

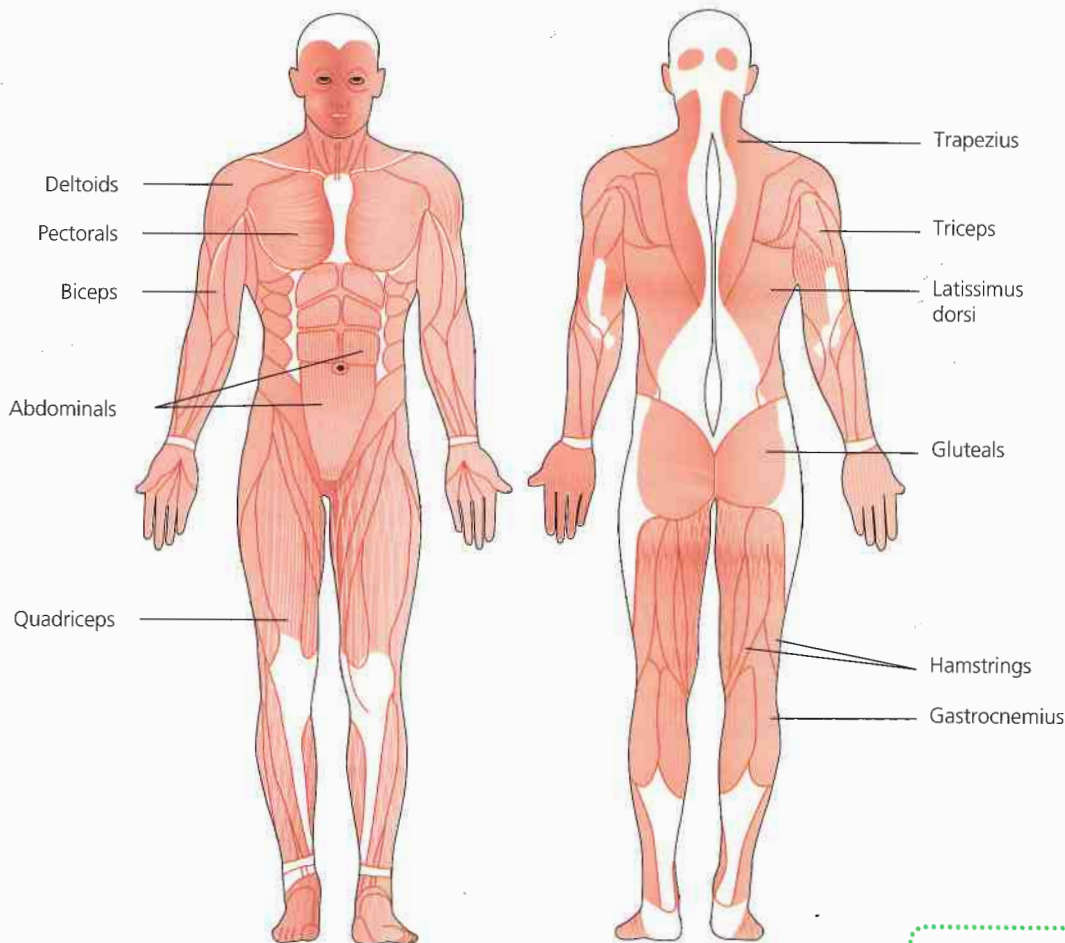
# Chapter 1.2

## The structure and function of the muscular system

### Understanding the Specification

This topic area will teach you the name and location of the main muscle groups in the human body and you will be able to apply them to examples from physical activity/sport. You will know the definitions and roles of the:

- agonist
- antagonist
- fixator
- antagonistic muscle action.



▲ Figure 1.2.1 The main muscle groups in the human body

Muscles are made up of soft muscle tissue and skeletal muscle enables us to move. In sport the study of muscle and how it works gives us a good insight into how we might make our sports skills and activities even more effective and efficient.

#### STUDY HINT

Be able to locate each of these major muscle groups and label an appropriate diagram showing the position of each muscle group. Also know the main role of each of these groups by using an example from sport.

## The location of major muscle groups

The following muscles are named in the specification:

- **Deltoid** – this is used in all movements of the arms. Its most important function is to lift the arm straight outwards and upwards (abduction at shoulder joint), e.g. to make a block in volleyball with arms straight above the head.
- **Trapezius** – this causes extension at the neck, e.g. a rugby forward in a scrum will use the trapezius to bind into the opponents.
- **Latissimus dorsi** – this is the broad back muscle. It causes adduction at the shoulder joint. It will swing the arm backwards and rotate it inwards. For example, a tennis player who swings their arm back to hit the ball when serving is using the latissimus dorsi.
- **Pectorals** – there are two sets of chest muscles: pectoralis major (greater chest muscle) and pectoralis minor (lesser chest muscle). This causes adduction and flexion at the shoulder joint in the horizontal plane. These help to adduct the arm and rotate it inwards as well as lowering the shoulder blades, e.g. a rugby player making a tackle would hold on to their opponent using the pectoral muscles.
- **Biceps** (biceps brachii) – this causes flexion at the elbow. Its function is to swing the upper arm forward and to turn the forearm so that the palm of the hand points upwards (supination), e.g. biceps curl in weight training.
- **Triceps** (triceps brachii) – this causes extension at the elbow. Its function is to straighten the elbow and to swing the arm backwards, e.g. backhand in table tennis.
- **Abdominals** – these bend the body forwards at the hips causing flexion of vertebral column and help to turn the upper body. For example, performing a sit-up exercise will use the abdominals.
- **Quadriceps** – this provides stability to the knee joint and extends or straightens the knee joint. For example, a long jumper when driving off the board will straighten the knee joint at take-off using the quadriceps.
- **Hamstrings** – these muscles will straighten the hip and cause flexion at the knee joint. They will also bend the knee and rotate it outwards. For example, a hockey player running across the pitch will be using her hamstrings in the running action to bend the knees.

### Activity

Write the names of the major muscle groups on Post-its and with a partner place each Post-it on each other's body showing that you know the location. Or use a diagram and identify the major muscle groups. This could be made into giant posters for the classroom walls and help you to remember the locations of these muscle groups.

### ? Extend your knowledge

There are three types of muscle:

- Involuntary muscle – or smooth muscle, which is found in the body's internal organs. This is involuntary muscle because it is not under our conscious control.
- Cardiac muscle – this is found in the heart only and is also involuntary.
- Skeletal or voluntary muscle – this is under our conscious control and is used primarily for movement, e.g. the biceps muscle in our arms.



▲ Figure 1.2.2 A hockey player will use her hamstrings to bend the knees when she runs

- **Gluteals** – these are the muscles in your buttocks. They cause extension at the hip joint and adduct the hip, rotate the thigh outwards and helps to straighten the knee. A sprinter will use the gluteals in the leg action of sprinting down the track.
- **Gastrocnemius** – the calf muscle is used to bend the knee and to straighten or plantarflex the ankle. For example, a swimmer doing front crawl will point their toes in the leg action using the gastrocnemius.

## The roles of muscles in movement

### Pairs of muscles

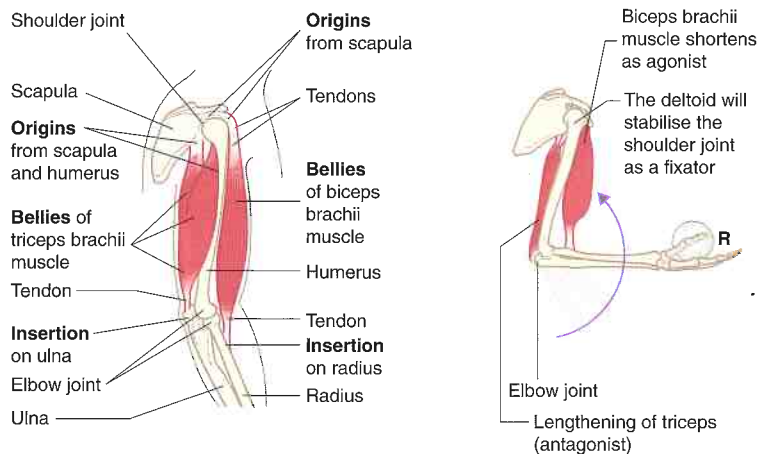
There is a vast range of movements that can be made by the human body. To produce these movements, muscles either shorten, lengthen or remain the same length when they contract. Muscles work in pairs: as one muscle contracts, the other relaxes. Muscles that work together like this are called **antagonistic pairs**. This type of action enables the body to move with stability and control.

Examples of antagonistic pairs are:

- **Biceps and triceps** – at the elbow joint. As the biceps bends or flexes the elbow joint by contracting, the triceps relaxes. As the arm straightens, the opposite occurs.
- **Hamstrings and quadriceps** – at the knee joint. The hamstrings contract and the quadriceps relax and the knee joint flexes. As the knee joint extends, the quadriceps (quads) contract and the hamstrings relax.

### Agonist

This is the working muscle that produces or controls the desired joint movement. It is also known as the **prime mover**. For example, the biceps brachii is the muscle that produces the flexion movement at the elbow.



▲ Figure 1.2.3 Flexion at the elbow with agonist labelled

### Key terms

**Origin** This is the end of the muscle attached to a bone that is stable, e.g. the scapula. The point of origin remains still when contraction occurs.

**Insertion** This is the end of the muscle attached to the bone that actively moves, e.g. the biceps insertion is on the radius.

### Antagonist

For movement to be co-ordinated, muscles work in pairs so that control is maintained. The movement caused by the agonist is countered by the action of the opposing muscle, called the antagonist. For example, the flexion at the elbow caused by the biceps shortening is opposed by the lengthening of the triceps, which acts as the antagonist, which is the relaxing muscle.

### Fixator

This is a muscle that works with others to stabilise the origin of the prime mover, e.g. the trapezius contracts to stabilise the **origin** of the biceps. Some muscles have two or more origins, e.g. the biceps muscle has two heads that pull on the one **insertion** to lift the lower arm.

### ? Extend your knowledge

#### Synergists

These refer to muscles that are actively helping the prime mover or agonist to produce the desired movement. They are sometimes called **neutralisers** because they prevent any undesired movements. Sometimes the fixator and the synergist are the same muscle, e.g. the brachialis acts as a synergist when the elbow is bent and the forearm moves upwards.

#### SUMMARY

- The agonist, also known as the prime mover, is the working muscle and produces the desired joint movement, e.g. the biceps brachii produces flexion at the elbow.
- The role of the antagonist is to counter or oppose the action of the agonist.
- The fixator works with others to stabilise the joint.
- Antagonistic muscle action is when muscles work in pairs. As one muscle contracts, the other relaxes.

### Practice questions

1. Label a diagram showing the major muscle groups. (11 marks)
2. Using an example from sport, describe how the biceps and triceps work as an antagonistic pair. (4 marks)
3. What is meant by a fixator? (2 marks)
4. What are the main functions of the following muscle groups? (4 marks)
  - Quadriceps
  - Gastrocnemius
  - Abdominals
  - Pectorals.