Overview

Classifying and managing sports injuries
- Direct injuries
- Indirect injuries
- Overuse injuries
- Soft tissue injuries
- Hard tissue injuries
- Assessment of injuries

Sports medicine and the demands of specific athletes
- Children and young athletes
- Adult and aged athletes
- Female athletes

Preventative action — enhancing the wellbeing of the athlete
- Physical preparation
- Protective equipment
- Thermoregulation
- Taping and bandaging

Managing injury recovery
- Injury management procedures
- Return to competitive sport

Ethical questions for sports medicine
- Playing with injury
- Use of drugs

Outcomes

On completion of this chapter, you will be able to:
- explain how a variety of training approaches and other interventions enhance performance and safety in physical activity (H8)
- select and apply strategies for the management of injuries and the promotion of safety in sport and physical activity (H13)
- devise methods of gathering, interpreting and communicating information about health and physical activity concepts (H16)
- select appropriate options and formulate strategies based on critical analysis of the factors that affect performance and safe participation (H17)
- show responsibility and a willingness to act for personal and community health (V&A)
- question issues that affect health and performance. (V&A)
Injuries are a part of sport. They occur more frequently in contact sports such as football, but may be the result of overuse caused by movements such as running.

Sports injuries are usually classified according to their cause. The most common classification is to identify injuries as direct, indirect, or overuse injuries. They can also be categorised as soft tissue and hard tissue injuries.

**Direct injuries**

Some injuries are caused by direct forces generated from outside the body. Direct injuries result in fractures, dislocations, sprains and bruises. A shoulder dislocation caused by a tackle in football or a broken bone caused by a collision between two hockey players are examples of direct injuries.

![Figure 13.1: Direct injuries are caused by external forces.](image)

**Indirect injuries**

Indirect injuries are caused by an intrinsic force — that is, a force within the body.

In contrast to direct injuries, indirect injuries are caused by an intrinsic force; that is, a force within the body. Indirect injuries normally occur as a result of inadequate warm-up, ballistic movements, excessive movement, or a fault in the execution of a skill. They are the result of excessive strain being placed on muscles, tendons and ligaments, causing irritation and possible damage to body structures. Examples of indirect injuries include a sprinter tearing a hamstring muscle during a race, or a volleyball player causing stress to ligaments in the knee joint (see figure 13.2).
Overuse injuries are caused by overuse of specific body regions over long periods of time.

Overuse injuries result from intense or unreasonable use of joints or body areas. They are provoked by repetitive, low-impact exercise such as jogging or stepping. These injuries cause pain and inflammation around the site of the injury. Typical overuse injuries include anterior shin splints (an irritation to the front portion of the shinbone; see figure 13.3) and tendonitis (irritation of tendons; for example, in the Achilles tendon in the heel).

Figure 13.2: Indirect injuries result from excessive stress on muscles and around joints.

Figure 13.3: Shin splints and stress fractures are common types of overuse injury.
Soft tissue injuries are injuries to all tissue other than bones and teeth.

Soft tissue injuries include damage to muscle, tendons, ligaments, cartilage, skin, blood vessels, organs and nerves. There are many types of soft tissue injury. They may be acute (occurring suddenly, such as a fracture or sprain) or chronic (prolonged). Acute soft tissue injuries include sprains, strains, dislocation, subluxation, torn cartilage, contusions and abrasions. Prolonged soft tissue injuries may include many of the same types of injury, but their severity necessitates a long rehabilitation. Two of the most common soft tissue injuries are tears and contusions.

![Achilles tendonitis](image)

**Figure 13.4:** Achilles tendonitis is an example of a soft tissue injury.

### Tears and contusions

A tear occurs when tissue is excessively stretched or severed. Two types of tear are sprains and strains.

Sprains arise from the stretching or tearing of a ligament.

Strains occur when a muscle or tendon is stretched or torn.

![Sprain classifications](image)

**Figure 13.5:** Sprains occur only in ligaments and are graded according to severity.
Strains are different to tears in that they happen only to muscles and tendons. They cause considerable pain and bleeding may cause discolouration around the injury. Any movement in the form of stretching and any pressure on or around the injury will result in sharp pain.

There are three levels of strains; these are illustrated in figure 13.6.

Impact with a player or object sometimes causes a contusion. Contusions vary in intensity. Some are superficial, remaining close to the skin. However, others penetrate deeply, causing bone to bruise. Contusions interrupt blood flow to surrounding tissue. When this occurs, a haematoma (blood tumour) forms as the blood clots in the connective tissue membrane. Internal bleeding into the area may continue for a period of time. A typical contusion is illustrated in figure 13.7.

**Inflammatory response**

When soft tissue is injured, it becomes inflamed but responds by activating a self-healing process. This is referred to as the inflammatory response and may last up to three or four days after the injury occurs, depending on the extent of the damage. The injury will progress through the following phases as part of the healing process.

Phase 1, the *inflammatory stage*, is characterised by:
- pain, redness and swelling around the injured area
- loss of function and mobility
- damage to cells and surrounding tissues
- increased blood flow to the area
- leakage of fluid causing swelling (oedema)
- the formation of many blood vessels to promote healing.

Phase 2, the *repair and regenerative stage*, may last from three days to six weeks. It is characterised by:
- the elimination of debris
- the formation of new fibres
- production of scar tissue.
Phase 3, the remodelling stage, can last from six weeks to many months. It is characterised by:

- increased production of scar tissue
- replacement tissue that needs to strengthen and develop in the direction that the force is applied. The type of remodelling varies according to the timing and degree of mobilisation of the injury. Excessive exercise too early will cause further damage. Too little exercise will allow large quantities of scar tissue to form, which lacks strength and flexibility.

Immediate treatment of soft tissue injuries aims to:

- reduce swelling
- prevent further damage
- ease pain.

In the long term, treatment aims to:

- restore flexibility
- regain full function
- prevent recurrence
- return the player to the field as soon as possible.

**Skin abrasions, lacerations, blisters and calluses**

Abrasions, lacerations, blisters and calluses are forms of skin trauma. They are caused by the application of force, such as scraping or friction to the outer layer of skin. They can cause concern and considerable discomfort.

**Abrasions**

Abrasions occur in games such as netball, where a player may fall on a dry, hard surface. The injury causes pain and shallow bleeding as a result of the skin being scraped. The skinned area may be embedded with dirt and foreign materials. Treatment will require gentle cleansing and sterilisation of the wound to prevent infection.

**Lacerations**

A laceration is a wound where the flesh has incurred an irregular tear. Particular care must be taken to prevent infection. Lacerations can occur to the scalp and mouth, particularly the lips and tongue if the soft tissue has been forced against the teeth. In the event of a scalp laceration, as illustrated in figure 13.8, the area needs to be thoroughly cleansed with antiseptic soap, dried and a sterile gauze pad applied. Pressure may still need to be applied to prevent bleeding. Lacerations longer than one centimetre need to be referred to a doctor. Mouth lacerations require a thorough inspection to ensure there is no further damage, such as dislodged teeth. The mouth can be rinsed with an antiseptic liquid. Sucking on ice will assist in the control of bleeding and swelling.

**Blisters**

Blisters are caused by a collection of fluid below or within the epidermal (surface) layer of the skin giving rise to intense pain. Blisters can contain clear liquid or even blood if a blood vessel has been ruptured. Blisters occur when:

- new equipment is being worn or used
- equipment is used for a long time, which may happen with clubs, bats or racquets
- the activity requires sudden changes of direction, causing friction in a sports shoe.

![Figure 13.8: A scalp laceration](image)
Management initially requires rest for 24 hours, when the symptoms may disappear. However, if the fluid in the blister is still present and causing concern, it may need to be surgically released and a donut pad applied. In the case of torn blisters or where the skin has been worn away, injury management requires the area be washed with soap and warm water and liquid antiseptic be applied. The area should be dried and antibiotic ointment applied. Use of ‘second skin’ dressing will aid the healing process.

**Calluses**

Calluses are increased thicknesses of skin that usually occur over bone protuberances. They are caused by constant pressure from external sources — for example, a shoe that is too small. Calluses are also commonly found on the hands and may be caused by habitual gripping of a bat or club. Calluses cause pain because the area underneath loses elasticity and blood supply, and moves as a mass under pressure, resulting in tears and cracks. Prevention requires ensuring that clothing and equipment fits, using materials that reduce friction (for example, two pair of socks) and applying donut pads and jellies to reduce resistance between the object and body.

**Identifying sports injuries**

Complete the table by identifying the type of injury from the following list and inserting it in the appropriate space: blister, overuse, sprain, laceration, strain, indirect injury, contusion.

<table>
<thead>
<tr>
<th>Type of injury</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tendonitis</td>
<td>Tendonitis is an example of this type of injury.</td>
</tr>
<tr>
<td>Injury that occurs only in soft tissue</td>
<td>Injury that occurs only in soft tissue</td>
</tr>
<tr>
<td>Injury caused by crushing of soft tissue</td>
<td>Injury caused by crushing of soft tissue</td>
</tr>
<tr>
<td>Injury to a ligament</td>
<td>Injury to a ligament</td>
</tr>
<tr>
<td>Fleshy wound with an irregular tear</td>
<td>Fleshy wound with an irregular tear</td>
</tr>
<tr>
<td>This injury results in the collection of fluid just underneath the skin.</td>
<td>This injury results in the collection of fluid just underneath the skin.</td>
</tr>
<tr>
<td>Type of injury caused by the mismanagement of forces within the body</td>
<td>Type of injury caused by the mismanagement of forces within the body</td>
</tr>
</tbody>
</table>

**Managing soft tissue injuries**

Management of soft tissue injuries requires application of the RICER principle. RICER is an acronym which stands for:

- rest
- ice
- compression
- elevation
- referral.
Properly used, the RICER method, which is explained fully in table 13.1, will ensure that the injury heals correctly and in the shortest period of time. If RICER is not used, the injury will take longer to repair and will have less strength and flexibility. This is illustrated in figure 13.10.

Table 13.1: The RICER method

<table>
<thead>
<tr>
<th>RICER</th>
<th>Why</th>
<th>How</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Rest</td>
<td>Place in a comfortable position with the injury elevated and supported.</td>
<td>Until beginning a program of careful mobilisation.</td>
</tr>
<tr>
<td>I</td>
<td>Ice</td>
<td>To reduce: pain, blood flow, swelling, spasm, enzyme activity, tissue demand for oxygen</td>
<td>20 minutes every hour up to four days.</td>
</tr>
<tr>
<td>C</td>
<td>Compression</td>
<td>Wrap an elastic bandage over the injured area, covering both above and below the site.</td>
<td>At the time of the injury and reapplied periodically for at least 24 hours.</td>
</tr>
<tr>
<td>E</td>
<td>Elevation</td>
<td>Decreases bleeding, reduces swelling, reduces throbbing</td>
<td>Whenever possible during the day and for the following two or three nights.</td>
</tr>
<tr>
<td>R</td>
<td>Referral</td>
<td>To understand the nature and extent of the injury, to seek guidance in a program of rehabilitation</td>
<td>As soon as possible following the injury.</td>
</tr>
</tbody>
</table>

Figure 13.10: Difference in injury repair when RICER is used and not used.
To ensure effective rehabilitation, it is important to remember that:

- **rest needs to be active.** Rest does not imply lack of physical work for all parts of the body. During rest, it is important to maintain physical condition (for example, through swimming) and to begin mobilisation of the injured part as soon as possible. Soft tissue injuries should not be strapped for long periods of time as this promotes clotting.

- **ice should not be applied to cuts and badly damaged skin** as this reduces blood supply (which provides nutrition) to the area.

- **ice should remain on soft tissue until it begins to feel numb** (about 20 minutes). There should always be padding, such as a towel, between ice and skin. The acronym HARM should be remembered so that techniques and substances that will cause further damage will be avoided.

  - Heat: do not apply heat for at least 48 hours as this increases bleeding.
  - Alcohol: do not consume alcohol as this increases swelling.
  - Running: while some mobilisation is encouraged, do not run as the weight and impact will cause further injury.
  - Massage: direct massage is discouraged in the first 72 hours as the pressure causes bleeding to increase.

**Immediate treatment of skin injuries**

Sometimes an injury will involve cuts (lacerations), skin scrapings (abrasions) and possibly punctures. The primary concern is to prevent infection. In each case, the wound needs to be cleansed with soap and warm water. Serious wounds will require medical treatment and it may be necessary to have a tetanus injection. Injuries such as these should be cleansed, but not treated with antiseptic before referral. Minor wounds must be cleansed and an antiseptic cream or solution applied before they are covered with a dressing.

**Applying the RICER procedures**

You are the trainer at a game of football. A player is kicked in the leg, which quickly begins to swell. Explain in detail how you would manage the injury.

**Practising RICER procedures**

You will need bags of ice or gel packs. In pairs, practise RICER procedures by treating a range of injuries including an ankle sprain, a contusion to the thigh and a forearm strain.

**Hard tissue injuries**

Hard tissue injuries cause damage to bones and teeth. They are frequently more serious than soft tissue injuries. Examples of hard tissue injuries include dislodging a tooth and fracturing a bone. The most common hard tissue injury is a fracture.

Like soft tissue, bone can also be traumatised by physical activity. However, because of its role as a structural support, hard tissue that has been injured must be carefully examined and cared for.

**Stress fractures** may be difficult to detect in the early stages. Local swelling and tenderness may indicate a stress fracture. They should be treated using the RICER method. If a fracture is suspected as the result of a collision or fall, professional help should be sought immediately.
Fractures

There are two broad classifications of fractures — simple and compound. In simple (closed) fractures, the bone breaks but remains underneath the skin, as shown in figure 13.12(a). In compound (open) fractures the bone breaks and protrudes through the skin, as shown in figure 13.12(b).

There are many different types of fracture. These include greenstick, comminuted, depressed, impacted, oblique, longitudinal, spiral, transverse and serrated. Some of these are illustrated below in figure 13.13.

Signs and symptoms of fractures include:
- intense pain
- possible sound of a bone cracking
- swelling, deformity, bruising and discolouration
- loss of function
- grating sound if moved.

When treating a suspected fracture, the following guidelines should be observed.
- The player must not be allowed to participate further in the game.
- Seek immediate medical assistance.
- Immobilise or splint the injury and make the player comfortable.

Dislocation

Dislocations are fractures caused by sudden movement or impact. They can be severe and require medical attention. Dislocations cause pain and are apparent because of the deformity they cause. Technically a dislocation is not a hard tissue injury because, although the bone is displaced, it is not damaged. The real damage is to ligaments which have been stretched or ruptured. In a dislocation, the bone actually comes out of the joint and remains out until it is physically reinserted. Dislocations should not be put back in place except by a qualified practitioner, as more damage can occur if the placement is incorrect.

The common signs and symptoms of dislocation are:
- deformity and swelling
- pain and tenderness
- loss of function.

Figure 13.12: (a) A simple fracture and (b) a compound fracture

Figure 13.13: Four different kinds of fracture: (a) greenstick (b) oblique (c) comminuted (d) depressed

Dislocation is the displacement of a bone at a joint.

Figure 13.14: Impact on the end of the finger can be enough to cause dislocation.
When treating a dislocation, follow these guidelines.

- Never attempt to relocate the displaced bone as this might increase the damage.
- Seek medical attention.

Sometimes a bone might momentarily ‘pop out’ and quickly return to place. This is called a *subluxation*. Although it stretches the ligaments, it may not cause additional damage at the time. However, the joint will be vulnerable and require rehabilitation and, possibly, surgery. A subluxation is illustrated in figure 13.15.

**Managing hard tissue injuries**

Hard tissue injuries occur to bones and teeth. Most will require *immobilisation* to some degree and almost all will require medical treatment.

**Teeth**

When teeth injuries happen, there may be bleeding from the mouth and the tooth may be dislodged. If the tooth has been loosened, keep it in place and seek immediate dental advice. If the tooth has been knocked out, put it back in place and splint it to an adjacent tooth using aluminium foil, if possible. If not, place the tooth in milk or clean it with the casualty’s saliva and seek urgent dental assistance. Most teeth can be saved if the root is not handled, hygiene is observed and attention is immediate.

**Finger dislocations**

Finger dislocations occur most often in contact sports. If the finger is dislocated it usually looks as if it is out of its normal position. Management requires:

- use of DRABCD (danger, response, airway, breathing, compression, defibrillation)
- securing with a splint to fully immobilise the injury
- ice, elevation and support using a bandage
- immediate medical attention.

**Fractures**

Management of fractures requires:

- use of DRABCD
- controlling bleeding
- treating shock
- support using a splint and bandage to reduce any movement to the area
- immediate medical assistance.

Most suspected fracture type injuries will require medical attention. Generally, medical attention will be required if:

- there is obvious deformity
- there is uncontrolled bleeding
- the casualty is unable to complete the TOTAPS regime (see page 390).

**Classifying sports injuries**

Copy and complete the following table to summarise the ways to classify and manage sports injuries. An example has been done for you.

<table>
<thead>
<tr>
<th>Classification of injury</th>
<th>Example</th>
<th>Management</th>
</tr>
</thead>
</table>
| Direct                   | Fracture| • Immobilise  
|                          |         | • Terminate participation in game or activity  
|                          |         | • Seek medical assistance  

**Figure 13.15:** With a subluxation, the bone ‘pops out’ and ‘pops in’.
Assessment of injuries

TOTAPS is an acronym that stands for talk, observe, touch, active movement, passive movement, skills test. It is used to assess the extent of injury to a player and determine whether or not the injured person can return to the field. If the player can complete all tasks required, they should be allowed to return to play. However, if the player is unable to complete any one of the requirements, the player should be allowed to return to the field only after assessment from a qualified medical practitioner.

TOTAPS

To complete the TOTAPS regime, follow these steps:

- **Talk.** Talk to the player to find out exactly what happened. This will provide valuable information about the nature of the injury.
- **Observe.** Look at the injury and see if there are any obvious signs of swelling or deformity. The easiest way to assess if an area is swollen is to compare both sides of the body.
- **Touch.** Gently feel the injury for any sign of deformity or swelling and try to pinpoint the area of pain.
- **Active movement.** Ask the player to perform a range of joint movements such as flexion, extension, and rotation. If these can be done without pain, then the assessment can proceed.
- **Passive movement.** The assessor physically mobilises the joint (flexion, extension, rotation) using a range of movements aimed at identifying painful areas and any instability in the joint.
- **Skills test.** In this phase the player is asked to perform a skill that will be required during the game — for example, a sidestep. If the player is able to perform to the satisfaction of the assessor, then the player can return to the game.

Assessment can be stopped at any stage if damage is apparent; for example, if the player feels pain. In the case of minor injuries, it is often possible to continue play. However, should there be a risk of further damage through continued play, then it is advisable to remove the player from the game.

![Figure 13.16: The TOTAPS regime](image-url)
Children and young athletes

Children and young athletes have special needs of which sports medicine practitioners need to be aware. Some of the more important issues concern treatment of specific medical conditions such as asthma, diabetes and epilepsy; management of overuse injuries, such as stress fractures; and general matters, such as matching opponents and providing guidelines to children in resistance training programs.

Medical conditions

Asthma

More than 2 million Australians (10 per cent of the population) suffer from asthma. While asthma may affect performance if not managed correctly, it should not be an excuse to avoid participation in sport, except in extreme cases. In fact, many elite sportspeople, including several Olympic gold medalists, are asthmatic. Asthma usually begins with coughing and wheezing and can lead to considerable fatigue. Activity can provoke an asthma attack. This is called exercise-induced asthma (EIA). During this condition, the airways are dilated during the physical activity but constrict immediately activity ceases, leading to an asthma attack (see figure 13.17).

Some activities provoke more asthma attacks than others. For example, there is a significant risk of an asthma attack occurring with running, some risk with cycling and little risk with swimming. The cause is related to the cooling process of nerve endings in the air passageways, which is more extreme during running-type activity. Swimming in warm water carries far less risk, as inspired air is saturated with warmer water vapour and the nerve endings are not cooled to the same degree.

It is generally agreed that exercise is of more benefit to asthmatics than no exercise at all. Swimming is the preferred form of exercise, as the warm, moist environment is less likely to cause an attack. During breathing, air is forced out of the lungs and into the water, which improves lung function.

The following measures will help sufferers work with and possibly control their asthma.

- Activity should be preceded by controlled breathing and relaxation exercises.
- Use a gradual warm-up and conclude with a leisurely warm down.
- Exercise intensity needs to be steady.
- If medication is required, it is essential to use it before exercise.
- Adequate water must be consumed.
- If attacks are triggered by environmental factors, remove the athlete from that environment.

If first aid is required, follow the directions outlined by the National Asthma Council in the chart ‘First Aid for Asthma’ (see figure 13.18).
First Aid for Asthma

What is an asthma attack?

People with asthma have extra-sensitive airways. Triggers like dust, pollen, animals, tobacco smoke and exercise may make their airways swell and narrow, causing wheeze, cough and difficulty breathing.

1. Sit the person comfortably upright. Be calm and reassuring.
2. Give 4 puffs of a blue Reliever inhaler (puffer) – Ventolin, Albuterol, Bronkaid, or Asmol. Relievers are best given through a spacer, if available.
   Use 1 puff at a time and ask the person to take 4 breaths from the spacer after each puff.
   Use the person’s own inhaler if possible. If not, use the First Aid kit inhaler or borrow one from someone else.
3. Wait 4 minutes. If there is no improvement, give another 4 puffs.
4. If little or no improvement, CALL AN AMBULANCE IMMEDIATELY (DIAL 000) and state that the person is having an asthma attack:
   Keep giving 4 puffs every 4 minutes until the ambulance arrives.
   Children: 4 puffs each time is a safe dose.
   Adults: up to 6 - 8 puffs every 5 minutes may be given for a severe attack while waiting for the ambulance.

With Spacer

- Shake inhaler and insert mouthpiece into spacer.
- Place spacer mouthpiece in person’s mouth and fire 1 puff.
- Ask the person to breathe in and out normally for about 4 breaths.
- Repeat in quick succession until 4 puffs have been given.

Without Spacer

- Shake inhaler.
- Place mouthpiece in the person’s mouth. Fire 1 puff as the person inhales slowly and steadily.
- Ask the person to hold that breath for 4 seconds, then take 4 normal breaths.
- Repeat until 4 puffs have been given.

What if it is the first attack of asthma?

- If someone collapses and appears to have difficulty breathing, CALL AN AMBULANCE IMMEDIATELY, whether or not the person is known to have asthma.
- Give four puffs of a Reliever and repeat if no improvement.
- Keep giving 4 puffs every 4 minutes until the ambulance arrives.
- No harm is likely to result from giving a Reliever to someone who does not have asthma.

For more information on asthma, contact your local Asthma Foundation 1800 645 130
For more copies of this chart, contact the National Asthma Council 1800 032 495

Although all care has been taken, this chart is a general guide only which is not intended to be a substitute for individual medical advice/treatment. The National Asthma Council expressly disclaims all responsibility (including for negligence) for any loss, damage or personal injury resulting from reliance on the information contained. (Copyright National Asthma Council Australia)

Figure 13.18: First aid procedure during an asthma attack (Source: National Asthma Council.)
**Diabetes mellitus** is a condition affecting the body’s ability to take glucose from the bloodstream to use it for energy.

**Epilepsy** is a disruption to brain function, causing a brief alteration to the level of consciousness and resulting in seizures or fits.

**Diabetes**

Until recently, children with diabetes mellitus were discouraged from participating in physical activity. However, today diabetics participate in all sports. Exercise is of considerable assistance in managing diabetes.

The diabetic athlete must balance insulin by way of injection, food intake and exercise if their physical performance is to be optimal. Their diet needs to be well balanced, with complex carbohydrates forming a significant portion. Because exercise increases the utilisation of sugar, diabetics require a pre-game meal to raise blood sugar levels and hourly glucose supplementation (for example, a banana) if exercise is protracted.

**Epilepsy**

Epilepsy should not prohibit people from becoming involved in sport or activity. However, the circumstances of each individual should be assessed and they should be guided by their doctor. It is generally believed that, if seizures occur on a daily or weekly basis, collision sports should be avoided. If seizures are controlled through medication or occur only during sleep, epilepsy should not prevent participation in a wide range of sporting activities. Other players, parents or supervisors should be present and know what to do if a seizure occurs. Some activities, such as swimming alone, scuba diving and rock climbing, must be completely avoided, as a seizure may go unnoticed or cause loss of control, leading to serious injury or death.

**Effects of medical conditions on sports performance**

Research the sporting achievements of an elite athlete with asthma, diabetes or epilepsy. Find out how the athlete managed the condition. Report your findings to the class.

**Overuse injuries**

One of the most common forms of overuse injury is the stress fracture. Signs and symptoms of stress fractures include:

- gradual onset of pain, which tends to be localised
- pain increasing if it is not adequately treated
- local swelling and tenderness.

A common type of stress fracture that occurs in the lower leg is shin splints (see figure 13.19).

Adequate treatment of a stress fracture requires:

- immediate rest lasting from four to eight weeks, depending on the severity of the injury
- frequent use of ice to reduce inflammation
- possible use of anti-inflammatory medication
- maintaining physical condition by pursuing activities that do not involve the injured part in pounding movements — for example, swimming
- use of corrective devices and exercises to improve body mechanics if stress fractures were caused by biomechanical factors.

**Thermoregulation**

Temperature control through balancing heat loss with heat gain is managed through thermoregulation. Children are at increased risk from environmental...
stress when compared to adults. Children do not have the same ability to lose heat through evaporation at the same rate as adults. This is because their sweat glands release fluid more slowly and are less responsive to temperature changes. Children therefore rely more on radiation and convection to lose heat. Children’s acclimatisation to heat is also slower, putting them at greater risk on hot, humid days. They have shorter tolerance time in extreme heat, increasing the possibility of dehydration. Research also suggests that children have a higher chance of developing hypothermia from exposure to cold when compared to adults, placing them at greater risk in these environments.

Matching opponents
To promote safety, it is desirable to match children with others of comparable size. While the risk is higher in contact sports such as rugby, size variations do make a difference in sports such as hockey and cricket, where larger children may be able to hit harder or bowl faster. The problem is difficult to address because most schools and junior sport controlling bodies match teams on age. This is convenient because birth certificates are readily available. However, there can be vast differences in physical maturity between individuals of the same age.

Class debate
Debate the merit of selecting junior teams that play contact sports, such as rugby or Australian rules, based on their physical size rather than age.

Resistance training for children/young athletes
Most literature supports the use of a safe program incorporating low resistance with high repetitions through the full range of motion. A strength training program for children must be an integral part of an overall program designed to improve skill and fitness. It should not be competitive. It is important that strength specialisation (for example, focusing on power or absolute strength) be avoided, as this can lead to imbalances between muscle groups and contribute to injury. Overall, there is considerable benefit from well-supervised programs and little risk of injury if guidelines are followed (see table 13.2).

Table 13.2: Basic guidelines for resistance exercise progression in children

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 or younger</td>
<td>Introduce child to basic exercises with little or no weight; develop the concept of a training session; teach exercise techniques; progress from body weight calisthenics, partner exercises, and lightly resisted exercises; keep volume low</td>
</tr>
<tr>
<td>8–10</td>
<td>Gradually increase the number of exercises; practise exercise technique in all lifts; start gradual progressive loading of exercises; keep exercises simple; gradually increase training volume; carefully monitor toleration to the exercise stress</td>
</tr>
<tr>
<td>11–13</td>
<td>Teach all basic exercise techniques; continue progressive loading of each exercise; emphasise exercise techniques; introduce more advanced exercises with little or no resistance</td>
</tr>
<tr>
<td>14–15</td>
<td>Progress to more advanced youth programs in resistance exercise; add sport-specific components; emphasise exercise techniques; increase volume</td>
</tr>
<tr>
<td>16 or older</td>
<td>Move child to entry-level adult programs after all background knowledge has been mastered and a basic level of training experience has been gained</td>
</tr>
</tbody>
</table>

Note: If a child of any age begins a program with no previous experience, start the child at previous levels and move him or her to more advanced levels as exercise toleration, skill, amount of training time and understanding permit. (Source: WJ Kraemer and SJ Fleck 2005, Strength Training for Young Athletes: Safe and Effective Exercises for Performance, 2nd ed, p. 13, table 1.1 © 2005 William J Kraemer and Steven J Fleck. Reprinted with permission from Human Kinetics, Champaign, IL.)
Growth plate injuries

‘Of all youth sports, competitive baseball is one of the greatest concerns because of its potential for serious epiphyseal injuries resulting primarily from the pitching motion.’

1. Use your research skills to investigate the nature of the epiphyseal plate and its importance to bone maturation and development. How can fractures affect body growth?

2. Investigate specific sports movements that might contribute to epiphyseal plate damage and suggest how the sport can be modified to prevent this occurring.

Adult and aged athletes

The most obvious concern for adult and aged athletes is pre-existing health risks. An older person who has a history of involvement in regular aerobic-type activity will probably not be at risk to the same degree as a person who suffers from obesity, hypertension, asthma or emphysema. However, heart conditions and bone and joint mobility problems will have a significant effect on the options available to adults and older people.

Heart conditions

People with heart conditions include individuals who suffer from high blood pressure, have experienced a heart attack or other heart problems, or have had bypass surgery. For many years, exercise for these groups was considered dangerous and to be avoided. It is now known that prescribed exercise conveys considerable benefit with little risk to people in these groups. Exercise reduces blood pressure in moderately hypertensive patients by an average of 11 systolic and nine diastolic points. However, to gain the maximum benefit, exercise needs to be combined with a balanced diet with low fat and low salt intake.

People with existing heart conditions should obtain medical clearance before starting an exercise program. Some people may require a stress test to determine the level of intensity their circulatory system will tolerate. Supervision may be required in the early stages, particularly if the person has been sedentary in the past. Aerobic exercise such as walking, cycling, jogging and swimming present the best options for these people. It is important that they begin slowly and progress gradually, using an exercise program that suits the individual, such as 30 minutes per day, three times a week. The intensity of exercise (how hard you are working) should steadily increase, then level off. This ‘steady state’ heart rate is considered safe as long as it is 10 or more beats per minute lower than levels that trigger abnormal signs or symptoms (nausea, shortness of breath, dizziness, abnormal heart rhythm and chest pain). This level can be determined by stress tests. It is important that each session begins with a warm-up and that progression is smooth and graded.

The key principles for sports participation for people with heart conditions are:

- initially, they require medical clearance
- exercise must be aerobic
- progress must be gradual
- activity needs to be of moderate intensity
the program should be tailored to individual tastes
the program must be sustainable as benefits will accrue only after a period of months.

People with heart conditions can also benefit from modified strength training programs. To be safe, the light loads must be used and the program must include the major muscle groups. Heavy weights and pure isometrics are not recommended, as they can raise blood pressure to dangerous levels.

**Fractures and bone density**
The most important objective of sports participation programs for people who have osteoporosis is to reduce the risk of falls and subsequent fractures.

Physical activity increases bone mass and makes bones stronger. Exercise is particularly important to older women because it contributes significantly to delaying post-menopausal bone density loss. Inactivity should be avoided, as this encourages calcium discharge from bone, making it weaker. Sport and exercise programs need to be safe, beneficial and not cause pain. They should focus on improved physical fitness, particularly in the areas of balance, strength, coordination, aerobic capacity and flexibility. Gains in these areas will lessen pain, increase confidence and broaden the range of activities available. However, before beginning a new activity, the risk of a fall should be noted and the activity avoided if this risk is of concern. Types of exercise and sports options available include:

- endurance activities such as walking, cycling, swimming
- low impact and balance activities such as aerobics
- low range strengthening exercises focusing on the limbs, trunk and back.

High loads must be avoided and resistance developed gradually. The advice of a doctor or physician is encouraged in this area.

The aim of these options is to develop postural retraining; that is, to teach safe ways of performing movements such as lifting and to avoid further fractures. People with osteoporosis need to be guided by their physician so that medication, exercise prescription and diet all work to improve safety and bone strength (see also page 400).

**Flexibility and joint mobility**
Exercise has a positive effect on flexibility and joint mobility in older people. Arthritis, aching joints and tight muscles, problems often experienced by older people, respond positively to exercise programs that focus on safe stretching and improving the range of motion in joints. Programs should also increase balance and stability and aim to reduce fractures caused by falls.

Programs need to:
- be low impact
- be specific to a person’s physical limitations
- consider existing medical conditions that might limit movement.

Generally, options available to this group include activities such as walking, cycling, swimming, flexibility classes and aqua-aerobics. Tai-chi has also gained in popularity because it is safe, controlled, low impact and promotes balance.

---

**Medical conditions and physical activity**
Research a medical condition common in older people and analyse the impact of the condition on involvement in physical activity.
Inquiry

Older people and exercise

Read the snapshot ‘Let not the years condemn’. Outline measures to ensure that exercise is safe for older people. Discuss how exercise improves quality of life for older people.

SNAPSHOT

Let not the years condemn

By Paula Goodyer

Ask anyone who has competed in a fun run and there is every chance they remember the moment they were overtaken by a person in their 60s. As you clock up another birthday, it’s not so much age that decides what you can and can’t do, but how you’ve used your body in the preceding years.

Pitted against a seasoned 50-year-old runner, an untrained, desk-bound person in his or her 20s is likely to run out of steam first, which is why exercise physiologists no longer pigeonhole people according to age. ‘We think in terms of a person’s functional age — meaning how active they are and what they can do physically — rather than chronological age,’ says exercise physiologist Chris Tzar, who is the manager of the Lifestyle Clinic at the University of NSW’s faculty of medicine.

There are few physical activities that chronological age stops us from doing, he says — it’s more about identifying health problems or factors that increase the risk of injury and getting expert advice to help you exercise safely.

20 to 35

What to do now: These are the bulletproof years — when death or disability seem eons away and there’s no urgency to fight dwindling strength or stiffening arteries. But there are advantages to exercising now. People who are active at this age have a lower mortality rate later in life than those who aren’t, Tzar says. It’s also smart to capitalise on the time of your life when bones are building their peak strength. The more bone you build before the mid-30s when bone density starts declining, the stronger your bones are as you age. Weight-bearing exercise such as running, speed walking, strength training and team sports all help boost bone density. Breaking a sweat now could help ward away breast cancer — there’s evidence long-term exercise reduces the risk, especially in women under 45 when breast cancer is more aggressive.

Beware of: Sporting injuries that set the scene for dodgy knees and other problems in middle age. ‘Weekend warriors in their 20s who do nothing all week, bar a single game of soccer or netball and one training session, have a high risk of injury,’ says James Short, the president of the Fitness NSW Personal Trainer Council. ‘Adding one or two sessions of strength training through the week reduces the risk.’

35 to 50

What to do now: This is when metabolism can start slowing down — a problem caused more by muscle loss than increasing age. The more muscle you have, the more energy you burn, and the easier it is to maintain a healthy weight. But unless you counteract it, muscle loss kicks in in the 40s. By your 50s you could lose about three kilograms of muscle each decade. These are also the years when inactivity — if you let it — helps prime you for later problems such as cardiovascular disease, some cancers, diabetes, and osteoporosis.

But when every moment seems consumed by work and family, how do you stay fit?

‘By spending less time working out, but working harder,’ Short suggests. ‘Instead of walking for 45 minutes or an hour, walk for 30 minutes but find a flight of steps and run — or walk briskly — up and down,’ he says. ‘Mix it up — alternate walking up one step at a time with walking up two steps at a time. Reach the top and do some push-ups. If you can only run or walk for 20 or even 10 minutes instead of 30, it’s still worth it — just do it faster and harder.’

As for strengthening muscles to prevent weight gain and future frailty, a gym with child care is one option for busy parents. But there are cheaper ways of getting stronger at home, Tzar says. He suggests callisthenics, such as push-ups, together with hand (continued)
weights or exercise bands. ‘You don’t have to buy hand weights — you can use two-litre milk containers filled with water or sand. As you get stronger, add more sand or water, or both, to the containers. If you’re at the park with the kids, do some push-ups.’

Beware of: If you’re sedentary and/or a smoker, see your GP for a check-up before starting any exercise program, Tzar says. If there are any health problems, your doctor can refer you to an exercise physiologist who can prescribe a suitable exercise program. If you’re diagnosed with diabetes, depression or arthritis, there’s a Medicare rebate for consultations with an exercise physiologist.

50 to 65

What to do now: How you use your body now can influence how well you live later in life, but it’s never too late to turn an inactive life around. German research has found that people who became physically active after 40 were 55 per cent less likely to develop heart disease than people who were inactive. The standard advice is to walk for 30 minutes on most days, preferably with two weekly strength-training sessions — but don’t assume you can’t do something more strenuous, providing you take it slowly.

‘If you wanted to start running, you could,’ Tzar says. ‘But you’d need to get fit first by regular walking. What’s important at this age is to increase the intensity of exercise gradually, in small doses — too much too soon increases the risk of injury.’

Good balance is important. Strength training helps. So does increasing ‘core strength’, meaning strengthening the muscles in your lower back, pelvis and abdomen to help keep you stable when you move around. Ways to boost core strength include Pilates, using an exercise ball or doing squats or lunges. The important thing is to activate core muscles by drawing your navel into your spine while you do these exercises, Short says. Expert advice will help you do them safely and effectively.

Beware of: ‘Thinking you’re still in your 30s and can go back to playing soccer or touch football even though you’re overweight and haven’t trained for 20 years,’ Short warns. ‘With contact sports, there’s a higher risk of injuries. At this age muscles are less elastic — any injuries take longer to heal.’

65-plus

What to do now: All aspects of fitness are important, but strength training is of the greatest benefit to people of this age, Short says. ‘People often lose confidence, but I find that when they feel stronger they’re more confident — they’re not scared about living alone, and because physical tasks are easier to do, they get less tired and have more energy.’

Beware of: Believing you’re too old to embrace physical activity. ‘You can continue to adapt and improve at any age,’ Tzar says.

Fitness at any age

Ideally we should nurture all four aspects of fitness at all ages — it makes everything you do easier and safer.

• Aerobic fitness increases your body’s ability to use oxygen and conditions the heart and lungs. Maintain them with regular walking, swimming, cycling, running or dancing.
• Build muscle strength using dumbbells, barbells, resistance bands, weight machines or your own body weight (for example, in a push-up).
• Flexibility allows you to move your joints through their full range of motion. Stay flexible with stretching exercises, yoga, and tai chi.
• Strong ‘core’ muscles in your lower back, pelvis, hips and abdomen help maintain your balance. Stay on your feet with regular exercise and strength training.

Female athletes

Female athletes have special dietary needs, including increased iron and calcium requirements. Iron levels are depleted by physical training and menstruation. Calcium is important in promoting strong bone growth and a sturdy structure for muscle attachments. Eating a wide variety of foods is recommended as no single food contains all the vitamins and minerals required for adequate functioning of essential body processes. Lack of energy and possible harm to the body can be caused by an unbalanced diet.

Eating disorders

It has been found that eating disorders affect more than half of the athletes who compete in events where low body fat and an idealised body shape and size are expected. Examples of activities where sport-specific physiques are an advantage include gymnastics, synchronised swimming, diving and dance. Running and swimming are also affected, but to a lesser degree.

Female athletes have twice the risk of developing eating disorders, which may result from:

• exposure to peer influence, magazines, television and other forms of media that make athletes susceptible to the pressures of weight loss
• exposure to social expectations to be thin
• pressures within the athletic subculture; for example, the desire for an ‘athletic shape’
• the need to conform to an ideal sporting image that overvalues ideal body shape, size, weight and low body fat.

Female athletes such as gymnasts and divers find themselves under pressure to conform to an ideal body size and weight. In these sports, body shape is not mentioned as part of the marking criteria although the body is clearly revealed. Thinness is an advantage to artistic and technical merit, which are considered when arriving at a score. Athletes in these sports can find themselves under significant pressure and even incur serious emotional damage in trying to please coaches and judges. In the 1980s and early 1990s, the importance of having the ideal shape for a particular sport escalated, making the problem of eating disorders of increasing concern. For example, in 1976 the average height of female gymnasts was 1.6 metres and average weight was 47.7 kilograms. In 1992, the average height had dropped to 1.4 metres and average body weight to 40.0 kilograms. Concern for the welfare of very young female gymnasts led, in 1996, to an increase in the age at which girls can compete in international gymnastics competitions to 16 years.

To help prevent eating disorders from developing in female athletes, it is important that trainers and coaches:

• expect athletes do their best and not focus solely on winning
• be better educated to detect signs of eating disorders and use nutrition experts and counsellors to program and advise in these areas
• observe training routines and social practices such as eating and take action when suspicious behaviours are disguised or turn into an obsession
• invite parents to training sessions to observe coaches to ensure that excessive pressure is not placed on athletes to meet unreasonable dietary or body size demands.

Eating disorders are characterised by behaviour such as purging, binge eating and starving. The most common eating disorders are anorexia nervosa and bulimia nervosa.
Iron deficiency

Although iron is required in only small amounts (35 to 50 mg per kilogram of body weight), many women consume less than the recommended amount. Iron deficiency causes anaemia.

If haemoglobin levels drop below 11 grams per 100 mL of blood, the person is considered to be anaemic. Haemoglobin forms the bulk of red blood cells. It binds with oxygen in the lungs and transports it to the muscle tissues. While only small amounts of iron are required in the body, the mineral plays a critical role in oxygen transportation. Without sufficient iron, the number of red blood cells are reduced, limiting the oxygen-carrying capacity of the blood and the degree to which the athlete is able to participate in sport. Iron deficiency contributes to fatigue and loss of energy. The problem is more evident in females because they usually consume less red meat and can lose from five to 40 mg during menstruation. The recommended daily intake for females is very small (15 mg), but many women do not consume this level of iron.

Exercise-induced anaemia (sports anaemia) is common in female athletes and is believed to be the result of intense training where iron reserves are heavily drained. Some believe this is caused by loss of iron in sweat together with the destruction of red blood cells from body temperature increases. The pounding effect of feet on hard surfaces may be an additional factor. This does not mean that every female athlete needs to take iron supplements. However, it does suggest that iron levels need to be monitored constantly and increased only as required. Supplementation benefits people whose intake is below recommended levels, but is of no benefit to those whose intake is satisfactory. Indiscriminate use of iron tablets can cause iron levels to reach toxic amounts and contribute to liver disease, diabetes, heart problems and joint damage.

Bone density

Bone density is directly related to the quantity of calcium in the bones. Bones that lack calcium are susceptible to fractures and structural weakening. This may happen in the spinal cord for example, which contributes to a hunchback. Calcium is regulated by the parathyroid glands, which regulate how much calcium is stored in the bones and how much will be released to the body. If the parathyroid glands become overactive, calcium from bone tissue is released to the bloodstream causing bones to become brittle and contributing to a condition called osteoporosis (see figure 13.20). Bone is strongest when a person is in their twenties, with deterioration beginning in the mid thirties. Following menopause, women lose calcium faster than men and some may require a form of oestrogen therapy.

Figure 13.20: An electron micrograph image of bone affected by osteoporosis or ‘brittle bone’ disease.
The female athlete needs to be aware of how bones will be affected by age, particularly post-menopause. Women beginning sports programs should focus on safety in activity and choose aerobic sports such as swimming, cycling, running and aerobics. Female athletes in continuing programs need to be aware of the effect of age and menopause on bone density. A well-balanced diet with adequate calcium-enriched foods, such as milk and cheese, is recommended. For women with osteoporosis it is important that activity includes a warm-up, progresses to stretching and that ice is used on inflamed or arthritic joints to prevent swelling and soreness.

**Pregnancy**

For some time it was thought that exercise caused excessive stress to the mother and the foetus. Most research now shows that sustained, moderate exercise creates no more stress to previously active, healthy women than the stress of weight gain. Furthermore, exercise regularly performed improves cardiovascular fitness. Moderation is the key, particularly if there is restricted placental blood flow which could place the foetus at risk. Pregnant women should exercise in the cool of the day and consume adequate water to avoid thermal stress, which can affect foetal development. It is easier to control these factors in self-regulated exercise programs than in competitive sports, which may have regulations regarding participation by pregnant women.

In an uncomplicated pregnancy, regular moderate exercise can have considerable benefits, including:
- maintenance of fitness and general wellbeing
- weight control in later stages of pregnancy
- improved muscle tone.

**Menstruation**

The effect of menstruation on performance and the impact of performance on menstruation will vary from one female to another. Some women have reported difficulties with performing to optimal capacity during times of menstruation, although many report no difficulty at all. In fact, some female athletes have established world record performances when they were menstruating. A number of exceptional performance times have been recorded in swimming by menstruating athletes. Activity should not be avoided during menstruation unless undue pain or abdominal cramping is experienced. If difficulties do occur, they should be discussed with a qualified physician.

**Problems faced by female athletes**

Choose one of the following conditions that may be experienced by female athletes: eating disorders, iron deficiency, decreasing bone density, pregnancy or menstruation. Critically analyse how the condition affects sports performance and what can be done for better management. Discuss your findings with the class.

**Addressing the demands of specific athletes**

Draw a web or bubble map (see page 33 for an example) to summarise responses to the following critical question: ‘How does sports medicine address the demands of specific athletes?’
The wellbeing of an athlete can be enhanced by developing skills that contribute to personal safety and taking preventative action in training and competition environments. While most injuries do not require surgery, some injuries do require hospitalisation (see figures 13.21 and 13.22) and can keep the athlete from training and playing for some time. However, many of these injuries are preventable through preparation.

**Figure 13.21**: Hospitalisation rate per 100 000 population due to sport and recreation injury, by sex, Australia, 2002–03 (Source: Hospitalised Sports Injury, Australia 2002–03, cat. no. INJCAT 79, AIHW, Canberra, March 2006, p. 13.)

**Figure 13.22**: Number of hospitalisations due to sport and recreation injury, by principal body region injured, Australia, 2002–03 (Source: Hospitalised Sports Injury, Australia 2002–03, cat. no. INJCAT 79, AIHW, Canberra, March 2006, p. 15.)
Analysing injury statistics

1. Examine the graph in figure 13.21. Choose three sports from the list and, for each sport, comment on:
   (a) the rate of injuries that require hospitalisation
   (b) the rate for females compared with males
   (c) possible reasons for the above.

2. Examine the graph in figure 13.22. Describe the main areas of the body where most injuries occur. Suggest measures that might prevent some of these injuries.

Physical preparation

Physical preparation enables the body to better cope with the demands of the sport or activity. The athlete undertakes training sessions that stress physiological capacities, making them adapt to the pressures required in the competitive environment. This may involve activities such as resistance training, interval training and general conditioning.

Skill and technique

Skill and technique relate to the efficiency with which we perform the required activities. Skilful players perform difficult movements with ease and precision. They display a high degree of temporal patterning (the smaller parts of the movement are executed in sequence), pacing (movements are precisely timed) and control. These features are acquired and developed through effort and practice.

Correct skill development is essential to prevent injury. The footballer who is unsure of correct tackling technique is at risk each time they make a tackle. The basketballer who is unable to rebound competently places his or her knees at risk of injury with each landing. Wrestlers who have inferior falling techniques risk injury each time they are thrown on the canvas. Most people appreciate the importance of skill acquisition to improved performance. It is equally important in the prevention of serious injury.

Safe sporting movement

Before difficult skills are practised, adequate groundwork in fundamentals must be given to ensure that the movements are acquired and rehearsed in the safest possible way. Safety equipment may need to be used, such as safety belts in gymnastics, foam cushioning pads when teaching tackling in rugby, or adequate clothing when learning to dive from the tower. Difficult skills should not be expected of young players, particularly if they do not have the physical or psychological maturity to meet the demand.

Flexibility

Muscles lose elasticity with age, so everyone should participate in a general stretching program at least four or five times per week. However, sportspeople are unique and require additional, specific flexibility according to the demands of their particular sport. Muscles need to be stretched beyond the range required of them in the sport prior to the performance. This is achieved by a safe stretch program using the following types of stretch.

- Static stretches — a muscle or group of muscles is gradually stretched beyond their normal range and the stretch held for about 30 seconds (see figure 13.23).
• Proprioceptive neuromuscular stretching (PNF) — often performed with a partner, although this is not essential. A static stretch is followed by an isometric contraction and a relaxation phase in the lengthened position (see figure 13.24). The procedure continues until the desired amount of stretch is complete.

Stretching programs must be specific to the needs of the sport. The muscle groups that will have greatest demands placed on them during the performance require specific attention. For example, a high jumper will stretch all major muscle groups in preparation for competition, but will give additional and specific attention to the calf and thigh muscle groups as the demands on these will be greatest.

1. Extend the toes, hold the stretch and pull back on the towel so the leg muscles are under tension while being stretched. Hold for 10 seconds.

2. Relax for five seconds then increase the stretch by pushing the toes further away from the body. Again pull back on the towel so that the muscles are placed under tension. Hold for 10 seconds.

3. Extend the stretch further and repeat the process.

Endurance

Endurance is the ability to resist physical tiredness and recover quickly from fatigue. It applies to both the skeletal muscle and the cardiorespiratory systems.

In terms of the skeletal muscle system, we refer to endurance as local muscular endurance. An example is the ability of the leg muscles to continue jogging without undue fatigue, or the abdominal muscles to continuously perform sit-ups.

Cardiorespiratory endurance is the ability of the heart and lungs to deliver oxygen to the working muscles for the cells to use and to remove wastes. Adequate physical preparation to improve endurance means that the appropriate energy system (anaerobic or aerobic) must be identified and specifically developed to meet the demands of the activity. Off-season and pre-season training is essential to developing endurance. At least six weeks’ regular training is essential prior to competing in endurance events. Athletes who fail to develop endurance risk fatigue, making tissue more susceptible to injury.

Strength

Strength is the ability of a muscle or muscle group to exert force against resistance. The degree of
strength required for a sport depends on the nature of the sport. Some activities, such as tenpin bowling, do not require excessive strength development. Other activities, such as rugby league and weight-lifting, require considerable body strength. A large range of sports, such as basketball, netball, soccer, touch football, surfing and rock climbing require varying levels of strength development for which programs need to be individualised.

Adequate strength development relevant to the sport is essential to prevent injury. Demand for strength (for example, pushing in a scrum) that has not been developed can lead to muscle and joint injuries in the form of sprains, strains, fractures and dislocations. Adequate strength (and power) must be developed to a level that ensures the body’s structures are able to cope with the potential physical stresses for the duration of the game. Inadequate levels will increase the potential for injury.

**Sport-specific requirements**

Each sport or activity is different, so the demands placed on performers in terms of physical preparation will vary considerably. Some sports demand a lot of the body in terms of physical preparation, while others require considerably less. The physical requirements of a sport determine the extent to which components of fitness (for example, speed and agility) need to be developed. Once the components are identified, training programs can be established that ensure each of the required components is developed appropriately. It is important also to realise that fatigue can lead to problems in performing skills or a loss of control over movements, which will cause injury.

Identifying the special requirements in these areas and developing them through adequate training will enhance physical preparation and be a major factor in the prevention of injury. Developing the essential components fosters physical attributes and enhances self-confidence and self-assurance.

**Individual participants’ needs**

The individual needs of participants encompasses the specialised needs of players in relation to:

- their genetic make-up, physical attributes and current levels of fitness
- their role on the field of play
- the position they play in the team.

In rugby league, for example, the players’ aerobic system must be well developed. However, for players in wing positions, anaerobic power will be more important as speed over short distances is essential. Similarly, goal shooters in netball require a less developed aerobic system than their constantly moving centre court players.

The somatotype (body shape) of the player should also be taken into account with respect to the position they play. The tall goal shooter may well require additional work on agility, flexibility and coordination to ensure that all aspects of safety relating to body type and positional requirements are addressed.

**Warm-up, stretching and cool-down**

Warm-up and cool-down are probably the most important injury prevention features of any training program. It is uncommon to see teams take the field without warming up. However, it is common to see inappropriate warm-ups. Cool-downs are often neglected.

As with all training programs, the warm-up needs to be geared to the demands of the sport. The time taken for warm-up will vary depending
on the activity. While it is not uncommon for sprinters to warm up for 45 minutes prior to a 10- to 12-second event, 20 to 25 minutes is often enough for sports such as touch football and netball. As a general rule, sports that require explosive movements such as sprinting, discus throwing and gymnastics require a longer warm-up than other activities where the prime demand is endurance (for example, cycling).

Warm-ups cause a redistribution in blood flow. When we are not exercising, most of our blood is located in the internal organs where it aids digestion and circulation. However, activity causes blood to be drawn to the skeletal muscles where oxygen and nutrients are needed by the cells to enable muscle contraction. Higher muscle temperatures increase the ability of the muscle to stretch without tearing and improve the time that it takes a muscle to respond to a stimulus (reflexes). This is associated with positive psychological feelings — the knowledge that the muscle will respond at the time because it has already done so. The same responsiveness does not occur in muscles that have not been warmed up.

The phases of the warm-up, suggested activities and benefits are listed in table 13.3.

### Table 13.3: Phases of the warm-up and associated benefits

<table>
<thead>
<tr>
<th>Phase</th>
<th>Nature</th>
<th>Suggested activities</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General body</td>
<td>Jogging and skipping</td>
<td>• increased blood flow&lt;br&gt;• raised muscle temperature</td>
</tr>
<tr>
<td></td>
<td>warm-up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Stretching</td>
<td>Static stretches followed by PNF stretches</td>
<td>• increased elasticity&lt;br&gt;• increased muscle extensibility</td>
</tr>
<tr>
<td>3</td>
<td>Callisthenics</td>
<td>Push-ups, abdominal crunches, half squats, star jumps</td>
<td>• strengthens muscle&lt;br&gt;• draws blood from internal organs to skeletal muscle</td>
</tr>
<tr>
<td>4</td>
<td>Skill rehearsal</td>
<td>Drills and routines</td>
<td>• increased agility&lt;br&gt;• game readiness&lt;br&gt;• maintenance of body temperature</td>
</tr>
</tbody>
</table>

The cool-down (recovery) is the period following competition or physical activity where body temperature, circulation and respiratory rates return to their pre-exercise state (or as close to this state as possible). The cool-down is essential to:
- *maintain the stretch in muscle groups* that may have shortened during the activity. For example, the leg muscles of a cyclist may shorten if the legs do not reach full extension during pedalling.
- *disperse lactic acid* that has built up during exercise. Exercise recovery as opposed to rest recovery results in a more effective dispersal of lactate.
- *prevent blood pooling*. A gradual reduction in heart rate reduces vasodilation (supply of blood to the working muscles) and the tendency of blood to ‘pool’ in muscles that have been heavily worked.

An adequate cool-down involves stretching for approximately 10 minutes, performing callisthenics, and finishing with a gross motor activity such as a light jog or swim. This is the reverse of the warm-up. However, it is not as intense and need not go for the same period of time. To be effective, the cool-down must emphasise stretching, but need not contain an extensive range of activities specifically related to the game skills.
Sports policy and the sports environment

Responsibilities of the club, school and sports administrator

Clubs, schools and sports administrators play a valuable role in ensuring that athletes enjoy what they do and are able to compete in secure environments. To achieve these goals, officials must ensure that:

- players are able to compete in a safe environment
- competitions are organised that will challenge players and provide opportunities for reward, enjoyment, energy outlet and socialisation
- competitions are adequately supervised, refereed by competent officials and organised with player safety and well-being in mind
- parents and supporters are appreciative, encouraging, understanding and do not exert pressure beyond what is reasonable and acceptable
- the highest standards of sporting behaviour are endorsed and sanctioned.

Rules of sports and activities

The rules of a sport assist the flow of play and protect participants from injury. Rules are enforced on the field by the referee or umpire and promote safety within the game. Injury has the potential to cause temporary and even permanent disability, so rule infringements must be dealt with. In collision sports, such as rugby league and rugby union, there is considerable potential for injury. This potential is significantly increased in the execution of common but illegal movements, such as the head-high tackle. As a result, both codes have well-defined rules stating what constitutes dangerous activity and a range of penalties to punish the offence.

Similar situations exist in other sports and activities. Marathon runners are obliged to consume fluid during their event to prevent heatstroke. Hockey goalkeepers must wear protective gear before being allowed to take the field of play. Softball catchers must wear face masks when they are in the catcher’s position behind the batter. There are many other examples of rules that have been established to protect players from injury.
It is essential that athlete safety is of the highest priority. Apart from the personal distress to the individual, many clubs have invested a lot of money in their players and do not wish to see them sidelined due to injury that could have been avoided. In rugby league, for example, it is not uncommon for the National Rugby League Judiciary to take legal action against players who cause injury to other players through violence or disregard for the rules.

**Modified rules for children**

Major modifications have been made to junior sport at most levels to accommodate the specific needs of children. Examples of changes include:

- lowering the backboard and ring in basketball and the ring in netball to enhance the chance of successful shooting
- using T-ball stands in softball to make contact with the ball easier
- modifying equipment and distances in Little Athletics to promote success
- simplifying the rules in most sport, so children require only a basic understanding to participate
- awarding trophies and certificates for achievements other than winning — for example, participation and effort.

Changes such as these are essential to encourage children to take part and continue in the activity. Children should not be seen as little adults, capable of using adult equipment on courts and fields marked for adults. Children, because of their stature and limited capabilities, have very specific needs in terms of equipment size, court dimensions, rules and playing environment. When this is suited to their needs, it adds to their potential to learn skills. If children see themselves as failures in a particular activity, they will not continue. Both the rules and the environment need to promote enjoyment, involvement, continuity in the sport and safety.

**My experience with modified sports**

Discuss the extent to which your school and sports club (if applicable) modified equipment, grounds or facilities to cater for your needs when you were younger.

**Even competition**

Competitions that are even are desirable at all levels of junior sport. Consideration should be given to the size, age, gender, strength, psychological development and skill level of competitors. When competitions are even, skills are matched and interest is heightened. However, if competitions are uneven, non-competitive sides quickly lose interest. In junior sport, it is relatively straightforward to establish even competitions if winning is not the major goal and all players receive the same award at the end of the game. This promotes much more desirable behaviour, as players are able to match their skills against opponents of similar ability and enjoy competition for its own sake, not solely to win.

**Grounds and facilities**

Player safety is of paramount concern on all sporting occasions. It is the responsibility of the organising group to ensure that every effort has been made to match facilities to safety expectations. *Safety Guidelines for Children in Sport and Recreation*, by Sports Medicine Australia, recommends that an appropriate club or association official follow these guidelines when preparing for play:
• Ensure the playing surface is in reasonable condition, without holes, exposed sprinkler heads or hard patches.
• Clear away all rubbish, especially broken glass, stones and lids from bottles and cans.
• Check that corner posts and other field posts cannot injure players on contact (these should be made of cardboard or similar material).
• Ensure permanent fixtures such as goal posts are padded.
• Ensure perimeter fences are well back from the playing area.
• Ensure spectators, unnecessary equipment and vehicles are kept well back from the sidelines.
• Ensure lighting is adequate if playing at night.
• Ensure adequate matting where necessary — for example, in gymnastics.

**Protective equipment**

Protective equipment is essential for players in most team sports. Ground surrounds and equipment must also be safe.

**Apparel and protective guards**

Many sports make provision for the use of protective equipment. All protective equipment must:
• adequately protect the wearer and other players
• allow freedom of movement
• allow air flow as required
• be comfortable.

Examples of protective equipment commonly used in games include:
• mouthguards, which are used in sports such as basketball and football
• helmets, such as those used in cricket and cycling
• face masks, such as those used in baseball and softball
• padding (shin, shoulder, chest, thigh) as used in cricket, football and hockey
• wetsuits for surfing
• sunglasses, such as those commonly used in cricket and golf
• hats to protect the face, ears and neck from potentially damaging ultraviolet rays
• gloves for hand protection in cricket and softball.

Good quality equipment is important for athlete safety. Equipment that costs more usually has been rigorously tested. The higher the risk of injury from impact in a sport or activity, the more important the need for equipment that is safe and reliable. In cricket, for example, where the ball can be bowled at considerable speed, the helmet is designed to protect the batsman from injury by a high-rising ball (see figure 13.27). The design of the helmet is crucial to the safety of the batsman. A gap that is too big and allows entry of the ball between the mask and metal grid, or a mask frame that breaks or bends on impact would leave the player at considerable risk (see figure 13.28). In sports and activities where the danger is highest and the risk of injury from equipment failure potentially serious, it is essential to use equipment that is rigid, supportive and reliable.
Footwear is both supportive and protective. Inappropriate footwear can lead to blisters, calluses and even structural deformities. Sports shoes are, and should be, unique to each individual sport. This is because different sports place different stresses on the foot. Football entails a lot of sidestepping on a grass surface, so there is a need for support (in the form of sprigs) to assist changes of direction. Basketball places different demands on footwear, requiring shoes that can grip a polished floor while the player performs agility skills and provide cushioned support when the player lands after a rebound.

The most popular sports shoe is that used for cross-training (a general purpose training shoe; see figure 13.29). Comfort will be enhanced and injury is most likely to be prevented if the shoe:

- is comfortable but not too tight
- is firm when socks are worn, but does not cramp the toes
- is flexible where the toes bend
- has a high heel to support the Achilles tendon
- has a midsole that is soft but sturdy and is capable of absorbing impact
- has a supportive heel counter that is firmly attached to the sole
- has built-in support for the arch of the foot
- has a quality, non-slip sole.

**Figure 13.29:** The quality sports shoe has many features that promote safety and ensure comfort.

**Safe court and field design**

The design of fields, courts and general playing facilities must contribute to player safety. For example, if goals are in or close to the field of play, they must be padded. Players who go beyond the field of play through movements such as tackles must have enough room to be able to stop safely. Sponsor signs, timing devices, false start equipment and lane markers should not interfere with player movements on or off the field.

**Safe playing equipment**

Equipment must be checked each time before being used. According to *Safety Guidelines for Children in Sport and Recreation*, all equipment must be:
School safety

Independently, conduct a review of your school’s sporting competitions and facilities. Suggest areas, including procedures, equipment and facilities, that need to improve. Discuss your findings with the class and draft recommendations for improvement. Investigate reasons why some individuals choose not to wear available protective equipment.

Thermoregulation

Thermoregulation is the maintenance of core body temperature. Control of the body’s temperature regulation mechanisms is part of the thermoregulatory system.

To maintain its core temperature, the body has many mechanisms that generate heat or dispose of it to the environment. The continuous process of gaining and losing heat contributes to the effective functioning of the heat balance mechanism, decreasing the likelihood of hyperthermia or hypothermia in hot or cold conditions.

Temperature regulation

Heat is gained through metabolism and physical exercise. It is lost through convection, conduction, radiation and evaporation. Body temperature is controlled by the hypothalamus in the brain. The hypothalamus reacts to changes in atmospheric temperature by triggering devices, such as the sweat mechanism, which cools the body. Adequate levels of body fluid are crucial to proper functioning of this mechanism. (See chapter 9, page 240, for more details regarding how the thermoregulatory system functions.)

Environmental conditions

Some environmental conditions, such as excessively high or low temperatures, humidity, wind and cold water, place the athlete at risk. In some cases, this will happen quickly. A knowledge of strategies that can be used in these situations will promote safety.

Temperature and humidity

Sports and performance injuries caused by thermoregulatory imbalance include heat exhaustion and heatstroke. These are serious conditions that are the result of dehydration, which develops when body fluid is lost at a greater rate than it is replaced. The prime cause of dehydration during physical activity is sweating. The body can lose two to three litres of fluid per hour through evaporation in hot conditions. Thirst is not a good indicator of dehydration, as a significant amount of fluid has been lost by the time mouth dryness is felt. Measuring weight and learning to monitor fluid loss accordingly in hot conditions is a more effective way of controlling dehydration. A decrease of one kilogram in body weight following exercise equates to approximately one
litre of lost fluid. The risk of heat injury is highest in conditions of high temperature (more than 30 degrees Celsius) and high humidity (more than 90 per cent). To prevent dehydration and hyperthermia, use the range of strategies outlined in chapter 9 on page 245 (hydration and heat disorder prevention).

Special precautions need to be taken with children as they are quite susceptible to heat illness. Children must be educated regarding the importance of fluid in the diet and its role in body functioning and temperature control. They should acquire the habit of keeping a water bottle with them and drinking water during play and training. The importance of wearing caps and hats for protection from the sun must be explained to children. These items are essential, not only in the prevention of skin damage, but also to prevent heat illness, which can be caused by exposure to direct sunlight for even short periods of time.

Figure 13.31 provides a guideline on the type and quantity of fluid necessary to prevent the onset of dehydration. The information is particularly important for athletes working in hot, humid conditions and for young children.

**Figure 13.30:** Athletes must replace body fluids to prevent dehydration.

<table>
<thead>
<tr>
<th>Event type</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>One hour or more of continuous exercise in normal conditions</td>
<td></td>
</tr>
</tbody>
</table>

**Before competition**
- At least 500 mL, 30 minutes prior to competition

**During competition**
- Drink 200 mL every 15 minutes, do not wait for thirst to develop
- Drink more in hot conditions
- Replace 80 per cent of fluid loss while still continuing to exercise

**What to drink**
- Water, if exercise lasts less than one hour
- Diluted carbohydrate/electrolyte drink, if exercise lasts longer than one hour
- No higher than 8 per cent carbohydrate solution
- Non-carbonated
- Cold fluid, as this empties from stomach faster
- No alcohol
- Fluid that tastes good to encourage drinking

**Following competition**
- Use water, then carbohydrate drinks
- Replenish fluid regularly until:
  - body weight returns to normal
  - urine is clear
- Replace 80 per cent of fluid loss while still continuing to exercise

**Figure 13.31:** Suggested fluid intake before and during competition

**Cold and wind**
Activities such as skiing, surfing, endurance running, cycling and scuba diving may occur in cold conditions. These are conditions that cause loss of body heat to the extent that the ability to maintain heat balance is jeopardised. Internal body temperature decreases in excess of one degree Celsius result in the activation of heat conservation mechanisms — shivering and peripheral vasoconstriction. Shivering will increase heat production, while peripheral vasoconstriction will decrease blood flow to the skin, slowing heat loss.
Athletes exercising in the cold should be aware of how much clothing is appropriate for the activity. Athletes should not overdress when exercising in cold conditions because excess clothing stimulates sweating. The moisture quickly evaporates, taking heat with it, causing the body to rapidly cool and chill. In cold environments, athletes with higher amounts of subcutaneous fat will have more protection and thereby lose heat more slowly. Children are more susceptible to heat loss than adults.

Wind is also a factor to be considered in heat loss. The combined effect of convection (air movement around the body) and conduction (transfer of heat to objects such as clothing) contribute to wind chill. This burning sensation on the skin can be further accentuated by increased cloud and humidity. Light clothing that covers most surface areas during running and cycling, wetsuits for surfing and full-body ski suits with face goggles are examples of attire used to prevent wind chill.

**Cold water**
In water where the temperature is higher than 32 degrees Celsius, core body temperature can usually be maintained if the individual is active. However, in cold water, the body quickly loses the ability to conserve heat, resulting in hypothermia. The heat loss process in cold water is more rapid than when surrounded by air. The combined effect of radiation and convection reduces body temperature four times faster in liquid than in air at the same temperature. For example, in water where the temperature is 15 degrees Celsius, the internal temperature of a body would reduce by approximately two degrees per hour. This sudden decline would quickly cause hypothermia.

Subcutaneous fat assists in heat conservation. Increased levels of subcutaneous fat are desirable for marathon swimmers. Swimming requires the use of large muscle groups and contributes to heat production. However, if the body is required to produce heat for long periods of time it becomes fatigued, causing muscles to become weaker and less capable of heat production.

**Inquiry**

1. Investigate how the four pathways for losing body heat control body temperature during exercise in:
   - high temperatures
   - cold, windy conditions
   - cold water.
2. Access the website for this book and click on the Preventing Heat Illness in Sport weblink for this chapter (see ‘Weblinks’, pages x–xi). Read the information and answer the following questions.
   (a) What is WBGT and what does it measure?
   (b) What factors impair the body’s ability to dissipate heat during high intensity sport?
   (c) Summarise in note form the four strategies for reducing the risk of heat illness for children in sport.

**Taping and bandaging**
Taping and bandaging are important safety measures. When used as preventative strapping or for injury rehabilitation, they increase the safety and wellbeing of the athlete.
Preventative taping

Taping refers to the application of adhesive or non-adhesive strapping or bandages to a joint area to protect, support or strengthen the joint during movement. Sports that require agility, speed, power and strength can place considerable stress on joints. Examples of such sports are basketball, football, soccer and netball. These sports demand explosive movements and frequent changes of direction, so the joints periodically sustain high levels of stress. Under these circumstances there is considerable potential for injury. Taping in these situations is a preventative or prophylactic measure. The general principles of taping are summarised in figure 13.32.

### Taping principles

- Use non-elastic tape for support. Elastic tape is used mainly for compression bandages.
- Ensure that the joint is placed in a position where it can be stabilised.
- Always begin with anchors.
- To ensure evenness of tension, pull the tape off the roll, then apply.
- Overlap each application by half to two-thirds to ensure strength.
- Maintain even pressure and reapply if circulation is cut.
- Avoid creasing the tape.
- Avoid continuous taping; that is, tear and restart after applying each strip (except when closing down).
- With the exception of eversion (rolling out) sprains, always tape in the direction that will tighten the structures at risk. For example, if the injury is on the lateral side of the ankle, the tape should pull from the lateral side upwards towards the medial side.
- Completely cover skin around the area with tape.
- Always finish with locks.
- Remove tape using blunt nose scissors to avoid risk of injury from incision.

### Figure 13.32: Principles of taping

The following method is prophylactic because it aims at preventing an injury. In this example, taping is used to prevent an inversion sprain, which is the most common form of ankle injury. In this injury, the ankle rolls laterally (to the side), causing a strain to the ligaments surrounding the lateral aspect (away from the body’s midline) of the ankle. Taping allows plantar and dorsi flexion (up and down movements), yet restricts inversion (rolling in) and eversion (rolling out) of the foot.

- **Positioning:** stabilise the ankle on a bench or table and shave the area to be taped. Set the ankle in a dorsi flexed position; that is, with the Achilles tendon fully stretched. Slightly evert the foot (roll it outwards) and adjust your height so that you are not bending excessively as you tape.
- **Anchors:** attach the first anchor 15 centimetres above the ankle joint. This should begin at the front of the foot and run obliquely around the lower leg, without creases, and overlap the beginning of the tape. Attach the second anchor below the first, overlapping by half.
- **Stirrups:** each stirrup begins with attachment to the anchor on the medial side (inside) of the leg. It is then taken over the back half of the ankle bone, under the arch of the foot and is joined to the anchor on the lateral side (outside) of the leg. Two stirrups are required. Each should overlap the previous stirrup by half to two-thirds.
- **Extra anchors:** apply two anchor strips to secure the stirrups.
• **Figure sixes**: begin by attaching the tape to the anchor on the inside of the leg and pull it down to the lower foot. Continue applying tape under the sole of the foot and then upwards and across the top of the foot. It will join the original tape, forming a figure six. Apply two or three figure sixes.

• **Heel locks**: begin on the inside of the heel. Apply tape across the top of the foot and underneath the heel. Continue coming up the medial side of the foot and extend around behind the heel, across the lateral ankle bone and the top of the foot. The tape finishes on the medial side of the foot attached to where it began. Apply a second heel lock in the same manner.

• **Close down**: beginning on the lateral side of the leg and on the lower side of the anchors, wind the tape around the leg, overlapping by one-third each time. Upon reaching the ankle, continue spiralling, but in a figure eight pattern which goes under the foot and around the ankle. Proper closing down ensures that all skin is covered and that the tape underneath is securely attached.

**Taping**

Working in pairs, practise taping an injured ankle using the technique illustrated in figure 13.33 and described in the text.

**Learning to tape a specific injury**

Choose another type of joint injury other than the ankle, such as a wrist, thumb, elbow or knee injury. Research how to effectively tape this injury. Describe the process and use illustrations to help. Share your findings with the class.

**Taping for isolation of injury**

Taping is often required after an injury has been sustained and may be necessary during the rehabilitation process. For example, an ankle injury may be healed, but requires testing in training. In cases such as this, support should be provided while the injured area becomes accustomed to the demands of full activity. Taping may also be required so that the athlete can participate in body conditioning exercises to maintain fitness as much as possible during recuperation.

**Bandaging for immediate treatment of injury**

Immediately an injury is sustained, some bandaging is essential. Using the RICER regime means that compression bandages will be applied to restrict bleeding into the injured area; however, other bandaging may also be helpful. The type of bandaging necessary will vary according to the location and type of injury sustained. However, bandaging at this point serves to limit the motion of the body part, usually by securing it to another body part. For example, a sprained thumb may need to be strapped and supported by the wrist, as illustrated in figure 13.34.

**Actions to prevent injury**

Draw a mind map (similar to the example on page 33) to summarise preventive actions that can be taken to avoid injuries during sport and exercise.
Injury management procedures

Rehabilitation is the process of restoring the athlete to the pre-injury level of physical fitness. It involves mobilisation, stretching, conditioning, taping, training and testing as part of the assessment process. It is important that a proper rehabilitation plan is followed through the various stages and that the injury is completely healed before recommencing competition. The time taken for complete recovery varies. However, where immobilisation was necessary or a previous injury has recurred, it is absolutely essential that the full recuperation takes place before recommencing competitive sport.

Progressive mobilisation

Following use of the RICER method (see page 386), it is important that movement be restored to the injury as soon as possible. This is referred to as progressive mobilisation and involves gradually extending the range of movement through which the injured part can be manipulated. This continues until the part is fully functional.

Stretching

Stretching the injured area is important to ensure that it heals without scarring. Scarring will shorten the muscle and make it prone to further injury. The most appropriate form of stretching is proprioceptive neuromuscular facilitation (PNF) stretching, where the muscle is stretched and strengthened during safe movements.

Conditioning

Conditioning involves adapting the body to a range of agility, strength and power skills, such as running, hitting and kicking to ensure the injured area functions fully. The experience must be pain free. This is followed by exposure to game skills in non-competitive situations where a full range of movement is required.

Total body fitness

Total body fitness is regaining the level of mental and physical fitness reached by the athlete before the injury occurred. The training program must progressively and gradually overload the muscle groups and energy systems so that the required adaptations are regained before competition is recommenced. In relation to rehabilitation these adaptations will include:

- hypertrophy (increased size) of the muscles
- strengthening of tendons and ligaments
- increased capillarisation and subsequent blood flow to the injured area
- increased elasticity of fibres
- increased joint mobility
- absence of all pain
- full confidence in knowing that the injured area can handle match stress
- fully restored balance and coordination.

Training

With total body fitness achieved, full training can resume. Here the athlete will be expected to participate in the full training program in a pain-free environment. This involves participating in warm-up, conditioning, drills, skills development exercises, tactics and cool-down.
Taping
During rehabilitation, taping may be used to support the injured area and protect it from the possibility of further injury. This is particularly important with knee and ankle injuries, where a demand for a quick change of direction or running on uneven surfaces may be sufficient to pressure the injury and cause damage. Prophylactic taping further develops confidence and provides physical support by restricting the degree of movement to an amount short of where harm will be caused.

Use of heat and cold
When to use heat and/or cold on injuries has always been controversial. Generally, cold can be applied for anything up to four days following injury and may be required at times following that to reduce inflammation. Heat is not generally used for two or three days after injury, depending on the injury type and extent of damage.

Cold applications
Commonly used cold applications include:

- *ice massage*, where ice is rubbed gently over the injury for up to 15 minutes at a time
- *ice water immersion*, where the injured area is placed in a container of iced water for short periods of time
- *vapocoolant sprays*, which cool affected areas quickly and help prevent muscle spasms.

Heat applications
Thermotherapy is the application of heat in various forms to the injury. When internal bleeding has stopped (about 48 hours after the injury), heat may be used to:

- increase elasticity to the new fibres during the stretching process
- reduce pain
- reduce stiffness
- increase blood flow
- reduce inflammation.

Heat energy is transmitted through radiation, convection and conduction. It may be applied using superficial techniques such as heat packs, or penetrating therapies such as ultrasound. Commonly used methods for heat application include:

- *moist heat packs* containing silicate gel. These are applied to the injury, with towels used as insulators between the packs and the injury
- *whirlpool baths*, where the injury is immersed in a small spa bath containing water at the desired temperature (may be hot or cold) and the injury massaged by the movement of the fluid
- *contrast baths*, where the water temperature is alternated after five minutes or so between hot and cold. This increases local circulation by causing vasodilation (from hot water) and vasoconstriction (from cold water) of the capillaries in the injured area.
- *microwave diathermy*, which is used to heat deeper tissue, particularly tissue with a higher water content such as muscle and blood. With a towel placed over the skin, the tissue surrounding the injury is heated to approximately 42 degrees Celsius and this temperature maintained for a period not exceeding 30 minutes.
• **ultrasound therapy**, which uses high frequency sound waves to produce heat energy. This is more effective in denser tissue, such as bone and ligament.

Joint movement and stretching can also be increased by using techniques such as:
• **electrotherapy**, where a low-voltage electric current passes through the tissues, stimulating circulation and contraction of the fibres
• **massage**, where light or deep stroking is used, depending on the severity of the injury and the stage of rehabilitation
• **manipulative therapy**, where the joint is carefully manipulated to restore articular movements.

**Specific programs**
Depending on the nature of the injury, some athletes may require specialised programs in addition to general programs. These might require such activities as resistance training focusing on strength and endurance, aerobic work, or plyometrics to increase power. Specific programs are developed by the coach or trainer in collaboration with the injured athlete to stretch, strengthen and mobilise the injured area in readiness for competitive sport.

**Use of heat and cold**
Imagine a player has received a sprained ankle in a soccer game. Suggest how heat and cold applications could be used in rehabilitation. Investigate current theories on when these techniques should be used with this type of injury.

**Return to competitive sport**
Injured athletes should not return to play until the injury has completely healed. Even then, specific procedures need to be followed and precautions taken to ensure the injury does not recur. In the case of head injuries such as concussion, a medical clearance is essential.

**Indicators of readiness to return to play**
Effective treatment and rehabilitation ensure that the healing process has resulted in measurable improvements to the injured area. These include:
• **elasticity.** The new tissue has been stretched, promoting lengthways elasticity and resultant flexibility.
• **strength.** The new tissue is strong and able to support the body in stressful movements.
• **mobility.** The athlete has gained full movement, particularly in terms of agility.
• **pain free.** The injury is pain-free during both light exercise and strenuous work.
• **balance.** The injured person is able to balance his or her body on the injured limb. Until this function is achieved, the rehabilitation process is not complete.

**Monitoring progress**
To monitor progress, results from a pre-test taken before the injury occurred could be compared to those of a post-test taken after the injury was sustained. This will establish if the athlete has lost fitness components such as speed and agility. The tests need to be specific to the injury. For example, if knee ligaments...
were damaged, an agility test such as the Illinois test (see Outcomes I) would be appropriate, while a grip strength or power test would be inappropriate.

Taping

It might be necessary to tape the injury for a period of time, depending on the extent of damage. Taping at this stage is preventative and also provides psychological support by increasing the confidence of the athlete. The technique used is the same as that outlined earlier.

Specific warm-up procedures

Athletes returning from injury must ensure they are fully warmed up and muscle groups have been properly stretched before training or a game. When returning from injury, the warm-up may need to be more specific to the injured area. For example, if a sprinter incurred a hamstring injury, additional stretching exercises to both quadriceps and hamstrings are recommended to ensure that muscle groups have been extended in a safe environment beyond what will be demanded of them in competition.

Progressive involvement

Return to play needs to be gradual to ensure that undue burden and fatigue is not placed on the injured area. It is important that the injury is gradually exposed to stress; for example, by recommencing play in lower grades, or by using frequent substitutions and interchanges. Excessive exercise in a short period of time may cause damage or fatigue, or weaken the area and make it susceptible to further injury. The complete recovery process is outlined in figure 13.35.

---

**Figure 13.35:** The muscle rehabilitation plan (Source: Sports Injury Prevention Plan, SIPP Sport Science and Research Centre of the Cumberland College of Health Sciences, BDF Australia, Lidcombe, © 1986, p. 18. Reproduced by permission of Beiersdorf Australia.)
Designing a skills test
Choose any sport. Design a skills test to test whether previously injured athletes are ready to return to competitive sport. Share your information with the class. Then select one of the tests and have each class member perform it. Evaluate the test and discuss your findings.

ETHICAL QUESTIONS FOR SPORTS MEDICINE

Playing with injury
Players frequently resume competitive sport while still injured, despite knowing the risks involved. Reasons for an early return are complex and are often inspired by financial and contractual arrangements, social rewards, internal motivation and possible feelings of indispensability. However, the risks are real and could impact detrimentally on the player’s health in the long term, leading to such conditions as arthritis and early retirement from the game.

Pressure to participate
Often, and particularly in elite sports, the services of talented players are required before injuries have fully healed. Some players may have injuries heavily strapped, while others are given injections to prevent pain from pressure or impact on the injured area. Many coaches see players as commodities, the products of lucrative contracts, who need to be on the field of play to gain value for cost. Irrespective of financial binds, it is unwise and dangerous to insist on or pressure players to resume competitive sport before injuries have fully healed. Pain in an injury indicates tissue damage and is a warning that rehabilitation is necessary for further healing. Painkilling injections desensitise injured tissue and set an environment for further damage without the athlete being aware of what is happening. This prolongs the healing process. If further rupturing occurs, permanent mutilation of fibres will occur.

Playing through the pain barrier
Read the snapshot ‘Playing through the pain barrier’ and debate the issue of allowing injured players who require painkillers to resume competitive sport.

SNAPSHOT

Playing through the pain barrier
By Roy Masters
Football’s darkest secret is the number of players taking the field each week with injuries that would immobilise most of the people watching in the stands.

A coach’s claim that he won’t choose a player ‘unless he’s a 100 per cent fit’ is football’s biggest lie. If this were true, why is it that grand-final teams are almost always at full strength?

No-one, not even coaches and doctors, can quantify each week the number of unfit players locked in an awful struggle of self-interrogation, confronting that uneasy equation: pain and play.
‘Playing hurt compared to playing injured is one of sport’s big questions,’ says reigning NRL premiership coach Tim Sheens, who concedes some players are only 50 per cent fit.

‘The public has no idea. Most of the players in this weekend’s grand-final qualifiers would be, at best, 90 per cent fit, especially after a long season where many of them have played representative footy as well.’

Swans doctor Nathan Gibbs, a former first-grade rugby league player, says: ‘You can’t tell from any medical I’ve done whether a player is injured, or just experiencing some pain. We look at physical signs, past injuries and psychological profiles but none of that is good at telling who can play injured.’

The Storms’ opponents tonight at Telstra Stadium, St George Illawarra, have a reputation as a club where a large number of players refuse to play hurt.

This may be unkind because it takes time for young players to learn to adapt to bumps and bruises. Mark Gasnier, the Dragons’ brilliant centre, who is in doubt for tonight’s match with a torn abdominal muscle and a bruised left hip, agrees. ‘You learn to play with pain as you get older,’ he says. ‘You know your body a lot better. Plus, you earn more the right to miss training in order to get yourself right. When you’re young, you don’t want any leniency. You don’t want to miss training and be seen to be a sook.’

He insists he will take needles tonight if necessary, saying: ‘You have to do whatever it takes to get out there.’

Gasnier’s centre partner, Matt Cooper, has a reputation for enduring. ‘The more games you play, the more injuries you get, but the more experience you acquire means the more you’ll put up with,’ Cooper says. ‘As you get older, you do more rehabilitation because you know your restrictions. When you’re young, you’re not aware that today’s physios come up with rehab stuff that gets you through a game.’

Dragons second-rower Matt Bickerstaff, 30, made his debut with the now extinct South Queensland Crushers.

‘I played a whole game with a broken left thumb and didn’t even have it strapped,’ he says of an 80-minute hell which would usually require hands forged of steel.

‘But I’ve also had a cork in my right quadriceps with quite severe calcifying. I had to have blood taken out, and I missed eight weeks because I couldn’t run on it. I’ve learned to push through injuries but some you can play with and some you can’t.’

Although the Swans hold the AFL record for fewest players used in a season, statistics provided by Gibbs reflect a club where pain is equivalent to cow manure — spend five minutes in the cowyard and you don’t notice it.

‘We would give 75 painkilling injections in competition games per year,’ he says. ‘On any given weekend, we would have five players having fitness checks at the last training session, with most of those taking injuries into the game.

‘Five players per week would go into a game without painkillers and three per week would use them. This year, in a club of 40 players, 15 will have surgery during the season, or after it.’

The sacrifices players make to take the field is etched in the memory of Sheens, a witness to needles making their stinging passage.

He cites Ricky Stuart, current Australian coach, and Royce Simmons, now Sheens’ assistant at Wests Tigers. ‘They each had two- to three-inch needles injected into torn cartilage high in the groin, behind the testicles,’ Sheens said. ‘In the ‘91 finals series, Ricky started having them before games but by grand final week, he was having painkillers before training sessions and at half-time in the grand final.

‘In retrospect, I shouldn’t have let him play. But how do you stop a bloke like him playing in a grand final? Royce was having cortisone needles to the same pubic area, and they were just as painful.’

In the past, the coach and player made the decision to play; now it is doctor and player.

Gibbs says: ‘I have to take the player’s word at face value. I can’t tell him he isn’t sore. As a doctor, it’s hard to force players to play. Some will. Some won’t.’

‘Sometimes, when you see a player released by another club, and he appears athletic and skilful, you wonder why he is going. Later you learn he can’t play injured.’

Sheens says: ‘There’s a fine line between playing hurt and injured, and only the player can recognise it. Some players have a higher tolerance than others.’

Sheens’ final comment will endear him to the 50 per cent of the population who can’t be expected to understand the pain men endure to play. ‘We don’t appreciate the pain women experience,’ he said. ‘There wouldn’t be many babies if men had babies.’

The roles of the sports medicine practitioner and coach

In many cases, and particularly in junior sport, the coach is also the sports medicine administrator. It would be desirable if all coaches were certified in their coaching role, as well as in first aid. However, this is not always the case, although the trend to become accredited is steadily increasing. In an ideal situation, the role of coach and sports medicine practitioner are separate.

The role of the sports medicine practitioner is to:

• prepare — have a full knowledge of injuries that might occur and recommended treatments.
• be equipped — carry sufficient tape, bandaging, ice packs, water and so forth to handle situations as they arise. A mobile phone is also useful.
• educate — take the opportunity to talk to players about measures they can take to prevent injury
• advise — inform the coach of the return and suggested degree of involvement of injured players.

The role of the coach is to:

• teach — pass on information and ideas on all aspects of the game or activity
• demonstrate — model what is expected by using the correct skill techniques
• train — apply knowledge and drills to improve the fitness levels of the players
• motivate — reinforce desirable and productive behaviours
• organise — coordinate practice sessions, players, parents and officials
• discipline — maintain a firm, fair and consistent approach
• plan — prepare and arrange training sessions, games and competition performances
• advise — counsel athletes when required.

Sports Medicine Australia guidelines for coaches are shown in figure 13.36.

Coaches help educate children in the fundamentals and various techniques of a sport. Appropriately trained and accredited coaches are vital to safe participation in junior sport.

Coaches should:

• remember that irrespective of the level of involvement, children play for fun and enjoyment. Winning is only part of their motivation
• have at least a National Coaching Accreditation Scheme (NCAS) level 1 accreditation
• complete a minimum of a sports medicine awareness course from Sports Medicine Australia’s Safer Sport Program. If responsible for immediate injury management, they should have a minimum of a sports first aid certificate
• be aware of the principles of children’s growth and development, as it should lead to more appropriate decision making

• encourage the development of basic skills
• avoid overplaying the talented player
• promote a realisation of the benefits of fitness and an active lifestyle
• be reasonable in the demands on young athletes’ time, energy and enthusiasm
• be aware of potential safety hazards in the sport
• show concern and caution towards sick and injured players, including modifying the session, seeking medical advice when necessary and maintaining the same interest and support as given to uninjured players
• not allow injured players to compete or train without medical clearance
• keep up to date, particularly in view of the speed with which science, information and technology changes
• err on the side of caution when changing or increasing training loads or demands.

Figure 13.36: Guidelines for coaches (Source: Safety Guidelines For Children in Sport and Recreation, Sports Medicine Australia, 1997, p. 3.)
**Resumption with injury**

A coach wants a player to compete in an Olympic selection trial because this is the only way of gaining a place on the team. If the player misses the selection he or she will have to wait four years for the same opportunity. However, the sports first aider says it is too early because the player was not able to complete the skill test. Debate the issues at stake.

**Use of drugs**

Athletes use many different methods to gain a competitive advantage, most of which are safe and in the spirit of ‘fair play’. One dangerous method is the use of ergogenic (performance-enhancing) drugs, including human growth hormone, anabolic steroids and erythropoietin (EPO). Some athletes also use drugs to circumvent drug testing and prevent detection in urine. The use of ergogenic drugs carries serious risks.

**Using drugs for strength**

**Human growth hormone**

Human growth hormone (HGH) or somatotropin is a hormone produced naturally by the body that is responsible for growth. It exists in every cell in the body that contains growth hormone receptors. Artificial forms of the hormone are taken by some athletes to increase muscle size and strength. It also acts in the mobilisation of fat and making it available as a source of energy. This allows glycogen to be held in storage for the later phase of endurance events, where a sprint finish may be required.

The long-term effects of using artificial growth hormone include:

- overgrowth of face, hands and feet (acromegaly)
- gigantism
- muscle weakness
- diabetes
- heart disease
- disfigurement from bony overgrowth
- osteoporosis and arthritis.

**Anabolic steroids**

Steroids can be anabolic (tissue building) or androgenic (producing masculine characteristics such as strength, power, speed and aggressiveness). It is impossible to produce a steroid that is completely anabolic or completely androgenic. This is particularly significant to female athletes who take anabolic steroids to increase strength, but who gain unwanted male features such as facial and body hair in the process.

Steroids were widely used over past decades to increase weight, strength and power and reduce the recovery time between workouts. They stimulate protein synthesis in muscle cells, while simultaneously arresting its breakdown. This increases the body’s ability to utilise protein and prevent its degeneration. Steroid use has been an issue in sports such as weight-lifting, body building, track and field (particularly throwing events) and some team sports where bulk and aggression is an advantage. Some athletes imbibe large quantities of steroids, sometimes up to 100 times the normal dose.

Steroids are usually taken orally or injected in a process referred to as ‘stacking’. They are generally taken over a six- to 12-week period followed...
by a period of months when they are not taken. This process is known as 'cycling'. During the stacking period, the amount of steroids taken is gradually increased. This is referred to as 'pyramiding'. The process of stacking, cycling and pyramiding increases the effectiveness of the steroid. However, the real effect of steroids is difficult to assess because:

- their use is illegal
- it is difficult to conduct studies because of ethical concerns in administering large doses to humans in chemical trials.

It is known that:

- steroids work best when incorporated with a heavy resistance training program
- the aggressiveness created by the drug is important to performance
- some weight and strength gains do occur
- there is no improvement in oxygen uptake or endurance capacity.

The effects of steroids depend on the dosage, regularity and time period of use. They can include:

- testicular atrophy and a decreased level of reproductive hormone
- increased or decreased libido (sex drive)
- liver damage
- higher blood pressure as well as decreased HDL (high density lipoprotein) and increased LDL (low density lipoprotein), leading to increased chance of heart disease and high susceptibility to blood clotting
- increased nervous tension and possible manic or depressive episodes
- increased masculinity and heightened risk of musculotendinous injury.

The effects on women include:

- infertility, clitoral hypertrophy and sore nipples
- increased sex drive
- masculine appearance, including deepening voice and facial hair
- increased aggressiveness.

Using drugs for aerobic performance

Erythropoietin

Erythropoietin (EPO) was originally developed for people with anaemia and kidney deficiencies to help them to manufacture extra red blood cells. Erythropoietin acts on bone marrow, stimulating red blood cell production. It is a form of ‘blood doping’, because the increased number of red blood cells allows athletes to absorb more oxygen and improve their stamina.

Athletes whose performance could benefit from EPO use are those who feature in endurance events where sustained effort is required, such as marathons, triathlons and distance cycling. However, athletes taking EPO are also more at risk in endurance events because they lose valuable fluid, causing changes to blood consistency. Erythropoietin increases blood viscosity, contributing to poor circulation, blood clots and even stroke. It also causes chest pain, headache, high blood pressure, joint pain, fatigue and shortness of breath after each dose. It has caused death in a number of cases. The drug has been popular because of its performance-enhancing properties and because, until recently, it was undetectable by testing procedures. However, tests are now available that detect EPO in both blood and urine.

Using drugs to mask other drugs

Some drugs, such as diuretics and alcohol, are used to mask other drugs, dilute urine or decrease excretion of the ergogenic drug.
Diuretics are drugs that increase the amount of fluid (water and urine) passing from the body.

**Diuretics**

Diuretics are used to treat health problems such as liver and kidney disease. They may be used by athletes involved in sports such as racing, boxing and weight-lifting, where weight reduction is often essential. They are also used to clear evidence of steroid use from the body. Apart from the interruptions to training caused by the need to urinate frequently, some detrimental effects of diuretics include:

- dehydration
- dizziness and possible fainting
- headache
- loss of coordination
- heart and kidney failure.

**Alcohol**

Alcohol is a depressant; that is, it slows down bodily functions. It is a powerful drug and toxic in large quantities. Alcohol is particularly dangerous when consumed with other drugs, such as sleeping pills. Alcohol is commonly found in cough mixture, so athletes may use cough mixture as a masking drug.

The effects of alcohol on the body are progressive and depend on the quantity consumed, the person’s size and tolerance level, and the length of time between drinks. The effects of alcohol include:

- dizziness and loss of coordination
- loss of inhibition
- slowed reactions and slurred speech
- blurred vision
- possible aggression
- vomiting
- unconsciousness or death if large amounts are taken.

**Drug testing**

Drug testing was first carried out at the Mexico Olympics in 1968. For many years, athletes who used performance-enhancing drugs were able to escape detection and subsequent disqualification. Concern about the ethical issues and dangers led to the establishment in 1999 of the World Anti-Doping Agency (WADA) which maintains a list of prohibited (banned) substances in professional sport.

Prior to the 2000 Olympic Games, only tests using urine samples were permitted by the International Olympic Committee. Urine tests were satisfactory for detecting steroids. However, it was suspected that many athletes had switched to EPO and growth hormone, which could not be detected in urine.

Developing a valid test for EPO and growth hormone was difficult because both substances occur naturally in the body. Tests for EPO had to focus on changes in blood markers, such as red blood cells. Prior to the 2000 Olympic Games, the International Olympic Committee approved the use of a blood test, developed in Australia, in combination with a urine test to detect EPO.

WADA’s global anti-doping code was introduced for the 2004 Olympic Games in Athens, where 3000 drug tests were carried out. Twenty-three athletes tested positive to banned substances, indicating that the use of performance-enhancing drugs was still widespread.

The process of drug testing is now well established for elite athletes and in Australia is carried out by the Australian Sport Anti-Doping Authority (ASADA).
Current drug testing procedures for urine samples involve:

- selection of an athlete, who is asked to complete a form listing the medications they have consumed over the past seven days
- collection of a urine sample under the supervision of a chaperone
- placement of the sample in two ‘envopaks’, both of which are identically numbered, but distinguished by the letters A and B
- sending both samples to the laboratory for analysis.

If the sample is positive the athlete is informed and action is taken by the sport’s governing body.

### Absolutely, positively, zero tolerance

1. Read the snapshot ‘Absolutely, positively, zero tolerance’.
   - (a) Which banned drugs are the main focus of anti-doping tests?
   - (b) What are the main reasons why elite athletes might risk taking performance-enhancing drugs, in spite of the dangers?
   - (c) What effects can performance-enhancing drugs have on an athlete’s health?

2. Learn more about the work of the World Anti-Doping Agency and the Australian Sports Anti-Doping Authority by going to the website for this book and clicking on the relevant weblinks for this chapter (see ‘Weblinks’, pages x–xi).

---

**SNAPSHOT**

### Absolutely, positively, zero tolerance

**By Kate Guest**

The history of drug use in sport is as long as that of sport itself. In ancient Greece, Olympians would ingest ground horse hooves, believing it gave an extra spring to their step. Today, for a small proportion of athletes, the hunger to win can be sated only by sophisticated performance-enhancing drugs designed by an illicit network of scientists — but with heavy costs, financially, professionally and physically.

A stringent anti-doping program is crucial to maintaining athletes’ health, ensuring a fair playing field and guaranteeing the credibility of major sporting events such as the Commonwealth Games. Dr Peter Harcourt, chief medical officer of Melbourne 2006, says the methods to be used at these games are at the forefront of anti-doping technology.

‘The technology that’s used in drug testing is developing all the time, and what we’ll be doing in Melbourne will be state-of-the-art for the time. So we will be doing some things which haven’t been done before,’ he says.

These will include testing procedures improved since the Athens Olympics for the detection of human growth hormone (HGH), which builds bone strength and muscle mass, and erythropoietin (EPO), a red blood cell-boosting hormone that increases endurance.

There will also be wider use of blood testing than at the Manchester Games. Blood testing targets substances that are particularly difficult to detect in urine tests, and when used in conjunction the two deliver a more sensitive and robust testing program.

The anti-doping program is expected to be administered by the Australian Sports Drug Agency (ASDA) [now the Australian Sports Anti-Doping Authority, ASADA, since 2006], with sample analysis conducted by the National Measurement Institute (NMI) in Sydney. The entire process — encompassing the list of prohibited substances, the testing procedure, accreditation of testing laboratories and therapeutic use exemptions — is regulated by the World Anti-Doping Authority (WADA) Code.

Harcourt estimates that about 25 per cent of athletes competing at the games will undergo a drug test at some stage.

ASDA is expected to send at least 50 drug control officers and between 200 and 300 chaperones to the Commonwealth Games. Athletes are chosen for testing via both random and targeted selection.
Targeted selection is aimed at high-risk sports, such as weight-lifting, as well as high place-getters and all world-record holders (a world record is not official until the athlete has passed a drug test).

Traditionally, low-risk sports receive less scrutiny, however, random selection means athletes cannot expect to avoid a test just because they compete in a low-risk sport.

For the first time at either an Olympic or Commonwealth Games, drug testing at Melbourne 2006 will be accompanied by a compulsory drug education campaign for all athletes. ‘There’s a huge amount of effort in Australia towards educating elite athletes. In a sense, what we want to try and do in Melbourne 2006 is extend that education to all athletes. Education is just as equal a part of our strategy as the testing; it’s not all just about drug tests,’ says Harcourt.

This two-pronged attack will leave athletes with no excuses for using prohibited substances, inadvertently or otherwise. And, by educating athletes about inadvertent drug use, organisers hope that the only athletes caught cheating will be those who have done so deliberately.

The drugs cheating athletes might take depend on their sport and the strengths and skills it requires. The most commonly used and tested-for prohibited substances include anabolic steroids, HGH, EPO, beta-blockers and diuretics.

Prohibited substances can be taken for a variety of uses, including building muscle mass, increasing endurance, steadying the heartbeat, losing weight or masking the use of other drugs. They also test for recreational drugs such as marijuana, ecstasy and cocaine.

Harcourt says the constant improvement in drug-detection science and education programs means deliberate cheats are ‘really rare’ these days, at least in Australia.

‘I rub shoulders with a lot of elite athletes and, really, flat out cheating — I’m not saying it doesn’t happen, but it’s so rare, certainly in Australia. I think there are some countries where it’s not rare, but their education and knowledge are not as substantial as Australia’s.’

It is virtually inevitable that drug-detection processes will always be one step behind cheating technology, but since the Sydney Olympic Games there have been vast advances made in research into the detection of substances such as EPO and HGH, as well as a major bust in San Francisco that uncovered a lot of drug-cheating technology . . .

The improvement in detection technology has forced some drug cheats to return to less sophisticated methods of avoidance, such as sample tampering and simply running away from the test, she says. ‘Because things like EPO are now detectable, people are going back to the old methodologies.’

Athletes found guilty of taking a prohibited substance fall into two categories: those who have done so deliberately and those who have done so inadvertently through their own mistake or that of a coach or doctor.

While drug issues operate on the principle of strict liability, the WADA code does make some allowances for these cases.

Given the wall of opposition they face, today’s deliberate drug cheats require plenty of cash, and a great deal of technological savvy — or at least access to people with the right knowledge, says Harcourt.

In addition to the risk they run to their career and reputation, most dangerous of all, he says, is the gamble they take with their health.

‘Just look at what’s happened overseas in East Germany, Russia and Eastern bloc countries, and more recently in cycling communities with the use of EPO,’ says Harcourt. ‘There’s been a very high incidence of quite nasty medical problems, death, and quite nasty psychiatric problems.’

So what motivates an athlete to take such risks and use a prohibited substance?

Jeff Bond, a sports psychologist and former head of the Sport Psychology Department at the Australian Institute of Sport, believes that when the contravention is deliberate there is really only one motivation — winning.

And he says athletes at the top of their game with the means to employ the right advisers may be arrogant enough to believe they can beat the testing.

‘They believe they’re smarter than everyone else and their profile is such that they will be able to get away with it. They think they can get away with anything, and they think all will be forgiven if they do get caught.’

Bond says the decision to take a prohibited substance is generally made in a state of desperation, whether to win, attract sponsors or overcome injury . . .

The struggle against doping in sport is an uphill and probably endless one, but nevertheless anti-doping organisations are making ground.

(continued)
I suspect the way sport is becoming more and more professional there will be always a way for athletes to find other ways of making a breakthrough. We haven’t seen the end of it all,’ says Bond.

At Melbourne 2006, at least, Harcourt says any athlete considering using drugs can expect to encounter a ‘no-nonsense, zero tolerance approach’.

Did you know?
Of more than 6500 tests conducted by the Australian Sports Drug Agency in 2003–04 just 0.36 per cent returned positive results.


Inquiry

Drug use and testing

Working in small groups, draw up a T chart. On one side list any reasons to support the use of performance-enhancing drugs by athletes and, on the other side, the reasons for opposing their use. Hold a class debate on the issue of drugs in sport and the value of drug-testing procedures.

SUMMARY

- Sports injuries can be classified as direct, indirect, overuse, soft tissue and hard tissue, depending on the way the injury was caused and the type of tissue damaged.
- The healing process of a soft tissue injury involves three phases — the inflammatory stage, repair and regenerative stage, and remodelling stage. The RICER method is the most appropriate way of managing the injury in the early stages.
- The two most common hard tissue injuries are fractures and displacement of teeth. These injuries require immobilisation and medical treatment.
- The TOTAPS (talk, observe, touch, active movement, passive movement, skills test) regime is recommended for assessing injury.
- Some children have special medical needs. Referees, coaches and supervisors should have knowledge of conditions such as asthma, diabetes, epilepsy, overuse injuries and heat stress conditions.
- It is important to structure children’s competitions so that they are matched as evenly as possible, particularly in terms of size.
- Children can benefit from some forms of weight training. However, strict supervision and adherence to guidelines such as focusing on high repetitions with low resistance must be applied to reduce the risk of injury.
- Adult and aged athletes may require sports medicine if an injury occurs during a performance. Aged athletes need to have medical clearances and be aware of their options and limitations, particularly those relating to heart conditions, joint mobility and fractures.
- Female athletes have special requirements. Sports medicine requires a knowledge of the effect of performance on eating disorders, iron deficiency, bone density, pregnancy and menstruation.
- Safety in sport is of paramount interest to sport practitioners. It concerns four areas — the physical preparation of the athlete, administration of competitions by organisers, protective equipment and general environmental concerns such as temperature. Most injuries are preventable if adequate knowledge is supported by sufficient time, preparation and planning.
Effective sports medicine requires that injuries are handled correctly by using the appropriate procedures. Taping may be required. It is important that injuries are managed correctly, rehabilitated and tested fully before the player returns to play.

Players should not return to play until their injury is fully healed, as further injury will make the healing process more difficult and protracted.

Some athletes use ergogenic aids to enhance performance. Most are illegal (for example, growth hormone, steroids, EPO) and have serious side effects. While national bodies are able to test for most banned drugs, some athletes escape detection.

**QUESTIONS**

**Revision**

1. Explain the difference between direct and indirect injuries. (H8)
2. Explain the difference between a sprain and a strain. (H8)
3. Describe how the inflammatory response would function in response to a contusion. (H8)
4. Complete the following chart summarising common forms of skin trauma. (H13)

<table>
<thead>
<tr>
<th>Skin trauma</th>
<th>Definition</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lacerations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blisters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calluses</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Outline the advantages of rest, ice, compression, elevation and referral in assisting recovery from soft tissue injury. (H8)
6. Explain the difference between soft tissue and hard tissue injuries. Using an example from both, discuss how each is managed. (H8)
7. What signs and symptoms would you need to be aware of when diagnosing a suspected simple fracture? (H16)
8. Explain the difference between a dislocation and a subluxation. (H8)
9. Explain how the TOTAPS regime would be used in the assessment of a player whose ankle rolled outwards (suspected inversion sprain) during a game of touch. (H16)
10. Discuss three specific medical conditions that relate to children. Outline how each can be managed to promote safety and wellbeing in sport. (H8)
11. Why is an awareness of thermoregulation important when coaching children? (H8)
12. Recent information suggests that physical activity together with resistance training is both safe and beneficial for adults with heart conditions. Visit the website for this book and click on the Physical Activity and Health Ageing weblink for this chapter (see 'Weblinks', pages x–xi) and use the information to comment on the suggestion. (H17)
13. Discuss how exercise prescriptions for youth, adults and older people should vary. (H18)
14. Discuss how iron deficiency, eating disorders and pregnancy would each impact on the wellbeing of a female athlete. Suggest strategies to address each problem. (H17)
15. Observe figure 13.21 on page 402. Explain why males generally have higher hospitalisation rates caused by sport and recreation injury than females. (H16)
16. Discuss how warm-up, stretching and cool-down assist in prevention of sports injury? (H17)
17. Investigate the degree to which protective equipment is used in your favourite sport. Discuss the barriers that exist that prevent full and proper use of protective equipment. Suggest interventions that will enhance safety. (H17)
18. Choose a sport or activity. Explain the changes that have been made to enhance the safety of children who play this sport. (H17)
19. Investigate the role of thermoregulation in enhancing safe participation in physical activity on hot days. (H16)
20. Explain the role of taping in the prevention of injury. (H15)
21. Investigate current theories on the use of heat in injury management. Briefly outline your findings. (H16)
22. Explain the benefits of stretching and strengthening as part of a muscle rehabilitation plan. (H8)
23. Outline the role of the sports medicine practitioner. (V&A)

24. Discuss the problems that might be caused by playing with injury. (H17)

25. ‘The only way that there will ever be a level playing field in elite sport is to allow all athletes to use performance-enhancing drugs.’ Discuss. (H17)

26. Refer to the article ‘Absolutely, positively, zero tolerance’. In view of the fact that ‘of 6500 tests conducted by the Australian Sports Drug Agency in 2003–04, only 0.3 per cent returned positive results’, discuss the value of drug testing of elite sportspeople. (H17)

Extension
Investigate and explain appropriate methods of taping for the following injuries — a dislocated finger, stretched lateral knee ligaments, tennis elbow. (H13)