very good form of injury rehabilitation. This is because of its low impact on the muscles and the use of water resistance as an effective way of applying force to the lower limbs.

This combination avoids muscle soreness, stress fractures and aching joints and enables an injured athlete to maintain fitness during a rehabilitation programme. This method of hydrotherapy can be used as an alternative option to training on hard running surfaces, in addition to supporting recovery from hard impact training.

**Nutrition**

By choosing the right diet and supplements, recovery from injury can be enhanced. Eating a diet that achieves a the balance between allowing the immune system to function normally, whilst preventing the inflammatory response from becoming excessive, will speed up the process of rehabilitation from injury.
Nutrition

Some foods contain anti-inflammatory agents as found in leafy green vegetables, avocados, fish (mackerel and salmon), mixed nuts, seeds and garlic. Tumeric is an anti-inflammatory spice that contains curcumin, an agent that suppresses the breakdown of protein and enhances the uptake of glucose into muscle, all good for injury rehabilitation.

A diet planned for injury recovery should avoid pro-inflammatory foods, such as processed foods high in saturated fats, and foods containing trans fats found in cakes, pies and cookies.

Getting the optimal energy intake is important. When the body is healing it requires more calories (CHO) than when completely sedentary but not as much as it would require when training at full fitness. The basal metabolic rate (BMR) can be a useful guide to work out a required calorie intake. Usually the main adjustment to be made is in reducing pre- and post-workout carbohydrates (in the case of injury this is a rehab workout).

Having plenty of good quality protein such as quality meat, whey and dairy products is important. Protein provides essential amino acids that provide the building blocks for recovery (figure 2.30).

Increase oily fish intake and consider taking a fish oil supplement, such as omega 3 fish oil capsules. Helpful foods include oily fish such as salmon tuna and mackerel, olive oil, nuts and seeds and avocado.

Eat foods that are rich in vitamins and minerals (figure 2.31). The immune system can be suppressed following injury and is important in supporting the body through the healing process.

Foods that contain essential micronutrients, like vitamins B and D, copper, calcium, and magnesium, as well as other compounds. Bromelain (in pineapple) and curcumin (in turmeric) are known to be effective in healing body tissues.

Supplementing the diet with whey protein and essential amino acids, such as glutamine, may be useful in providing some of the building blocks for tissue repair. While a good rehabilitation programme is a must when recovering from injury, having the correct nutritional strategy also plays its part.

POLICE and RICE

There are two recognised first aid methods that are used to assist the healing process:

RICE

RICE (Rest, Ice, Compression and Elevation) is a traditional procedure applied to soft tissue injury. Apply the frozen object to the area for 20 minutes three times a day for the first 48 hours.

- Rest: by resting the injured body part, further damage is prevented and the healing process is speeded up.
- Ice: applied to injured body part, reduces internal bleeding and swelling. Ice can help to reduce acute pain.
RICE

- **Compression**: reduces swelling by supporting soft tissues, minimising the danger of further damage and speeding up recovery. Compression is used in conjunction with ice to cool and compress the injury, for example the use of a cryo-cuff (figure 2.17, page 43).
- **Elevation**: elevating the injured area above the heart aids the drainage of any liquid/leakage caused by the injury, reducing swelling and inflammation to the injured site.

POLICE

The POLICE method is another simple acronym to help ensure that the injured body part is protected, optimally loaded, and receives the benefits of ice, compression, and elevation. POLICE (Protection, Optimal Loading, Ice Compression and Elevation) is a more recent procedure for injuries, though not necessary soft tissue injuries.

The main difference between RICE and POLICE is the inclusion of Protection and Optimal Loading in POLICE.

- **Protection**: includes rest and protection for the injured area during the first few days following an injury.
- If it hurts to bear weight on the injury, use assistive devices, for example, crutches or a hinged brace (figure 2.18, page 43).
- If it hurts to move the area, immobilise it with a splint.
- These aids offer protection for the injured area.
- After a few days, gentle motion can be started whilst maintaining a level of protection.
- **Optimal loading**: whilst protecting the injured body part, gentle motion can, and should be started as soon as possible during the repair phase of a rehab programme.
- For example, after a shoulder injury the injured person would be able to progress from a few days of rest to passive ROM, active ROM, and finally, rotator cuff strengthening exercises (figure 2.23, page 46).
- This progressive loading of the injured body part can help promote optimal healing of the injury, and it can prevent delays in returning to normal due to joint and muscle tightness or muscle atrophy.
- Progressive optimal loading is highly supported by medical practitioners.
- POLICE is much better than RICE as rest is not always required.

Summary of advantages and disadvantages of rehabilitation strategies

**Table 2.3 - advantages and disadvantages of compression clothing**

<table>
<thead>
<tr>
<th>advantages</th>
<th>disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>compression clothing increases venous return and transportation of oxygenated blood to body tissues</td>
<td>compression clothing is expensive to buy</td>
</tr>
<tr>
<td>removes waste products such as lactic acid</td>
<td>if clothing is too tight, it can cause tissue damage and decrease ROM</td>
</tr>
<tr>
<td>recovery is improved and DOMS and cramping are reduced</td>
<td>need to seek specialist guidance on fabric specifications</td>
</tr>
<tr>
<td>compression stockings help prevent DVT following surgery</td>
<td>the rationale for wearing compression sportswear is solid, but the evidence is weak</td>
</tr>
<tr>
<td>reduces muscle oscillation</td>
<td></td>
</tr>
<tr>
<td>muscle and joints can be passively moved to full range</td>
<td></td>
</tr>
<tr>
<td>increases proprioception</td>
<td></td>
</tr>
<tr>
<td>body shape is more aerodynamic</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2.4 - advantages and disadvantages of nutrition as a therapy**

<table>
<thead>
<tr>
<th>advantages</th>
<th>disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>in association with a controlled rehab programme, eating the right foods and supplements and required intake will aid the recovery process</td>
<td></td>
</tr>
</tbody>
</table>
### Table 2.5 - advantages and disadvantages of physiotherapy

<table>
<thead>
<tr>
<th>advantages</th>
<th>disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>physiotherapy offers a range of recovery methods that treat both acute and chronic musculoskeletal field injuries within a rehabilitation programme</td>
<td>physiotherapists rely on the experience of other team members that may not always be correct in their injury diagnosis</td>
</tr>
<tr>
<td>this ranges from joint, nerve and soft tissue mobilisations as well as other modalities which are underpinned by a scientific evidence base, such as ultrasound and electro stimulation (ES)</td>
<td>going privately for both physiotherapy and sports massage sessions is expensive</td>
</tr>
<tr>
<td>ultrasound reduces the healing time of certain soft tissue injuries, during the early rehab phase, by acting as a pro-inflammatory agent</td>
<td>ultrasound therapy has been associated with nervous damage and should only be applied during the early stages of rehab</td>
</tr>
<tr>
<td>ES serves to stimulate weaker muscles to contract and improve strength more quickly</td>
<td>in acute injuries, taping may restrict circulation</td>
</tr>
<tr>
<td>sports massage assists in soft tissue mobilisation, muscle function and pain reduction during the repair stage</td>
<td>massage cannot be used on soft tissue injuries such as tendon ruptures and open wounds</td>
</tr>
<tr>
<td>muscle and joints can be passively moved to full range</td>
<td></td>
</tr>
<tr>
<td>sports massage can be used as a gentle recovery method during the acute stage of an injury to assist in lymphatic drainage in order to reduce swelling</td>
<td>tape may cause may cause irritation by mechanical or chemical means or because of allergy and the effects may be exaggerated by sweating, itching and bacterial infection</td>
</tr>
<tr>
<td>taping and bracing are recovery methods used by physiotherapists to support a weakened part of the body, without limiting its function</td>
<td>taping may lull the athlete into a false sense of security, encouraging the athlete to resume his or her sporting activity too soon thereby making the injury worse</td>
</tr>
<tr>
<td>physiotherapists are part of a team which includes doctors, other therapists, sport psychologists and coaches who work together to maximise the athlete’s recovery</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2.6 - advantages and disadvantages of climate chambers

<table>
<thead>
<tr>
<th>advantages</th>
<th>disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>environmental chambers replicate different climates at the press of a button with precise and harmonious control of altitude, temperature and humidity</td>
<td>access to climate chambers may be difficult and therefore climate chamber treatment may be limited</td>
</tr>
<tr>
<td>to provide controlled environments where rehab of both acute and chronic injuries can take place from the initial injury phase to active full recovery</td>
<td>methods may be restricted to those who can afford it or elite athletes who are supported by a medical care scheme</td>
</tr>
<tr>
<td>HBOT facilitates a speedier resumption to pre-injury activity levels, following injury, due to increased delivery of increased amounts of oxygen to body tissues</td>
<td>not always 100% effective</td>
</tr>
<tr>
<td>hypobaric chambers stimulate erythropoietin production and hence oxygen uptake that can be used to stimulate the healing of bone fractures</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2.7 - advantages and disadvantages of cryotherapy

<table>
<thead>
<tr>
<th>advantages</th>
<th>disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>less pain because nerve activity is slowed down</td>
<td>if an ice pack is too cold or applied for too long, it can actually damage skin and nerve tissues</td>
</tr>
<tr>
<td>less swelling because constriction of the blood vessels helps reduce blood flow to the area, reducing swelling</td>
<td>prolonged exposure in a cryochamber can give the athlete hypothermia, in addition to long-term tissue damage</td>
</tr>
<tr>
<td>faster healing because cellular activity slows down, which contributes to a faster healing process</td>
<td>the sudden drop in body temperature can be harmful, causing a sudden increase in heart rate and breathing rate</td>
</tr>
<tr>
<td>removes waste materials from the injured site</td>
<td></td>
</tr>
</tbody>
</table>
Table 2.8 - advantages and disadvantages of heat therapies

<table>
<thead>
<tr>
<th>advantages</th>
<th>disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>a combination of hot and cold therapies dilates and constricts the blood vessels of the muscles thereby increasing the flow of oxygen and nutrients to musculoskeletal tissues, helping to heal the damaged tissue and removing waste products</td>
<td>heat treatment should not be too hot, as this may lead to the skin being burnt</td>
</tr>
<tr>
<td>heat stimulates voluntary muscles and the sensory receptors in the skin, decreasing the transmissions of pain signals to the brain and partially relieve the discomfort</td>
<td>heat treatments should not be used on damaged skin or on areas where circulation is poor</td>
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<tr>
<td>heat application facilitates stretching the soft tissues, including muscles, connective tissue, and adhesions that become stiff following injury</td>
<td></td>
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<tr>
<td>hydrotherapy provides a safe, low impact form of heat therapy used in rehabilitation programmes</td>
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</tbody>
</table>

Table 2.9 - advantages and disadvantages of RICE and POLICE

<table>
<thead>
<tr>
<th>advantages</th>
<th>disadvantages</th>
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</thead>
<tbody>
<tr>
<td>RICE is an established first aid procedure using during the initial injury phase</td>
<td>people can take the rest phase a little too far, and that can lead to decreased muscle strength and flexibility and so delay the restoration of normal functional mobility and activity</td>
</tr>
<tr>
<td>POLICE extends the remit of RICE to include protection and optimal loading and so deals with both the initial phase of an injury to the recovery phases of healing and rehabilitation</td>
<td>compressing an injury may reduce swelling, but when too tight it can cause numbness, tingling, or increased pain some experts believe that ice, applied initially after an injury, impedes the normal healing process</td>
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</tbody>
</table>

Summary of how coaches can assist athletes to manage and recover from injury

Table 2.11 - summary

<table>
<thead>
<tr>
<th>coaches assist athletes by:</th>
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<tbody>
<tr>
<td>working with the athlete and specialist staff to evaluate the nature of the injury and its physical and psychological implications for performance and rehabilitation</td>
</tr>
<tr>
<td>working with the athlete and specialist staff to devise a strategy to assist the athlete to manage and recover from injury</td>
</tr>
<tr>
<td>ensuring the strategy is effectively integrated into the overall coaching programme</td>
</tr>
<tr>
<td>providing and supporting agreed activities that will assist the athlete to manage and recover from the injury</td>
</tr>
<tr>
<td>evaluating and reviewing the success of the strategy for injury management and recovery</td>
</tr>
<tr>
<td>monitoring and refining the strategy for injury management and recovery as part of the coaching programme</td>
</tr>
</tbody>
</table>

Practice questions

1) Sports injuries can be broadly classified as either acute or chronic.
   a) Explain what is meant by these two classifications, using examples where appropriate. 4 marks
   b) What are the common causes of chronic injuries? 3 marks

2) a) Describe the medical condition known as tendinopathy. 2 marks
   b) What are the similarities and differences between golfer’s elbow and tennis elbow? 6 marks
3) Why are joint sprains a particular problem?  2 marks

4) Screening is a key part of the professional sportspersons daily life. How can it be used in injury prevention?  4 marks

5) Rapid recovery from injury is vital for elite performers and they now use a wide range of injury recovery techniques. For each of the following methods describe the treatment and its purpose.
   a) Cryotherapy.
   b) Proprioceptive retraining.
   c) Therapeutic massage.

6) Playing kit and equipment are major factors that an athlete needs to consider in injury prevention. Identify the key factors that affect the selection of their use.  4 marks

7) Tiny tears and inflammation can develop near the site of an injury.
   a) Explain how cooling down and compression clothing can speed up the recovery process.  6 marks
   b) Explain why it is important for an athlete to recover after exercise.  4 marks
   c) Identify three other strategies used by athletes to speed up recovery.  3 marks

8) Hyperbaric oxygen chambers and ice baths are aids to rehabilitation for elite performers. Briefly describe how each of these therapies assist in this process.  6 marks

9) Describe a suitable method of treatment that is appropriate for an acute soft tissue injury.  4 marks

10) Explain how periodisation could be used to minimise the risk of sports injuries.  4 marks

11) Elite competitors often continue training with and through their injuries. Discuss the implications for coaches and sports medical teams in establishing an appropriate protocol for rehabilitation and return to sport from injury.  15 marks

12) Discuss the advantages and disadvantages of contemporary rehabilitation strategies when dealing with sports injuries.  8 marks

13) A basketball player twists his ankle in a game and has to leave the court.
   a) Describe the immediate treatment that they should use.  4 marks
   b) The injury does not respond to the treatment. Identify two other treatments that could be used to help recovery.  3 marks

14) Discuss the principles and guidelines for injury prevention.  5 marks

15) Why should stretching be part of an injury preventative training programme?  2 marks

16) Discuss the importance of nutrition as part of an injury rehabilitation programme.  6 marks

17) Assess the use of POLICE rather than RICE as a rehabilitation strategy for sporting injuries sustained in a team game.  8 marks

Answers link: http://www.jroscoe.co.uk/downloads/a2_revise_pe_edexcel/EdexcelA2_ch2_answers.pdf